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Sahuaro (*Cereus giganteus*), the State flower of Arizona. The flowers open at night and have an odor like that of ripe melon.

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FLOWERING PLANTS AND
FERNS OF ARIZONA

BY

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and

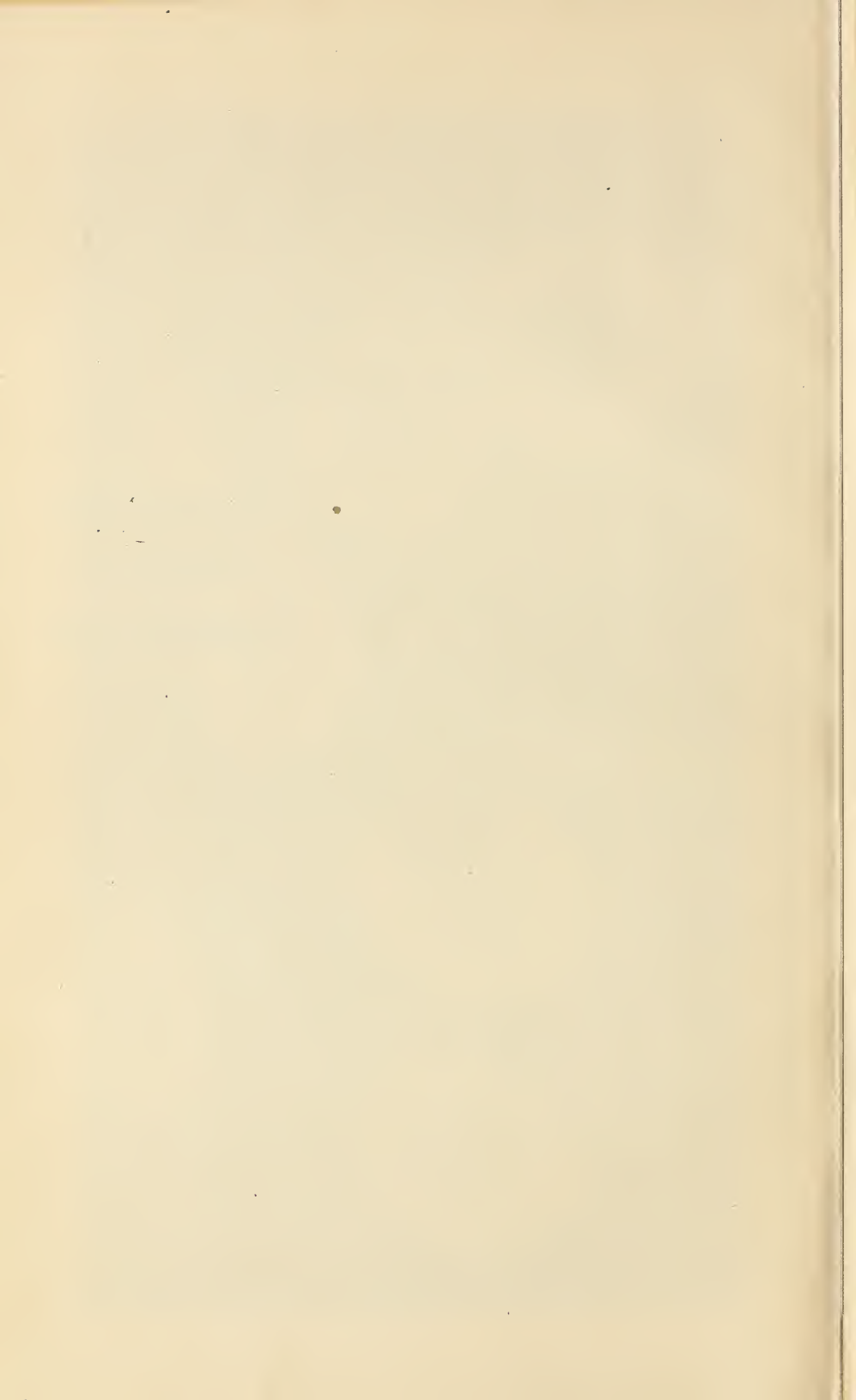
Collaborators

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Flowering Plants and Ferns of Arizona

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INTRODUCTION

Arizona ranks very high among the States in the richness and diversity of its flora. Approximately 3,200 species of flowering plants and ferns, growing without cultivation, are known to occur within its limits. Many other species have been collected so near the borders of Arizona that they are almost certain to be found in the State. Furthermore, much of the area has not yet been explored thoroughly, so it is highly probable that the Arizona flora will be found, eventually, to comprise not fewer than 3,500 species of higher plants, even with the conservative conception of what constitutes specific rank that the authors have sought to maintain.

The number of families of flowering plants represented in this flora is 121, in addition to 7 families of ferns and fern allies. The 10 families comprising the largest number of species are as follows:

Family:	<i>Number of species</i>	Family:	<i>Number of species</i>
Compositae	518	Polygonaceae	91
Gramineae	325	Cyperaceae	89
Leguminosae	283	Euphorbiaceae	80
Scrophulariaceae	108	Cactaceae	76
Cruciferae	97	Rosaceae	66

The leading families, it will be noted, are mainly those occupying this rank in other North American local floras and, to a large extent, in all temperate parts of the Northern Hemisphere. The outstanding exception is the family Cactaceae. No other State of the Union, save Texas, has so rich a representation of this group, and 11 of the 76 species occurring in Arizona have not been found hitherto beyond its borders.

It is surprising that there has never been a comprehensive publication dealing with this extraordinarily interesting State flora. In the

absence of such a publication, identification of plants collected in Arizona is very difficult, requiring access to an extensive herbarium and botanical library. Approximately two-thirds (67.2 percent) of the total area of the State is controlled by the Federal Government, 48.2 percent being administered by the Indian Service, Forest Service, National Park Service, and Fish and Wildlife Service, and 19 percent being classified as vacant public land. Many of the native plants of Arizona are economically important, and the scientific staffs of the services mentioned, as well as of other branches of the Federal Government, frequently require accurate identification of plants collected by them. It therefore seems appropriate that the United States Department of Agriculture should undertake publication of a flora of Arizona.

COLLABORATORS

Authorities on many difficult families and genera have contributed treatments of their specialties, adding greatly to the value of this publication. The writers are most grateful for the collaboration of these botanists, whose names, and the group or subject contributed, follow:

- Benson, Lyman, University of Arizona. Genus *Ranunculus*.
 Blake, S. F., Division of Plant Exploration and Introduction, Bureau of Plant Industry, United States Department of Agriculture. Family Compositae.
 Epling, Carl, University of California at Los Angeles. Family Labiatae.
 Ewan, Joseph, University of Colorado. Genus *Delphinium*.
 Hermann, F. J., Division of Plant Exploration and Introduction, Bureau of Plant Industry, United States Department of Agriculture. Genus *Juncus*.
 Hitchcock, C. Leo, University of Washington. Genus *Draba*.
 Johnston, I. M., Arnold Arboretum, Harvard University. Family Boraginaceae.
 Keck, David D., Carnegie Institution of Washington. Genus *Penstemon*.
 Killip, Ellsworth P., Smithsonian Institution. Genus *Passiflora* (key).
 Mathias, Mildred E., and Constance, Lincoln, University of California. Family Umbelliferae.
 Maxon, William R., Smithsonian Institution. Ferns and fern allies.
 McVaugh, Rogers, Division of Plant Exploration and Introduction, Bureau of Plant Industry, United States Department of Agriculture. Family Campanulaceae.
 Morton, C. V., Smithsonian Institution. Genera *Datura* and *Nicotiana* (keys).
 Muller, Cornelius H., Division of Plant Exploration and Introduction, Bureau of Plant Industry, United States Department of Agriculture. Genera *Quercus* and *Choisya*.
 Munz, Philip A., Pomona College. Family Onagraceae.
 Rollins, Reed C., Dudley Herbarium, Stanford University. Genus *Arabis*.
 Shreve, Forrest, Carnegie Institution of Washington. The vegetation of Arizona.
 Stacey, J. W., California Academy of Sciences. Genus *Carex*.
 Svenson, H. K., Brooklyn Botanic Garden. Genus *Eleocharis*.
 Swallen, Jason R., Division of Plant Exploration and Introduction, Bureau of Plant Industry, United States Department of Agriculture. Family Gramineae.
 Wheeler, Louis C., University of Pennsylvania. Family Euphorbiaceae.
 Wherry, Edgar T., University of Pennsylvania. Genus *Phlox*.
 Yuncker, T. G., DePauw University. Genus *Cuscuta*.

The writers also wish to express their sincere appreciation of the courteous assistance rendered by the curators of herbaria and members of the botanical staff of the following institutions: National Herbarium, Smithsonian Institution; the Forest Service, United States Department of Agriculture; Gray Herbarium, Harvard University; New York Botanical Garden; Field Museum; Missouri Botanical Garden; Rocky Mountain Herbarium, University of Wyoming; University of Arizona; Museum of Northern Arizona; Desert Botanical

Laboratory, Tucson, Ariz.; Soil Conservation Service, United States Department of Agriculture, Tucson, Ariz.; National Park Service, United States Department of Interior, Grand Canyon, Ariz.; California Academy of Sciences; University of California; Stanford University; Pomona College.

C. V. Morton, of the Smithsonian Institution, has kindly reviewed the manuscript and has contributed many helpful suggestions. Finally, to Mrs. Rose E. Collom, Payson, Ariz., the writers are indebted for the privilege of using her manuscript notes on the habitat, time of flowering, and economic uses of Arizona plants.

PLAN OF THE WORK

Keys are provided to the families, the genera of each family, and the species of each genus. These are for the most part artificial. Each pair of contrasting paragraphs in a key has the same indentation and the same introductory number (at the left) and this number is not again repeated in the same key. Each paragraph ends (at the right) with the name of a family, genus, or species, or else with a number in parentheses, the latter indicating the pair of paragraphs next to be referred to. Thus, if the characterization in the first paragraph numbered 1 does not apply to the plant in hand, the user of the key goes on to the second paragraph numbered 1. If this ends in a number in parentheses, for example (4), the two paragraphs numbered 4 are to be referred to next, and so on, until a paragraph ending in a name and corresponding to the plant in hand is reached. The sequence of families, genera, or species in the keys usually does not correspond to their sequence in the text, but the number preceding the name of the family, genus, or species in the key indicates its position in the text. Thus, in the key to the families of seed-producing plants (Spermatophyta) "5. Naiadaceae" stands third in the key, but is the fifth family in the text.

Brief descriptions are given of each family and genus; these, as well as the characterizations in the keys, being worded, in the main, so as to apply only to forms occurring in Arizona. Limitation of space has made it impracticable to give descriptions of the species, but the characterizations in the keys to species are usually ample, and in many cases additional characters are mentioned under the species in question.

Under each species are given the geographical and altitudinal range within the State, usually also the habitat and time of flowering, and the general geographical distribution of the species. Type specimens are cited, with few exceptions, only if the type was collected in Arizona. Synonymy is limited, in the main, to (1) the name-bringing synonym, (2) synonyms based on Arizona types, and (3) names used in works often consulted in identifying Arizona plants, such as Wooton and Standley, *Flora of New Mexico*.¹ Many species included in this flora are not known definitely to occur in the State but have been collected so near its borders as to make their occurrence in Arizona highly probable. Such species are indicated by an asterisk preceding the name.

References are given, under many of the genera, to recently pub-

¹ WOOTON, E. O., and STANDLEY, P. C. *FLORA OF NEW MEXICO*. Contrib. U. S. Natl. Herbarium 19: 1-794. 1915.

lished monographs and revisions that have been consulted in preparing the text. These citations should be helpful to those who may desire further information on the groups in question. As a rule,

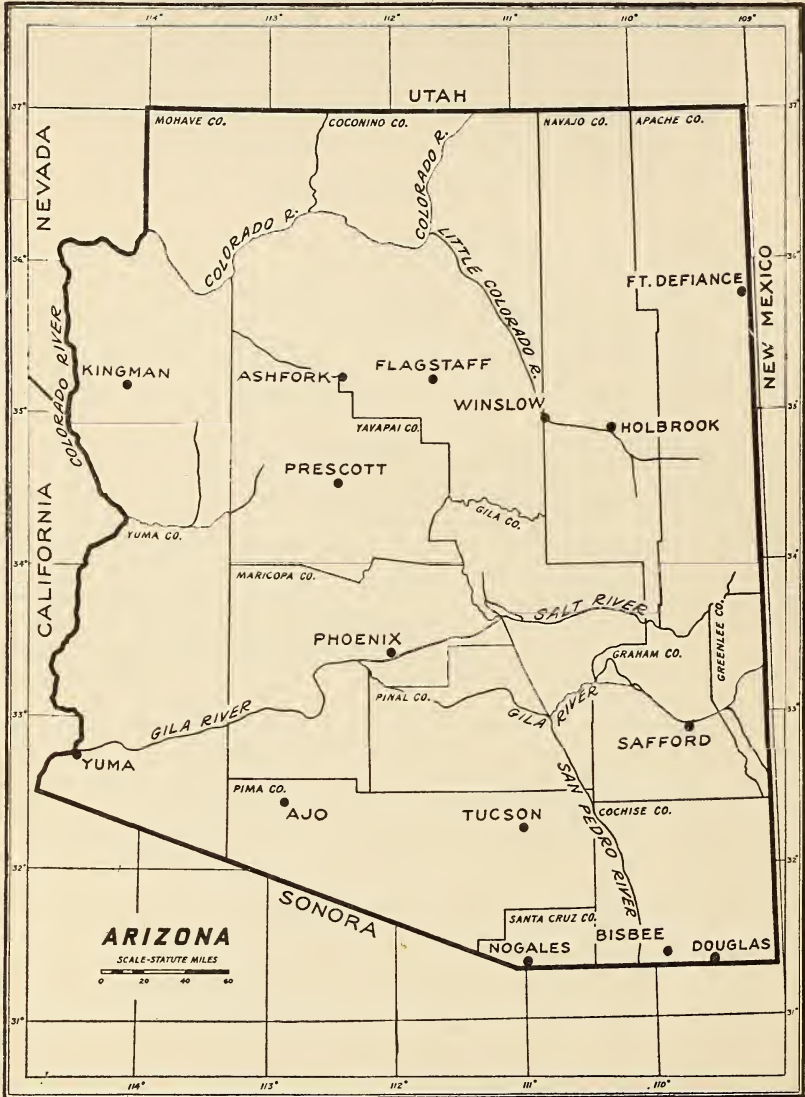


FIGURE 1.—Sketch map of Arizona, showing the boundaries of the counties, the principal rivers, and some of the more important towns.

comprehensive and generally accessible works such as the Synoptical Flora of North America, North American Flora, and Das Pflanzenreich are not included in these references; nor has it seemed necessary to cite floras of neighboring States and of Mexico, although, of course, these works have been consulted freely.

In order to save indexers the labor of reviewing so large a work, no new names or combinations are published here.

A sketch map of Arizona, showing the boundaries of the counties, the principal rivers, and some of the more important towns, is provided (fig. 1).

ECONOMIC INFORMATION

Under the several families and genera and occasionally under a particular species, there are some brief statements of economic uses by the Indians and others, including such particulars as food value for man and livestock, timber value, soil-binding utility, medicinal and poisonous properties, and possibilities as cultivated ornamentals. These notes have been compiled from many sources, including personal observation. It has not seemed necessary to cite the authority for each statement, but a list of publications from which the information was obtained will be found at the end of the volume (pp. 1036-37).

BOTANICAL EXPLORATION OF ARIZONA²

Botanical exploration of territory now comprised in the State of Arizona may be said to have begun with the military expedition of 1846-47 led by Lt. W. H. Emory, from Santa Fe, N. Mex., to California, during the Mexican War. His route followed the Gila River from near its source to its mouth. In the early 1850's, the naturalists of the United States-Mexican Boundary Survey, J. M. Bigelow, C. C. Parry, Arthur Schott, George Thurber, and Charles Wright, collected extensively in the extreme southern part of what is now Arizona. In 1851, S. W. Woodhouse, surgeon-naturalist of Capt. L. Sitgreaves' expedition across northern Arizona to the Colorado River, obtained botanical specimens. J. M. Bigelow, accompanying Lt. A. W. Whipple on his exploration for a railway to the Pacific in 1853-54, brought back important collections from the same general region. The geologist, J. S. Newberry, as a member of the expedition of Lt. J. C. Ives, in 1858, up the Colorado River and across northern Arizona via the Grand Canyon and Hopi pueblos to Fort Defiance, collected many plants. These early collections were studied and reported upon by such eminent botanists as John Torrey, Asa Gray, and George Engelmann.

In the 1860's two distinguished ornithologists, J. G. Cooper and Elliott Coues, collected plants, the first in the vicinity of Fort Mohave, the second chiefly around Prescott. Dr. Charles Smart obtained numerous specimens in the Mazatzal Mountains and along the Verde River. It was in this decade that an indefatigable collector, Edward Palmer, began his botanical explorations of Arizona, first in association with Coues and afterward alone, collecting at intervals until 1890 and traversing nearly all parts of the State. The large number of species named for him attests the importance of his discoveries.

The most important contribution to the knowledge of the Arizona flora during the 1870's was made by the forester, J. T. Rothrock, botanist of Lt. George M. Wheeler's expedition (United States geographical surveys west of the one-hundredth meridian). Dr. Rothrock collected extensively in southeastern Arizona, chiefly in 1874. In

² For citations of literature see JOSEPH EWAN. BIBLIOGRAPHY OF THE BOTANY OF ARIZONA. Amer. Midland Nat. 17: 430-454. 1936.

the same decade Mrs. E. P. Thompson brought to light many botanical novelties in extreme northern Arizona, near Kanab, Utah, and P. F. Mohr collected around Fort Huachuca.

The 1880's witnessed great botanical activity in many parts of the State. Southern Arizona was intensively explored by those outstanding collectors, J. G. Lemmon and wife (1880-82) and C. G. Pringle (1881-84). In 1884 the Lemmons shifted their attention to the northern part of the State. H. H. Rusby explored the Clifton region in 1881 and collected extensively in Yavapai and Coconino Counties in 1883, obtaining the first adequate representation of the flora of the San Francisco Peaks. W. F. Parish collected around Camp Lowell, near Tucson, in the early 1880's. G. R. Vasey made large collections around Tucson and Yuma in 1881. Marcus E. Jones, whose name is indelibly stamped upon the Arizona flora, began collecting in the State in 1884 and continued his activities there at intervals until 1930. Although the northern counties were his chosen field, he also made several collecting trips to the southern mountains. An Army surgeon, E. A. Mearns, made large collections in Yavapai and Coconino Counties in 1888, and, in the early 1890's, as naturalist of the second United States-Mexican boundary survey, along the southern border. In 1889 F. H. Knowlton made a fruitful exploration of the San Francisco Peaks and E. L. Greene collected less extensively in the same region.

From 1890 to the present, so many persons have collected plants in Arizona that only a few of those who made large collections may be mentioned here. During the 1890's, outstanding collectors were: A. Davidson in Greenlee County; E. A. Mearns and F. X. Holzner along the Mexican border; Walter Hough in Apache and Navajo Counties (continuing into the next decade); D. T. MacDougal in Coconino, Yavapai, and Gila Counties; G. C. Nealley in the Rincon Mountains; C. A. Purpus in Coconino and Yavapai Counties; J. W. Toumey in many parts of the State; T. E. Wilcox in the Huachuca Mountains; N. C. Wilson in the northern and central counties; E. O. Wooton in many parts of the State, at intervals from 1892 to 1914; and Myrtle Zuck in Navajo and Pima Counties.

The work continued actively during the 1900's, in which period extensive collections were made by: J. C. Blumer, chiefly in the Chiricahua Mountains; H. D. Burrall and J. S. Holmes, in the same area; F. V. Coville, in the White Mountain region; E. A. Goldman, in nearly all parts of the State; David Griffiths, in Pima County, the White Mountains, and elsewhere; J. B. Leiberg on the San Francisco Peaks; G. A. Pearson, in Coconino County; J. J. Thornber, chiefly in Coconino and Pima Counties; Ivar Tidestrom at several localities from the northern to the southern boundary; and L. F. Ward in the Little Colorado River and Grand Canyon regions.

Among those who collected during the decade 1910-19 the following may be mentioned: Alice Eastwood, in many parts of the State (continuing at intervals until 1938); W. W. Eggleston in eastern Arizona (also in the next decade); L. N. Goodding, chiefly in the White Mountains and the southern counties (continuing until the present time); J. A. Harris in the Santa Catalina Mountains; A. S. and A. E. Hitchcock in the Grand Canyon region; Alfred Rehder in many parts of the State; Forrest Shreve chiefly in the Pinaleno and Santa Catalina

Mountains (continuing until the present time); and P. C. Standley in the Carrizo Mountains.

In the 1920's, in addition to some of those who began their work in the preceding decade, the following made important collections: W. N. Clute in the Painted Desert region; Mrs. Rose E. Collom in Gila and Coconino Counties (continuing until the present time); M. F. Gilman and F. A. Thackery, chiefly in the Baboquivari Mountains; W. W. Jones chiefly in Yavapai County; Susan D. McKelvey in many parts of the State (continuing in the 1930's); Pauline Mead on the Kaibab Plateau; and the writers and their colleagues, with headquarters at the United States Field Station, Sacaton, throughout the State (continuing until the present time).

The last decade (1930 to 1939) was notable for the large number of persons engaged in collecting plants in Arizona. Among these were: H. C. Cutler in northern Arizona; Alice Eastwood and J. T. Howell in Coconino, Navajo, and Apache Counties; J. W. Gillespie in Maricopa and Pinal Counties; Elbert L. Little, Jr., on the San Francisco Peaks; Bassett Maguire chiefly north of the Colorado River and in Graham County; Aven Nelson in many parts of the State; M. J. A. Wetherill in the vicinity of Navajo National Monument; A. F. Whiting and his colleagues of the Museum of Northern Arizona in Coconino and Navajo Counties; and Ira L. Wiggins in southwestern Arizona.

GEOGRAPHICAL RELATIONSHIPS OF THE FLORA

The geographical position of Arizona and its great diversity of topographic and climatic conditions make it a veritable "melting pot," where floral elements from nearly all parts of the North American continent are to be found, if not side by side, at least within a few miles of one another. It is the only State in which occur both alpine and subalpine plants, of which some 50 species are found on the higher mountains of the northern part of the State, and representatives of genera and families that are mainly tropical, in the lower country near the Mexican boundary. It may surprise those who know Arizona only in its semidesert aspect that no fewer than 20 species of those humus-loving plants, the terrestrial orchids, are found within its borders.

The diversity of life forms is remarkable. First and foremost are the Cactaceae, culminating in the huge sahuaro (*Cereus giganteus*) which Arizona has chosen, appropriately, as its State flower. In southern and western Arizona, especially, one is impressed by the bizarre forms of Yuccas, Agaves, crucifixion-thorn (*Holacantha*), elephant tree (*Bursera*), and ocotillo (*Fouquieria*). In the southwestern corner occur two remarkable parasitic flowering plants, the tiny *Pilotyles thurberi*, of the mainly tropical family Rafflesiaceae, and the sandfood (*Ammobroma sonora*), one of the very few members of a strictly American family. Even a species of palm (*Washingtonia*) is native in Arizona.

The 3,200 species of flowering plants, ferns, and fern allies known definitely to occur in Arizona may be classified roughly, on the basis of their distribution outside the State, into 12 geographical categories. Obviously these are not hard and fast, and many species have been placed somewhat arbitrarily in one or the other of them. Table 1

gives the percentages of the total number of species in the State that are represented in the several categories or in various combinations of 2 categories. The species are classified on the basis of their distribution as a whole, regardless of the fact that some of them are represented in Arizona only by a variety of more limited geographical range.

TABLE 1.—*Flowering plants and ferns of Arizona, classified according to their geographical ranges outside the State, the number of species referred to each category being expressed as a percentage of the total number of species known to occur in the State*

Geographical category	Representation	Geographical category	Representation
	<i>Percent</i>		<i>Percent</i>
Endemic	5.1	Tropical or subtropical	6.6
Pacific	2.5	Rocky Mountain	13.0
Coloradan	8.4	Rocky Mountain and Pacific	9.0
Sonoran	10.5	Great Plains	2.5
Sonoran and Coloradan .....	.6	Atlantic .....	.3
Chihuahuan	14.6	North American	12.0
Chihuahuan and Coloradan	1.0	Transoceanic	4.8
Chihuahuan and Sonoran	3.1	Adventive	6.0

The geographical categories of the flora are defined as follows:

ENDEMIC.—There are 163 species not known to occur elsewhere than in Arizona. Of these, 45 are limited to the northern part of the State, 33 to the central portion, and 69 to the region south of the Gila River, the remaining 16 endemic species being more widely distributed. Many of the southern endemics occur so close to the Mexican border that they will almost certainly be found, eventually, in Sonora or Chihuahua. Some of the northern species probably occur also in southern Utah, Nevada, or Colorado.

PACIFIC.—Species ranging throughout all or a part of the region from British Columbia to Baja (Lower) California. The number of Pacific coast species extending into Arizona, excluding plants of the deserts of southeastern California, is not large, but the group is of interest as comprising several species found only from southern Oregon to northern Baja California, and in south-central Arizona, principally in the Pinal and Mazatzal Mountains. Notable examples of this interrupted distribution are: *Dryopteris arguta*, *Ribes quercetorum*, *Cercocarpus betuloides*, *Lupinus succulentus*, *Rhus ovata*, *Rhamnus crocea*, *Fremontodendron californicum*, *Lonicera interrupta*.

COLORADAN.—Occupying all or a part of the Colorado River drainage basin, from southwestern Colorado to southeastern California. Most of the species of this category that reach California do not occur west of the Mohave Desert and the Death Valley region. In Arizona they are found mostly in the northern part of the State, commonly in treeless areas or with the juniper-pinyon association, at elevations below 8,000 feet. The large genera *Eriogonum* and *Astragalus* are well represented in this category.

SONORAN.—Species confined mainly to the deserts at low elevations in southeastern California, Baja California, northwestern Sonora, and southwestern Arizona. The perennial plants of this category are mostly pronounced xerophytes. This highly specialized flora reaches its northeastern limit in Maricopa and Pinal Counties with such conspicuous representatives as *Colubrina californica*, *Horsfordia newberryi*, *Abutilon palmeri*, and *Beloperone californica*.

CHIHUAHUAN.—The center of distribution of species of this category is the Rio Grande drainage basin in western Texas, southern New Mexico, and northern Mexico, but many of them reach Arizona, especially the southeastern part of the State, and some of them extend into the second tier of States of the Republic of Mexico (San Luis Potosí, Zacatecas, Durango, Sinaloa). This is the largest single geographical category of the Arizona flora, unless the Rocky Mountain category be considered as including species found also in the Pacific Coast States.

TROPICAL OR SUBTROPICAL.—Species ranging farther southward in Mexico than those of the Sonoran and Chihuahuan categories, many of them extending to Central or South America and several occurring also in the West Indies and the subtropical portion of the eastern United States. Because of the relatively low latitude and altitude of southern Arizona, subtropical species are much more numerous than in any other State west of Texas. A number of species, mostly belonging to the Pacific category, that are found in temperate North America and in southern South America but not in the intervening Tropics, are, of course, not included here.

ROCKY MOUNTAIN.—Many species of this category range from the Canadian Rockies to the Sierra Madre in northern Mexico, but not a few of them are known only from Arizona and New Mexico. There are also many Rocky Mountain species that extend westward into the Pacific Coast States. The higher mountains of Arizona and the elevated plateaus in the northern part of the State offer congenial habitats for characteristic plants of this category. Such genera as *Penstemon*, *Erigeron*, and *Artemisia* are well represented.

GREAT PLAINS.—Species found chiefly east of the Rocky Mountains, including some that extend even farther eastward into the prairie States. This is a relatively small component of the Arizona flora, confined chiefly to grassy plains in the eastern part of the State.

ATLANTIC.—Species mainly of the southeastern United States, extending often as far west as central Texas and in some cases along the northern coast of the Gulf of Mexico into Mexico, but absent in western Texas and New Mexico. The following 11 species, all of which occur only in the southern part of Arizona, have this peculiar distribution: *Ophioglossum engelmannii*, *Corallorrhiza wisteriana*, *Hexaletris spicata*, *Cerastium teranum*, *Crotalaria sagittalis*, *Clitoria mariana*, *Acalypha ostryaefolia*, *Chimaphila maculata*, *Isanthus brachiatius*, *Galium pilosum*, *Cyclanthera dissecta*.

NORTH AMERICAN.—Species of wider distribution on this continent than those of any of the foregoing categories. A large number of these range across the continent in Canada and the northern United States, reaching lower latitudes only in the higher mountains.

TRANSOCEANIC.—Species that are believed to be indigenous in both the Eastern and Western Hemispheres. A large majority of them are temperate or circumpolar, occurring in the northern part of Europe, or of Asia, or of both continents, and have a distribution in North America similar to that of many species in the North American category. Some of them, however, are found in the tropical and subtropical parts of both hemispheres. It is always uncertain, of course, whether plants having the latter distribution are really indigenous in both hemispheres. Some of the aquatic and marsh plants of the Transoceanic category are of almost world-wide distribution (cos-

mopolitan). Remarkable examples of discontinuous distribution are afforded by two ferns, *Asplenium exiguum* and *Cetarach dalhousiae*, found only in a few widely separated localities in North America and in the Himalaya Mountains. Both species are extremely local in Arizona.

ADVENTIVE.—Plants introduced by the agency of man from other parts of the world, chiefly from Eurasia. The category includes numerous species that have become naturalized in Arizona and others of sporadic occurrence that have not yet established themselves as components of the flora. A large majority of the introduced weeds are common in California and probably reached Arizona from that State. There are also a few species of central Asiatic origin that occur here and there in the Great Basin region and in Arizona. It seems probable that these were introduced with seeds of alfalfa from Turkistan and Siberia, there having been formerly rather extensive importations of such seed into the western United States.

THE VEGETATION OF ARIZONA³

Contributed by FORREST SHREVE

In whatever direction one might traverse the United States he would continually encounter new species of plants and new types of vegetation and would look in vain for some of the ones that had previously been familiar in the landscape. Many plants would be seen again and again for long distances, whereas others would be found only in restricted localities. If time were taken to travel completely around the area occupied by each species, it would be found that scarcely any two of them coincide exactly. The traveler would also find that changes in temperature conditions are encountered on going from north to south, and that changes in moisture conditions are found on passing from east to west.

Any scheme of representing these gradations of conditions on a map would result in a gigantic checkerboard with squares perhaps 150 miles in diameter, the symmetry of which would be greatly modified by the mountains and elevated plains. No one plant species would be found to occur in all of the squares of a map of the western United States. Although there would be no two of the squares on which the conditions for plant life would be identical, nevertheless there would be many plants found on a large number of the squares. Indeed, there would be very few plants found on just one or two of them. Some plants are able to adjust themselves to a wide range of conditions, so that they are able to grow in many of the squares. Perhaps they range widely in a northern and southern direction, encountering great differences in temperature, or perhaps their greatest extension is from east to west, showing them to be capable of withstanding a considerable range of moisture conditions. The character of the physical conditions of each square serves to admit or exclude and thereby rigidly to control the plant population of the area.

The modifications in the symmetry of the checkerboard caused by mountains and other elevations are due to the existence in every elevated place of a set of conditions that would not prevail there if the land were flat and at sea level. In the warmer latitudes an elevated

³ Citations to literature on the vegetation of Arizona are given on pp. 1036,

plateau exhibits conditions that are similar to those at sea level in some other place, although never exactly like them. By reason of its size and rugged topography Arizona comprises a great many squares on the checkerboard. In fact, there are only two or three States that would comprise more than Arizona does. It is 395 miles from the southern boundary of the State to the northern, which would make considerable difference between the climate of the northern part and that of the southern part, even if the State were flat. In fact, the State covers one-third of the distance from Mexico to Canada, and because of the mountainous character of some of it and its position with reference to major climatic provinces, the diversity of conditions is multiplied many times. As a result the vegetation is rich and diversified.

Arizona is essentially a desert State. Its plains and valleys are desert, in both a physical and a biological sense, from the lowest elevations to an altitude of about 4,000 feet in the south and to nearly 6,000 feet in the north. To the ameliorating conditions of the higher altitudes are due the areas of grassland and forest that are so often likened to islands surrounded by a sea of desert. A close acquaintance with the vegetation of the higher altitudes brings to light many features in which the nearness of the desert and the fringe of desert conditions are of considerable moment in the life of a vegetation that is otherwise so much like that of moist regions.

Not only do the hills and mountains carry plants to higher and less arid levels, but even at low elevations they afford habitats that are more favorable than the outwash plains, although not so favorable as the flood plains of the larger valleys. The soil of a slope that is covered with stones has more favorable moisture conditions. The pockets of soil filling the depressions and cracks in the buried rocky surface of a hill are very favorably located for the infiltration of rain water and for its retention. Innumerable localities might be cited in which the vegetation of an outwash plain is replaced on the adjacent hillsides by a different type of vegetation of much higher water requirement.

Approximately 60 percent of the surface of Arizona is desert. The vegetation in the various parts of the desert is far from being uniform; in fact, it is much more varied than that of the forested areas. Everywhere the perennial plant covering of the desert is made up of a small number of species. Passing beyond the distributional limit of any one of these will bring a striking change in the appearance of the vegetation and in the character of the landscape. Uncommon in Arizona are the areas of shifting sand or barren rock that are commonly called to mind by the word "desert." The regions of low and uncertain rainfall are covered by bushes, dwarf trees, half woody perennials, and cacti growing in an abundance, which is truly remarkable in view of the low rainfall, the high temperature, and the almost continual sunshine in daytime. The nonsucculent and the succulent desert plants grow side by side in varying relative abundance. The latter are less ubiquitous than the former, as they are sparsely represented in the driest and also in the coldest parts of the desert. Where they are at their best, however, the cacti are the dominant plants in some of the most striking landscapes in the State.

The peculiar character of the vegetation of southern Arizona is largely due to the close mingling of plants, which differ greatly in size, form, habit of growth, and manner of adjustment to the adverse

conditions of an arid climate. Plants are closely associated in which the vegetative organs are so unlike as to indicate the possession of very dissimilar relations to climate and soil. In some cases the physiological behavior of these plants has been found very different. Survival under conditions that are very favorable for short periods and very unfavorable for longer ones is assured in a great variety of ways. The most common examples are reduction of leaf size, assumption of leaf functions by the stem, storage of water, and development in the annuals of rapid growth and early maturity.

The principal types of vegetation are more clearly marked in Arizona than in the States that were originally heavily forested or in those covered by different types of grassland. The dominant plants of the desert, the grassy areas, the open woodlands of juniper and pinyon, and the forests of pine, spruce, and fir, all differ greatly in stature, density, foliage, and seasonal habits. In any place where it is possible to see two of these types of vegetation in the landscape it is easy to distinguish them and to be certain of their identity at a distance of several miles. Almost all of the characteristics distinguishing the great communities of plants are related, in ultimate analysis, to the amount and seasonal distribution of their water supply.

In considering plant life as "vegetation," attention is focused on the anatomy and physiology of the plants, and the relation of their structure and life processes to the environmental conditions. It is also possible to view the plants from the standpoint of their phylogenetic relationships, and to investigate the distribution of the "flora." Maps of the vegetational areas of Arizona and of the floristic areas would not be identical. Between the two maps, however, there would be a strong general resemblance, for the differences in vegetation are very commonly accompanied by differences in flora. There are many plants, however, that occur only in part of each vegetational area, and many others that occur in at least two of them.

In order to describe the plant areas of Arizona from a vegetational standpoint, without reference to floristic differences or the controlling climatic conditions, a modification of the classification and nomenclature adopted in describing the vegetation of the United States from the same standpoint will be used.⁴

Nine major types of vegetation are found in Arizona. Three of these are desert, one an arid grassland, and one an arid chaparral. There are small areas of true grassland, two types of forest, and one small area of alpine vegetation above timber line. These nine types are as follows: California microphyll desert, Arizona succulent desert, Great Basin microphyll desert, Desert-grassland transition, Grassland, Arizona chaparral, Western xeric evergreen forest, Northern mesic evergreen forest, Alpine summits.

These types of vegetation are described briefly in the following pages.

TYPES OF VEGETATION

CALIFORNIA MICROPHYLL DESERT.—There is much in common between the vegetation of the parts of Arizona and California that lie within 50 to 100 miles of the Colorado River south of the confluence of the Virgin River. On the Arizona side there is a somewhat greater

⁴ SHREVE, FORREST. A MAP OF THE VEGETATION OF THE UNITED STATES. Geog. Rev. 3:119-125, map. 1917.



Microphyll desert near Tule Tanks, Yuma County, altitude 1,000 feet, with a sparse stand of *Larrea tridentata* and *Fraseria dumosa* and scattered individuals of *Fouquieria splendens*, *Cercus giganteus*, and *Cercidium floridum*. In the foreground, *Jatropha spatulata*.

number of trees along the streamways, and a notably greater number of cacti, which is doubtless due to the increasing amount of summer rainfall encountered on going eastward from the Mojave Desert. Sahuaro (*Cereus giganteus*) is very nearly limited in its westward distribution by the Colorado River, but there are no other important plants for which the river serves as a boundary. Several species of *Opuntia* (*O. echinocarpa*, *O. bigelovii*, *O. basilaris*) are frequent in the microphyll desert of Arizona but rare in that of California until the desert slopes of the Chocolate, Chuckawalla, and Cuyamaca Mountains are reached.

Over much of the microphyll desert the surface of the ground is far less stony than in the other types of desert, resulting in greater erosion by wind and water. The sparse vegetation of the microphyll desert is to be attributed chiefly to the low rainfall of 4 to 6 inches per year, of which 70 percent falls in winter, and partly to the very adverse conditions for seedlings.

In the part of Arizona under consideration a very high percentage of the total land surface is occupied by outwash slopes and slightly tilted plains or bajadas. Over many areas of this character *Larrea tridentata* (creosotebush) and *Franseria dumosa* form 80 percent of the plant population. Usually the two are found together, but in general *Franseria* is the more abundant. The monotony of the vegetation is occasionally broken by plants of *Acacia constricta*, *Fouquieria splendens* (ocotillo), *Echinocereus engelmannii*, *Opuntia echinocarpa*, or *O. ramosissima*. Perennial grasses are infrequent, except for colonies of *Hilaria rigida* (big galleta) on sandy soil, and several species of *Aristida* (pl. 1).

Some of the volcanic mountains near the mouth of the Colorado River are unusually bare of vegetation, supporting little more than occasional clumps of *Heteropogon contortus* (tanglehead grass), *Bebbia juncea*, and *Encelia farinosa* (inciense). On the granite mountains are to be found *Cereus giganteus*, *Cercidium microphyllum* (paloverde), *Olneya tesota* (ironwood), *Bursera microphylla*, *Echinocactus acanthodes* (bisnaga), *Opuntia basilaris* (beavertail cactus), and other plants, which are either confined to this part of Arizona or else are found farther east on the outwash slopes. In the latter case is seen an excellent example of the common phenomenon of the occurrence of a plant in the more favorable habitats of an unfavorable region and also in the unfavorable habitats of a more favorable climate.

Some very sharp contrasts of vegetation are to be seen in the microphyll desert by reason of the great river, which carries past it such a large volume of water derived from a distant region of dissimilar character. In many places the alluvial flats of the Colorado support a forest of *Populus fremontii* (cottonwood) within a few yards of the low sparse stands of *Franseria*. Along the Colorado and Gila Rivers there are broad swamps of *Typha angustifolia* (cattail) and *Scirpus olneyi*, and dense thickets of *Pluchea sericea* (arrowweed), the latter often 10 to 12 feet in height. Where the moisture of the soil is more deep-seated there are low forests of *Prosopis juliflora* (mesquite) or *Prosopis pubescens* (screwbean). Along the small streamways there are often remarkably large trees of *Cercidium floridum* (paloverde), 30 to 40 feet in height, as well as *Olneya*, and the smaller but very striking *Dalea spinosa* (smoketree).

The mesquite often grows in circular clumps from 30 to 50 feet.

in diameter, in the midst of which the soil is usually built up several feet above the surrounding level. All of the visible branches of such a clump are small, but underground they are connected by large limbs, and in fact the whole is a single large, nearly buried, tree. The inhabitants of the region often dig for wood.

ARIZONA SUCCULENT DESERT.—This type of vegetation extends south into Mexico, and its rich display of succulent plants is scarcely equaled elsewhere in the United States. In the open plains and low mountains of southwestern Arizona there is a very gradual transition from the microphyll desert to the succulent desert. The broad plains, or lower bajadas, are in fact often poor in succulents in regions where the upper bajadas and low hills are covered with heavy stands of them. From its poorly defined western edge the Arizona succulent desert extends eastward and northward to a very irregular boundary, which lies between 3,000 and 3,500 feet elevation in southern Arizona, but somewhat lower in Yavapai and Mohave Counties (pl. 2).

The matrix of the vegetation is *Larrea*, usually accompanied on coarse soils by heavy stands of *Franseria deltoidea*. Over extensive plains *Larrea* retains its dominance in communities where the number of succulents is large. It is only on upper bajadas, and particularly those of granitic mountains, that *Larrea* is replaced by *Cercidium microphyllum* and *C. floridum*, *Acacia constricta*, *Olneya*, and *Prosopis*, plants which in turn form the matrix for the still heavier stands of cacti clothing the upper bajadas and the lower hills. Only rarely and very locally do the cacti form even as much as 75 percent of the plant population. The heaviest stands of either the arborescent opuntias, *O. fulgida*, *O. spinosior*, *O. versicolor*, or the pricklypears, *O. engelmannii* and *O. phaeacantha*, are never without their accompanying non-succulent shrubs. The local distribution of shrubs is relatively uniform and bears a more or less obvious relation to the topographic and soil features. The occurrence of the heaviest stands of cacti appears, however, to be random and fortuitous. This circumstance undoubtedly has its basis in the vegetative multiplication to which so many individuals of *Opuntia* owe their existence, as well as to the partial independence of soil-moisture conditions, which is given them by their water-storing tissue.

The Arizona succulent desert is given its most distinctive characteristic by the abundance and variety of the cacti, but it is also marked by a large number of plants that differ greatly from one another in form, mode of branching, character of foliage, and seasonal habits. It is on the upper bajadas, the hills, and the lower slopes of the mountains that this type of vegetation is seen in its best development (pl. 3). The commonest perennials found throughout the area, in the approximate order of their abundance, are: *Larrea tridentata*, *Franseria deltoidea*, *Cercidium microphyllum*, *Acacia constricta*, *Opuntia fulgida*, *O. spinosior*, *Fouquieria splendens*, *Prosopis juliflora*, *Acacia greggii*, *Opuntia engelmannii*, *Cereus giganteus*, *Opuntia phaeacantha*, *Celtis pallida*, *Lycium andersonii*, *Simmondsia chinensis*, *Opuntia versicolor*, *Cercidium floridum*, *Olneya tesota*, *Jatropha cardiophylla*, *Krameria parvifolia*, and *Echinocereus engelmannii*.

The smaller perennials persist from season to season by survival of roots or larger branches. They form a conspicuous element of the vegetation in favorable localities that have not been heavily grazed. Among the abundant and characteristic smaller cacti are *Mammillaria*



Succulent desert on a coarse outwash plain in the Tucson Mountains, Pima County, altitude 2,200 feet, with *Cereus giganteus*, *Olneya tesota* (right), *Cercidium microphyllum* (center), *Celtis pallida* (left center), *Opuntia fulgida* (right center). The low shrubs are *Franseria deltoidea*.



Upper edge of the succulent desert at the south end of Hualpai Mountain, Mohave County, altitude 3,000 feet, with *Yucca brevifolia* (right), *Yucca baccata* (left), *Cereus giganteus*, *Juniperus utahensis*, *Amphipappus fremontii*, and *Hilaria mutica*.

microcarpa, *Echinocereus engelmannii*, and *Opuntia leptocaulis*. Even in such a relatively small area as the one under consideration several species of cacti are conspicuous elements of the vegetation in certain parts of the area and wholly absent from the rest of it. This is true of *Echinocactus lecontei*, *Opuntia echinocarpa*, *O. acanthocarpa*, and *O. stanlyi*.

The habitats in which cacti are least abundant, and sometimes absent over large areas, are the flood plains and the level or nearly level areas of fine soil subject to sheet floods and consequent deposition.

The flood plains of the succulent desert area were originally clothed with heavy stands of large trees of mesquite or else with thickets of *Atriplex canescens* (saltbush), and *Sporobolus wrightii* (sacaton). The texture of the soil, the depth to ground water, and the relative quantity of soluble salts seem to have determined this difference. The largest tree of the desert lowlands is *Populus fremontii* (cottonwood), which usually occurs singly or in small groups but forms a veritable forest for several miles along the Gila River in the vicinity of Hayden and at several places along the Verde River. Other common trees of streams and streamways are *Salix gooddingii* (willow), *Platanus occidentalis* (buttonwood), *Sambucus mexicana* (elder or tapiro), and several species of *Fraxinus* (ash). Among the shrubs common in these situations are *Baccharis glutinosa*, *Condalia lycioides*, *Chilopsis linearis*, and *Hymenoclea* spp.

In both the larger and smaller valleys there are nearly level central areas through which in many cases there is a very poorly defined drainage system, frequently resulting in flooding during periods of heavy rainfall. Such valleys are occupied by saltbush in some cases and by *Larrea* in others, the only common associates of these plants being mesquite, as a bush or small tree, *Acacia greggii* (catclaw), and several species of *Lycium*. In soils of high salt content *Suaeda torreyana* and *Sarcobatus vermiculatus* (greasewood) are common.

The lower bajadas, as already stated, are the optimum habitat for *Larrea*, which in some places covers them in nearly pure stands for many square miles. The plants which most commonly break the uniformity of these areas are *Acacia constricta*, *A. greggii*, *Opuntia fulgida*, *O. phaeacantha*, *Koeberlinia spinosa* (crucifixion-thorn), and *Lycium andersonii*.

A striking feature of the vegetation in the microphyll and succulent deserts is the large number of short-lived herbaceous plants that appear in the early spring and late summer, following the principal rainy seasons. In favorable years these plants carpet the desert, often completing their life cycle in 6 to 9 weeks. Brilliant displays of color often result from the simultaneous flowering of large pure or mixed stands, especially on sandy soil. There are several hundred species of ephemeral herbaceous plants, each of which is confined to one of the two growing seasons.

GREAT BASIN MICROPHYLL DESERT.—Lines drawn north and east from Flagstaff would define the northeastern corner of Arizona, in which a high percentage of the surface is occupied by microphyll desert of the type prevailing throughout the Great Basin. The range of elevations is greater here than in the southern desert areas of Arizona (from 3,000 to 6,000 feet), the rainfall is less but somewhat more evenly distributed through the year than in the south, and the vegetation is more desartic

in aspect. The soils are varied and have even more influence than differences of altitude in determining the vegetation, but through the entire area only 16 species of perennials are abundant. These are low in stature and usually widely spaced or else occurring in clumps. The perennials are chiefly semishrubs—much branched, with soft wood, indeterminate growth, and evergreen leaves—whereas true shrubs with winter-deciduous or drought-deciduous leaves are few. Cacti are represented by a few low-growing species, and the yuccas by two acaulescent species. In many respects there is a sharp contrast between the deserts of the southwestern and northeastern corners of the State (pl. 4).

The southern edge of the Great Basin Microphyll Desert, from Wide Ruin to the mouth of the Little Colorado, has a very poor plant cover. In the areas of the Painted Desert the topography is in an early stage of active erosion, and the poverty of the vegetation makes visible the brilliant display of color in the various layers of old lacustrine deposits that have been exposed. Where erosion is less active *Atriplex confertifolia*, *A. canescens*, and *Sporobolus wrightii* are the only common plants.

North and east of the broad valley of the Little Colorado River, the Great Basin Microphyll Desert is a network occupying the intervals between the lightly forested sandstone or limestone mesas. The soils in this network are prevailing sandy, sometimes with a level stabilized surface or quite as often with a poorly stabilized one in which the large plants occupy small hummocks, separated by bare spaces in which the wind is constantly moving the sand. There are no active dune areas involving large masses of sand. Below 6,000 feet the stabilized surfaces are occupied by scattered colonies of *Bouteloua gracilis* and *Hilaria jamesii*, and by *Ephedra viridis*, *E. cutleri*, *Atriplex confertifolia*, *Chrysothamnus nauseosus*, *Yucca angustissima*, *Opuntia hystricina*, and *Lycium pallidum*. The principal hummock-forming plants on sandy bajadas and plains are *Ephedra viridis* and *E. cutleri*, which in some localities form 90 percent of the perennial vegetation over many square miles (pl. 5).

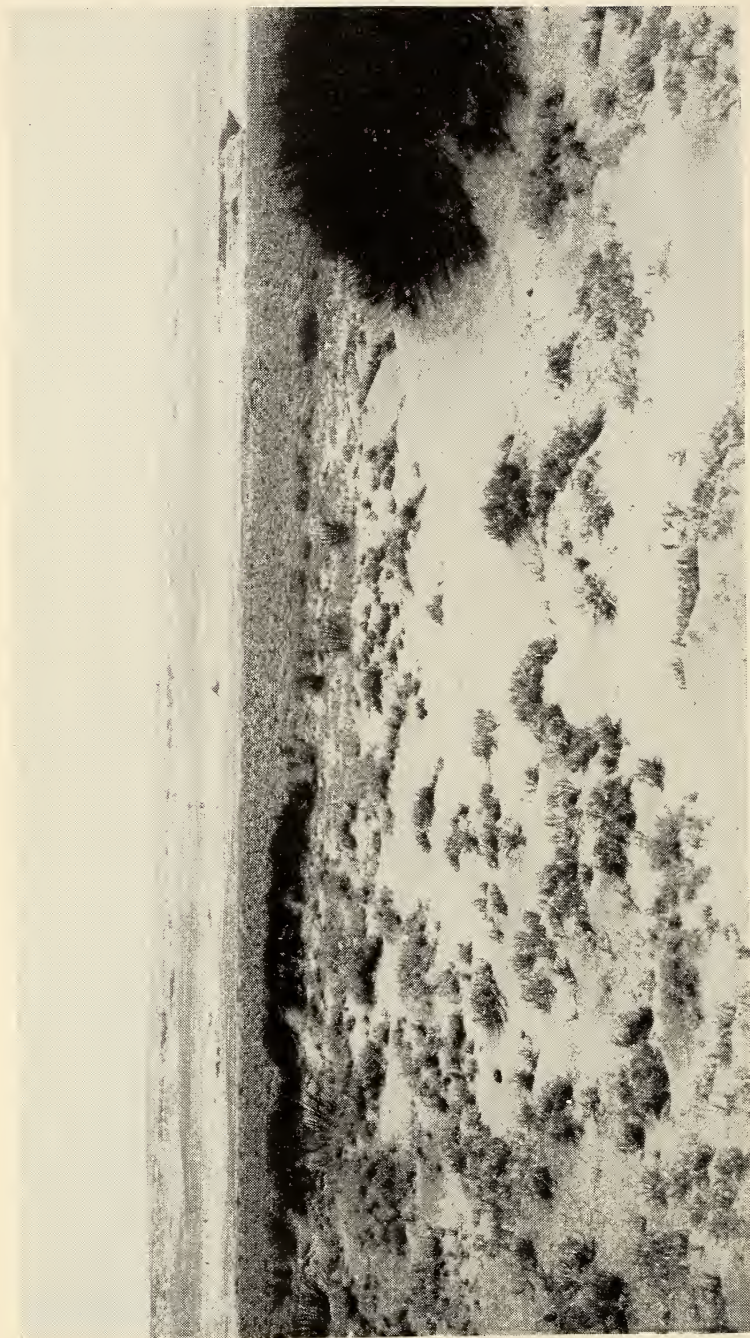
On very loose sand are found *Ephedra viridis*, *E. cutleri*, *E. torreyana*, *Chrysothamnus nauseosus*, *Poliomintha incana*, *Parryella filifolia*, *Yucca angustissima*, and *Oryzopsis hymenoides*. After copious spring rains many annuals and small herbaceous perennials appear on the sandy areas, including species of *Oenothera*, *Cryptantha*, *Euphorbia*, *Stephanomeria*, *Abronia*, *Lygodesmia*, *Allium*, *Astragalus*, *Calochortus*, and *Festuca*.

Above 6,000 feet the plains and bajadas on which soil has accumulated are occupied by pure stands of *Artemisia tridentata*, varying in height with the depth of the soil and the supply of moisture. Few perennials are associated with the *Artemisia*, save occasional plants of *Yucca baccata* and small root perennials.

Where rocks other than sandstone have given rise to the soil the bajadas are smooth, with gravelly surface, and are dominated by nearly pure stands of *Coleogyne ramosissima*. North of Tuba and Tyende (Kayenta), and along the Chinle Wash, there are innumerable areas of bare rock, varying in size from a few square yards to many acres, and devoid of plants. In favorable spots there are crevice plants, notably *Aplopappus* spp., *Eriogonum aureum*, *Fragaria anomala*, *Amelanchier utahensis*, and small trees of *Juniperus utahensis*



Great Basin microphyll desert northwest of Chloride, Mohave County, altitude 3,200 feet. An open stand of *Colcogippe ramosissima*, *Eriogonum fasciculatum*, *Tetradymia canescens*, and *Ephedra torreyana*, with scattered individuals of *Yucca mohavensis*, *Larrea tridentata*, and *Acacia greggii*.



Great Basin microphyll desert, 9 miles east of Tuba, Coconino County, looking south across Moenkopi Wash, altitude 5,200 feet. The sand is arrested by hummocks of *Ephedra cutleri* and scattered tufts of *Oryzopsis hymenoides*. *Yucca* sp. (probably *Y. bairdii*), is also abundant.

and *Pinus edulis*, here found at the lower edge of their altitudinal ranges.

It is characteristic of the Great Basin Microphyll Desert that the smaller drainageways are without distinctive plants and do not have a marginal fringe of upland plants growing more densely than elsewhere. *Forestiera neomexicana* and *Sarcobatus vermiculatus* are sometimes found in such situations, but there are no perennials that assume the role played in southern Arizona by *Populus*, *Prosopis*, *Cercidium floridum*, and *Baccharis*. In the flood plains of large streams *Sarcobatus*, *Forestiera*, and *Atriplex canescens* are characteristic. The first of these forms dense thickets in favorable places.

DESERT-GRASSLAND TRANSITION.—Between elevations of 4,000 and 6,000 feet are found large and small areas of this vegetation, perhaps forming one-tenth of the area of the State. The desert grassland is the best grazing land in Arizona, and has great potential value under more careful management than has commonly been practiced in the past. Over this region there is an annual rainfall of 12 to 18 inches, which is intermediate between the precipitation of the desert and that of the forest. Although the vegetation is favored by somewhat higher rainfall, there is a lower range of temperatures than in the desert, which serves as a limiting condition to exclude the great majority of desert plants.

In the desert-grassland areas there is, in general, a good soil of sufficient depth to favor root development in deep-rooting types of plants. There are a number of areas, especially in the central part of the State, which occupy the same elevations as the desert grassland and have similar climatic conditions, but possess a scanty and shallow soil. Some of these are limestone areas, whereas others are volcanic, locally known as "mallapy" (*mal pais*).

The largest area of desert grassland is found in the drainage of the Little Colorado River in Apache, Navajo, and Coconino Counties. Other large areas occur in Yavapai, Graham, and Cochise Counties.

The typical communities of the desert grassland are made up of perennial grasses, these commonly occurring as separate bunches with intervening bare ground. The dominant grasses are species of *Bouteloua*, *Sporobolus*, *Aristida*, *Muhlenbergia*, *Hilaria*, and *Stipa*. With one or more grasses forming the matrix of the vegetation there are associated with them a large number of species of root perennials and a few annuals. Cacti are by no means absent, although the number of species is small. Several species of *Yucca* are a characteristic feature of this vegetation, *Y. elata* and *Y. baccata* being the most common. *Dasylyrion* and *Nolina* are frequent but have their greatest abundance where the soil is relatively shallow.

Shrubs occur sporadically, usually in restricted localities. Where the desert grassland borders on the xeric evergreen forest there is no line of demarcation between the two. Throughout northern Arizona there are hundreds of square miles on which a very open stand of low junipers is found in typical desert-grassland country, and in southeastern Arizona the same conditions are found on passing into the evergreen oak forest. Higher rainfall, or better conditions for retention of soil moisture, favor the occurrence of a few trees without permitting the growth of a stand sufficiently dense to break the continuity of the desert grassland.

GRASSLAND.—The areas in which grasses form a nearly continuous cover lie between 5,000 and 7,000 feet and usually close to the margin of xeric or mesic forest. In fact, some of the best areas of grass lie within the borders of the forest, and, therefore, can scarcely be regarded as true grassland. Along the northern edge of the mesic forest which covers the Mogollon Mesa is found a belt of grassland that lies partly in the open and partly inside the margin of the forest. Under virgin conditions there were large areas in Apache, Navajo, and Coconino Counties that then merited the designation of grassland but now must be regarded as desert-grassland transition. Smaller areas also occurred in Chino Valley, Yavapai County, in Sulphur Springs Valley, Cochise County, and in other elevated valleys in Cochise and Santa Cruz Counties.

In Navajo and Coconino Counties the characteristic grasses are: *Festuca arizonica*, *Sporobolus interruptus*, *Muhlenbergia montana*, *Agropyron smithii*, *Bromus ciliatus*, *Bouteloua simplex*, *Muhlenbergia richardsonis*.

In the Chino Valley, Yavapai County, the commonest grasses are: *Muhlenbergia torreyi*, *Bouteloua gracilis*, *Stipa comata*, *Bouteloua hirsuta*, *B. eriopoda*, *Aristida ternipes*.

In the southeastern counties the grasses that are most important are: *Bouteloua curtipendula*, *B. gracilis*, *B. rothrockii*, *Sporobolus cryptandrus*, *Bouteloua eriopoda*, *B. hirsuta*, *Leptochloa dubia*, *Sporobolus wrightii*.

Both in the north and the southeast the grasses are accompanied by scattered individuals of a large number of species of herbaceous root perennials, as well as by more infrequent small shrubs.

ARIZONA CHAPARRAL.—This type of vegetation is found throughout the semiarid foothills of the Mogollon Mesa from the eastern border of the State to the vicinity of Ash Fork and Skull Valley, and locally farther west. In its typical form it usually occurs in belts or relatively small areas between elevations of 4,000 and 6,000 feet. In the general vicinity of Prescott it occupies slopes of all exposures between 5,000 and 6,000 feet, but at any given elevation there are differences in its composition on slopes of different aspect. Open chaparral occurs on north slopes as low as 3,500 feet in the vicinity of Roosevelt Lake and small stands of it on south slopes are found exceptionally as high as 7,000 feet northeast of Pine, Gila County. Chaparral occurs on slopes with stony or shallow soil just below the xeric forest. Its lower edge is in contact with grassland northwest of Prescott and with succulent desert southeast of Payson. None of the characteristic plants of the chaparral are found in the succulent desert, but many of them occur in the xeric or mesic forests, locally in close stands but more commonly as scattered individuals.

The dominant plant in the Arizona chaparral is *Quercus turbinella* (scrub oak), which forms 80 percent of the stand in many localities. Common associates are *Arctostaphylos pungens* (manzanita), *Rhus trilobata* (squawbush), *Cercocarpus breviflorus* and *C. betuloides* (mountain-mahogany), *Ceanothus greggii* (buckbrush), *Garrya wrightii* (silk tassel), and *Fallugia paradoxa* (Apache-plume). These shrubs have a relatively uniform height of 3 to 6 feet, occasionally broken by taller shrubs or by yuccas. The leaves of the dominant plants are small and thick and are evergreen in all but *Rhus trilobata*. The physiognomy of the Arizona chaparral, and the sclerophyllous character of the leaves

of its dominant plants, link it closely with the same type of vegetation in California, although there are very few species common to both regions.

A number of shrubs, semishrubs, and other plants are infrequent in the chaparral or only locally abundant, including, in order of abundance: *Rhus ovata*, *Covania stansburiana*, *Quercus palmeri*, *Arctostaphylos pringlei*, *Garrya flavescens*, *Nolina microcarpa*, *Berberis haematocarpa*, *Agave parryi*, *Mimosa biuncifera*, *Eriodictyon angustifolium*, *Aplopappus* spp., *Eriogonum wrightii*, *Quercus gambelii*, *Brickellia californica*.

WESTERN XERIC EVERGREEN FOREST.—This type of vegetation is widely distributed in central and northern Arizona, forming a zone which surrounds the mesic evergreen forest or occurs in large and small isolated stands. Its limits are seldom sharply defined, for it stretches down in attenuated form into the grassland, and its characteristic trees extend upward to altitudes at which they mingle with the larger trees of the mesic forest. So far as its dominant plants are concerned it has the simplest composition of any of the vegetations of the Southwest. There is a wide floristic difference between the xeric forest of southern Arizona, often composed solely of evergreen oaks, and that of central and northern Arizona, composed almost wholly of juniper and pinyon. Also, there are greater variations in density and stature in the xeric forest than in any of the other types of vegetation, the low and open stands being at lower altitudes, and the dense tall ones at higher elevations.

The type of xeric evergreen forest in which the oaks are dominant is nearly confined to the eastern part of the State south of the Gila River, where rainfall is somewhat greater in summer than in winter. It occurs chiefly on hills and mountain slopes between altitudes of 4,000 and 6,500 feet, and in many localities extends from the mountain base out onto the upper bajada but does so only above 5,000 feet. The most extensive oak forests are found in the foothills of the larger mountains of the southeastern counties. The commonest tree is *Quercus emoryi* (bellota), which appears to be the most drought resistant of the evergreen oak trees. *Quercus arizonica* (Arizona oak) and *Q. oblongifolia* (blue oak) are less abundant than the bellota at lower elevations, but are equally common above 5,500 feet. *Juniperus monosperma* (oneseed juniper) is of sporadic occurrence and is seldom an important associate of the oaks, but *J. pachyphloea* (alligator juniper) is abundant, usually mingled with the oaks, sometimes occurring in limited nearly pure stands, or again growing in company with *Pinus cembroides* (nut pine).

The oak type of xeric forest is rarely closed, being commonly an open or a very open community, with many associated shrubs, succulents, and semisucculents. Among the commonest of these associates in Cochise, Graham, Pima, and Santa Cruz Counties are: *Yucca elata*, *Y. schottii*, *Nolina microcarpa*, *Dasyllirion wheeleri*, *Agave palmeri*, *Cercocarpus breviflorus*, *Mimosa biuncifera*, *Dalea wislizeni*, *Rhus trilobata*, *Echinocactus wislizeni*, *Opuntia spinosior*, *Garrya wrightii*, *Arctostaphylos pungens*, *Aplopappus* spp.

Juniper and pinyon mingle extensively with the evergreen oaks in the xeric forest of southern Arizona, but on passing northward the oaks become less frequent. Throughout the northern half of the State juniper is more abundant than pinyon below 6,500 feet. Above that

elevation pinyon is the dominant or, in some places, the only tree. A narrow belt of xeric evergreen forest surrounds the Mogollon Mesa, stretches over wide areas in Coconino County, and covers the plateaus and mesas of Navajo and Apache Counties at elevations between 6,000 and 7,200 feet. The alligator juniper, common in the mountains of the southern part of the State, is less frequent in central Arizona and absent from the northern part. The oneseed juniper is the common form along both edges of the Mogollon Mesa. *Juniperus utahensis* (Utah juniper) is the commonest form in the extreme north. In Yavapai County and some of the adjacent regions all of these junipers may be found, together with *J. scopulorum* (Rocky Mountain juniper). *Pinus cembroides*, the common pinyon of the southernmost counties, is absent from the northern half of the State where the commonest form is *P. edulis* (pl. 6).

There are no other trees that deserve mention as common, or even infrequent, components of this type of forest. Along the streams and drainageways are found several deciduous trees, notably *Fraxinus velutina* (ash), *Quercus gambelii* (Gambel oak), *Platanus wrightii* (sycamore), *Populus fremontii* (cottonwood), *Acer grandidentatum* var. *brachypterum* (maple), and *Acer negundo* var. *interius* (boxelder).

NORTHERN MESIC EVERGREEN FOREST.—The mesic forests of Arizona are predominantly made up of needle-leaved evergreen trees, and in their physiognomy and ecological characteristics are very similar to the coniferous forests that cover the higher elevations of the Rocky Mountain region. This is predominantly a pine forest, and, as represented in Arizona, presents some marked differences in its floristic composition from the forests of the States to the north and northeast. The mesic forest is confined to the mountains and higher elevations of the State and is commonly surrounded by xeric evergreen forest. The larger bodies of mesic forest extend from northwestern to eastern central Arizona, over the region of highest altitude, and smaller bodies of it occur in the extreme northeast, in the central counties, and in the southeast. Some of the smallest bodies are found in small mountain ranges, where they are very effectively isolated from the larger areas (pl. 7).

From both the physiognomic and floristic standpoints the mesic forest is naturally divisible into drier and more open pine forests and moister closed spruce and fir forests. The lower limit of pine forest varies from 6,000 to over 7,000 feet, according to local conditions, and its upper limit is about 9,000 feet. The spruce and fir forest ranges from about 7,000 or 7,500 feet to about 11,000 feet, at which elevation it is open and stunted.

The pine forests are dominated north of the Gila River by *Pinus ponderosa* (western yellow pine) and in the south by *Pinus arizonica* (Arizona pine). With respect to the plants associated with these trees there are some striking differences between the forest of the desert mountains south of the Salt River and those of the Mogollon Mesa. In the former are to be found many plants that have their principal areas in Mexico and reach their northern limits in southern Arizona. In the desert mountains the lower limit of the pines is formed by *Pinus latifolia* (Apache pine) or by *P. leiophylla* (Chihuahua pine) and the upper limit by *P. strobiformis* (Mexican white pine), all of which are confined to the southern half of the State. A considerable number of shrubs and root perennials that are found in the pine



Xeric evergreen forest on Black Mesa, Navajo County, altitude 7,150 feet. *Juniperus utahensis* and *Pinus edulis* are the principal trees. The commonest shrub in the open forest is *Artemisia tridentata*.



Mesic evergreen forest between Elden Mountain and San Francisco Peaks, Coconino County, altitude 7,400 feet. The trees are *Pinus ponderosa* and *Pseudotsuga taxifolia*. The clean floor of the forest is heavily carpeted by the grasses *Festuca arizonica*, *Muhlenbergia rigens*, *Sporobolus interruptus*, and *Agropyron smithii*.

forests of the southern counties are rarely seen north of Salt River.

The trees most commonly associated with the pines in southern Arizona are *Juniperus pachyphloea*, *Quercus hypoleucoides*, *Arbutus arizonica* (madroño), and *Quercus gambelii*. The large shrub *Q. diversicolor* is frequent in the forest and often forms extensive thickets where trees are absent. Along the streams are found *Alnus oblongifolia* (alder), *Acer negundo* var. *interius*, *Acer grandidentatum* var. *brachypterum*, and shrubby willows.

In late summer the floor of the pine forests is richly covered with a large number of species of root perennials, in which grasses, legumes, and composites predominate. There are very few species of annuals, and likewise none of the herbaceous perennials are active in the late winter, at a time when the desert is often covered with flowering annuals. Some of the commonest root perennials in the pine forests of southern Arizona are: *Pteridium aquilinum*, *Poa fendleriana*, *Muhlenbergia virescens*, *Panicum bulbosum*, *Potentilla subbricosa*, *Lupinus palmeri*, *Lathyrus graminifolius*, *Cologania longifolia*, *Apocynum androsaemifolium*, *Lithospermum multiflorum*, *Monarda austromontana*, *Hedeoma hyssopifolium*, *Houstonia wrightii*, *Solidago sparsiflora*, *Erigeron* spp., *Hymenopappus mexicanus*, *Helenium hoopesii*, *Tagetes lemmoni*, and *Achillea lanulosa*.

In northern Arizona the pine forests are somewhat poorer in the number of associated trees and in the variety of root perennials but have a greater abundance of shrubs. The floor of the forest is much more heavily carpeted with grasses in the northern counties, and young pines are themselves more abundant. Large openings or parks, dominated by grasses and sedges, are a characteristic feature of the forests throughout the most heavily wooded part of the State.

The commonest tree associated with the pines is the deciduous oak *Quercus gambelii*, which seldom reaches more than half the height of the tallest pines and is found singly or more often in close groups of 10 to 50 small trees. Another locally very abundant deciduous tree is *Populus tremuloides* (aspen), the largest stands of which occupy north slopes or old burns, usually above elevations of 7,500 feet. In rocky situations and on north slopes *Pseudotsuga taxifolia* (Douglas-fir) may be found at all elevations above 7,000 feet, and piñon and juniper are frequently found among the pines below that elevation.

The floor of the pine forests in northern Arizona is sometimes very bare in appearance prior to the summer rains, but under virgin conditions bore a light or heavy cover of perennial grasses, in addition to scattered shrubs, perennial composites, and smaller root perennials. The commonest and most widespread of the grasses are *Festuca arizonica*, *Muhlenbergia montana*, *Bouteloua gracilis*, *Blepharoneuron tricholepis*, and *Aristida arizonica*. Other common grasses are *Sporobolus interruptus*, *Agropyron smithii*, *Muhlenbergia rigens*, *Bromus ciliatus*, *Muhlenbergia richardsonis*, and *M. wrightii*.

Among the herbaceous perennials of common occurrence in the pine forests of northern Arizona may be mentioned: *Iris missouriensis*, *Comandra pallida*, *Eriogonum alatum*, *E. racemosum*, *Silene laciniata*, *Potentilla thurberi*, *Lupinus* spp., *Trifolium fendleri*, *Psoralea tenuiflora*, *Dalea albiflora*, *Oxytropis lambertii*, *Lathyrus* spp., *Cologania longifolia*, *Phaseolus angustissimus*, *Gayophytum ramosissimum*, *Frasera speciosa*, *Asclepiodora decumbens*, *Gilia aggregata*, *Phacelia heterophylla*, *Monarda menthaefolia*, *Penstemon barbatus*, *P. linarioides*, *P. virgatus*,

Castilleja spp., *Cordylanthus wrightii*, *Aster commutatus*, *Erigeron* spp., *Antennaria rosulata*, *Achillea lanulosa*, *Artemisia dracunculoides*.

In many localities in the northernmost part of the State *Artemisia tridentata* occurs in extensive colonies in the xeric or mesic forest, often accompanied by *Chamaebatiaria millefolium*, *Cowania stansburiana*, and *Fallugia paradoxa*.

The type of northern mesic evergreen forest dominated by spruce and fir is represented by very small areas on the desert mountains of southern Arizona, by a large area in the White Mountains, by small areas on the San Francisco Peaks, and by an area of considerable extent on the Kaibab Plateau. This is a closed forest of large trees reaching heights of 60 to 100 feet with a floor, which is sometimes open, sometimes occupied by shrubbery. At elevations of 10,500 to 11,000 feet, the size of the trees becomes less and the stand more open. The lowest bodies of this forest occupy north slopes at 7,000 to 7,500 feet elevation, and it is found on level ground or south slopes only above an elevation of about 9,500 feet.

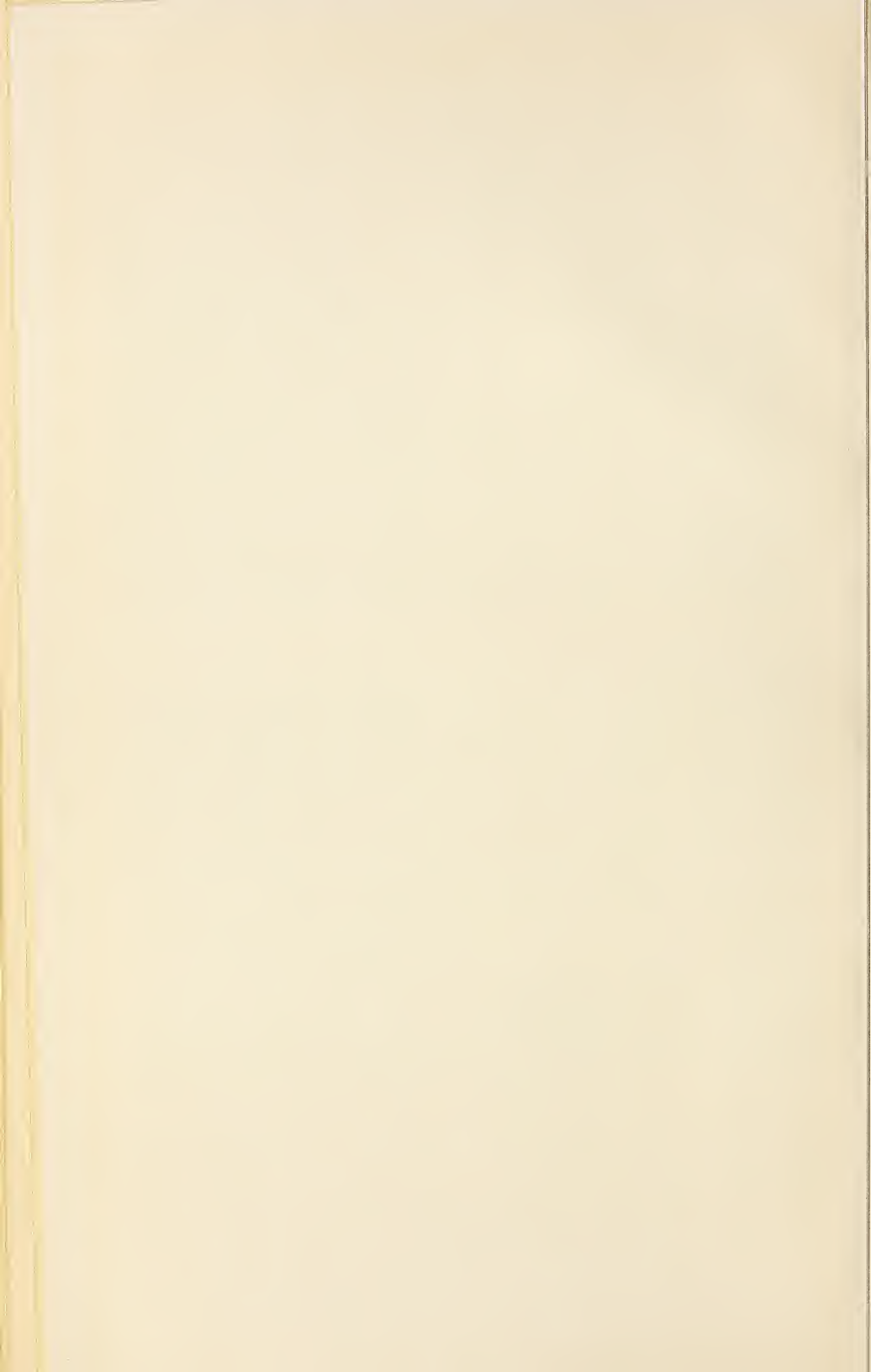
The dominant trees of this type of forest in Arizona are *Pseudotsuga taxifolia* (Douglas-fir), *Abies concolor* (white fir), *Picea engelmanni* (Engelmann spruce), *Picea pungens* (blue spruce), *Pinus flexilis* (limber pine), *Abies lasiocarpa*, and *A. arizonica* (corkbark fir). The Douglas-fir is found at lower elevations and in drier situations than the other forms mentioned. *Pinus flexilis* is confined to the San Francisco Peaks and Navajo Peak. The spruces are found only at the highest altitudes. *Abies lasiocarpa* is abundant on the Kaibab Plateau and on a few high mountain peaks. On the whole, the spruce-fir type of mesic forest exhibits greater variety in its composition than the pine type does (pl. 8).

South of the Mogollon Mesa, Douglas-fir and white fir are the dominant trees, with Mexican white pine playing a minor role. Above 9,500 feet in the Pinaleno Mountains the dominant trees are *Picea engelmanni* and *Abies* sp. (*A. arizonica*?). Near the summit of these mountains (10,500 feet) the forest is somewhat open, the trees retain their branches down to the base of the trunk, and the crowns are pointed, all indicating an approach to the limiting conditions for tree growth. The highest elevation in the White Mountains (Baldy Peak, 11,470 feet) is forested to the summit by *Picea engelmanni*, *Pseudotsuga taxifolia*, and *Abies concolor*. The summits of the San Francisco Peaks are surrounded by a belt of spruce-fir forest, in which the limber pine is found in addition to the trees last named. On the summit of the Kaibab Plateau there is an area of spruce forest estimated to be about 375 square miles in extent. The dominant trees are *Picea engelmanni* and *P. pungens*. The aspen (*Populus tremuloides*) occurs in scattered or nearly pure stands, and *Quercus gambelii*, *Betula fontinalis* (water birch), and *Acer negundo* var. *interius* are the commonest deciduous trees. The prostrate shrubby mountain juniper, *Juniperus communis* var. *montana*, is locally abundant on the Kaibab Plateau.

ALPINE SUMMITS.—The summit of the San Francisco Peaks is the only truly alpine area in Arizona. The timber line varies from about 11,000 to 11,400 feet, according to slope exposure, above which the slopes are steep, poorly watered during the latter part of the growing



Kaibab Plateau, Coconino County, altitude about 8,200 feet. *A*, A natural opening in the mesic evergreen forest. The trees are chiefly *Picea engelmanni*. *B*, A thick stand of young *Populus tremuloides*. The coniferous seedlings are *Picea pungens* and *Pseudotsuga taxifolia*.



season, and mainly covered with loose volcanic cinders in which it is difficult for plants to become established. It seems very certain, in fact, that timber line on the San Francisco Peaks is not a truly climatic line, but one in which the character of the substratum cooperates to bring the tree limit down to a somewhat lower level than would exist on a mountain that presented favorable soil conditions. An approach to timber-line conditions is found on Baldy Peak (Mount Thomas) in the White Mountains and on Mount Graham, in the Pinaleno Mountains.

The vegetation of the summits of the San Francisco Peaks is of interest on account of the character of the few plants that are able to persist there and also on account of their distributional relationships. No species is very abundant and there are few spots in which the vegetation covers the substratum. The most abundant species are those forming mats in the crevices of rock, as *Silene acaulis*, *Saxifraga caespitosa* var. *lemmonii*, and *Potentilla sibbaldi*. Small size and low habit are characteristic, but large flowers make many of these plants conspicuous.

In common with other alpine areas in the United States the flora above timber line on the San Francisco Peaks embraces several plants that range north to the Arctic Circle, and a few that have very close relatives in the high latitudes of Europe and Asia. The following list includes the most characteristic and abundant species; an asterisk indicates plants found also in the Arctic regions of North America. *Poa rupicola*, **Phleum alpinum*, *Carex bella*, **Luzula spicata*, **Oxyria digyna*, **Cerastium beeringianum*, **Arenaria sajanensis*, **Arenaria verna*, **Silene acaulis*, **Ranunculus eschscholtzii*, *Thlaspi fendleri*, *Draba crassifolia*, *Saxifraga caespitosa* var. *lemmonii*, **S. flagellaris*, *Potentilla diversifolia*, **Potentilla sibbaldi*, *Epilobium saximontanum*, *Pseudocymopterus montanus*, **Moneses uniflora*, *Primula parryi*, **Androsace septentrionalis* var. *subumbellata*, *Gentiana monantha*, *Polemonium confertum*, *Penstemon whippleanus*, *Pedicularis parryi*.

VEGETATION OF THE GRAND CANYON

The scenic grandeur and geological interest of the Grand Canyon have long made it the most outstanding natural feature of Arizona. In the present-day distribution of plant and animal life from the rim to the river the Canyon is equally remarkable. Crowded into the vertical space of 1 mile and the horizontal space of 10 to 20 miles are nearly all phases of environment and vegetation to be found in the entire State. It is possible to descend in a few hours from pines and firs to mesquites and cacti. At the same time that the Canyon is an epitome of the vegetation of the State, its conditions and the distribution of its plants are very complicated. The climatic differences due to altitude are modified by slope exposure, by the shade of the great cliffs, by seepage of water, and by the ever-changing currents of warm and cool air. Plants may be found growing near each other that have very different life requirements and are elsewhere found only many miles apart. Only a very few of the plants of Arizona appear to be peculiar to the Canyon, but on its walls may be found a large percentage of the species of plants known to occur in the State.

ANNOTATED LIST OF THE PLANTS OF ARIZONA, WITH KEYS

Key to the phyla

Plants without flowers, producing spores, not seeds..... PTERIDOPHYTA.
 Plants with flowers, producing seeds..... SPERMATOPHYTA.

PTERIDOPHYTA. FERNS AND FERN ALLIES

Contributed by WILLIAM R. MAXON

Plants exhibiting a life cycle of two well-marked phases, sporophyte and gametophyte. The former, known commonly as a fern or fern ally, is differentiated into root, stem, and leaf, is provided with vascular tissues, and bears spores asexually, these either alike or of two kinds called megaspores and microspores. On germinating, the spore produces the gametophyte or minute sexual stage (prothallium). The large growth phase developing from the impregnation of an egg cell of the prothallium by a single coiled motile male element (spermatozoid) is the sporophyte.

Key to the families

1. Leaves very numerous, spirally arranged in many ranks upon freely branched creeping stems, minute, lance-subulate or bractlike, sessile, never united; plants heterosporous, producing megaspores and microspores.
 7. SELAGINELLACEAE.
1. Leaves fewer, mostly much larger, or, if small, united in short sheaths upon the stem or its branches; plants either homosporous or heterosporous (2).
 2. Stems jointed, fluted, mostly hollow, simple and rushlike or with numerous whorled branches; leaves minute, united in toothed sheaths at the nodes; sporophylls small, borne in terminal cones..... 6. EQUISETACEAE.
 2. Stems not jointed or fluted, solid, without whorled branches; leaves mostly large, simple to compound; sporophylls never in cones (3).
 3. Plants terrestrial, homosporous (4).
 4. Sporangia very large, sessile, united in a simple fleshy apical spike or borne in a loose terminal panicle, the sterile blade (simple to compound) appearing lateral..... 1. OPHIOGLOSSACEAE.
 4. Sporangia minute, mostly long-stalked, borne in clusters (sori) on the back of ordinary leaves..... 2. POLYPODIACEAE.
 3. Plants aquatic or of wet situations, producing both megaspores and microspores (5).
 5. Leaves grasslike, tufted upon a very short trunk, the sporangia borne within their expanded hollow bases..... 5. ISOETACEAE.
 5. Leaves not grasslike; sporangia not borne within hollow leaf bases (6).
 6. Plants rooting in mud; sori 4 to many, borne within large free, bony, septate, basal conceptacles..... 3. MARSILEACEAE.
 6. Plants floating, minute; sori indusiate, borne in pairs on the submerged lower lobe of the leaves..... 4. AZOLLACEAE.

1. OPHIOGLOSSACEAE. ADDERSTONGUE FAMILY

Sporophytes herbaceous, with short fleshy rhizome and long fleshy roots; leaves (fronds) 1 or several, consisting of a simple, pinnatifid, or dissected sterile blade and (if fertile) a stalked sporebearing spike or panicle, borne at the apex of a common stalk; sporangia marginal, in 2 rows, sessile, opening by a transverse slit; spores uniform; gametophytes (prothallia) hypogean, tuberlike.

Key to the genera

1. Sterile blade simple, with reticulate veins; sporangia united in a simple slender fleshy spike..... 1. OPHIOGLOSSUM.
1. Sterile blade 1 to 4 times pinnately divided, with free veins; sporangia globose, distinct, borne in a panicle..... 2. BOTRYCHUM.

1. OPHIOGLOSSUM. ADDERSTONGUE

Mostly small terrestrial herbs, the rhizome ending in an erect exposed bud; leaves erect; sterile blade simple, entire, linear-lanceolate to ovate, with reticulate venation, the areoles simple or compound; sporophyll a simple, slender, long-stalked spike, the large globose sporangia coalescent in two ranks.

Key to the species

1. Fronds usually solitary; sterile blade with a pale median band, not apiculate; areoles small, numerous----- 1. *O. VULGATUM*.
 1. Fronds two or several; sterile blade lacking a median band, apiculate; areoles large, including numerous secondary ones----- 2. *O. ENGELMANNII*.

1. *Ophioglossum vulgatum* L., Sp. Pl. 1062. 1753.

A single specimen, said to have been collected in the Huachuca Mountains, is cited by Clausen (Mem. Torrey Bot. Club 19: 126. 1938). Prince Edward Island to Alaska, south to northern Florida, the Gulf States, Texas, Arizona, and Mexico; Eurasia.

2. *Ophioglossum engelmannii* Prantl, Ber. Deut. Bot. Gesell. 1: 351. 1883.

Huachuca Mountains and near Hereford (western Cochise County), Mustang Mountains and Sonoita Valley (Santa Cruz County), 4,000 feet or higher, in damp places, usually in calcareous soil. Virginia to Missouri, Florida, Louisiana, Texas, Arizona, and Mexico.

2. BOTRYCHIUM. GRAPEFERN

Succulent terrestrial herbs; rhizome erect, the bud for the following year wholly or partially enclosed in the base of the common stalk; leaves erect, 1 to 3; sterile blade 1 to 3 times pinnately or ternately divided or compound, the divisions small, with free veins; sporophyll solitary, usually a long-stalked, 1- to 5-pinnate panicle, the large globose sporangia sessile or nearly so, free.

Key to the species

1. Sterile blades large, ternately decompound, membranous; bud at base of common stalk partially exposed, pilose----- 1. *B. VIRGINIANUM*.
 1. Sterile blades small, once or twice pinnately divided, fleshy; bud completely enclosed in base of common stalk, glabrous (2).
 2. Blades deltoid, acute, once or twice pinnately divided, the segments narrow and acute; sterile blade and sporophyll bent down in veneration. 2. *B. LANCEOLATUM*.
 2. Blades oblong or triangular-oblong, once pinnate, the segments flabelliform to lunate or reniform; sterile blade and sporophyll erect in veneration. 3. *B. LUNARIA*.

1. *Botrychium virginianum* (L.) Swartz, Jour. Bot. Schrad. 1800²: 111. 1801.

Osmunda virginiana L., Sp. Pl. 1064. 1753.

Santa Rita Mountains (*Pringle*). Prince Edward Island and New Brunswick to British Columbia, south to Florida, the Gulf States, Arizona, and Mexico; Eurasia.

2. **Botrychium lanceolatum** (S. G. Gmel.) Ångs., Bot. Notiser 1854: 68. 1854.

Osmunda lanceolata S. G. Gmel., Nov. Comment. Acad. Petrop. 12: 516. 1768.

San Francisco Peaks, 11,000 feet, subalpine meadows (*Little* 4679, 4740). Newfoundland and Quebec to northern Maine; Alaska, southward in the mountains to Colorado and Arizona; Greenland; Eurasia. The var. *angustisegmentum* Pease and Moore is found from Newfoundland to West Virginia, westward to Wisconsin.

3. **Botrychium lunaria** (L.) Swartz, Jour. Bot. Schrad. 1800?: 110. 1801.

Osmunda lunaria L., Sp. Pl. 1064. 1753.

San Francisco Peaks, 11,000 feet, open spruce-fir forests (*Kearney* and *Peebles* 12123, *Little* 4741, *Collom* 890). Labrador and Newfoundland to Alaska, southward in two or more varietal forms to Maine, New York, Michigan, Colorado, Arizona, and southern California; Argentina; Greenland; Eurasia; Australia; New Zealand.

2. POLYPODIACEAE. FERN FAMILY

Leafy vascular plants of varied habit, the rhizomes paleaceous or hairy, creeping to erect; fronds usually stalked; blades simple to several times pinnatifid or pinnate, coiled in veneration; sporangia (in our species) borne in clusters or lines (sori) upon the back of the blades, mostly long-stalked, provided with an incomplete vertical ring of thickened hygroscopic cells (the annulus), splitting transversely; sori with or without a membranous protective organ (indusium); prothallia green, epigean.

Key to the genera

1. Sori dorsal upon the veins, separate, not marginal (2).
2. Indusium attached to receptacle beneath the sporangia, its divisions spreading on all sides..... 1. **WOODSIA**.
2. Indusium, if present, centrally peltate or attached at the sinus (3).
3. Sori round to oval (4).
4. Stipes jointed to the rhizome; blades deeply pinnatifid; indusia wanting..... 2. **POLYPODIUM**.
4. Stipes not jointed; blades 1- to 3-pinnate; indusia present (5).
5. Indusium orbicular, centrally peltate (6).
6. Sori in a single row at either side of the midrib..... 3. **POLYSTICHUM**.
6. Sori in 2 or more rows..... 4. **PHANEROPHLEBIA**.
5. Indusium not as above (7).
7. Indusium firm, roundish-reniform, attached at its sinus..... 5. **DRYOPTERIS**.
7. Indusium membranous, hood-shaped, attached by its base at one side, early thrust back..... 6. **CYSTOPTERIS**.
3. Sori oblong or linear to lunate or hippocrepiform (8).
8. Venation partially areolate, the large tumid sori borne in a chainlike row close to the midribs..... 7. **WOODWARDIA**.
8. Venation free; sori oblique (9).
9. Rhizome scales with thin-walled cells; blades large, delicate; sori mostly lunate or hippocrepiform..... 10. **ATHYRIUM**.
9. Rhizome scales with dark-walled cells; blades small; sori oblong to linear, straight or nearly so (10).
10. Blades sinuate-pinnatifid..... 8. **CETERACH**.
10. Blades pinnate..... 9. **ASPLENIUM**.

1. Sori submarginal or the sporangia borne in naked lines along the veins (11).
11. Sporangia following the veins throughout (12).
12. Blades densely ceraceous beneath..... 11. PITYROGRAMMA.
12. Blades conspicuously hairy..... 12. BOMMERIA.
11. Sporangia borne at or near apex of the veins (13).
13. Plants large, coarse; sporangia borne on a veinlike receptacle connecting the vein ends..... 13. PTERIDIUM.
13. Plants mostly small and rock-loving; sporangia not borne on a special transverse receptacle (14).
14. Sporangia borne on under side of sharply reflexed membranous lobes of the leaf..... 14. ADIANTUM.
14. Sporangia not borne on the back of reflexed lobes (15).
15. Vein ends distinctly thickened; proper marginal indusium often present..... 15. CHEILANTHES.
15. Vein ends scarcely or not at all enlarged; proper membranous indusium invariably wanting (16).
16. Margin of segments widely reflexed or revolute, usually modified; blades glabrous or nearly so..... 16. PELLAEA.
16. Margin of segments narrowly or not at all revolute; blades variously hairy, paleaceous, or ceraceous beneath..... 17. NOTHOLAENA.

1. WOODSIA

Small rock ferns, the rhizomes tufted; fronds many, fasciculate, suberect; blades linear to lance-ovate, 1- to 2-pinnate, the segments lobed or pinnatifid, hairy or subglabrous, free-veined; sori dorsal, roundish, often confluent with age; indusia inferior in attachment, the spreading divisions cleft to filiform, often concealed at maturity.

Key to the species

1. Blades bearing numerous flexuous, flaccid, hyaline, septate hairs beneath. 1. W. SCOPULINA.
1. Blades devoid of flexuous septate hairs (2).
2. Indusia ample, consisting normally of a few short, broad, concave lobes; blades obviously glandular-pubescent..... 2. W. PLUMMERAE.
2. Indusia consisting of hairlike segments; blades glabrous or nearly so (3).
3. Segments of indusium numerous, truly capillary, flaccid, greatly exceeding the sporangia; leaf tissue coriaceous; segments sharply dentate, with whitish-crustose margins, the teeth ending in several hairlike processes. 3. W. MEXICANA.
3. Segments of indusia few, short, turgid, moniliform from a broader base, often obscure at maturity; leaf segments herbaceous, the margins not altered..... 4. W. OREGANA.

1. *Woodsia scopulina* D. C. Eaton, *Canad. Nat.* II. 2: 90. 1865.

Recorded for Arizona on the basis of a collection purporting to be from the Huachuca Mountains (*Lemmon* in 1882) and one from "Maricopa" (*Pringle* in 1882). Quebec to the Great Lakes region and Alaska, southward to western Oklahoma, Colorado, Arizona, and California; also northwestern Virginia to western North Carolina and eastern Tennessee.

2. *Woodsia plummerae* Lemmon, *Bot. Gaz.* 7: 6. 1892.

Woodsia obtusa var. *glandulosa* D. C. Eaton and Faxon, *Torrey Bot. Club Bul.* 9: 50. 1882.

Springerville (Apache County), Kaibab Forest (Coconino County), to the mountains of Cochise, Santa Cruz, Pima, and Yuma Counties, 2,000 to 9,000 feet; shaded ledges and cliffs. Western Texas to Arizona and northern Mexico.

3. *Woodsia mexicana* Fée, Mém. Foug. 7: 66. 1854.

Mountains of southern Coconino, Yavapai, Greenlee, Gila, Cochise, Santa Cruz, and Pima Counties, 3,500 to 8,000 feet, crevices of cliffs and rocky slopes. Western Texas to Arizona and Mexico.

4. *Woodsia oregana* D. C. Eaton, Canad. Nat. II. 2: 90. 1865.

Navajo Mountain, Kaibab Plateau, Grand Canyon, San Francisco Peaks, etc. (Coconino County), 5,500 to 11,500 feet, from the pinyon belt to timber line; rock crevices. Gaspé Peninsula to British Columbia, south to northwestern Oklahoma, New Mexico, Arizona, and southern California.

2. POLYPODIUM. POLYPODY

Plants of varied habit, the rhizomes paleaceous, mostly slender and creeping; fronds several, articulate to the rhizome; blades once pinnate or pinnatisect in the Arizona species; sori round or oval, large, dorsal, separate, nonindusiate.

Key to the species

1. Blades naked; veins free..... 1. *P. HESPERIUM*.
 1. Blades copiously scaly beneath; veins areolate..... 2. *P. THYSSANOLEPIS*.

1. *Polypodium hesperium* Maxon, Biol. Soc. Wash. Proc. 13: 200. 1900.

Polypodium prolongilobum Clute, Fern Bul. 18: 97. 1910.

Polypodium vulgare var. *perpusillum* Clute, Fern Bul. 18: 98. 1910.

Mogollon Escarpment (southern Coconino County), Sierra Ancha (Gila County), Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), 7,000 to 8,000 feet, sides of canyons. South Dakota to Yukon, south to New Mexico, Arizona, southern California, and Baja California.

Variable, its relation to *P. vulgare* L. not well understood.

2. *Polypodium thyssanolepis* A. Br. ex Klotzsch, Linnaea 20: 392. 1847.

Chiricahua and Huachuca Mountains (Cochise County), Baboquivari Mountains (Pima County), at 5,000 to 6,000 feet, among rocks in canyons. Western Texas to Arizona, Mexico, Peru, and Bolivia; Jamaica; Hispaniola.

3. POLYSTICHUM. HOLLYFERN

Rigid ferns of talus slopes and rocky forests, the woody rhizomes stout, copiously paleaceous; fronds stiffly ascending; blades uniform, simply pinnate in the Arizona species, of harsh texture, with sharply toothed margins; veins free; sori round, dorsal, the indusium orbicular, centrally peltate.

1. *Polystichum lonchitis* (L.) Roth, Roem. Arch. Bot. 2¹: 106. 1799.

Polypodium lonchitis L., Sp. Pl. 1088. 1753.

Pinaleno Mountains, above sawmill (*Thorner and Shreve* 7767). Newfoundland to Alaska, southern Ontario, Michigan, and Montana, and in the mountains to Colorado, Arizona, and California; Greenland; Eurasia.

4. PHANEROPHLEBIA

Coarse ferns of rocky situations, similar in general to *Polystichum*; fronds rigidly ascending, the blades simply pinnate, with spinulose margins; veins several times branched, free in *P. auriculata*; sori borne in 2 or several rows on either side of the midvein; indusia orbicular, centrally peltate.

1. **Phanerophlebia auriculata** Underw., Torrey Bot. Club Bul. 26: 212. *pl.* 360. 1899.

Superstition Mountains (Pinal County), Chiricahua Mountains (Cochise County), Sycamore Canyon near Ruby (Santa Cruz County), Baboquivari Mountains (Pima County), Kofa Mountains (Yuma County), 2,000 to 6,000 feet; damp shaded walls of canyons. Western Texas to Arizona and northern Mexico.

5. DRYOPTERIS. WOODFERN

Mostly woodland ferns of upright habit, the rhizomes various, paleaceous; fronds borne singly or in a crown, mostly pinnate to decompose, glabrous, pubescent, or paleaceous; sori roundish, dorsal, mostly indusiate, the indusium (if present) roundish-reniform, fixed at its sinus.

Key to the species

1. Blades subternate, equilateral, the large deltoid basal pinnae nearly equaling the terminal portion; indusia wanting..... 1. *D. LINNAEANA*.
 1. Blades oblong-lanceolate to deltoid-ovate; indusia present (2).
 2. Rhizome slender, creeping; segments of pinnae subentire; veins simple..... 2. *D. FEEI*.
 2. Rhizome stout, decumbent or erect; segments of pinnae toothed to subpinately divided; veins freely forked (3).
 3. Blades deltoid-ovate, nearly tripinnate at base, noticeably glandular-puberulous..... 5. *D. PATULA*.
 3. Blades oblong-lanceolate to narrowly ovate (4).
 4. Pinnae mostly sessile, oblong-lanceolate; veinlets spreading, all ending in salient spinelike teeth..... 3. *D. ARGUTA*.
 4. Pinnae mostly stalked, deltoid-lanceolate; veinlets oblique, fewer, ending in oblique, usually curved, acute teeth..... 4. *D. FILIX-MAS*.

1. **Dryopteris linnaeana** C. Chr., Ind. Fil. 275. 1905.

Polypodium dryopteris L., Sp. Pl. 1093. 1753.

Phegopteris dryopteris Fée, Gen. Fil. 243. 1852.

Bonito Creek, White Mountains (Apache County), on steep shaded slopes (*Goodding* 1222). Newfoundland and Labrador to Alaska, south to Virginia, Indiana, Kansas, New Mexico, Arizona, and Oregon; Greenland; Eurasia.

2. **Dryopteris feei** C. Chr., Ind. Fil. 89, 264. 1905.

Aspidium puberulum Fée, Mém. Foug. 10: 40. 1865. Not Gaud., 1827.

Santa Maria River, southwestern Yavapai County (*Hester* in 1936), Aravaipa Canyon, Graham County (*Mohr* in 1873). Southern Arizona and the coastal canyons of southern California; Baja California and Mexico generally.

3. Dryopteris arguta (Kaulf.) Watt, *Canad. Nat.* II. 3: 160. 1866.*Aspidium argutum* Kaulf., *Enum. Fil.* 242. 1824.*Dryopteris rigida* var. *arguta* Underw., *Our Native Ferns*, ed. 4, 116. 1893.

Queen Creek Canyon above Superior, Pinal County (*Harrison* 2089, 3180), Superstition Mountains, Pinal County (*Goodding* 6151), Sierra Ancha, Gila County (*Little* 4221), 4,000 to 5,000 feet, along streams. Extreme southwestern Washington to southern California and Arizona.

4. Dryopteris filix-mas (L.) Schott, *Gen. Fil.* 1834.*Polypodium filix-mas* L., *Sp. Pl.* 1090. 1753.*Aspidium filix-mas* Swartz, *Jour. Bot. Schrad.* 1800²: 106. 1801.

White Mountains (Apache County), San Francisco Peaks and vicinity (Coconino County), and mountains of Graham, Gila, Cochise, and Pima Counties, 7,000 to 10,000 feet, in rich soil among rocks and along streams. Newfoundland to British Columbia, south to Vermont, Michigan, and in the mountains to western Oklahoma, western Texas, New Mexico, Arizona, southern California, and Mexico; Greenland; Eurasia.

From this species, known from the time of the old herbalists as male-fern, is derived the drug aspidium, used extensively as a vermifuge, especially for tapeworm. It is a violent poison, and grave consequences have resulted from overdoses.

5. Dryopteris patula (Sw.) Underw., *Our Native Ferns*, ed. 4, 117 1893.*Aspidium patulum* Swartz, *Svenska Vetensk. Akad. Handl.* 38: 64. 1817.

Variable; widely distributed in tropical America. It is represented in the United States (Arizona only) by var. *rossii* C. Chr.; canyons of the Huachuca Mountains, Cochise County (*Lemmon* in 1882, *Goodding* 1328), in moist swales; Mexico.

6. CYSTOPTERIS. BLADDERFERN

Delicate small ferns of rocky or alluvial shaded situations, the rhizomes slender and creeping; fronds ascending or recurved; blades 1- to 4-pinnate, the fertile ones commonly longer stalked and less leafy than the sterile; veins free; sori roundish, dorsal, separate; indusium membranous, hoodlike, attached at the inner side of the broad base, at first concealing the sporangia, soon thrust back.

Key to the species

1. Blades narrowly triangular-lanceolate, the greatly elongate apex usually bearing bulblets beneath..... 1. *C. BULBIFERA*.
 1. Blades broadly lanceolate, the apex acute; bulblets wanting... 2. *C. FRAGILIS*.

1. Cystopteris bulbifera (L.) Bernh., *Neues Jour. Bot. Schrad.* 1²: 10. 1806.*Polypodium bulbiferum* L., *Sp. Pl.* 1091. 1753.*Filix bulbifera* Underw., *Our Native Ferns*, ed. 6, 119. 1900.

Oak Creek, Coconino County, 5,400 feet (*Goldman* 2188). Newfoundland to Manitoba, south to Georgia, Alabama, and Arkansas, and in the mountains to New Mexico and Arizona.

2. *Cystopteris fragilis* (L.) Bernh., Neues Jour. Bot. Schrad. 1²: 27. pl. 2, f. 9. 1806.

Polypodium fragile L., Sp. Pl. 1091. 1753.

Filix fragilis Gilib., Exerc. Phytol. 558. 1792.

White Mountains (Apache County), San Francisco Peaks (Coconino County), and mountains of Graham, Gila, Cochise, and Pima Counties, 6,000 to 11,000 feet, rich moist shaded soil, among rocks and around springs.

Brittlefern. This is the most widely distributed of all ferns, being nearly cosmopolitan. In North America the typical form of the species ranges from Greenland to Alaska, south to northern New England, the Great Lakes region, Missouri, and in the mountains to western Texas, New Mexico, Arizona, and southern California. Other varieties occupy adjacent regions or partially overlap the range of the typical variety. Most of the Arizona specimens are referable to var. *tenuifolia* (Clute) Broun, a singularly delicate and beautiful large form.

7. WOODWARDIA. CHAINFERN

Coarse ferns of moist shady situations, the stout woody rhizomes paleaceous; fronds several, in a large crown, the blades leafy, pinnate-pinnatifid; sori linear-oblong, nearly straight, borne singly on the outer vein of a continuous series of elongate costal areoles, sunken, facing inward and occupying the areoles, the elongate arching indusia persistent.

1. *Woodwardia fimbriata* J. E. Smith ex Rees's Cyclop. 38: no. 6. 1818.

Woodwardia chamissoi Brack. in Wilkes, U. S. Expl. Exped. 16: 138. 1854.

Willow Spring (southern Apache County), Sierra Ancha and Mazatzal Mountains (Gila County), Huachuca Mountains (Cochise County), Santa Rita and Santa Catalina Mountains (Pima County), 5,300 to 7,200 feet, rich soil in canyons. British Columbia to Nevada, Arizona, and California.

8. CETERACH

Small, strongly xerophilous ferns of distinctive form and habit, the rhizome short and conspicuously paleaceous; fronds rotate, the short stipes imbricate-paleaceous; blades deeply sinuate-pinnatifid, spongi-ose-coriaceous, the veins free (in the Arizona species) or partially areolate; sori linear; indusium lateral, as in *Asplenium*.

1. *Ceterach dalhousiae* (Hook.) C. Chr., Ind. Fil. 170. 1905.

Asplenium dalhousiae Hook., Icon. Pl. pl. 105. 1837.

Asplenium alternans Wall. ex Hook., Sp. Fil. 3: 92. 1860.

Asplenium ferrissii Clute, Fern Bul. 16: 1. 1908.

Asplenium rupium Goodding, Muhlenbergia 8: 92. 1912.

Mule and Huachuca Mountains (Cochise County), Baboquivari Mountains (Pima County), about 6,000 feet; shaded moist soil and

rocky canyons. Known otherwise only from Abyssinia and the mountains of southern Asia. A similar instance of discontinuous range is that of *Asplenium exiguum* Bedd.

This species is of doubtful systematic position. In habit it closely resembles the Old World type species of *Ceterach* (*C. officinarum* DC.), but differs in its free veins and well-developed indusia and thus might almost equally well be referred to *Asplenium*, as was long done.

9. ASPLENIUM. SPLEENWORT

Ferns of moist cliffs and rocky woods, of various habit, the rhizome scales with dark partition cell walls; fronds uniform, the blades once to several times pinnate or pinnatifid, the rachises often dark and shining; veins free; sori oblong to linear; indusia always present, attached laterally.

Key to the species

1. Plants grasslike, densely tufted; blades short, alternately divided into a few, very oblique, narrowly cuneate segments----- 1. *A. SEPTENTRIONALE*.
1. Plants not grasslike; blades with simple or pinnately cleft or parted, spreading pinnae (2).
 2. Blades narrowly lanceolate or triangular (3).
 3. Leaf tissue herbaceous; blades narrowly lanceolate; pinnae subequal, narrowly oblong, sharply incised----- 6. *A. EXIGUUM*.
 3. Leaf tissue coriaceous; blades triangular; pinnae much larger, unequal the large basal ones deltoid, once or twice pinnately parted.
 7. *A. ADIANTUM-NIGRUM*.
 2. Blades linear; pinnae subentire to crenate or dentate (4).
 4. Sori few (1 to 3), confined to the proximal side of the pinnae.
 2. *A. MONANTHES*.
 4. Sori numerous, in pairs, i. e. those of the distal and proximal sides about equal in number (5).
 5. Pinnae distinctly toothed; fronds mostly recurved and rooting at tip.
 3. *A. PALMERI*.
 5. Pinnae subentire or crenulate; fronds not radicate (6).
 6. Stipes blackish; pinnae oblong, coriaceous, auriculate; sori short, nearer the margin than the midvein----- 4. *A. RESILIENS*.
 6. Stipes dark castaneous or purplish brown; pinnae oval to broadly oblong, herbaceous, not auriculate; sori narrowly oblong, medial.
 5. *A. TRICHOMANES*.

1. *Asplenium septentrionale* (L.) Hoffm., Deut. Fl. 2: 12. 1795.

Acrostichum septentrionale L., Sp. Pl. 1068. 1753.

White Canyon, San Francisco Peaks, 8,000 feet, in crevices of rocks (*MacDougal* 68), Elden Mountain near Flagstaff (*Wherry* in 1940). Black Hills of South Dakota to western Oklahoma, New Mexico, Arizona, and Baja California; Eurasia.

2. *Asplenium monanthes* L., Mant. 1: 130. 1767.

Asplenium monanthemum Murray, Syst. Veg. 933. 1784.

Huachuca Mountains, Cochise County (*Lemmon* in 1882, *Pringle* in 1884, and others), about 8,000 feet, on shaded cliffs. Known in the United States only from southern Arizona; Mexico to Chile; West Indies; Africa; Hawaiian Islands.

3. *Asplenium palmeri* Maxon, Contrib. U. S. Natl. Herbarium 13: 39. 1909.

Asplenium parvulum var. *grandidentatum* Goodding, Muhlenbergia 8: 92. 1912.

Mule Mountains, Cochise County (*Goodding* 976), Sycamore Canyon near Ruby, Santa Cruz County (*Goodding* 6148), Baboquivari

Canyon, Pima County (*Gilman* 11, *Harrison* 3531), moist sheltered rocky situations. New Mexico, Arizona, Mexico, and Guatemala.

4. *Asplenium resiliens* Kunze, Linnæa 18: 331. 1844.

Asplenium parvulum Mart. and Gal., Mém. Acad. Roy. Belg. 15⁵: 60. 1842. Not Hook., 1840.

Near Flagstaff (Coconino County), Blue River Canyon (Greenlee County), Chiricahua and Huachuca Mountains (Cochise County), Kofa Mountains (Yuma County), 2,000 to 7,000 feet, among boulders and in crevices of cliffs. Pennsylvania to Florida, west to Kansas and Arizona; Mexico to Argentina; Jamaica; Hispaniola.

5. *Asplenium trichomanes* L., Sp. Pl. 1080. 1753.

Flagstaff (Coconino County), White River (Apache County), Chiricahua Mountains (Cochise County), Rincon and Santa Catalina Mountains (Pima County), 7,000 to 8,000 feet, sheltered crevices of cliffs. Nova Scotia to Alaska, south to Georgia, Alabama, Texas, New Mexico, and Arizona; Eurasia.

6. *Asplenium exiguum* Bedd., Ferns South. India, pl. 146. 1863.

Asplenium glenniei Baker in Hook. and Baker, Syn. Fil., ed. 2, 488. 1873.

Conservatory Canyon, Huachuca Mountains, Cochise County (*Lemmon* in 1882), Sycamore Canyon, near Ruby, Santa Cruz County, about 3,500 feet (*Goodding* in 1937). In the United States known only from southeastern Arizona; northern Mexico; Asia. The Arizona specimens collected by *Lemmon* were distributed as "*Asplenium fontanum*, var." and Mexican material was the basis of *A. glenniei*. American specimens are indistinguishable from the Himalayan *A. exiguum*, a similar case of sporadic distribution being that of *Ceterach dalhousiæ*.

7. *Asplenium adiantum-nigrum* L., Sp. Pl. 1081. 1753.

Asplenium andrewsii A. Nels., Biol. Soc. Wash. Proc. 17: 174. 1904.

Mountain slopes near Flagstaff, in rocky crevices (*Whitehead* 2051). Known otherwise in the United States only from Zion National Park, Utah, and from Boulder Canyon, Colorado, the type locality of *A. andrewsii*; Eurasia and Africa.

10. ATHYRIUM

Large ferns of graceful upright habit; rhizomes stout, paleaceous, the scales membranous, with thin-walled cells; fronds ample, erect-spreading, the blades elongate, 2- to 3-pinnate, thin-herbaceous; sori dorsal, oblique, oblong or crossing the vein and recurved, becoming lunate or hippocrepiform; indusia shaped like the sori, delicate, facing outward.

1. *Athyrium filix-femina* (L.) Roth, Roem. Arch. Bot. 2¹: 106. 1799.

Polypodium filix-femina L., Sp. Pl. 1090. 1753.

A polymorphic Eurasian species, ranging from Newfoundland and Quebec to Alaska, south to New Mexico, Arizona, and California, the typical form being ascribed to the region from British Columbia to Wyoming, Colorado, and Oregon.

Ladyfern. Arizona specimens pertain to var. *californicum* Butters, which extends from southern Idaho and western Wyoming to New Mexico and Arizona. White Mountains (Apache County), Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), 7,000 to 8,000 feet; rich shaded ground about springs and along streams.

11. PITYROGRAMMA

Ferns of dryish banks and ledges, the stoutish rhizomes paleaceous; fronds clustered, long-stipitate; blades 1- to 3-pinnate, deltoid-pentagonal in the Arizona species, densely ceraceous beneath; sporangia following the short, spreading, branched veinlets throughout, confluent with age.

1. **Pityrogramma triangularis** (Kaulf.) Maxon, Contrib. U. S. Natl. Herbarium 17: 173. 1913.

Gymnogramma triangulare Kaulf., Enum. Fil. 73. 1824.

The typical form ranges from British Columbia (Vancouver Island) to Nevada and Baja California.

Goldfern. In Arizona the species is represented by var. *maxonii* Weatherby, which is not uncommon in Gila, Maricopa, Pinal, and Pima Counties, 2,000 to 2,500 feet, on rock ledges; type from Rincon Mountains (*Blumer* 3271). This variety occurs also in southern California, Sonora, and Baja California.

12. BOMMERIA

Small ferns of rocky situations, the rhizomes wide-creeping; fronds uniform; blades palmately divided, broadly pentagonal, the divisions bipinnatifid, conspicuously hairy; sori linear, following the course of the veins, nonindusiate.

1. **Bommeria hispida** (Mett.) Underw., Torrey Bot. Club Bul. 29: 633. 1902.

Gymnogramme hispida Mett. in Kuhn, *Linnaea* 36: 72. 1869.

Mountains of Yavapai, Gila, Graham, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, on shaded cliffs. Western Texas to Arizona and Mexico.

13. PTERIDIUM. BRACKEN

Coarse ferns, the slender, woody rhizome wide-creeping underground; fronds borne singly, large; blades deltoid-ovate, pinnately decompound; veins free; sori linear, borne on a continuous transverse receptacle connecting the vein ends; indusium double, the conspicuous outer one formed by the reflexed membranous leaf margin, the inner one minute, facing outward beneath the sporangia.

1. **Pteridium aquilinum** (L.) Kuhn in Decken, Reisen, III. Bot. Ost-Afrika 11. 1879.

Pteris aquilina L., Sp. Pl. 1075. 1753.

Viewed broadly, this is a nearly cosmopolitan species, the type European. Arizona material is referable to var. *pubescens* Underw., which occurs in Quebec and the Great Lakes region, and from Alaska south to South Dakota, Texas, New Mexico, Arizona, and California.

In Arizona it is very common in open pine forests, 7,000 to 8,000 feet; Kaibab Plateau (Coconino County), and White Mountains (Apache County), to the mountains of Cochise and Pima Counties.

This fern is reported to be poisonous to cattle and horses when eaten in large quantities, but the poisonous properties may be eliminated by cooking; and the rootstocks and young fronds have been utilized for food.

14. ADIANTUM. MAIDENHAIR

Delicate graceful ferns of moist situations, the slender creeping rhizome paleaceous; fronds clustered, ascending or pendent, the stipes purplish black, polished; blades 2- to 3-pinnate at base; sori appearing marginal, the sporangia borne on the underside of sharply reflexed lobes.

1. *Adiantum capillus-veneris* L., Sp. Pl. 1096. 1753.

Adiantum modestum Underw., Torrey Bot. Club Bul. 28: 46. 1901.

Adiantum rimicola Slosson, Torrey Bot. Club Bul. 41: 308. 1914.

Throughout most of the State, 1,600 to 6,000 feet, mostly on moist cliffs and in springy places. Virginia to Florida, west to Missouri, Utah, southern California, and the Mexican border region; also western South Dakota and southern British Columbia; widely distributed in tropical and subtropical regions of both hemispheres.

15. CHEILANTHES. LIPFERN

Small xerophilous ferns, mostly with pubescent, tomentose, or imbricate-paleaceous foliage; fronds uniform; blades 1- to 4-pinnate, the ultimate segments commonly minute; sori borne at the enlarged tips of the veins, usually numerous and narrowly confluent, protected by the recurved, more or less modified leaf margin or (as in *C. lendigera*) by an introrse membranous proper indusium.

Key to the species

1. Rhizomes massive, multicapital, the divisions erect or decumbent, scarcely creeping (2).
2. Leaf blades devoid of scales (3).
 3. Blades deltoid-ovate, subpentagonal, membranous, reddish-glandular beneath, otherwise glabrous throughout-----1. *C. PYRAMIDALIS*.
 3. Blades linear-oblong to ovate, herbaceous, laxly whitish-villous above, densely fulvous-tomentose beneath-----2. *C. FEELI*.
2. Leaf blades scaly, at least along the primary rachis (4).
 4. Pinnae copiously imbricate-paleaceous beneath, the large whitish ovate scales concealing the segments; segments coarsely villous above, the hairs stiff, flattish, tortuous-----3. *C. VILLOSA*.
 4. Pinnae imbricate-paleaceous along the rachis, the scales not concealing the segments; segments not coarsely villous above (5).
 5. Segments hoary above, densely tomentose on both surfaces, the entangled hairs closely enveloping and joining the fragile segments.
 4. *C. EATONI*.
 5. Segments green and delicately villous-tomentose above, glabrescent with age, separate, not entangled (6).
 6. Scales of rachises nearly capillary, pale cinnamomeous, lax.
 5. *C. TOMENTOSA*.
 6. Scales more abundant, extending to the minor rachises, narrowly lanceolate, castaneous-----6. *C. CASTANEA*.

1. Rhizomes slender, creeping, often widely so, or if condensed the branches elongate (7).
7. Blades devoid of scales (8).
8. Segments round to obovate, beadlike, glabrous above, beneath (together with rachises) densely clothed with long ferruginous hairs; indusium membranous, very broad, covering most of the segment.
 7. *C. LENDIGERA.*
8. Segments elongate, not beadlike, glabrous throughout; indusium firm, narrow (9).
9. Stipe and rachises black, terete, shining; sori subcontinuous, the indusium linear----- 8. *C. ALABAMENSIS.*
9. Stipe and rachises light brown, with a broad deep ventral groove, dull; sori distinct, at end of ultimate lobes, the indusia short.
 9. *C. WRIGHTII.*
7. Blades copiously paleaceous, at least upon the rachises (10).
10. Pinnæ closely canescent-tomentulose above, the hairs persistent, entangling the segments----- 10. *C. LINDHEIMERI.*
10. Pinnæ glabrous (11).
11. Scales of blade invariably long-ciliate, widely imbricate, wholly covering or exceeding the segments (12).
12. Rhizome scales persistent, narrow, attenuate, rigid, dark brown, strongly sclerotic; scales of blade lightly attached above the sinus of the deeply cordate base, the lobes overlapping.
 11. *C. COVILLEI.*
12. Rhizome scales deciduous, relatively broad, acuminate, membranous, usually pale brown, never strongly sclerotic; scales of blade firmly attached at the subcordate or cordate base.
 12. *C. WOOTONI.*
11. Scales of blade slightly sinuate-denticulate, nonciliate, loosely imbricate or spreading (13).
13. Blades mostly oblong-lanceolate; scales large, firm, straight, borne on all the vascular parts and nearly covering the segments; leaf tissue coriaceous----- 13. *C. FENDLERI.*
13. Blades roundish-ovate or deltoid; scales much smaller, very delicate, lax, flexuous, borne only on the rachises, not at all concealing the pinnules; leaf tissue membrano-herbaceous--- 14. *C. PRINGLEI.*

1. *Cheilanthes pyramidalis* Fée, Mém. Foug. 7: 38. 1857.

A highly variable species, widely distributed in Mexico and Central America, represented in the United States by var. *arizonica* (Maxon) Broun, confined to the Huachuca Mountains, Cochise County (*Lemon* in 1882, *Goodding* 760, 1327, type), rich, moist soil, slopes and canyons.

2. *Cheilanthes feei* Moore, Ind. Fil. xxxviii. 1857.

Myriopteris gracilis Fée, Gen. Fil. 150. 1852.

Cheilanthes gracilis Mett., Abhandl. Senckenb. Naturf. Gesell. 3: 80. 1859. Not Kaulf., 1824.

Almost throughout the State, 2,000 to 7,000 feet, on dry rocky slopes and cliffs. Illinois and southern Minnesota to British Columbia, south to the Mexican border region from Texas to southern California.

3. *Cheilanthes villosa* Davenp., Cat. Davenport Herbarium Sup. 45. 1883.

Sierra Estrella (Maricopa County), Mule and Huachuca Mountains (Cochise County), Santa Catalina and Santa Rita Mountains (Pima County); granitic or limestone slopes and ledges. Western Texas to Arizona and northern Mexico.

4. **Cheilanthes eatoni** Baker in Hook. and Baker, Syn. Fil. 140. 1867.
Holbrook (Navajo County), Elden Mountain (Coconino County), and mountains of Graham, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,000 feet, on dry rocky slopes and cliffs, often in chaparral. Oklahoma and central Texas to Colorado, Arizona, and Mexico.
5. **Cheilanthes tomentosa** Link, Hort. Berol. 2: 42. 1833.
Huachuca Mountains (Cochise County), Santa Rita, Santa Catalina, and Baboquivari Mountains (Pima County), in shaded rocky places. Virginia to Georgia and northern Arkansas, west to Arizona; Mexico.
6. **Cheilanthes castanea** Maxon, Biol. Soc. Wash. Proc. 32: 111. 1919.
Mule Mountains and Huachuca Mountains (Cochise County), near Nogales (Santa Cruz County), Santa Rita, Santa Catalina, and Baboquivari Mountains (Pima County), 4,000 to 6,000 feet, on rocky slopes and cliffs. Oklahoma and western Texas to Arizona and northern Mexico.
7. **Cheilanthes lendigera** (Cav.) Swartz, Syn. Fil. 128. 1806.
Pteris lendigera Cav., Desc. Pl. 268. 1802.
Pomatophytum pocillatum M. E. Jones, Contrib. West. Bot. 16: 12. 1930.
Chiricahua and Huachuca Mountains (Cochise County), about 6,000 feet, under dry cliffs, rare, the type of *Pomatophytum pocillatum* from Ramsey Canyon, Huachuca Mountains (Jones 24690). Also in western Texas; Mexico to Venezuela and Ecuador.
8. **Cheilanthes alabamensis** (Buckl.) Kunze, Linnaea 20: 4. 1847.
Pteris alabamensis Buckl., Amer. Jour. Sci. 45: 177. 1843.
Conservatory Canyon, Huachuca Mountains (Lemmon in 1882). Virginia to Alabama, west to southwestern Missouri and Arizona; Mexico; mountains of Jamaica.
9. **Cheilanthes wrightii** Hook., Sp. Fil. 2: 87. 1852.
Mountains of Greenlee, Graham, Gila, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,000 feet, rocky slopes and ledges. Western Texas to Arizona and northern Mexico.
10. **Cheilanthes lindheimeri** Hook., Sp. Fil. 2: 101. 1852.
Myriopteris lindheimeri J. Smith in Seem., Bot. Voy. Herald 340. 1854.
Mountains of Graham, Gila, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,000 to 8,000 feet, dry slopes among rocks; common. Western Texas to Arizona and northern Mexico.
11. **Cheilanthes covillei** Maxon, Biol. Soc. Wash. Proc. 31: 147. 1918.
Black Mountains (Mohave County) to mountains of Cochise, Gila, and Pinal Counties, 2,000 to 5,000 feet, cliffs and rock ledges. Southwestern Utah and Arizona to southern California, and Baja California.

12. *Cheilanthes wootoni* Maxon, Biol. Soc. Wash. Proc. 31: 146. 1918.

Clear Creek (Coconino or Navajo County), and mountains of Yavapai, Graham, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 6,500 feet, rock ledges and among boulders; common. Oklahoma, southeastern Colorado, and western Texas to Arizona and northern Mexico (Sonora).

13. *Cheilanthes fendleri* Hook., Sp. Fil. 2:103. 1852.

Slate Mountain (Coconino County), Hualpai Mountain (Mohave County), to the mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, dry rocky slopes and cliffs. Western Texas to Colorado and Arizona.

14. *Cheilanthes pringlei* Davenp., Torrey Bot. Club Bul. 10: 61. 1883.

Cheilanthes sonorensis Goodding, Muhlenbergia 8: 92. 1912.

Mazatzal Mountains (Gila County), Chiricahua Mountains (Cochise County), Baboquivari Mountains (Pima County), 3,000 to 5,000 feet, at base of cliffs. Known only from Arizona, the type collected by Pringle in 1883, and northern Mexico.

16. PELLAEA. CLIFFBRAKE

Rather small, rock-inhabiting ferns, with erect, nearly glabrous foliage; fronds uniform, the blades 1- to 4-pinnate; segments coriaceous, varying in shape and size; veins free; sori terminal on the veins, laterally confluent in a broad intramarginal line, usually concealed at first by the reflexed or revolute, continuous, indusiform margin, the border modified or not.

Key to the species

1. Rhizomes cordlike, creeping, often widely so; stipe and rachises buff or pale brownish..... 1. *P. INTERMEDIA.*
1. Rhizomes thick, multicapital; stipe and rachises castaneous to atropurpureous (2).
 2. Scales of rhizome concolorous, light to dark ferruginous (3).
 3. Blades once pinnate, or the basal pinnae sometimes ternately cleft or divided at base; rachises smooth..... 2. *P. SUKSDORFIANA.*
 3. Blades bipinnate nearly throughout; rachises scabrous.
 3. *P. ATROPURPUREA.*
 2. Scales of rhizome bicolorous, i. e., with a sharply defined, linear, blackish median stipe (4).
 4. Blades triangular-ovate; pinnae with 6 to 10 pairs of segments, these sessile or short-stalked, articulate, grayish-pruinose.
 4. *P. LONGIMUCRONATA.*
 4. Blades linear to narrowly lanceolate; pinnae ternately divided or with 1 to 4 pairs of semiadnate or sessile segments (5).
 5. Stipe and rachis castaneous; pinnae commonly with 2 or 3 pairs of spaced segments or, if ternately divided, the apical segment stalked.
 5. *P. WRIGHTIANA.*
 5. Stipe and rachis atropurpureous, glaucous; pinnae ternately cleft or divided or, if (rarely) pinnate, the 3 segments subequal, the apical one sometimes stalked..... 6. *P. TERNIFOLIA.*

1. *Pellaea intermedia* Mett. in Kuhn, Linnaea 36: 84. 1869.

Sierra Ancha and Mazatzal Mountains (Gila County), Chiricahua and Huachuca Mountains (Cochise County), near Patagonia (Santa Cruz County), Baboquivari Mountains (Pima County), 3,500 to 7,000

feet, dry rocky slopes and in crevices of limestone ledges. South-western Texas to Arizona and Mexico.

2. *Pellaea suksdorfiana* Butters, Amer. Fern Jour. 11: 40. 1921.

Pellaea glabella var. *simplex* Butters, Amer. Fern Jour. 7: 84. 1917.

Near Jacobs Lake, Kaibab Plateau, 8,000 feet, on rocky southern slopes (*Korstian* and *Baker* in 1917). British Columbia and Washington, south to Utah, New Mexico, and Arizona.

3. *Pellaea atropurpurea* (L.) Link, Fil. Sp. Hort. Berol. 59. 1841.

Pteris atropurpurea L., Sp. Pl. 1076. 1753.

Heber (Navajo County), and mountains of Cochise and Pima Counties, 5,000 to 6,500 feet, on cliffs. Vermont and Ontario to Wisconsin and western South Dakota, south to northwestern Florida, the Gulf States, New Mexico, and Arizona; Mexico and western Guatemala.

4. *Pellaea longimucronata* Hook., Sp. Fil. 2: 143. 1858.

Pellaea wrightiana var. *longimucronata* Davenp., Cat. Davenport Herbarium Sup. 46. 1883.

Pellaea truncata Goodding, Muhlenbergia 8: 94. 1912.

Grand Canyon (Coconino County) to Kingman (Mohave County), south to the mountains of Cochise and Pima Counties, 2,000 to 6,000 feet, among rocks and on cliffs; very common. Colorado and New Mexico, west to Nevada and Arizona; northern Mexico (Chihuahua). The type of *P. truncata* is from the Mule Mountains (*Goodding* 977).

5. *Pellaea wrightiana* Hook., Sp. Fil. 2: 142. 1858.

Near Flagstaff (Coconino County), mountains of Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,000 feet, among rocks and on cliffs. Southwestern Oklahoma and central Texas, west to Arizona.

6. *Pellaea ternifolia* (Cav.) Link, Fil. Sp. Hort. Berol. 59. 1841.

Pteris ternifolia Cav., Desc. Pl. 266. 1802.

Huachuca Mountains, Cochise County, on dry cliffs (*Patzky* in 1899, *Goodding* 766). Western Texas and southeastern Arizona; Mexico to Peru; Hispaniola.

17. NOTHOLAENA. CLOAKFERN

Small, rock-loving, xerophilous ferns, with glandular, ceraceous, paleaceous, or hairy foliage; fronds rigid, the blades 1- to 4-pinnate, linear to deltoid or pentagonal; sori mostly submarginal, roundish or oblong, borne at or near the end of the veins (in some species decurrent), somewhat confluent laterally. Indusia wanting, the margins mostly recurved and partially covering the sporangia.

Key to the species

1. Blades simply pinnate (2).
2. Pinnæ coarsely lobed, deciduously stellate-paleaceous above, very densely imbricate-paleaceous beneath..... 1. *N. SINUATA*.
2. Pinnæ pinnatifid (segments narrow), villosulous above, densely tomentose beneath..... 2. *N. AUREA*.

1. Blades 2- to 4-pinnate, or barely bipinnate in Nos. 5 and 7 (3).
3. Pinnae hairy above, beneath densely paleaceous or hairy, not obviously ceraceous (4).
4. Stipes stout, scaly; blades bipinnate; segments large, linear-oblong, thinly stellate-hairy above, beneath covered with imbricate ciliate scales.
 3. *N. ASCHENBORNIANA.*
4. Stipes slender, wiry, hirsute; blades tripinnate; segments small, roundish or ovate-oblong, coarsely grayish-hirsute-tomentose above, buff-tomentose beneath----- 4. *N. PARRYI.*
3. Pinnae glabrous or minutely glandular-pulverulent above, ceraceous beneath except in *N. jonesii*, sparsely paleaceous also in *N. grayi* (5).
5. Blades linear to narrowly oblong (6).
6. Rachis light brown, bearing numerous attenuate, yellowish-brown scales, these extending to the minor rachises and the midveins beneath.
 5. *N. GRAYI.*
6. Rachis atropurpureous, naked; no scales upon the pinnae.
 6. *N. LEMMONI.*
5. Blades ovate, triangular, or pentagonal (7).
7. Blades barely bipinnate, the basal pinnae bipartite; rachis free only at base----- 7. *N. STANDLEYI.*
7. Blades fully 2- to 4-pinnate (8).
8. Segments devoid of ceraceous covering----- 8. *N. JONESII.*
8. Segments densely ceraceous beneath, sparingly glandular-ceraceous above (9).
9. Pinnae and pinnules long-stalked----- 9. *N. LIMITANEA.*
9. Pinnae and pinnules sessile (10).
10. Stipes reddish brown; blades broadly pentagonal; rhizome scales concolorous----- 10. *N. CALIFORNICA.*
10. Stipes black; blades narrower, acuminate; rhizome scales bicolorous----- 11. *N. NEGLECTA.*

1. *Notholaena sinuata* (Lag.) Kaulf., Enum. Fil. 135. 1824.

Acrostichum sinuatum Lag. ex Swartz, Syn. Fil. 14. 1806.

Canyons of the Colorado (Coconino and Mohave Counties), to the mountains of Cochise, Santa Cruz, and Pima Counties, 3,000 to 7,000 feet; dry rocky slopes and crevices, often on limestone; very common. Western Oklahoma and Texas to southern California; Mexico to Chile; Jamaica; Hispaniola.

This species is highly variable. A form with narrow blades and small few-lobed pinnae is var. *crenata* Lemmon, having substantially the same range in Arizona as the typical form, with which it intergrades. It was long known erroneously as *N. sinuata* var. *integerrima* Hook., a name properly belonging to a Mexican form. More recently it has been described as *N. cochisensis* Goodding (Muhlenbergia 8: 93. 1912) on specimens from the Huachuca Mountains (*Goodding* 373).

2. *Notholaena aurea* (Poir.) Desv., Mém. Soc. Linn. Paris 6: 219. 1827.

Pteris aurea Poir. in Lam., Encycl. 5: 710. 1804.

Acrostichum bonariense Willd., Sp. Pl. 5: 114. 1810.

Notholaena bonariensis C. Chr., Ind. Fil. 459. 1906.

Willow Spring (southern Apache County) and mountains of Cochise and Pima Counties, 4,000 to 7,000 feet, dry ledges and rocky slopes. Texas to Arizona; Mexico to Argentina; Jamaica; Hispaniola.

3. *Notholaena aschenborniana* Klotzsch, Linnaea 20: 417. 1847.

Mule Mountains, Cochise County (*Goodding* 1387), Santa Rita Mountains, Pima County (*Pringle* in 1884), dry rocky slopes. Western Texas to Arizona and Mexico.

4. **Notholaena parryi** D. C. Eaton, Amer. Nat. 9: 351. 1875.

Grand Canyon (Coconino County), Pagumpa and Yucca (Mohave County) to Maricopa, Pinal, and Yuma Counties, 2,000 to 4,000 feet, dry hot situations, crevices of canyon walls and among rocks; very common. Southwestern Utah and Arizona to the desert region of southern California.

5. **Notholaena grayi** Davenp., Torrey Bot. Club Bul. 7: 50. 1880.

Notholaena hypoleuca Goodding, Muhlenbergia 8: 24. 1912.

Near Clifton (Greenlee County), mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, dry rocky slopes; type from southeastern Arizona (*Courtis*); the type of *N. hypoleuca* is from the Mule Mountains (*Goodding* 1004). Western Texas to Arizona and Mexico.

6. **Notholaena lemmoni** D. C. Eaton, Torrey Bot. Club Bul. 7: 63. 1880.

Rincon, Santa Catalina, and Santa Rita Mountains (Pima County), about 4,000 feet. Known only from Arizona (the type, *Lemmon* in 1880) and northern Mexico.

7. **Notholaena standleyi** Maxon, Amer. Fern Jour. 5: 1. 1915.

Notholaena hookeri D. C. Eaton in Wheeler, U. S. Survey 100th Merid. Rpt. 6: 308. 1879. Not Lowe, 1856.

Greenlee, Gila, Maricopa, Pinal, Santa Cruz, and Pima Counties, 1,100 to 6,500 feet, among rocks; common. Western Oklahoma and Texas to Colorado, Arizona, and Mexico.

8. **Notholaena jonesii** Maxon, Amer. Fern Jour. 7: 108. 1917.

Vasey's Paradise, Coconino County (*Clover* and *Jotter* 2254), near Superior, Pinal County (*Whitehead* 1806), crevices of limestone cliffs. Southern Utah and Arizona to southern California.

9. **Notholaena limitanea** Maxon, Amer. Fern Jour. 9: 70. 1919.

Clear Creek Canyon, Grand Canyon National Park (Coconino County), and mountains of Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,000 feet, hillsides and cliffs. Western Texas to southern Utah and Arizona.

The var. *mericana* (Maxon) Broun, founded on material from Chihuahua, Mexico, is represented by a collection from the Chiricahua Mountains, 6,000 feet (*Blumer* 2390). It differs in its narrower and less divided blades and its larger segments. Northern Mexico; several collections.

10. **Notholaena californica** D. C. Eaton, Torrey Bot. Club Bul. 10: 27. 1883.

Near Congress Junction, Yavapai County (*Wooton* in 1892), Tule Tank, Yuma County (*Wiggins* 6577), Tinajas Altas, Yuma County (*Whitehead* in 1936), 1,000 to 3,000 feet, dry rocky slopes and canyons. Arizona, southern California, and Baja California.

11. **Notholaena neglecta** Maxon, Contrib. U. S. Natl. Herbarium 17: 602. 1916.

Cochise County in the Mule Mountains (*Goodding* 1384) and Huachuca Mountains (*Lemmon* in 1882), south faces of limestone cliffs. Southeastern Arizona and northern Mexico.

3. MARSILEACEAE. PEPPERWORT FAMILY

Aquatic or semiaquatic, perennial plants with long-creeping, branched, hairy rhizomes, rooting in mud; leaves in 2 rows, circinate in bud, herbaceous, the long-stipitate blades 4-foliolate, cloverlike; sporocarps borne at base of stipe, large, bony, 2-celled vertically, containing both megaspores and microspores.

1. MARSILEA. PEPPERWORT

1. *Marsilea vestita* Hook. and Grev., Icon. Fil. 2: 159. 1831.

Prescott, Yavapai County, about 5,000 feet, in a pond (*Kearney and Peebles* 12784), and near Fort Huachuca (*Lemmon* 2896). South Dakota to British Columbia, south to Oklahoma, Texas, New Mexico, Arizona, southern California, and Mexico; naturalized in Florida.

4. AZOLLACEAE. AZOLLA FAMILY

Fugacious, very small, floating, mosslike plants, the stems bearing roots below; leaves minute, green or reddish green, borne alternately in 2 rows upon short branches, deeply bilobed, the lower lobe submersed; sori completely indusiate, borne in pairs on the submersed lobes, one acorn-shaped, containing a single megasporangium, the other globose, containing numerous microsporangia.

1. AZOLLA

1. *Azolla caroliniana* Willd., Sp. Pl. 5: 541. 1810.

Camp Lowell, near Tucson, Pima County, in running water (*Rothrock* 714). New York to Alaska, south to Florida, Arizona, and California; tropical America; sporadic, perhaps owing to escape from cultivation.

Mosquito-fern.

5. ISOETACEAE. QUILLWORT FAMILY

Small, submersed or partially emersed plants of ponds, streams, or moist depressions; stems short, cormlike, crowned by numerous crowded, subulate, inflated leaves; sporangia axillary, borne within the enlarged hollow leaf bases, producing large subspherical megaspores and very numerous, powdery, angled microspores.

1. ISOETES. QUILLWORT

1. *Isoetes bolanderi* Engelm., Amer. Nat. 8: 214. 1874.

In a small lake about 2 miles east of Tunnel Road, Black Mesa Forest Reserve (*Coville* 1053). Mountain ponds and lakes, British Columbia to Wyoming, Colorado, Arizona, and California.

The var. *pygmaea* (Engelm.) Clute (*Isoetes pygmaea* Engelm.) was collected in the Huachuca Mountains by Lemmon; known otherwise only from Mono Pass, Calif., and Walker Lake, Nev. It differs from the typical form of the species in its stouter and somewhat shorter leaves.

6. EQUISETACEAE. HORSETAIL FAMILY

Rushlike plants of low places, the rhizomes perennial, wide-creeping; stems mostly erect, cylindric, fluted, siliceous, simple or with whorled

branches at the solid sheathed nodes; leaves minute, united lengthwise to form nodal sheaths, the tips free or connivent, persistent or deciduous; fruit a terminal cone formed of stalked peltate bracts, these bearing a few sporangia beneath; spores uniform, provided with 4 hygroscopic bands; gametophytes minute, dioecious, green.

1. EQUISETUM. HORSETAIL

Key to the species

1. Aerial stems dimorphous, the fertile ones flesh-colored, succulent, withering; sterile stems green, with numerous slender branches in dense verticils.
 1. *E. ARVENSE*.
1. Aerial stems uniform, simple or sometimes a few branches borne basally or in irregular whorls (2).
 2. Spikes blunt or acutish; aerial stems annual..... 2. *E. KANSANUM*.
 2. Spikes rigidly apiculate; aerial stems evergreen, persisting 2 or more seasons (3).
 3. Sheaths distinctly longer than broad, dilated upward, the lower ones with a dark band below..... 3. *E. LAEVIGATUM*.
 3. Sheaths nearly or quite as broad as long, nearly cylindrical, tight, mostly ashly at maturity, with 2 dark bands (4).
 4. Ridges of the stem with a row of elevated cross bands of silica; leaves sharply 3-carinate, the central keel sometimes grooved.
 4. *E. PREALTUM*.
 4. Ridges usually with 2 distinct rows of silica tubercles; leaves 4-carinate, the central groove usually well defined..... 5. *E. HYEMALE*.

1. **Equisetum arvense** L., Sp. Pl. 1061. 1753.

Near Flagstaff (Coconino County), Ryan Ranch, White Mountains (Apache County), Sierra Ancha (Gila County), 6,000 to 7,000 feet, moist soil along streams. Newfoundland and Labrador to Alaska, southward nearly throughout the United States; Greenland; Eurasia.

2. **Equisetum kansanum** Schaffn., Ohio Nat. 13: 21. 1912.

Coconino, Yavapai, Gila, Cochise, and Pima Counties, 5,000 to 8,000 feet, marshes and springy places; sometimes a weed in cultivated land. Ontario to British Columbia, southward to Ohio, Texas, New Mexico, Arizona, and southern California; northern Mexico (Chihuahua).

3. **Equisetum laevigatum** A. Br., Amer. Jour. Sci. 46: 87. 1844.

Equisetum hyemale var. *intermedium* A. A. Eaton, Fern Bul. 10: 120. 1902.

Equisetum intermedium Rydb., Fl. Rocky Mount. 1053. 1917.

Tuba and near Flagstaff (Coconino County), near Fort Huachuca (Cochise County), 5,000 to 7,000 feet; moist alluvial thickets and sandy banks. New York to British Columbia, south to Illinois, Missouri, Texas, and the Mexican border region to southern California; Mexico and Guatemala.

4. **Equisetum prealtum** Raf., Fl. Ludovic. 13. 1817.

Equisetum robustum A. Br., Amer. Jour. Sci. 46: 88. 1844.

Chinle Creek (Apache County), Oak Creek Canyon (Coconino County), Sierra Ancha (Gila County), Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), 5,000 to 7,000 feet, springy places and along streams. Nova Scotia to British Columbia, southward nearly throughout the United States; Mexico.

5. *Equisetum hyemale* L., Sp. Pl. 1062. 1753.

A Eurasian species, represented in Arizona by var. *californicum* Milde, in moist alluvial situations: Coconino County, at Navajo Mountain (*Wetherill*), Cedar Ranch (*MacDougal* 394), and Oak Creek (*Fulton* 7379), 6,000 to 7,000 feet, springy places. Alaska to California, Arizona, and New Mexico.

7. SELAGINELLACEAE. SELAGINELLA FAMILY

Low, depressed or creeping, leafy terrestrial plants of mosslike habit; leaves (in the Arizona species) arranged spirally in many ranks, imbricate, minute; sporangia borne in quadrangular sessile terminal spikes of modified leaves (sporophylls), axillary, of 2 kinds, the larger ones containing 3 or 4 large megaspores, the smaller ones very numerous minute, reddish or orange, powdery microspores.

1. SELAGINELLA

Key to the species

1. Plants strongly dorsiventral, all the divisions flattish; leaves unequal, those of the under ranks obliquely imbricate, upcurved and clasping.
 1. *S. ARIZONICA*.
1. Plants not at all dorsiventral; leaves alike, equally ascending or appressed-imbricate on all sides (2).
 2. Stems widely creeping, rooting sparingly throughout (3).
 3. Plants bright green; leaves oblique, 2 to 3 mm. long, subulate-attenuate, distantly short-ciliate, ending in a long, greenish-white, scabrous seta..... 2. *S. UNDERWOODII*.
 3. Plants grayish green, the divisions cordlike; leaves closely appressed, 1.5 to 2 mm. long, ovate-oblong, freely longer-ciliate, acutish, the seta obsolete..... 3. *S. MUTICA*.
 2. Stems rigidly ascending or erect, rooting only at extreme base (4).
 4. Leaves whitish-marginate, lance-acicular, evenly attenuate to a very long, stiff, yellowish-white seta..... 4. *S. RUPINCOLA*.
 4. Leaves not marginate, subulate-attenuate to an acutish apex, giving rise rather abruptly to the short whitish-hyaline seta..... 5. *S. NEOMEXICANA*.

1. *Selaginella arizonica* Maxon, Smithsn. Misc. Collect. 72⁵: 5. 1920.

Graham, Gila, Maricopa, Pinal, Pima, and Yuma Counties, 2,000 to 4,500 feet, rocky ledges and cliffs; type from the Santa Catalina Mountains (*Shreve* in 1914). Western Texas to Arizona and northern Mexico.

2. *Selaginella underwoodii* Hieron. in Engl. and Prantl, Nat. Pflanzenfam. 1⁴: 714. 1901.

San Francisco Peaks, Walnut Creek, and Oak Creek (Coconino County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), Santa Rita and Baboquivari Mountains (Pima County), 5,500 to 7,500 feet, cliffs and rock ledges. Western Texas to Wyoming and Arizona.

3. *Selaginella mutica* D. C. Eaton ex Underw., Torrey Bot. Club Bul. 25: 128. 1898.

Navajo County, probably near Tyende (*Wetherill* 536), Grand Canyon, Coconino County (several collections), Chiricahua Mountains (*Toumey* in 1894), 6,500 feet or lower, damp cliffs. Western Texas to Colorado and Arizona.

4. *Selaginella rupincola* Underw., Torrey Bot. Club Bul. 25: 129. 1898.

Chiricahua and Dragoon Mountains (Cochise County), Patagonia Mountains (Santa Cruz County), Santa Rita and Santa Catalina

Mountains (Pima County), 3,000 to 6,000 feet, dry cliffs and ledges. Western Texas to Arizona and northern Mexico.

5. *Selaginella neomexicana* Maxon, Smithsn. Misc. Collect. 72⁵:2. 1920.

Paradise, Cochise County, about 5,000 feet (*J. H. Ferriss* in 1904). Westernmost Texas to southern Arizona.

SPERMATOPHYTA. FLOWERING PLANTS

Seed-producing plants, the first phase of the life cycle very brief and concealed. Pollen grains (microspores) borne in anther sacs (microsporangia). Ovules (macrosporangia) enclosed in an ovary (except in the Gymnospermae), each ovule containing an embryo sac (macrospore). Embryo resulting from the union of an egg cell in the embryo sac and a pollen grain, the ovule thereupon developing into a seed containing the embryo, the latter usually consisting of 1 or more leaves (cotyledons), a hypocotyl and radicle, and a terminal bud (plumule).

KEY TO THE CLASSES AND SUBCLASSES⁵

1. Stigma none; ovules and seeds not enclosed, borne on the face of a scale or bract----- Class GYMNOSPERMAE.
1. Stigma or stigmas present; ovules and seeds in a closed cavity (ovary).----- Class ANGIOSPERMAE (2).
 2. Cotyledon usually 1; flower parts commonly in 3's; stem not differentiated into bark, wood, and pith (endogenous); veins of the leaves mostly longitudinally parallel (sometimes with netted veinlets between the parallel principal veins)----- Subclass MONOCOTYLEDONEAE.
 2. Cotyledons usually 2; flower parts commonly not in 3's; stem differentiated into bark, wood, and pith (exogenous); veins of the leaves seldom parallel (commonly branching at a greater or less angle from the midvein, this alone extending the whole length of the leaf).----- Subclass DICOTYLEDONEAE (3).
 3. Perianth none, or single or appearing so, with segments all much alike in texture and color----- Series 1. APETALAE.
 3. Perianth present, evidently double, the outer segments (calyx) and the inner segments (corolla) usually conspicuously different in texture and color (4).
 4. Petals separate or united only at base----- Series 2. POLYPETALAE.
 4. Petals united well above the base----- Series 3. GAMOPETALAE.

GYMNOSPERMAE

Key to the families

1. Stems not jointed; leaves narrowly linear or needlelike, or else scalelike, crowded, and imbricate; fruits in woody cones, or berrylike---- 1. PINACEAE.
1. Stems jointed; leaves reduced to scales, these distant, opposite, or in whorls of 3; fruits in small thin-scaled cones----- 2. GNETACEAE.

ANGIOSPERMAE-MONOCOTYLEDONEAE

Key to the families

1. Plants strictly aquatic, immersed in or floating on the surface of water; perianth none or inconspicuous (2).
2. Flowers perfect, in spikes, 4-merous; leaves alternate, with or without broad floating blades: Genus *Potamogeton*----- 5. NAIADACEAE.
2. Flowers unisexual (3).
 3. Stems elongate; leaves narrowly linear or filiform, mostly opposite or whorled; flowers axillary, solitary or in small umbellike clusters.----- 5. NAIADACEAE.

⁵ In this key, as well as in the keys to the families, the genera in each family, and the species in each genus, the characterizations are restricted so as to apply only to forms that occur in Arizona.

3. Stems very short or none, the plants floating; inflorescences subtended by spathes (4).
4. Plants reduced to small frondlike floating bodies without differentiation of stem and leaf; inflorescence 2- or 3-flowered, borne on the edge of the frond..... 12. LEMNACEAE.
4. Plants differentiated but stem very short; leaves in a rosette, with broadly obovate blades and short petioles; inflorescence several flowered; spathe white..... 11. ARACEAE.
1. Plants terrestrial or semiaquatic or, if strictly aquatic, then the perianth relatively large and showy (5).
5. Perianth none or very rudimentary, reduced to bristles or minute scales (6).
6. Flowers not individually subtended by scales or assembled in spikelets, unisexual, very numerous in a dense cylindric spike with the staminate flowers above..... 3. TYPHACEAE.
6. Flowers individually subtended by scales (glumes) and assembled in spikelets, these sometimes reduced to 1 flower; leaves with a sheathlike basal portion enclosing the stem (7).
7. Stems round or flat, usually hollow except at the joints; leaves 2-ranked, the sheath commonly split; flowers with a 2-nerved scale (palea) next to the axis..... 8. GRAMINEAE.
7. Stems often triangular, usually solid; leaves 3-ranked, the sheath not split; flowers without a 2-nerved scale next to the axis. 9. CYPERACEAE.
5. Perianth evident, at least in the pistillate flowers (8).
8. Divisions of the perianth not showy, greenish or brownish; plants mostly of wet ground (9).
9. Perianth relatively large, regular, the 6 divisions resembling the glumes of grasses in texture; flowers perfect..... 16. JUNCACEAE.
9. Perianth small (10).
10. Flowers unisexual, in dense round heads, the fruiting inflorescences burlike; perianth of the pistillate flowers irregular, the divisions chaffy, the staminate flowers naked..... 4. SPARGANIACEAE.
10. Flowers perfect, in slender elongate racemes; perianth regular, the divisions not chaffy or glumelike..... 6. JUNCAGINACEAE.
8. Divisions of the perianth (at least the inner ones) showy, petallike (11).
11. Plants trees, with a tall trunk; leaf blades fan-shaped, many ribbed, deeply lobed..... 10. PALMAE.
11. Plants not trees or, if treelike, then the leaves not fan-shaped or lobed (12).
12. Plants epiphytic (growing on the branches of trees). 13. BROMELIACEAE.
12. Plants terrestrial (rooted in soil), or aquatic (13).
13. Pistils several or many, in a head or ring; ovary 1-celled; flowers perfect or unisexual..... 7. ALISMACEAE.
13. Pistil one; ovary usually 3-celled, or the ovules on 3 placentae; flowers mostly perfect (14).
14. Stamens more than 3, commonly 6, some of them (in genus *Commelina*) often imperfect (15).
15. Perianth adnate below to the ovary and appearing as if borne upon it..... 18. AMARYLLIDACEAE.
15. Perianth free from the ovary or nearly so (16).
16. Segments of the perianth sharply differentiated, the outer ones green, sepallike, the inner ones petallike, fugacious, not bearing glands; flowering stems not from a bulb..... 14. COMMELINACEAE.
16. Segments of the perianth not sharply differentiated or, if so (in genus *Calochortus*), then the inner ones bearing a conspicuous fringed gland and the flowering stems from a bulb..... 17. LILIACEAE.
14. Stamens 3 or fewer (17).
17. Perianth very irregular, adnate below to the ovary; stamens 1 or 2; flowers not subtended by spathes. 20. ORCHIDACEAE.
17. Perianth regular or very nearly so; stamens 3; flowers subtended by spathe-like bracts (18).

18. Ovary superior; plants aquatic or semiaquatic; leaves not equitant----- 15. PONTEDERIAACEAE.
 18. Ovary inferior; plants terrestrial; leaves equitant (in 2 ranks, enfolding one another)----- 19. IRIDACEAE.

ANGIOSPERMAE-DICOTYLEDONEAE

SERIES 1. APETALAE

Key to the families

1. Flowers (of one or both sexes) in catkins or catkinlike racemes or spikes; plants mostly trees or shrubs (2).
 2. Pistillate flowers solitary or in few-flowered clusters, the staminate flowers in catkins (3).
 3. Fruit small, achenelike, enveloped by a winged calyx; leaves narrow, entire, fleshy: Genus *Sarcobatus*----- 34. CHENOPODIACEAE.
 3. Fruit large, nutlike; leaves large, not fleshy (4).
 4. Leaves pinnately compound; nut with a thick hard shell; cotyledons 2-lobed----- 23. JUGLANDACEAE.
 4. Leaves simple (sometimes deeply lobed); nut (acorn) with a relatively thin shell, partly enclosed in a cuplike involucre; cotyledons entire. 25. FAGACEAE.
 2. Pistillate (and usually the staminate) flowers in catkins or catkinlike inflorescences (5).
 5. Flowers monoecious, the pistillate ones subtended by conspicuous bracts; mature catkins dry----- 24. BETULACEAE.
 5. Flowers dioecious or, if monoecious, not conspicuously bracted and the pistillate catkins fleshy at maturity (6).
 6. Perianth none; fruit a capsule; seeds with a conspicuous tuft of silky hairs----- 22. SALICACEAE.
 6. Perianth present, at least in the staminate flowers (7).
 7. Fruits numerous, fused into a compound fleshy fruit, or dry and subtended by conspicuous papery bracts; leaf blades usually lobed, thin----- 27. MORACEAE.
 7. Fruits, remaining separate; leaf blades entire, thick; Genus *Garrya*. 92. CORNACEAE.
 1. Flowers not in catkins (8).
 8. Ovary inferior or appearing so, wholly or partly adnate to the perianth tube or in fruit very closely enveloped by it (9).
 9. Plants aquatic (the stems wholly or partly immersed in water); leaves entire and in whorls, or the immersed ones filiform-dissected; flowers minute, axillary----- 89. HALORAGIDACEAE.
 9. Plants not aquatic (10).
 10. Perianth really double but appearing single and corollalike; calyx with tube wholly adnate to the ovary and the limb obsolete or reduced to a mere border: Families properly of the series Polypetalae and Gamopetalae (11).
 11. Fruit a pair of contiguous, 1-seeded carpels (12).
 12. Flowers in umbels; leaves alternate or basal, mostly compound. 91. UMBELLIFERAE.
 12. Flowers in cymes or solitary in the axils; leaves appearing verticillate, simple: Genus *Galium*----- 116. RUBIACEAE.
 11. Fruit achenelike, not paired (13).
 13. Flowers in heads subtended by an involucre; corolla tubular, funnellform, or strap-shaped, not spurred; anthers often connate. 121. COMPOSITAE.
 13. Flowers not in involucre heads but sometimes in rather dense clusters; corolla spurred; anthers not connate: Genus *Plectritis*. 118. VALERIANACEAE.
 10. Perianth evidently in one series, calyxlike or corollalike (14).
 14. Plants parasitic on the stems of trees and shrubs (15).
 15. Stems well developed, much branched; leaves with well-developed blades, or reduced to small scales; fruit a 1-seeded berry. 29. LORANTHACEAE.

15. Stems almost none outside the bark of the host, only the flowers and a few imbricate bractlike leaves apparent; fruit several-seeded..... 32. RAFFLESIAACEAE.
14. Plants terrestrial, autophytic, or exceptionally root-parasitic (16).
16. Perianth very irregular, with the segments united below into a tube..... 31. ARISTOLOCHIAACEAE.
16. Perianth regular or nearly so (17).
17. Fruit of 2 partly separate beaked carpels: Genus *Heuchera*.
50. SAXIFRAGACEAE.
17. Fruit of a single carpel (18).
18. Ovules 2 or more; ovary truly inferior, crowned in fruit by the persistent perianth..... 30. SANTALACEAE.
18. Ovule solitary; ovary technically superior, but in fruit very closely enveloped by the base of the perianth tube and appearing inferior (19).
19. Plants herbaceous or suffrutescent; pubescence not stellate; perianth campanulate, funnelform, or salverform, usually corollalike in texture; fruit dry... 36. NYCTAGINACEAE.
19. Plants shrubby; pubescence stellate-scurfy; perianth urn-shaped, not corollalike, its base fleshy in fruit.
86. ELAEAGNACEAE.
8. Ovary superior, free or very nearly free from the perianth when the latter is present (20).
20. Pistils commonly more than 1; stamens numerous; fruits indehiscent (achenes) or longitudinally dehiscent on one suture (follicles).
42. RANUNCULACEAE.
20. Pistil 1, simple or compound (21).
21. Style and (or) stigma 1 (22).
22. Plant aquatic (the stems immersed in water); leaves in whorls, finely dissected..... 41. CERATOPHYLLACEAE.
22. Plants not aquatic, the stems not immersed (23).
23. Fruit a circumscissile crested several-seeded capsule: Genus *Trianthema*..... 38. AIZOACEAE.
23. Fruit not a circumscissile several-seeded capsule (24).
24. Plants herbaceous (25).
25. Fruit berrylike; flowers in terminal racemes; perianth-segments 4: Genus *Rivina*..... 37. PHYTOLACCACEAE.
25. Fruit not berrylike (26).
26. Ovary 2-celled; fruit a flat, obcordate capsule: Genus *Lepidium*..... 46. CRUCIFERAE.
26. Ovary 1-celled; fruit a 1-seeded, indehiscent utricle or achene (27).
27. Leaves pinnate; stamens usually 2; achene enclosed in an urn-shaped, 4-winged hypanthium: Genus *Sanguisorba*..... 53. ROSACEAE.
27. Leaves simple; stamens usually more than 2 (28).
28. Stipules present or absent; inflorescences loose, axillary; perianth not scarious..... 28. URTICACEAE.
28. Stipules none; inflorescences dense, terminal or axillary; perianth often scarious.... 35. AMARANTHACEAE.
24. Plants shrubs or trees (29).
29. Stamens 10 or more, or, if fewer than 10, then the leaves bipinnate (30).
30. Leaves simple; flowers solitary or in few-flowered fascicles: Genera *Cercocarpus*, *Coleogyne*..... 53. ROSACEAE.
30. Leaves pinnate or bipinnate; flowers in heads, spikes, or spikelike racemes: Subfamily Mimosoideae and genus *Parryella*..... 54. LEGUMINOSAE.
29. Stamens 5 or fewer; leaves never bipinnate (31).
31. Ovary 4- or 5-celled; fruit a capsule; stamens 5, the filaments united below into a tube: Genus *Fremontodendron*.
75. STERCULIACEAE.
31. Ovary 2-celled; fruit a samara or a drupe; stamens 2 or 4, separate; leaves simple or pinnate..... 98. OLEACEAE.

21. Styles and (or) stigmas 2 or more, exceptionally 1 in family Euphorbiaceae (32).
32. Stems woody, the plants shrubs or trees (33).
33. Fruit a drupe (34).
34. Style none; stigmas 2, elongate, spreading or recurved, plumose or tomentose; ovary 1-celled; drupe with 1 stone; leaf blades very unequal at base and very scabrous above.
26. ULMACEAE.
34. Style present (often very short); stigmas not recurved or plumose; ovary 2- or 3-celled; drupe with 1 to 3 stones; leaf blades not conspicuously unequal at base or scabrous; Genera *Condalia*, *Rhamnus*----- 71. RHAMNACEAE.
33. Fruit not a drupe (35).
35. Leaves palmately lobed or divided, or pinnate with few leaflets; fruit a pair of samaras, united at base, each with a 1-sided wing----- 69. ACERACEAE.
35. Leaves simple (palmately lobed in certain of the family Euphorbiaceae); fruit not a pair of samaras (36).
36. Fruit acornlike with 1 large seed; leaves entire, coriaceous.
66. BUXACEAE.
36. Fruit not acornlike (37).
37. Ovary 2- to 4-celled (exceptionally 1-celled in the family Euphorbiaceae); fruit a capsule, commonly longitudinally dehiscent; flowers unisexual, in *Dodonaea* by abortion (38).
38. Capsule not winged; leaves not viscid, entire to palmately parted----- 64. EUPHORBIACEAE.
38. Capsule conspicuously 2- to 4-winged; leaves somewhat viscid, narrow, entire: Genus *Dodonaea*.
70. SAPINDACEAE.
37. Ovary 1-celled; fruit not longitudinally dehiscent (39).
39. Flowers perfect, subtended by a cylindrical, turbinate, or cup-shaped, gamophyllous involucre; stamens 9; fruit a 3-angled or winged achene: Genus *Eriogonum*.
33. POLYGONACEAE.
39. Flowers perfect or unisexual, not with an involucre as in the foregoing, but the pistillate flowers often subtended by a pair of accrescent bractlets; stamens 5 or fewer; fruit a utricle... 34. CHENOPODIACEAE.
32. Stems herbaceous or nearly so (40).
40. Inflorescence of many small naked flowers in a dense cylindrical spike subtended by a conspicuous involucre of white petallike bracts, the whole appearing like a single large flower.
21. SAURURACEAE.
40. Inflorescence not as in the foregoing (41).
41. Plants aquatic; stems wholly or partly immersed; stipules none; fruit at maturity separating into 4 nutlets.
65. CALLITRICHACEAE.
41. Plants not aquatic or, if so, then the stems jointed and the stipules united into a sheath around the stem (42).
42. Ovary completely or incompletely 2- or more-celled, exceptionally 1-celled in the family Euphorbiaceae (43).
43. Fruit a depressed-globose, several-seeded berry; plant a coarse herb with large leaves: Genus *Phytolacca*.
37. PHYTOLACCACEAE.
43. Fruit a capsule (44).
44. Flowers unisexual, with or without a perianth.
64. EUPHORBIACEAE.
44. Flowers perfect, with a perianth----- 38. AIZOACEAE.
42. Ovary 1-celled (45).
45. Fruit a many-seeded, longitudinally dehiscent capsule: Genus *Sagina*----- 40. CARYOPHYLLACEAE.

45. Fruit a 1-seeded achene or utricle (46).
 46. Flowers subtended by an involucre (this campanulate, turbinate, or cylindric, and several-toothed or -cleft, or consisting of a single 2-lobed bract), or, if without an involucre, then the stipules present and united into a sheath around the stem; fruit an achene, usually triangular but sometimes, in genus *Polygonum*, lenticular..... 33. POLYGONACEAE.
46. Flowers not subtended by an involucre or this consisting of a pair of appressed bracts; stipules none, or not united in a sheath; fruit not triangular (47).
 47. Stipules present; flowers perfect, in axillary clusters; plants small, with spreading, prostrate, or densely caespitose stems..... 40. CARYOPHYLLACEAE.
47. Stipules none; flowers perfect or unisexual (48).
 48. Bracts and perianth not scarious; plants often fleshy, scurfy, or mealy; filaments separate.
 34. CHENOPODIACEAE.
48. Bracts and perianth usually scarious; plants not fleshy, scurfy, or mealy; filaments commonly more or less united..... 35. AMARANTHACEAE.

SERIES 2. POLYPETALAE

Key to the families

1. Corolla distinctly irregular (2).
 2. Leaves compound, rarely reduced to a single leaflet (3).
 3. Sepals 2; corolla conspicuously spurred, not pealike; leaves decomposed with numerous narrow segments, glaucous; plants herbaceous: Genus *Corydalis*..... 45. PAPAVERACEAE.
3. Sepals or calyx lobes more than 2; corolla not or inconspicuously spurred, usually pealike (reduced to 1 petal in *Amorpha*); leaves variously compound..... 54. LEGUMINOSAE.
2. Leaves simple, sometimes palmately lobed or parted (4).
 4. Carpels normally more than 1, separate, in fruit becoming several-seeded follicles; leaf blades palmately cleft to parted; flowers showy, normally blue or bluish, very irregular, the sepals larger than the petals and similarly colored: Genera *Delphinium*, *Aconitum*.
 42. RANUNCULACEAE.
4. Carpel solitary or, if more than one, united to form a single fruit (5).
 5. Stems mostly woody; leaf blades entire; petals purplish red; fruit spiny, turgid, indehiscent, and the leaf blades narrow, or fruit a flat, dehiscent pod, and the leaf blades round-cordate: Genera *Krameria*, *Cercis*..... 54. LEGUMINOSAE.
5. Stems mostly herbaceous; fruit not spiny; leaf blades not round-cordate and entire or, if so, then the corolla spurred, white, yellow, or violet (6).
 6. Leaf blades palmately cleft or parted; fruit a thick-walled capsule, 2 cm. long or longer; stamens many... 80. COCHLOSPERMACEAE.
6. Leaf blades entire or with shallowly toothed margins; fruit thin-walled, much less than 2 cm. long; stamens 12 or fewer (7).
 7. Stipules present; sepals, petals, and stamens 5... 82. VIOLACEAE.
7. Stipules none or reduced to glands (8).
 8. Filaments separate, borne on the calyx: Genus *Cuphea*.
 87. LYTHRACEAE.
8. Filaments more or less united (9).
 9. Petals 2; stamens 3; capsule turgid, 4-lobed.
 48. RESEDACEAE.
9. Petals commonly 3; stamens 6 to 8; capsule flat, 2-celled.
 63. POLYGALACEAE.
1. Corolla regular or nearly so (10).
 10. Ovary inferior, at least the lower part distinctly adnate to the hypanthium or calyx tube (11).
 11. Petals and stamens indefinitely numerous; stems very thick and succulent, flat or cylindric; leaves none or greatly reduced and terete.
 85. CACTACEAE.

11. Petals 10 or fewer, usually not more than 5; stems not succulent or only moderately so; leaves well developed (12).
12. Flowers in umbels or dense round heads, very small (13).
13. Fruit a several-seeded berry----- 90. ARALIACEAE.
13. Fruit dry, of 2 closely contiguous carpels, these 1-seeded.
91. UMBELLIFERAE.
12. Flowers not in umbels or dense round heads, if the inflorescence subcapitate, then the plant armed with barbed stinging hairs (14).
14. Herbage very rough-pubescent, the hairs commonly barbed, sometimes stinging----- 84. LOASACEAE.
14. Herbage not rough-pubescent, or the hairs not barbed (15).
15. Stems herbaceous or merely suffrutescent (16).
16. Plants aquatic; leaves (or some of them) finely dissected; flowers minute----- 89. HALORAGIDACEAE.
16. Plants not aquatic or, if so, then the flowers showy; leaves simple, sometimes pinnatifid (17).
17. Stems and leaves more or less succulent; fruit a circumscissile capsule: Genus *Portulaca*----- 39. PORTULACACEAE.
17. Stems and leaves not succulent; fruit not circumscissile (18).
18. Styles 2 or 3; stamens 5 or 10; ovary of 2 or 3 partly separate carpels----- 50. SAXIFRAGACEAE.
18. Style 1; ovary entire (19).
19. Stamens commonly 4 or 8 (seldom only 2); fruit a 2- to 5-celled capsule, or sometimes indehiscent and nut-like----- 88. ONAGRACEAE.
19. Stamens 3; fruit 1-celled, large and gourdlike: Genus *Apodanthera*----- 119. CUCURBITACEAE.
15. Stems woody (20).
20. Fruit dry, follicular or capsular (21).
21. Stamens 8 or more----- 50. SAXIFRAGACEAE.
21. Stamens 5 or fewer----- 71. RHAMNACEAE.
20. Fruit a more or less fleshy drupe, pome, or berry (22).
22. Flowers small, in many-flowered compound cymes; leaves simple, entire; fruit a drupe, the stone containing 1 or 2 seeds; calyx limb minute: Genus *Cornus*.
92. CORNACEAE.
22. Flowers in relatively few-flowered racemes or corymbs or, if in many-flowered compound cymes, then the leaves pinnate; fruit several-seeded; calyx limb well-developed (23).
23. Leaves palmately lobed; stamens not more than 5; fruit a berry: Genus *Ribes*----- 50. SAXIFRAGACEAE.
23. Leaves not palmately lobed, simple or pinnate; stamens numerous; fruit a pome (the carpels embedded in the thickened receptacle)----- 53. ROSACEAE.
10. Ovary superior, free from the calyx or very nearly so (24).
24. Anthers opening by terminal valves or pores (25).
25. Plants shrubs or undershrubs; leaves compound; stamens 6; ovary 1-celled----- 43. BERBERIDACEAE.
25. Plants herbaceous or nearly so; leaves simple; stamens 8 or more; ovary several-celled (26).
26. Flowers with petals of unequal width and stamens dimorphic; leaf blades palmately cleft or parted; stems from a large tuberlike root; stamens numerous----- 80. COCHLOSPERMACEAE.
26. Flowers regular or very nearly so; leaf blades not lobed (sometimes reduced to scales and the plant without chlorophyll); root not tuberlike; stamens 8 to 10----- 94. ERICACEAE.
24. Anthers opening longitudinally (27).
27. Flowers very numerous in dense globose heads; plant a tree; leaves large, palmately lobed----- 51. PLATANACEAE.
27. Flowers not in dense globose heads, or the plant not a tree with palmately lobed leaves (28).
28. Flowers with a more or less thickened disk surrounding or under the ovary or ovaries, this often bearing the stamens, or the stamens numerous and borne in one or more circles on the throat of the calyx (29).

29. Pistil more than 1; stamens usually numerous (30).
30. Seeds with a fimbriate aril and a copious endosperm, reniform; plants shrubby; leaves without stipules.
52. CROSSOSOMATACEAE.
30. Seeds not arillate, the endosperm scanty or none; plants small trees, shrubs, or herbs; leaves usually with stipules.
53. ROSACEAE.
29. Pistil 1 (exceptionally 2 or 3 in genus *Purshia*), simple or compound (if the carpels several and almost separate, then the plant a very thorny shrub with the leaves reduced to scales); stems commonly woody (31).
31. Ovary 1-celled; plants mostly shrubs or small trees (32).
32. Leaves reduced to small scales, these imbricate and covering the twigs; flowers minute, in elongate spikelike inflorescences----- 78. TAMARICACEAE.
32. Leaves with well-developed blades (33).
33. Styles 3; fruit a small drupe; leaves compound or simple.
67. ANACARDIACEAE.
33. Style 1 or none; fruit dry, an achene or foliicle; leaves simple, sometimes deeply cleft (34).
34. Stamens more than 10; flowers with a turbinate or funnel-form hypanthium, or the pistil enclosed in a sheathlike extension of the disk: Genera *Purshia*, *Coleogyne*.
53. ROSACEAE.
34. Stamens 10; hypanthium none; pistil not enclosed in a sheath: Genus *Forsellesia*----- 68. CELASTRACEAE.
31. Ovary with 2 or more cells (35).
35. Leaves reduced to small scales; plant with sharp-pointed rigid spiny branches; carpels 5 or more, nearly separate, in fruit a circle of 1-seeded drupes----- 60. SIMARUBACEAE.
35. Leaves with well-developed blades (36).
36. Plants vinelike, the stems climbing or trailing; fruit a berry.
72. VITACEAE.
36. Plants not vinelike (37).
37. Leaves punctate with translucent glands; fruit a capsule or a nearly orbicular samara----- 59. RUTACEAE.
37. Leaves not punctate with translucent glands (38).
38. Fruit a pair of laterally winged samaras, these united near the base; leaves simple and palmately lobed, or palmately divided, or pinnate with few leaflets.
69. ACERACEAE.
38. Fruit not a pair of samaras (39).
39. Leaves simple (40).
40. Fruit not fleshy; stamens alternate with the petals----- 68. CELASTRACEAE.
40. Fruit a more or less fleshy drupe; stamens opposite the petals----- 71. RHAMNACEAE.
39. Leaves pinnate; fruit drupelike or berrylike (41).
41. Fruit 3-angled, dry; bark and foliage strong-scented----- 61. BURSERACEAE.
41. Fruit globose, with translucent pulp; bark and foliage not strong-scented: Genus *Sapindus*.
70. SAPINDACEAE.
28. Flowers without a disk, or this represented by separate glands or scales, or rudimentary; stamens not borne on the throat of the calyx or, if so, not more than 12 (42).
42. Filaments united, at least at base (43).
43. Plants vinelike, the stems climbing or trailing; calyx throat bearing a conspicuous fringed crown. 83. PASSIFLORACEAE.
43. Plants not vinelike; calyx throat not with a fringed crown (44).
44. Carpels adnate to a central column, from which they or the persistent styles become more or less detached at maturity.
55. GERANIACEAE.
44. Carpels not adnate and separating as in the foregoing (45).
45. Leaves compound, often sensitive (46).

46. Stamens more conspicuous than the small petals; leaves bipinnate, with several or numerous small leaflets; fruit a flat 1-celled pod: Subfamily Mimosoideae.
54. LEGUMINOSAE.
46. Stamens less conspicuous than the petals; leaves digitately compound with 3 or more wedge-shaped leaflets; fruit a turgid 5-celled capsule.--- 56. OXALIDACEAE.
45. Leaves simple (47).
47. Flowers mostly unisexual (monoecious); pubescence (if any) commonly of hairs affixed at the middle (malpighiaceus); stamens usually 10, the anthers in 2 whorls: Genus *Ditaxis* ----- 64. EUPHORBIACEAE.
47. Flowers perfect (48).
48. Pubescence (if any) of simple hairs; filaments united only at base (49).
49. Stamens 5; ovary 4- or 5-celled (or apparently 8- to 10-celled); leaves not glandular-punctate.
57. LINACEAE.
49. Stamens numerous; ovary 3-celled, or 1-celled with 3 placentae; leaves glandular-punctate.
76. HYPERICACEAE.
48. Pubescence at least partly of forked or stellate hairs (50).
50. Leaves opposite, the blades entire; stems trailing or twining, woody below; fruit nutlike or winged.
62. MALPIGHIACEAE.
50. Leaves alternate; stems not trailing or twining (51).
51. Stamens much more numerous than the calyx lobes; anthers 1-celled; fruit of several or numerous finally separate carpels, or a several-celled capsule.----- 74. MALVACEAE.
51. Stamens (fertile ones) of the same number as the sepals or calyx lobes; anthers 2- or 3-celled; fruit a 1-celled or 5-celled capsule.
75. STERCULIACEAE.
42. Filaments separate (52).
52. Carpels more than 1, becoming separate or nearly separate fruits (53).
53. Ovules 2 or more in each ovary, exceptionally solitary in family Crassulaceae (54).
54. Leaves decomposed; petals with long spurs: Genus *Aquilegia*----- 42. RANUNCULACEAE.
54. Leaves simple; petals not spurred (55).
55. Carpels more than 5, becoming torulose and, at maturity, breaking transversely into indehiscent 1-seeded joints: Genus *Platystemon*----- 45. PAPAVERACEAE.
55. Carpels 5 or fewer, not becoming torulose or breaking transversely (56).
56. Plants more or less succulent; carpels 3 to 5; fruits follicles.----- 49. CRASSULACEAE.
56. Plants not succulent; carpels 2; fruits follicles or capsules.----- 50. SAXIFRAGACEAE.
53. Ovule solitary (57).
57. Stems twining; flowers dioecious, small; sepals 6, in 2 series.
44. MENISPERMACEAE.
57. Stems not twining; flowers mostly perfect; sepals rarely more than 5 (58).
58. Plants herbaceous; calyx of separate sepals, deciduous; hypanthium none.----- 42. RANUNCULACEAE.
58. Plants woody or, if herbaceous, then the calyx of more or less united sepals, persistent; hypanthium usually present.----- 53. ROSACEAE.

52. Carpel 1, or, if carpels more than 1, these united at least until maturity (59).
59. Leaves compound, or the blades pinnatifid or deeply palmately lobed (60).
60. Fruit juicy, berrylike (61).
61. Plant not vinelike, the stems erect; leaves large, decomposed; stamens numerous: Genus *Actaea*.
42. RANUNCULACEAE.
61. Plant vinelike, the stems climbing or trailing; leaves digitate, with 5 to 7 leaflets; stamens 5: Genus *Parthenocissus*-----
72. VITACEAE.
60. Fruit dry (62).
62. Fruit a 2-valved pod, or sometimes dehiscent by apical valves in family Papaveraceae, rarely transversely multicellular and indehiscent in family Cruciferae (63).
63. Sepals 2 or 3; plants herbaceous; leaves decomposed with narrow segments, or sinuate-pinnatifid and prickly; stamens numerous--
45. PAPAVERACEAE.
63. Sepals or calyx lobes 4 or 5 (64).
64. Calyx gamophyllous with 4 or 5 teeth or lobes; stamens numerous; leaves bipinnate; plants most woody: Subfamily Mimosoideae.
54. LEGUMINOSAE.
64. Calyx of 4 separate sepals; plants herbaceous (65).
65. Ovary 2-celled, stipitate or sessile; stamens 6, tetradynamous (2 shorter, 4 longer, barely so in genus *Stanleya*); leaves pinnate or pinnatifid.
46. CRUCIFERAE.
65. Ovary commonly 1-celled, stipitate; stamens 6 or more, not tetradynamous; leaves digitately 3- to 5-foliolate-----
47. CAPPARIDACEAE.
62. Fruit a 3- to 5-celled, or apically 3-valved, capsule (66).
66. Ovary not lobed, appearing externally as one carpel; flowering shoots from rootstocks bearing bulblets: Genus *Lithophragma*-----
50. SAXIFRAGACEAE.
66. Ovary lobed, of 5 carpels, these becoming more or less separate in fruit after maturity; bulblets none (67).
67. Styles separating at maturity from the central column; leaves palmately lobed, or pinnate with pinnatifid leaflets-----
55. GERANIACEAE.
67. Styles not separating from the column; leaves pinnate or digitately 2- or 3-foliolate, the leaflets entire-----
58. ZYGOPHYLLACEAE.
59. Leaves simple, never pinnatifid or palmately lobed (68).
68. Plants shrubby; sepals or calyx lobes 4 to 6 (69).
69. Leaves with well-developed blades, these narrow, emarginate at apex, otherwise entire, lepidote beneath; plant not spiny; fruit berrylike: Genus *Atamisquea*.
47. CAPPARIDACEAE.
69. Leaves reduced to small scales; plants very spiny (70).
70. Petals, stamens, and carpels 5; fruit a dry turgid 5-valved capsule: Genus *Canotia*.
68. CELASTRACEAE.
70. Petals 4; stamens 8; carpels 2; fruit a globular berry.
81. KOEBERLINIACEAE.
68. Plants herbaceous or, if somewhat woody, then the sepals usually 2, or the plant succulent, or the fruit a 2-valved capsule (71).
71. Sepals united most of their length (72).
72. Styles 2 to 5; stamens 10, free from the calyx.
40. CARYOPHYLLACEAE.
72. Style 1; stamens and petals borne on the calyx.
87. LYTHRACEAE.
71. Sepals separate to the base or nearly so (73).
73. Petals more numerous than the sepals, the latter commonly 2-----
39. PORTULACACEAE.

73. Petals not more numerous than the sepals, the latter usually more than 2 (74).
74. Stamens usually more than 10; petals yellow or salmon-colored (75).
75. Style 1; fruit a long slender 2-valved pod; leaves not punctate..... 73. TILIACEAE.
75. Styles 3; fruit a short capsule, 3-celled or the ovary with 3 placentae; leaves glandular-punctate..... 76. HYPERICACEAE.
74. Stamens 10 or fewer (76).
76. Stamens 6, tetradynamous (2 shorter, 4 longer, barely so in genus *Stanleya*); fruit a 2-valved pod or, if 1-celled, then flat, indehiscent, and containing a single seed... 46. CRUCIFERAE.
76. Stamens commonly 10, 5, or fewer, not tetradynamous (77).
77. Ovary 1-celled; plants not aquatic; petals often notched or cleft... 40. CARYOPHYLLACEAE.
77. Ovary 2- to 5-celled; plants semiaquatic; petals entire..... 77. ELATINACEAE.

SERIES 3. GAMOPETALAE

Key to the families

1. Corollas (or some of them) distinctly irregular (2).
2. Stamens with the filaments or the anthers connate, or the filaments not attached to the corolla (3).
 3. Ovary superior; anthers separate (4).
 4. Leaves compound (rarely reduced to 1 leaflet); stamens commonly 10; petals usually 5; fruit a 2-valved pod..... 54. LEGUMINOSAE.
 4. Leaves simple; stamens 6 or 8; petals 3; fruit a flat 2-celled capsule. 63. POLYGALACEAE.
 3. Ovary inferior; stamens 4 or 5, the anthers separate or united (5).
 5. Flowers not in heads; involucre none; calyx limb well developed; fruit a turgid many-seeded capsule: Subfamily Lobelioideae. 120. CAMPANULACEAE.
 5. Flowers in dense heads subtended by an involucre; calyx limb reduced to bristles, scales, teeth, etc.; fruit a 1-seeded achene. 121. COMPOSITAE.
2. Stamens separate from one another, the filaments attached to the tube or the throat of the corolla (6).
 6. Ovary inferior; leaves opposite (7).
 7. Calyx limb obsolete; corolla bearing a well-developed spur; plants herbaceous; fruit achenelike: Genus *Plectritis*. 118. VALERIANACEAE.
 7. Calyx limb well developed; corolla not spurred, the tube sometimes gibbous on one side; stems woody; fruit a berry. 117. CAPRIFOLIACEAE.
 6. Ovary superior (8).
 8. Fruit at maturity separating into 2 or 4 dry nutlets or, if a fleshy drupe, then the flowers in headlike clusters (9).
 9. Ovary entire or longitudinally grooved; style apical; fruit of nutlets or drupelike; corolla only slightly irregular. 107. VERBENACEAE.
 9. Ovary 4-lobed, the style rising between the lobes; fruit of nutlets; corolla nearly regular to strongly bilabiate.... 108. LABIATAE.
 8. Fruit not separating into nutlets; fruit a capsule, this somewhat fleshy and partly indehiscent in genus *Martynia* (10).
 10. Plants root parasites without chlorophyll, the leaves reduced to fleshy scales..... 113. OROBANCHACEAE.
 10. Plants not or weakly parasitic, with chlorophyll; leaves with well-developed blades (11).
 11. Anther-bearing stamens 5; capsule usually 3-celled. 104. POLEMONIACEAE.

11. Anther-bearing stamens 4 or 2; capsule 2-valved (12).
 12. Ovary 1-celled; fruit large, ending in a long incurved hooked beak..... 112. MARTYNIACEAE.
 12. Ovary 2-celled; fruit not with a long hooked beak (13).
 13. Capsule long and slender; seeds comose or winged.
 111. BIGNONIACEAE.
 13. Capsule not long and slender; seeds not comose, rarely winged (14).
 14. Seeds usually indefinitely numerous, commonly sessile, with copious endosperm; cotyledons narrow.
 110. SCROPHULARIACEAE.
 14. Seeds not more than 10 (often only 2) in each cell, stalked, the endosperm scanty or none; cotyledons broad.
 114. ACANTHACEAE.
1. Corollas regular or nearly so (15).
 15. Ovary inferior (16).
 16. Flowers in heads subtended by an involucre; fruit an achene; calyx limb reduced to bristles, scales, teeth, etc..... 121. COMPOSITAE.
 16. Flowers not in heads subtended by an involucre (17).
 17. Stamens free from the corolla or very nearly so (18).
 18. Corolla lobes and stamens indefinitely numerous; plants very succulent..... 85. CACTACEAE.
 18. Corolla lobes not more than 5; stamens 10 or fewer; plants not or scarcely succulent (19).
 19. Plant shrubby; corolla cylindrical or urceolate; anthers opening by terminal pores; fruit a berry: Genus *Vaccinium*.
 94. ERICACEAE.
 19. Plants herbaceous; corolla campanulate or rotate; anthers splitting longitudinally (20).
 20. Flowers unisexual (rarely perfect); stamens commonly more or less united; stems climbing or trailing; corolla yellow or whitish; fruit various..... 119. CUCURBITACEAE.
 20. Flowers mostly perfect; stamens separate; stems erect; corolla normally blue or violet; fruit a capsule, opening by pores or valves: Subfamily Campanuloideae. 120. CAMPANULACEAE.
17. Stamens borne on the corolla (21).
 21. Calyx limb reduced to bristles, these elongate and plumose in fruit; plants herbaceous..... 118. VALERIANACEAE.
 21. Calyx limb not reduced to bristles (22).
 22. Fruit dry, a capsule, or achenelike, or separating at maturity into 2 or 4 usually closed carpels..... 116. RUBIACEAE.
 22. Fruit berrylike or drupelike or, if achenelike, then the stems creeping and the flowers in pairs, nodding on long slender peduncles.
 117. CAPRIFOLIACEAE.
15. Ovary superior (free from the calyx) or very nearly so (23).
 23. Stamens more or less united by the filaments or the anthers (24).
 24. Leaves bipinnate; stamens much more conspicuous than the small corolla; flowers in heads or spikes: Subfamily Mimosoideae.
 54. LEGUMINOSAE.
 24. Leaves simple, sometimes pedately cleft or parted (25).
 25. Flowers unisexual; seeds carunculate: Genus *Jatropha*.
 64. EUPHORBIACEAE.
 25. Flowers perfect; seeds not carunculate (26).
 26. Corolla only slightly gamopetalous; stamens numerous; fruit of several separating carpels, or a several-celled capsule.
 74. MALVACEAE.
 26. Corolla strongly gamopetalous; stamens 5 (27).
 27. Ovaries 2, connected only by the united stigmas; pollen grains in masses; filaments united into a column; fruit a pair of follicles..... 102. ASCLEPIADACEAE.
 27. Ovary 1, usually 2-celled; pollen grains separate; anthers more or less connate; fruit a berry: Genus *Solanum*.
 109. SOLANACEAE.
23. Stamens separate (28).
 28. Filaments free from the corolla or very nearly so (29).
 29. Leaves bipinnate; stamens much more conspicuous than the small corolla; flowers in dense heads or spikes: Subfamily Mimosoideae.
 54. LEGUMINOSAE.

29. Leaves simple; stamens less conspicuous than the corolla; flowers not in dense heads or spikes (30).
30. Anthers awned or opening by pores or both; plants shrubs or else saprophytic, without chlorophyll, the leaves reduced to scales; corolla urceolate or subglobose 94. ERICACEAE.
30. Anthers not awned, splitting longitudinally; plants suffrutescent, always with chlorophyll and well-developed leaf blades; corolla salverform 96. PLUMBAGINACEAE.
28. Filaments attached to the corolla (31).
31. Plants without chlorophyll, parasitic; leaves reduced to scales (32).
32. Stems mostly subterranean, thick and succulent, attached to the roots of the host plant; corolla lobes and stamens 6 or more; flowers small, very numerous, crowded on a dilated saucer-shaped receptacle 93. LENNOACEAE.
32. Stems above ground, twining, slender, yellow, attached to the stems of the host plant; corolla lobes and stamens not more than 5; flowers in cymose clusters: Genus *Cuscuta*.
103. CONVOLVULACEAE.
31. Plants with chlorophyll and with well-developed leaf blades (33).
33. Fruit at maturity separating into 2 to 4 dry nutlets, or by abortion only 1 (34).
34. Stamens and corolla lobes 5; stems not 4-angled.
106. BORAGINACEAE.
34. Stamens 2 or 4, if 4 then in 2 pairs; stems often quadrangular (35).
35. Ovary entire or longitudinally grooved, the style apical.
107. VERBENACEAE.
35. Ovary 4-lobed, the style rising between the lobes.
108. LABIATAE.
33. Fruit not separating into nutlets (36).
36. Plants shrubs or small trees, usually thorny or spiny; fruit a drupe containing 1 stone (37).
37. Stamens 5, with 5 petaloid staminodia; corolla with a pair of lobelike appendages in each sinus of the 5 true lobes; flowers inconspicuous, in axillary clusters.
97. SAPOTACEAE.
37. Stamens 4; staminodia none; corolla without appendages; flowers showy, in terminal headlike clusters: Genus *Lantana* 107. VERBENACEAE.
36. Plants various; fruit not a drupe, if berrylike, then several-seeded (38).
38. Stamens 10 or more (39).
39. Plants herbaceous, succulent, with a rosette of relatively large basal leaves, the stem leaves bractlike, persistent; carpels normally 5, separate or nearly so: Genus *Echeveria* 49. CRASSULACEAE.
39. Plant a thorny shrub with long whiplike branches; stem leaves not bractlike, soon deciduous; carpels 3, united.
79. FOUQUIERACEAE.
38. Stamens fewer than 10, seldom more than 5 (40).
40. Fruit a samara with the wing mostly terminal, or a didymous capsule; stamens 2 or 4 98. OLEACEAE.
40. Fruit not a samara or a didymous capsule (41).
41. Ovaries 2, united only by the common style or stigma; fruit a pair of elongate follicles; seeds often comose.
101. APOCYNACEAE.
41. Ovary 1, sometimes deeply parted; fruit a single capsule or berry; seeds not comose (42).
42. Ovary 1-celled or sometimes imperfectly 2-celled by introflexion of the placentae (43).
43. Stamens opposite the corolla lobes; style 1; stigma entire 95. PRIMULACEAE.
43. Stamens alternate with the corolla lobes (44).
44. Style 1 and entire, or none; stigma 1, more or less distinctly 2-lobed or bilamellate, or the stigmas 2; plants mostly glabrous; leaf blades entire; inflorescence not scorpioid.
100. GENTIANACEAE.

44. Styles 2, or single and 2-cleft; plants mostly pubescent; leaf blades seldom entire; inflorescence commonly scorpioid. 105. HYDROPHYLLACEAE.
42. Ovary with 2 or more cells or, if 2-celled only at base (in genus *Limosella*), then the plant a small semi-aquatic herb with small solitary flowers, a 5-lobed corolla, and 4 stamens (45).
45. Fruit a circumscissile capsule; flowers small, in dense terminal spikes. 115. PLANTAGINACEAE.
45. Fruit not circumscissile (46).
46. Plants shrubby; flowers small, in dense axillary clusters, these often forming leafy interrupted spikes. 99. LOGANIACEAE.
46. Plants herbaceous or suffrutescent or, if shrubby, then the flowers solitary or in few-flowered loose axillary clusters, in genus *Lycium*, or in scorpioid terminal racemes, in genus *Eriodictyon* (47).
47. Stigmas 3; style 1, often 3-cleft. 104. POLEMONIACEAE.
47. Stigmas 1 or 2, or sometimes 4 in family Convolvulaceae (48).
48. Styles 2, entire or cleft, or the style 1, 2-cleft (49).
49. Ovules 2 in each cell of the ovary; stems often twining; flowers not in scorpioid racemes. 103. CONVULVULACEAE.
49. Ovules more than 2 in each cell; stems never twining; flowers often in scorpioid racemes. 105. HYDROPHYLLACEAE.
48. Style 1, entire (50).
50. Ovules 2 in each cell of the ovary. 103. CONVULVULACEAE.
50. Ovules several or many in each cell of the ovary (51).
51. Anther-bearing stamens normally 5 or, if 4 and a rudimentary stamen present, then the flowers lateral, solitary, or in small clusters; inflorescence never an elongate terminal spike. 109. SOLANACEAE.
51. Anther-bearing stamens 2 or 4 or, if 5, then the inflorescence an elongate terminal spike. 110. SCROPHULARIACEAE.

1. PINACEAE. PINE FAMILY

Trees or shrubs, resinous; leaves evergreen, needle-shaped, narrowly linear, or else scalelike, crowded, and imbricate; flowers unisexual; perianth none; staminate inflorescences with numerous spirally arranged stamens; pistillate inflorescences with scales arranged spirally or in pairs alternately crossing at right angles (decussate), these bearing at base 2 or several naked ovules; fruits in cones, these sometimes berrylike.

Key to the genera

1. Leaves in the adult state closely imbricate, minute, scalelike or, if not closely imbricate and scalelike, then the cones berrylike, juicy; scales of the pistillate flowers without bracts (2).
2. Cones globular, dry at maturity, the scales woody and finally separating, the cones long-persistent on the branches after the seeds have fallen; seeds numerous under each scale, winged. 5. CUPRESSUS.

2. Cones berrylike, the scales fleshy and remaining fused at maturity, the cones not long-persistent on the branches; seeds few, not winged. 6. JUNIPERUS.
1. Leaves in the adult state not closely imbricate, elongate, needlelike or linear; cones dry at maturity; scales of the pistillate flowers in the axils of persistent bracts (3).
3. Leaves sheathed at base, at least when young, usually in fascicles of 2 or more, mostly needlelike; cone scales very thick and woody, umbonate on the back; bracts minute, much shorter than the scales; fruit maturing in the second (rarely third) season----- 1. PINUS.
3. Leaves not sheathed or fascicled, linear or subulate; cone scales not very thick and woody, not umbonate; bracts relatively large; fruit maturing in the first season (4).
4. Cones erect, the scales falling from the axis at maturity and much longer than the bracts; leaves sessile, flat or somewhat 4-sided... 4. ABIES.
4. Cones pendulous, the scales persistent on the axis; leaves stalked (5).
5. Branchlets roughened by the persistent, hard, peglike leaf bases; leaves mostly 4-sided, deciduous in drying; bracts shorter than the cone scales, erose-dentate or nearly entire----- 2. PICEA.
5. Branchlets not roughened by persistent leaf stalks; leaves compressed but strongly ribbed and channeled, persistent in drying; bracts longer than the cone scales, conspicuous, 2-lobed and aristate at apex----- 3. PSEUDOTSUGA.

1. PINUS.⁶ PINE

Trees; leaves in fascicles subtended by a sheath, rarely solitary, needle-shaped or narrowly linear; scales of the pistillate flowers in the axils of minute persistent bracts; cones in fruit with thick woody scales, these umbonate on the back; fruit maturing in the second or third season; seeds winged or wingless.

This genus comprises some of the most valuable timber trees of the world. The western yellow pine (*P. ponderosa*), in Arizona as in most of its range, is by far the most important species economically. It is the only species forming extensive nearly pure stands in readily accessible localities. Lumbering is rated as a \$5,000,000 industry in Arizona, and yellow pine constitutes about 95 percent of the total of sawed lumber. Annual production in the State during the past 10 years has varied from about 55 to 165 million board feet. Sold locally as "native pine," the wood is heavy, hard, and brittle but not coarse-grained, yellow to reddish brown in color. The sapwood, known as "western white pine," is easily worked and is much used for finishing. The wood of this and several other pines that occur in Arizona is used locally for rough construction, poles, fence posts, railway ties, and fuel.

Seeds of all pines are important food of squirrels and other rodents and of birds. The well-flavored seeds of the pinyons or nut pines (*Pinus cembroides*, *P. edulis*, *P. monophylla*) are used by the Indians for food, and in recent years those of *P. edulis*, by far the most abundant and widely distributed of the three species, have become an article of commerce. This is an important source of revenue to the Indians of northern Arizona and New Mexico. The seeds are picked up on the ground, taken from the nests of rodents, or extracted by roasting the nearly ripe cones. The resin of *P. edulis* is used by the Indians to waterproof bottles for holding water and to cement the turquoise stones in their jewelry.

⁶ Reference: SUDWORTH, GEORGE B. THE PINE TREES OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Bul. 460. 47 pp., illus. 1917.

Pines suffer considerably from the ravages of bark beetles. Species of the white pine group, with normally 5 needles in the fascicle (*P. aristata*, *P. flexilis*, *P. strobiformis*), are likely to be attacked by blister rust if that destructive fungus should reach Arizona.

Key to the species

1. Leaves commonly less than 5 cm. long, usually strongly incurved, the margins entire or very nearly so; trees small (2).
2. Fascicles mostly 5-leaved; bark of young trees smooth, white; sheaths persistent 1 or 2 years, soon revolute; leaves very densely crowded toward the ends of the branches, stout, deep green; cones 6 to 10 cm. long, commonly at least 1½ times as long as wide, cylindric or cylindric-ovoid, at maturity deep brown purple; scales bearing a slender, deflexed, deciduous prickle about 5 mm. long----- 4. *P. ARISTATA*.
2. Fascicles seldom more than 3-leaved; bark of young trees not white; sheath soon deciduous, short, revolute; cones usually less than 6 cm. long, little if any longer than wide, broadly ovoid or nearly globular, light brown at maturity; scales usually muticous, the prickle, if any, very stout, strongly deflexed, and not more than 1 mm. long; seeds edible: Pinyons, nut pines (3).
3. Leaves commonly in 3's, seldom more and often less than 1 mm. wide, deep bluish green (at least on young trees) and strongly glaucous on the ventral face, usually very crowded toward the ends of the branches----- 1. *P. CEMBROIDES*.
3. Leaves commonly in 2's or single, commonly more than 1 mm. wide, yellowish green or sometimes moderately glaucous, usually not very crowded (4).
4. Leaves commonly in 2's, semiterete, deeply channeled-- 2. *P. EDULIS*.
4. Leaves mostly single, terete----- 3. *P. MONOPHYLLA*.
1. Leaves usually more than 5 cm. long, straight or only slightly incurved (5).
5. Fascicles 5-leaved; leaves slender, the margins entire or very obscurely and remotely serrulate; sheaths deciduous; cones at maturity cylindric or cylindric-ovoid, at least 1½ times as long as wide, 8.5 to 25 cm. long, pendent; scales muticous; bark of young trees silvery gray; branches often drooping: White pines (6).
6. Cone scales broadly truncate at apex, the tip not or scarcely reflexed; trunk short, branched nearly from the ground; leaves yellowish green----- 5. *P. FLEXILIS*.
6. Cone scales narrowed toward the rounded apex, the tip strongly reflexed; trunk of mature trees well developed and clear of branches to a considerable height, often tapering rapidly; leaves bluish green----- 6. *P. STROBIFORMIS*.
5. Fascicles normally 3-leaved (except in *P. arizonica*); leaves dark yellowish green, the margins minutely but distinctly and closely serrulate; cones at maturity ovoid to nearly globular, seldom more and usually less than 1½ times as long as wide; scales bearing a short, stout, deflexed prickle; bark of young trees not silvery gray, that of older trees deeply and narrowly furrowed (7).
7. Sheaths soon deciduous; leaves 5 to 12 cm. long, about 1 mm. wide; cones 4 to 7 cm. long, on a stalk 10 to 15 mm. long, this often falling with the cone; prickles of the cone scales gradually deciduous--- 7. *P. LEIOPHYLLA*.
7. Sheaths persistent; leaves 10 cm. long, or longer; cones 5 to 15 cm. long, sessile, the basal scales usually persistent on the branch after the cone falls; prickles of the cone scales persistent: Yellow pines (8).
8. Leaves usually more than 25 (up to 37) cm. long, about 2 mm. wide; sheaths 20 to 35 mm. long----- 10. *P. LATIFOLIA*.
8. Leaves 10 to 20 (rarely 25) cm. long; sheaths mostly 10 to 20 mm. long (9).
9. Fascicles commonly 3-leaved; leaves mostly 1.5 mm. wide; cones 7 to 15 cm. long----- 8. *P. PONDEROSA*.
9. Fascicles mostly 5-leaved; leaves about 1 mm. wide; cones 5 to 9 cm. long----- 9. *P. ARIZONICA*.

1. **Pinus cembroides** Zucc., Akad. Wiss. München Abhandl. 1: 392. 1832.

Chiricahua Mountains to the Baboquivari Mountains (Cochise, Santa Cruz, and Pima Counties), 5,000 to 7,500 feet. Western Texas to Arizona and northern Mexico.

Mexican pinyon. The trees attain a height of 50 feet (15 m.) and a trunk diameter of 14 inches (35 cm.), but are usually smaller. The trunk is commonly very short, the crown compact and conic in young trees, wide and rounded with mostly horizontal main branches in older trees. The bark of old trunks is thin, scaly, reddish brown.

2. **Pinus edulis** Engelm. in Wisliz., Mem. North. Mex. 88. 1848.

Widely distributed and abundant in northern and central Arizona, from the Carrizo Mountains (Apache County) to the Kaibab Plateau (Coconino County), southward to the White Mountains (Apache and Greenlee Counties), Pinal Mountains (Gila County), and Prescott (Yavapai County), 5,000 to 7,000 feet, sometimes occurring in continuous stands of considerable extent. Western Oklahoma and Texas to Wyoming, eastern Utah, Arizona, and Baja California.

Pinyon, nut pine. The trees are commonly straggling, with usually short and often crooked trunks, attaining a height of 10.5 m. (35 feet) and a trunk diameter of 75 cm. (30 inches) but usually smaller. The crowns are broadly conic in young trees, rounded or flat-topped in older trees. The old bark is yellowish or reddish brown, irregularly furrowed, and broken superficially into small scales. Pure stands have been likened to an old apple orchard.

3. **Pinus monophylla** Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 319. 1845.

Occurs sporadically in Coconino, Mohave, Yavapai, Greenlee, Graham, and Gila Counties, 4,000 to 6,500 feet. Utah and Arizona to California and Baja California.

Singleleaf pinyon. As it occurs in Arizona, this pine scarcely differs from the ordinary pinyon (*Pinus edulis*) except in its solitary leaves, and may be only a variant of that species. Presumably typical *P. monophylla*, in California and Nevada, has thicker and more rigid leaves and larger cones than the Arizona form.

4. **Pinus aristata** Engelm., Amer. Jour. Sci., ser. 2., 34: 331. 1862.

Occurs in Arizona only on the San Francisco Peaks (Coconino County), 9,700 to 12,000 feet. Colorado and northern New Mexico to northern Arizona, Nevada, and California.

Bristlecone pine, foxtail pine. This tree reaches a height of 12 m. (40 feet) and a trunk diameter of 75 cm. (30 inches) but is usually smaller. The crown is pyramidal in young trees and in dense stands, but older trees growing in exposed situations are characterized by long, more or less erect upper limbs and long, drooping lower branches. The deep-green leaves are very crowded and appressed at the ends of the branchlets. The young bark is smooth and nearly white, the older bark dull reddish brown and not deeply furrowed.

5. **Pinus flexilis** James in Long, Exped. 2: 34. 1823.

San Francisco Peaks and Navajo Mountain (Coconino County), probably also in the White Mountains (Apache County) and Pinaleno

Mountains (Graham County), 8,000 feet or higher. Alberta to western Texas, Arizona, and California.

Limber pine. In Arizona the trees reach a height of at least 15 m. (50 feet) and a trunk diameter of 0.9 m. (3 feet). The trunk is relatively short and the crown widely branched, with drooping limbs. The bark is smooth and grayish white in young trees, but on old trunks it is nearly black and split by deep furrows into wide plates. This species affords a small quantity of sawed lumber in Arizona.

6. *Pinus strobiformis* Engelm. in Wisliz., Mem. North. Mex. 102. 1848.

Pinus reflexa Engelm., Bot. Gaz. 7: 4. 1882.

White River watershed above Fort Apache (Apache or Navajo County) to the Pinaleno Mountains (Graham County), Chiricahua and Huachuca Mountains (Cochise County), and Santa Rita and Santa Catalina Mountains (Pima County), 6,500 to 10,000 feet. Southern New Mexico, southern Arizona, and northern Mexico. The type of *P. reflexa* was collected in the Santa Rita Mountains.

Mexican white pine. This tree attains a height of 18 to 30 m. (60 to 100 feet) and a trunk diameter of 0.5 to 0.9 m. (20 to 36 inches). The bark of the trunk is dark gray or dull reddish brown, somewhat deeply and irregularly furrowed and narrowly ridged. The absence of stomata on the backs of the leaves is said always to distinguish this pine from its close relative, the limber pine.

7. *Pinus leiophylla* Schlecht. and Cham., Linnaea 6: 354. 1831.

Pinus chihuahuana Engelm. in Wisliz., Mem. North. Mex. 103. 1848.

White River (southern Apache or Navajo County), Pinaleno Mountains (Graham County), Pinal Mountains (Gila County), Chiricahua Mountains (Cochise County), and west to the Santa Rita and Santa Catalina Mountains (Pima County), 5,000 to 7,500 feet, mostly on dry slopes and benches, fairly common in most of its range. Southwestern New Mexico, Arizona, and Mexico.

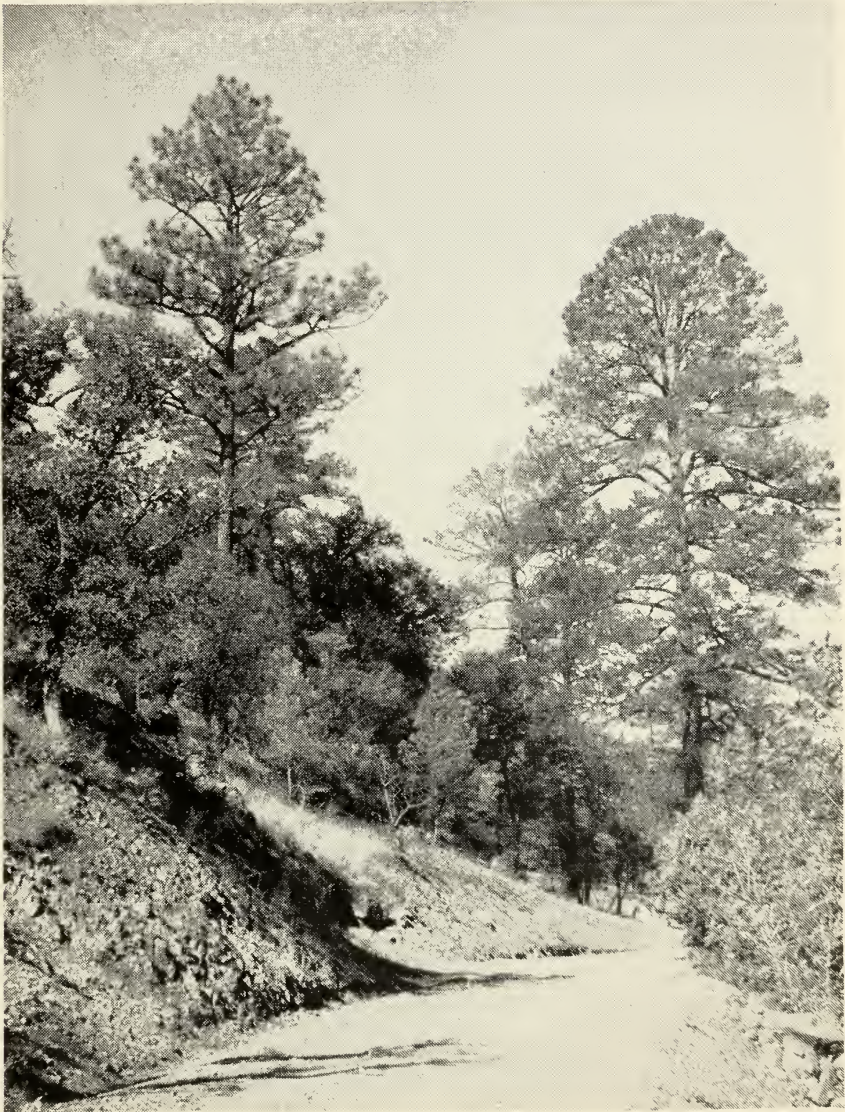
Chihuahua pine. A relatively small tree, reaching a maximum of 18 m. (60 feet) in height and 0.6 m. (2 feet) in trunk diameter, with wide-spreading limbs, dark brown, deeply furrowed older bark and very persistent cones (pl. 9).

8. *Pinus ponderosa* Douglas ex P. Lawson, Agr. Man. 354. 1836.

Pinus brachyptera Engelm. in Wisliz., Mem. North. Mex. 89. 1848.

Pinus ponderosa var. *scopulorum* Engelm. in S. Wats., Bot. Calif. 2: 126. 1880.

Widely distributed in Arizona, from the Carrizo Mountains (Apache County) to the Kaibab Plateau (Coconino County), southward to the Pinaleno Mountains (Graham County), Pinal Mountains (Gila County), and the Prescott region (Yavapai County), sometimes, especially in Coconino County, occurring in nearly pure stands of great extent, 5,500 to 8,000 feet, rarely as low as 3,600 feet or as high as 9,000 feet. Widely distributed in the United States and Canada from the Rocky Mountains to the States of the Pacific coast.



Pines in the Chiricahua Mountains, Cochise County, the Chihuahua pine (*Pinus leiophylla*) at the left, and the Arizona pine (*P. arizonica*) at the right.



Western yellow pines (*Pinus ponderosa*) on the Defiance Plateau, Apache County, altitude 7,600 feet. The parklike appearance of this forest, with reproduction reduced to the minimum, apparently is the result of overgrazing.

Western yellow pine, ponderosa pine. In Arizona this species attains a height of 38 m. (125 feet) and a trunk diameter of 0.9 m. (3 feet) or more. The massive straight trunk, free from branches to a great height in mature trees, and the long narrowly pyramidal or nearly cylindric crown with upturned branches, are characteristic. The bark is gray brown to black in young trees, warm russet brown and split into broad plates covered with small concave scales, in older trees. The leaves vary from 2 to 5 in the fascicle, but 3 is the prevailing number (pl. 10).

9. *Pinus arizonica* Engelm. in Wheeler, U. S. Survey West 100th Merid. Rpt. 6: 260. 1878.

Pinus ponderosa Lawson var. *arizonica* Shaw, Pubs. Arnold Arboretum 1: 24. 1909.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita and Santa Catalina Mountains (Pima County), 6,000 to 9,000 feet, type from the Santa Rita Mountains. Southwestern New Mexico, Arizona, and northern Mexico.

Arizona pine. This tree attains a height of 30 m. (100 feet) and a trunk diameter of 1.2 m. (4 feet). It is very similar to the western yellow pine (*P. ponderosa*), differing chiefly in its usually more slender leaves and in having these commonly 5 in the fascicle. Specimens from the mountains of Cochise and Pima Counties that have been identified as *P. ponderosa*, having fewer than 5 leaves in the fascicle, are perhaps properly referable to *P. arizonica*. In the Huachuca Mountains trees with 3 and with 5 needles, respectively, have been observed growing together (see pl. 9).

10. *Pinus latifolia* Sarg., Gard. and Forest 2: 496. 1889.

Pinus apachea Lemmon, Erythea 2: 103. 1894.

Pinus mayriana Sudworth, U. S. Dept. Agr., Forestry Div. Bul. 14: 21. 1897.

Chiricahua, Huachuca, and Dragoon Mountains (Cochise County), Santa Rita Mountains (Pima County), infrequent, 5,000 to 8,200 feet, type of *P. apachea* from the Chiricahua Mountains (*Lemmon* in 1881), type of *P. latifolia* from the Santa Rita Mountains (*Mayr* in 1887). New Mexico and Arizona (probably also northern Mexico).

Apache pine, Arizona longleaf pine. The great length of the leaves gives young trees a rather striking resemblance to the longleaf pine of the Southeastern States (*Pinus palustris*), but mature trees have much the habit of western yellow pine (*P. ponderosa*). This species is reported to attain a height of 23 m. (75 feet) and a trunk diameter of 75 cm. (30 inches). The bark of the trunks is described as darker colored than in *P. ponderosa*. The lumber is reported to be of fine quality, but the tree is not sufficiently abundant to have commercial importance.

2. PICEA.⁷ SPRUCE

Trees; leaves evergreen, narrow, 4-sided, short stalked, blue green or whitish, often silvery in young trees, deciduous in drying; branchlets rough with the persistent, peglike bases of the leaves; cones pendulous,

⁷ Reference: SUDWORTH, GEORGE B. THE SPRUCE AND BALSAM FIR TREES OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Bul. 327. 1916.

cylindric, with large, relatively thin, persistent scales longer than the erose-dentate or nearly entire bracts; seeds small, winged.

On the Kaibab Plateau, in the White Mountains, and on the summit of Mount Graham the Engelmann spruce occurs in extensive stands which afford protection to the headwaters of streams. Present conditions are unfavorable to commercial exploitation in this State, but elsewhere the wood, which is rather weak and knotty, is utilized to some extent, chiefly for making boxes. Both species that occur in Arizona are valuable ornamentals but thrive only in a cool moist climate. They are in demand for Christmas trees. Some species of spruce are very important as a source of paper pulp.

Key to the species

1. Young branches and petiolelike leaf bases commonly pubescent or puberulent; leaves not rigid, acute or acutish at apex; cones commonly about 5 cm. long, the scales more or less rounded and distinctly thinner at apex.
 1. *P. ENGELMANNI*.
1. Young branches and leaf bases commonly glabrous; leaves rigid, spinescent-acuminate at apex; cones commonly about 8 cm. long, the scales truncate and not distinctly thinner at apex.----- 2. *P. PUNGENS*.

1. *Picea engelmanni* Parry in Engelm., Acad. Sci. St. Louis Trans. 2: 212. 1863.

Kaibab Plateau, San Francisco Peaks, White Mountains, Pinaleno Mountains, and Chiricahua Mountains (Coconino, Apache, Graham, and Cochise Counties), 8,000 to 12,000 feet, often in dense stands. British Columbia through the Rocky Mountains to New Mexico and Arizona, and through the Pacific Coast States to northern California.

Engelmann spruce. Attains a height of 30 m. (100 feet) and a trunk diameter of 90 cm. (3 feet), but is perhaps rarely so large in Arizona. Trunk straight and tapering, crown narrow-pyramidal, pointed and short in dense stands, but in widely spaced trees much longer, with drooping branches often extending nearly to the ground. Bark of older trunks russet to dark purplish brown or gray brown, thin, hard, splitting into plates. This species affords some sawed lumber, especially on Mount Graham, where growth conditions are good.

2. *Picea pungens* Engelm., Gard. Chron., ser. 2, 11: 334. 1879.

Picea parryana (André) Sarg., Silva North Amer. 12: 47. 1898.

Kaibab Plateau (Coconino County), Lukachukai and White Mountains (Apache County), 7,000 to 11,000 feet, sometimes in dense stands. Wyoming to New Mexico and Arizona.

Blue spruce. This species is less widely distributed in Arizona than Engelmann spruce, which it resembles in habit and appearance, although usually smaller, with foliage of young trees more pronouncedly glaucous and bark rougher and duller colored. According to Marco⁸ the resin canals extend into the upper half of the leaf in *P. pungens*, whereas in *P. engelmanni* they terminate in the basal half.

3. PSEUDOTSUGA. DOUGLAS-FIR

Tree; leaves evergreen, narrowly linear, obtuse, short-petioled, compressed but strongly ribbed and channeled, not deciduous in drying,

⁸ MARCO, H. F. NEEDLE STRUCTURE AS AN AID IN DISTINGUISHING COLORADO BLUE SPRUCE FROM ENGELMANN SPRUCE. Bot. Gaz. 92: 446-449. 1931.

their bases not persisting on the branchlets; cones pendulous, ovoid-cylindric, with thin persistent scales shorter than the conspicuous 2-lobed, aristate bracts.

This is one of the most important timber trees of the Pacific Northwestern States, and the wood is in great demand for heavy construction. In Arizona it is of little importance commercially, as it seldom occurs in pure stands, commonly being mixed with western yellow pine and at higher elevations with spruce. A limited quantity is sawed, and it is also used for rough construction, telephone poles, and railway ties. The wood of young trees is reddish and coarse-grained, hence the trade name "red fir," whereas in older trees it is yellowish and fine grained, is marketed under the name "Oregon pine," and is used for fine finish work.

1. *Pseudotsuga taxifolia* (Poir.) Britton ex Sudworth, U. S. Dept. Agr., Forest. Div. Bul. 14: 46. 1897.

Abies taxifolia Poir. in Lam., Encycl. 6: 523. 1804.

Pseudotsuga mucronata (Raf.) Sudworth, Contrib. U. S. Natl. Herbarium 3: 266. 1895.

Common in the northern and central parts of the State, southward to the Chiricahua, Santa Catalina, and Santa Rita Mountains, 6,500 to 10,000 feet, descending to 5,200 feet in canyons. British Columbia to western Texas, Arizona, California, and northern Mexico.

In Oregon and Washington this tree attains a height of 90 m. (300 feet) and a trunk diameter of 4.5 m. (14.5 feet), but in Arizona the species reaches no such dimensions, although in favorable situations it is probably the largest tree in the State. The trunk is usually straight, the crown broadly pyramidal, with drooping lower branches, and the bark furrowed, firm but not hard, in age cinnamon brown and very thick. The form of the Rocky Mountain region (including Arizona) is *P. glauca* Mayr, regarded by some authorities as specifically distinct from the Pacific coast form. The distinguishing characters of the two forms are enumerated by Van Dersal.⁹ Several other segregate species, of questionable validity, some of them stated to occur in Arizona, were published by F. Flous.

4. ABIES.¹⁰ FIR

Trees; young bark with numerous horizontally elongate resin pockets; leaves evergreen, linear, flat, mostly blunt or notched at apex, or on fruiting branchlets acutish to acuminate; branchlets marked with conspicuous circular scars left by the fallen leaves; cones erect, ovoid-cylindric to nearly globose, with thin deciduous scales much longer than the bracts; seeds winged.

No species of fir occurs in Arizona in sufficient abundance and accessibility to be commercially important. In other Western States the light, soft, straight-grained wood of the white fir (*Abies concolor*) is used to a limited extent as saw timber.

⁹ VAN DERSAL, WILLIAM R. NATIVE WOODY PLANTS OF THE UNITED STATES. U. S. Dept. Agr. Misc. Pub. 303. 1938 (p. 208, footnote).

¹⁰ Reference: SUDWORTH, GEORGE B. THE SPRUCE AND BALSAM FIR TREES OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Bul. 327. 1916.

Key to the species

1. Resin ducts of the leaves near the lower epidermis; cones grayish green; bracts of the cone scales with a short triangular tip; cones 7 to 12 cm. long.
 1. *A. CONCOLOR.*
1. Resin ducts of the leaves central; cones dark brown purple; bracts of the cone scales with a long, subulate tip; cones 5 to 10 cm. long (2).
 2. Old bark moderately thick, light gray to grayish brown----- 2. *A. LASIOCARPA.*
 2. Old bark very thick and spongy, yellowish white----- 3. *A. ARIZONICA.*

1. *Abies concolor* (Gordon and Glendinning) Hoopes, Book of Evergreens 220, 427. 1868.

Picea concolor Gordon and Glendinning, Pinetum 155. 1858.

Rim of the Grand Canyon (Coconino County) to the Chiricahua Mountains (Cochise County), Santa Catalina Mountains (Pima County), and Hualpai Mountain (Mohave County), 5,500 to 9,000 feet. Wyoming to Oregon, south to northern Mexico.

White fir. In Arizona, where this is much the commonest species of fir, it attains a height of about 30 m. (100 feet) and the massive trunk a diameter of 1 m. (40 inches). In young trees the crown is symmetrically conic and sharp pointed, but becomes more or less irregular and rounded at the summit. Where the trees are widely spaced, the branches extend nearly to the ground, but in crowded stands one-half or more of the trunk is often bare. The bark, smooth and brownish gray at first, becomes very thick, hard, deeply furrowed, and ash-colored. A limited quantity of the soft, coarse-grained, light-colored wood is sawed in Arizona.

The writers are indebted to Elbert L. Little, Jr., for bringing to their notice what seems to have been the first effective publication of the name *Abies concolor*.

2. *Abies lasiocarpa* (Hook.) Nutt., North Amer. Sylva 3: 138. 1849.

Pinus lasiocarpa Hook., Fl. Bor. Amer. 2: 163. 1842.

Kaibab Plateau and Navajo Mountain (Coconino County), Escudilla Mountain and White Mountains (Apache County), Pinaleno Mountains (Graham County), also reported from the Santa Catalina Mountains (Pima County), 8,000 feet and upward. Alberta to Alaska, south to northern New Mexico, Arizona, and Oregon.

Alpine fir. Tree up to 27.5 m. (90 feet) high and 0.6 m. (2 feet) in trunk diameter, but much dwarfed at high elevations. The crown is elongate, narrowly conic, pointed, with branches often extending nearly to the base of the tree. The bark, smooth and ashy gray or whitish at first, becomes shallowly furrowed and gray or grayish brown.

3. *Abies arizonica* Merriam, Biol. Soc. Wash. Proc. 10: 115. 1896.

Abies lasiocarpa var. *arizonica* (Merriam) Lemmon, Sierra Club Bul. 2: 167. 1898.

San Francisco Peaks (Coconino County), the type locality, 8,500 feet and upward. Reported also from Colorado and New Mexico.

Corkbark fir. This doubtfully valid species seems to be distinguishable from *A. lasiocarpa* only by the usually thicker, spongier, and lighter-colored bark. None of the other characters given by Merriam and others as diagnostic appear to be constant, and there is intergradation even in the thickness and color of the bark. A form



Arizona cypress (*Cupressus arizonica*) in the Chiricahua National Monument, Cochise County, altitude 5,400 feet, showing a form with graceful, drooping branchlets.



occurring near the summit of Mount Graham seems to be intermediate, the bark being thick and spongy as in *A. arizonica*, but light gray in color.

5. CUPRESSUS.¹¹ CYPRESS

Trees; leaves all alike, small, scalelike, closely imbricate and appressed to the branchlets, usually with a pit on the back containing a resin gland; cones nearly globular, with woody scales that separate at maturity, persistent on the branches several years, long after the seeds have fallen; seeds numerous under each scale, winged.

The moderately soft, light, straight-grained wood is suitable for manufacture of sashes, doors, blinds, etc. The timber is rarely if ever milled, however, because the stands are of limited extent and usually rather inaccessible. Locally, cypress is cut for small rough construction and for making posts, although there is some question as to the durability of the wood. The Arizona cypress is frequently cultivated as an ornamental and is very attractive, especially in the young stage while the foliage is covered with a heavy bloom. Individuals differ greatly in symmetry of growth, and there is much opportunity for selection of desirable specimens for planting. It is reported that the French Government has found Arizona cypress useful for reclaiming barren land in France and northern Africa.

Key to the species

1. Outer bark persistent except in saplings, rough----- 1. *C. ARIZONICA*.
 1. Outer bark deciduous except on the trunks of very old trees, leaving exposed the smooth, dark purplish-red inner bark----- 2. *C. GLABRA*.

1. *Cupressus arizonica* Greene, Torrey Bot. Club Bul. 9: 64. 1882.

Cupressus arizonica var. *bonita* Lemmon, West-Amer. Cone-Bearers ed. 3, 76. 1895.

Mountains of Greenlee, Graham, Cochise, and Pima Counties, 3,500 to 7,200 feet, type from near Clifton, Greenlee County (*Greene*). Southwestern New Mexico, Arizona, and northern Mexico.

Arizona cypress. The trees attain a height of 21 m. (70 feet) and a stem diameter of 1.2 m. (4 feet), but such large specimens are rarely seen where the stands are readily accessible. The trunk branches from near the ground or is well developed, the crown is narrowly pyramidal or broad and flat. The outer bark is thin, dark brownish gray, longitudinally fissured and fibrous, or occasionally checkered somewhat as in *Juniperus pachyphloea* (pl. 11).

2. *Cupressus glabra* Sudworth, Amer. Forestry 16: 88. 1910.

Upper Oak Creek Canyon (Coconino County), and abundant along the Mogollon Escarpment and in the Mazatzal Mountains (northwestern Gila and northeastern Maricopa Counties), 3,500 to at least 5,000 feet, reported by Sudworth to occur also in the Santa Catalina and Santa Rita Mountains (Pima County), type collected by Toumey at Natural Bridge, Gila County. Known only from Arizona.

Smooth cypress. Apparently the only satisfactory character for distinguishing this form from *C. arizonica* is the habit of shedding the outer bark of the trunk until the tree has reached a very advanced

¹¹ Reference: SUDWORTH, GEORGE B. THE CYPRESS AND JUNIPER TREES OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Bul. 207. 1915.

age. The exposed inner bark is much like that of manzanita (*Arctostaphylos* spp.). Both forms are highly variable and show intergradation in shape of the crown (narrowly conic to broad and rounded), color of the foliage, presence or absence and size, when present, of the dorsal pit and gland of the leaves, and size of the seeds. The ranges of the two forms overlap but slightly, if at all.

6. JUNIPERUS.¹² JUNIPER, CEDAR

Evergreen trees or shrubs; leaves small, in alternate pairs or whorls, subulate and spreading in the juvenile form, imbricate and appressed in the mature form (except in *J. communis*); flowers commonly monoecious; cones berrylike, the scales becoming fleshy and not separating at maturity, or only slightly so at apex of the cone.

Arizona possesses extensive stands of juniper, especially in the central and northern portions, chiefly on well-drained, rather sterile soils. The wood is much used in manufacturing lead pencils, but in Arizona its chief utilization is for fuel and in making fence posts, for which the very durable heartwood adapts it admirably. *J. utahensis*, with relatively straight branches, is especially suitable for fence posts. The foliage of junipers is browsed when other forage is scarce but is injurious to livestock if eaten too freely. The berries are eaten greedily by birds and other wild creatures, and formerly were used as food by the Indians of Arizona. Those of *J. communis* are employed elsewhere to give the characteristic flavor to gin and are the source of oil of juniper, which has been used extensively in patent medicines. This species forms a valuable ground cover where it is sufficiently abundant. Juniper is used in various ways for medicinal and ritualistic purposes by the Hopi Indians.

Key to the species

1. Shrub, usually less than 1 m. high; branches prostrate or ascending; leaves 5 to 15 mm. long, lanceolate, not thickened or imbricate, the upper surface exposed to view and conspicuously whitened..... 1. *J. COMMUNIS*.
1. Shrubs or trees, 2 to 16 m. high; leaves of the ultimate twigs 1 to 3 mm. long, ovate, thickened, closely imbricate, the upper surface not exposed to view (2).
 2. Bark divided into rectangular plates; foliage copiously dotted with resinous exudate; mature fruit mealy or resinous but not succulent; seeds mostly 3 or 4..... 2. *J. PACHYPHLOEA*.
 2. Bark fibrous, longitudinally fissured (3).
 3. Leaves entire, paired; fruits 4 to 6 mm. in diameter, succulent; seeds 1 to 3, usually 2; unseasoned heartwood reddish or purplish; branchlets flattened, often more or less drooping..... 3. *J. SCOPULORUM*.
 3. Leaves minutely denticulate, usually in pairs but often in whorls of 3; seeds 1 or 2, commonly solitary; heartwood yellowish brown; branchlets not flattened (4).
 4. Flowers dioecious; mature fruits succulent, 4 to 7 mm. in diameter; trunk almost invariably wanting, the plant spreading, with curved limbs arising at or below ground level; foliage inclined to bunch at ends of the branches; cotyledons 2..... 4. *J. MONOSPERMA*.
 4. Flowers monoecious; mature fruits mealy or fibrous, 7 to 18 mm. in diameter; trunk either continuous or branched, but the limbs usually arising above ground level; foliage not inclined to bunch; cotyledons 4 to 6..... 5. *J. UTAHENSIS*.

¹² Reference: SUDWORTH, GEORGE B. THE CYPRESS AND JUNIPER TREES OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Bul. 207. 1915.

1. **Juniperus communis** L., Sp. Pl. 1040. 1753.

Kaibab Plateau and on the San Francisco, Navajo, Carrizo, White, and Chuska Mountains (Coconino and Apache Counties), above 8,000 feet. Cooler parts of North America; Eurasia.

Common juniper, also known as dwarf juniper and groundcedar. The species is represented in Arizona only by a dwarf form, var. *montana* Ait.

2. **Juniperus pachyphloea** Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 142. 1857.

Common in the southeastern and central parts of the State, extending at least as far north as Flagstaff (Coconino County) and west to the Baboquivari Mountains (Pima County), 4,500 to 8,000 feet. Western Texas to Arizona and Mexico.

Alligator juniper. This, the largest of the Arizona species, is usually a tree, exceptionally attaining a height of 20 m. (65 feet). It rarely occurs in pure stands.

3. **Juniperus scopulorum** Sarg., Gard. and Forest 10: 420. 1897.

Juniperus virginiana L. var. *scopulorum* Lemmon, West-Amer. Cone-Bearers ed. 4, 114. 1900.

Kaibab and Coconino Plateaus to the Mogollon Escarpment, also Lukachukai and White Mountains (Coconino, Apache, and Gila Counties), 5,000 to 9,000 feet. Alberta and British Columbia to New Mexico, Arizona, and Nevada.

Rocky Mountain juniper. The form with drooping branchlets, called "weeping juniper," is not uncommon in Arizona. The tree is graceful and highly ornamental despite the usually sparse foliage, reaching a height of 6 m. (20 feet) and a trunk diameter of 45 cm. (18 inches).

4. **Juniperus monosperma** (Engelm.) Sarg., Silva North Amer. 10: 89. 1896.

Juniperus occidentalis Hook. var. *monosperma* Engelm., Acad. Sci. St. Louis Trans. 3: 590. 1877.

Juniperus gymnocarpa Cory, Rhodora 38: 184. 1936.

Common and well distributed over the State, except in the northeastern and the extreme western and southwestern portions, occasionally forming forests, as on the slope of the Coconino Plateau east of Flagstaff, but more often growing with Utah juniper or other trees, 3,000 to 5,000 feet or somewhat higher. Kansas to Nevada and southward, probably extending into Mexico.

Oneseed juniper. Fruits with exposed seeds, the principal distinguishing character of *J. gymnocarpa* Cory, are a not uncommon abnormality.

5. **Juniperus utahensis** (Engelm.) Lemmon, Calif. Board Forest. Rpt. 3: 183. 1890.

Juniperus californica Carr. var. *utahensis* Engelm., Acad. Sci. St. Louis Trans. 3: 588. 1877.

Abundant over most of the State north of the Gila River, 3,000 to 7,500 feet. Southern Idaho to New Mexico, Arizona, and California.

Utah juniper. The most valuable and abundant species of juniper

in Arizona, often forming forests (such as the one south of Ash Fork, Yavapai County), below the pinyons and yellow pines. It grows ordinarily as a small, conical tree 3 to 4.5 m. (10 to 15 feet) high, with a definite trunk. The limbs are not much curved. *Juniperus megalocarpa* Sudworth, the bigberry juniper, seems to be no more than a form with large fruits and seeds. The fruit is described as 14 to 18 mm. in diameter.

2. GNETACEAE. JOINTFIR FAMILY

1. EPHEDRA.¹³ JOINTFIR

Xerophytic shrubs; stems opposite or whorled, slender; jointed, striate, equisetoid; leaves reduced to scales, paired or ternate, more or less connate; inflorescence (strobile) conelike; flowers dioecious; staminate flowers with 2 to 8 or more stamens, the filaments united; bracts of the ovulate strobile in several pairs or ternate whorls, in the Arizona species firm or scarious; seeds 1 to 3, hard, angled or subterete.

All Arizona species, with the possible exception of *E. trifurca*, are valuable browse in winter when better forage is lacking. *E. cutleri* has considerable value as a soil binder. A palatable tonic beverage (Mormon-tea, Brigham-tea) is made from the dried stems and flowers of these plants, which contain certain alkaloids, such as pseudoephedrin, and tannins. The Indians and early white settlers esteemed *Ephedra* for treatment of syphilis and other affections. The drug ephedrin, commonly administered as an astringent and as a mild substitute for adrenalin, is obtained from *E. sinica* Stapf, a Chinese herb. The plants flower in spring.

Key to the species

1. Scales 3 at each node; bracts of the fruiting cones clawed, 7 to 10 mm. wide, flexible and scarious; seeds slender, about twice as long as thick (2).
2. Scales 5 to 12 mm. long, persistent but soon shreddy; bracts of the fruiting cones entire-margined, reddish brown, cordate ----- 1. *E. TRIFURCA*.
2. Scales 3 to 5 mm. long, tardily deciduous but not becoming shreddy; bracts erose-margined, yellowish, rounded or truncate at base. 2. *E. TORREYANA*.
1. Scales 2 at each node; bracts not clawed, 3 to 5 mm. wide, firm, with narrow scarious margin; seeds plump (3).
3. Base of the scales dark brown, persistent; seeds prevailingly paired (4).
4. Peduncles of the ovulate spikes wanting or very short; stems not viscid. 3. *E. VIRIDIS*.
4. Peduncles of the ovulate spikes up to 2 cm. long; stems often viscid. 4. *E. CUTLERI*.
3. Base of the scales gray, deciduous (5).
5. Seeds mostly paired, brown, smooth ----- 5. *E. NEVADENSIS*.
5. Seeds mostly solitary, grayish or light brown, vertically wrinkled. 6. *E. FASCICULATA*.

1. *Ephedra trifurca* Torr. in Emory, Mil. Recon. 152. 1848.

Greenlee County to Gila, Yavapai, and Mohave Counties, south to the Mexican boundary, up to 4,500 feet, desert or grassland. Southwestern Texas to southern California and adjacent Mexico.

The largest Arizona species, occasionally attaining a height of 15 feet (4.5 m.).

¹³ References: GROFF, G. W., and CLARK, G. W. THE BOTANY OF EPHEDRA. Calif. Univ. Pubs. Bot. 14: 247-282. 1928.
CUTLER, H. C. MONOGRAPH OF THE NORTH AMERICAN SPECIES OF THE GENUS EPHEDRA. Mo. Bot. Gard. Ann. 26: 373-428. 1939.

2. ***Ephedra torreyana*** S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 299. 1879.

Apache County to Mohave County, mostly 4,000 to 6,000 feet. Southwestern Colorado to Nevada, south to western Texas, Arizona, and Chihuahua.

3. ***Ephedra viridis*** Coville, Contrib. U. S. Natl. Herbarium 4: 220. 1893.

Navajo, Coconino, Mohave, and Yavapai Counties, 3,000 to 7,000 feet. Southwestern Colorado, Utah, Nevada, Arizona, and California.

4. ***Ephedra cutleri*** Peebles, Wash. Acad. Sci. Jour. 30: 473. 1940.

Ephedra coryi Reed var. *viscida* Cutler, Mo. Bot. Gard. Ann. 26: 413. 1939.

Apache, Navajo, Coconino, and Yavapai Counties, mostly 5,000 to 6,000 feet, type from west of Rock Point, Apache County (Cutler 2209). Southwestern Colorado, southeastern Utah, northeastern New Mexico, and northwestern Arizona.

Similar in many respects to *E. viridis*, but distinguished by the well-developed peduncles and often viscid stems. This *Ephedra* is very common on the Navajo Indian Reservation, often growing so thickly on sandy plains as to resemble a luxuriant growth of grass. *Ephedra arenicola* Cutler is the name for a presumable hybrid between *E. torreyana* and *E. cutleri* found near Dinnehotso, Apache County (Cutler 2217 and 2221).

5. ***Ephedra nevadensis*** S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 298. 1879.

Kingman, Mohave County (*Eastwood* 18007). Oregon, Utah, Arizona, and California.

6. ***Ephedra fasciculata*** A. Nels., Amer. Jour. Bot. 21: 573. 1934.

Mohave, Graham, Gila, Pinal, Maricopa, and Yuma Counties, desert regions, up to about 4,000 feet, type from Phoenix (Maricopa County). Arizona and California.

Although *E. fasciculata* was described originally from sterile branches, Cutler describes the seeds as 8 to 13 mm. long. *E. clokeyi* Cutler, with seeds only 5 to 8 mm. long, is very similar. This, a more common form in Arizona than typical *E. fasciculata*, ranges into Utah, Nevada, and California.

E. californica S. Wats. and *E. aspera* Engelm. are also stated by Cutler to occur in Arizona, but examination of the Arizona specimens cited by him indicates that they do not belong to the species in question.

3. TYPHACEAE. CATTAIL FAMILY

1. TYPHA. CATTAIL

Semiaquatic perennial herbs; flowering stems from creeping root-stocks, tall, terete, not jointed; leaves long, flat, equitant; flowers monoecious, very numerous in a dense cylindric spike, the staminate ones above; perianth reduced to bristles; ovary stipitate, 1- or 2-celled.

Plants of marshes and sloughs.

Key to the species

1. Staminate and pistillate portions of the inflorescence usually contiguous, the pistillate portion finally more than 2 cm. in diameter; pollen grains in 4's; pistillate flowers commonly without bractlets..... 1. *T. LATIFOLIA*.
1. Staminate and pistillate portions of the inflorescence usually separate, the pistillate portion less than 2 cm. in diameter; pollen grains single; pistillate flowers commonly with hairlike bractlets, these more or less dilated at apex..... 2. *T. ANGUSTIFOLIA*.

1. *Typha latifolia* L., Sp. Pl. 971. 1753.

Flagstaff and Tuba (Coconino County), Pinal Creek (Gila County), Fish Creek (Maricopa County), 1,500 to 7,000 feet. Widely distributed in North America and Eurasia.

Broadleaf cattail.

2. *Typha angustifolia* L., Sp. Pl. 971. 1753.

Apache, Coconino, Gila, Maricopa, and Cochise Counties, 1,000 to 7,500 feet. Widely distributed in the Northern Hemisphere, also in South America.

Narrowleaf cattail. Apparently more common in Arizona than *T. latifolia*. The two species are not always distinguishable by the width of the leaves.

4. SPARGANIACEAE. BURREED FAMILY**1. SPARGANIUM. BURREED**

Aquatic or semiaquatic herbs; leaves 2-ranked, alternate, sessile, linear; flowers monoecious, small, in dense globular heads, these sessile or stalked; staminate flowers borne in the upper heads, with 3 to 5 stamens, without a true perianth but subtended by minute scalelike bracts; pistillate flowers borne in the lower heads, with a perianth of 3 to 6 scalelike divisions; ovary 1- or 2-celled; fruit 1- or 2-seeded.

Key to the species

1. Achenes sessile or very nearly so, obovoid or cuneate-obpyramidal, truncate or depressed at apex, with a stout conic beak more than one-half as long as the achene; inflorescence usually branched; fruiting heads at maturity commonly 2 to 3 cm. in diameter..... 1. *S. EURYCARPUM*.
1. Achenes stipitate, fusiform, pointed at apex; inflorescence not branched; fruiting heads less than 2 cm. in diameter..... 2. *S. SIMPLEX*.

1. *Sparganium eurycarpum* Engelm. in A. Gray, Man., ed. 2, 430. 1856.

McNary (Apache County), 7,400 feet, in a marsh (*Peebles* and *Smith* 12480). Newfoundland to British Columbia, south to Virginia, Arizona, and California.

2. *Sparganium simplex* Huds., Fl. Angl., ed. 2, 401. 1778.

Kaibab Plateau (Coconino County), "abundant in older ponds" (Herb. Grand Canyon Nat. Park). Widely distributed in the Northern Hemisphere.

The authors refer the specimen in question to *S. simplex* with considerable hesitation. The bracts are not conspicuously scarious-margined, but the leaves seem too broad for *S. angustifolium* Michx.

5. NAIADACEAE. PONDWEED FAMILY

Plants aquatic; flowers perfect or unisexual, axillary, sometimes subtended by an involucre or a spathe; true perianth none (in *Potamogeton* a false perianth formed by the sepallike appendages of the 4 stamens); stamens 1 to 4; pistil 1 or more, the ovary 1-celled, the ovule usually solitary.

Key to the genera

1. Flowers perfect, in axillary spikes or clusters; anthers 4, sessile, the connectives expanded dorsally into herbaceous sepallike bodies; ovaries 4, sessile; leaves alternate or nearly opposite..... 1. POTAMOGETON.
1. Flowers unisexual, axillary; anther solitary, not appendaged; leaves mostly opposite or whorled (2).
 2. Leaves linear-filiform, entire; pistillate flowers 2 to 5, subtended at base by a scarious, cup-shaped involucre; stigma one, cup-shaped, sometimes slightly 2-lobed..... 2. ZANNICHELLIA.
 2. Leaves linear, serrulate to spinulose-dentate or pinnatifid, dilated at base; pistillate flower solitary, not subtended by an involucre; stigmas 2 to 4, subulate..... 3. NAIAS.

1. POTAMOGETON. PONDWEED

Leaves with membranous stipules, mostly alternate, all much alike or the lower ones narrower and submersed and the upper ones with broad floating blades; flowers perfect, in axillary spikes, these often emersed; perianth technically none but closely simulated by the concave sepallike appendages of the 4 stamens; anthers sessile; pistils 4, the style short or the stigma sessile.

Plants of ponds and sluggish streams, flowering mostly in summer. In irrigation ditches the plants are sometimes so abundant as materially to retard the flow. The species are at best difficult to identify and the difficulty is especially great with Arizona specimens, which rarely have good fruit. The following treatment is necessarily provisional.

Key to the species

1. Leaves dimorphic, some floating, with broad, thickish, long-petioled blades, others submersed, narrower, thin, commonly sessile or short-petioled (2).
2. Submersed leaves mostly filiform or narrowly linear, mostly not more than 2 mm. wide, or a few of the uppermost submersed leaves often broader but soon disappearing (3).
 3. Blades of the floating leaves commonly broadly ovate and cordate at base, more than 3 cm. long, with more than 15 nerves; spikes all alike, cylindric, in fruit commonly 2 cm. long or longer; stems usually stout..... 1. P. NATANS.
 3. Blades of the floating leaves elliptic, rounded or short-cuneate at base, seldom more (usually less) than 3 cm. long, with fewer than 15 (commonly 7) nerves, these deeply impressed beneath; spikes of 2 kinds, emersed, several- to many-flowered, cylindric, less than 2 cm. long, and submersed, few-flowered, subglobose; stems very slender..... 2. P. DIVERSIFOLIUS.
2. Submersed leaves lanceolate or broader, if linear more than 2 mm. wide, mostly 7-nerved; nutlets 3-keeled (4).
 4. Nutlets less than 3 mm. long, not prominently keeled... 3. P. GRAMINEUS.
 4. Nutlets 3 to 4 mm. long, prominently keeled, the middle keel crested or winglike..... 4. P. ZIZII.
1. Leaves all much alike and submersed (5).
 5. Blades lanceolate or broader; mature spikes 3 cm. long, or longer; nutlets 3-keeled, the middle keel crested or winglike..... 4. P. ZIZII.

5. Blades linear or capillary (6).
 6. Fruiting spikes commonly 1.5 cm. long or longer, conspicuously interrupted; flowers numerous, seldom fewer than 10 in a spike; stipules adnate to the sheathing base of the leaf; leaves less than 2 mm. wide, mostly 1-nerved (7).
 7. Leaves capillary; stigma capitate, borne on a distinct style; nutlets 2.5 mm. long..... 5. *P. PECTINATUS*.
 7. Leaves narrowly linear; stigma broad and depressed, sessile or nearly so; nutlets not more than 2 mm. long..... 6. *P. INTERIOR*.
 6. Fruiting spikes less than 1.5 cm. long; flowers commonly fewer than 10 in a spike; stipules free or nearly so (8).
 8. Nutlets flat, cochleate, prominently crested; leaves capillary or nearly so, 1-nerved; spikes globose..... 2. *P. DIVERSIFOLIUS*.
 8. Nutlets plump, not cochleate; leaves linear, 3- to 5-nerved, the lateral nerves sometimes obscure (9).
 9. Leaves not glandular at base; peduncles commonly less than 1 cm. long; spikes continuous, short-ovoid or globose; nutlets rounded-lenticular, conspicuously keeled or crested on the back; winter buds none..... 7. *P. FOLIOSUS*.
 9. Leaves biglandular at base; peduncles up to 3 cm. long; spikes often interrupted, commonly noticeably longer than wide; nutlets obliquely ellipsoid, not conspicuously keeled or crested; winter buds sometimes present..... 8. *P. BERCHTOLDI*.

1. *Potamogeton natans* L., Sp. Pl. 126. 1753.

San Francisco Peaks, Coconino County (*Thornber* in 1907), Mesa, Maricopa County (*Toumey* 497), Marsh Lake, White Mountains, Apache County (*Goldman* 2453), 1,200 to at least 7,000 feet. Widely distributed in the Northern Hemisphere.

The last-mentioned collection is of doubtful identity, the blades of the floating leaves being exceptionally narrow for the species and not cordate.

2. *Potamogeton diversifolius* Raf., Med. Repos. N. Y., ser. 2, 5: 354. 1808.

Potamogeton hybridus Michx., Fl. Bor. Amer. 1: 101. 1803.
 Not Thuill., 1790.

Grandview Trail, Grand Canyon, Coconino County (*Thornber* 8506). Maine to Florida and westward.

3. *Potamogeton gramineus* L., Sp. Pl. 127. 1753.

Northern and central Arizona (Navajo, Coconino, Yavapai, and Gila Counties). Widely distributed in North America; also in Eurasia.

The form occurring in Arizona is var. *graminifolius* Fries (*P. heterophyllus* of authors, not of Schreb.).

4. *Potamogeton zizii* Roth, Enum. Pl. Phaen. Germ. 1: 531. 1827.

Potamogeton angustifolius Bercht. and Presl, Rost. 1: 19. 1823.
 Not DC., 1805.

Montezuma Well, Yavapai County (*Taylor* 78, *Jackson* 52), altitude 3,500 feet. Widely distributed in North America; Eurasia.

The immature specimens cited above are referred doubtfully to this species.

5. *Potamogeton pectinatus* L., Sp. Pl. 127. 1753.

Near Tucson, Pima County (*Thornber* in 1913). Almost throughout North America; cosmopolitan.

6. *Potamogeton interior* Rydb., Colo. Agr. Expt. Sta. Bul. 100: 13. 1906.

Central and southern Arizona (Yavapai, Gila, Pinal, Maricopa, and Pima Counties). Canada to New Mexico, Arizona, and Nevada.

Closely related to *P. pectinatus*, with which it apparently intergrades.

7. *Potamogeton foliosus* Raf., Med. Repos. N. Y., ser. 2, 5: 354. 1808.

Coconino County to Cochise and Pima Counties, up to 8,400 feet. Nearly throughout North America.

8. *Potamogeton berchtoldi* Fieber in Berchtold and Fieber, Potamog. 40. 1838.

Potamogeton pusillus, of authors. Not L., 1753.

San Francisco Peaks, Coconino County (*Thornber* 2856), also Young's Ranch (*Lemmon* in 1884). Widely distributed in North America; Eurasia.

2. ZANNICHELLIA. HORNED-PONDWEED

Stems filiform; leaves very narrow, opposite or whorled; flowers monoecious, axillary, without perianth, the pistillate ones 2 to 5, subtended by a cup-shaped involucre; staminate flowers solitary, the stamen 1; ovary flask-shaped, the stigma 1, expanded.

1. *Zannichellia palustris* L., Sp. Pl. 969. 1753.

Coconino, Gila, Pinal, and Pima Counties, growing in ponds, ditches, and slow streams. Cosmopolitan.

3. NAIAS

Stems slender, wholly submersed; leaves narrow, serrulate to spinulose-dentate, mostly opposite or whorled; flowers unisexual, axillary, solitary; staminate flowers with a spathe-like involucre, the stamen 1; pistillate flowers naked, the ovary 1, the stigmas 2 to 4.

1. *Naias marina* L., Sp. Pl. 1015. 1753.

Santa Cruz River near Tucson, Pima County (*Smart* in 1867, *Pringle* in 1881), Crittenden, Santa Cruz County, in a spring (*Thornber* 2890), 2,300 to 4,200 feet. Almost throughout North America; Eurasia.

6. JUNCAGINACEAE. ARROWGRASS FAMILY

1. TRIGLOCHIN. ARROWGRASS

Plants herbaceous, rushlike; leaves all basal, long, narrow, semiterete, with membranous sheaths; flowers in narrow spikes or spikelike racemes terminating long scapes; perianth small, greenish, of 6 concave segments; stamens 3 to 6, the anthers sessile or nearly so; pistil compound, of 3 to 6 carpels.

1. *Triglochin maritima* L., Sp. Pl. 339. 1753.

Northeastern Arizona, at Holbrook, Navajo County (*Zuck* in 1896), Tuba, Coconino County (*Peebles* 11843), about 5,000 feet, June to July. Widely distributed in the Northern Hemisphere.

The Arizona form is var. *debilis* M. E. Jones. The plant sometimes develops hydrocyanic acid and has been found toxic, either fresh or

dried, especially when the plants are stunted by drought. Cattle are particularly susceptible.

7. ALISMACEAE. WATERPLANTAIN FAMILY

Plants herbaceous, aquatic or semiaquatic; stems scapelike; leaves with sheathing bases and usually broad blades; flowers perfect or unisexual; perianth regular, with green calyxlike outer segments and white petallike inner segments; stamens 6 or more; pistils several or many in a ring or a dense head; ovary 1-celled; ovule usually solitary; fruit achenelike, compressed.

Key to the genera

1. Carpels in one or few series; leaf blades not sagittate, short-cuneate to subcordate at base; flowers perfect, small, in ample compound panicles.
 1. ALISMA.
1. Carpels in several series, forming a dense head in fruit; leaf blades (some or all of them) commonly sagittate; flowers dioecious, or monoecious with the lower ones pistillate and upper ones staminate, in verticillate simple or somewhat compound panicles.----- 2. SAGITTARIA.

(Representatives of the genera *Echinodorus* and *Lophotocarpus* are also likely to be found in Arizona. These differ from *Sagittaria*, the former in having the flowers in ample compound panicles and all perfect, the leaf blades not sagittate; the latter in having the lower flowers perfect and the upper ones staminate.)

1. ALISMA. WATERPLANTAIN

Roots fibrous; leaves mostly emersed with the blades broadly ovate and usually cordate or rounded at base, but the leaves occasionally floating and narrower; inflorescence a large open panicle; flowers small, perfect; stamens commonly 6; receptacle flat.

1. *Alisma plantago-aquatica* L., Sp. Pl. 342. 1753.

Near Williams and Mormon Lake (Coconino County), Prescott (Yavapai County), in shallow ponds, 5,000 to 7,000 feet, not common, flowering in summer. Throughout the cooler parts of the Northern Hemisphere.

The Arizona form is subsp. *brevipes* (Greene) Samuelson (*A. brevipes* Greene). A pungent volatile oil is obtained from the roots. The leaves are irritating to the skin and have been used medicinally.

2. SAGITTARIA.¹⁴ ARROWHEAD

Flowering stems from rootstocks, these often tuber-bearing; leaves (in the Arizona species) mostly emersed, with triangular-ovate, deeply sagittate blades; inflorescence a narrow verticillate panicle, simple or branched below; flowers relatively large, unisexual; stamens commonly numerous; receptacle elevated.

Plants of shallow stagnant ponds, flowering in summer. One species (*S. latifolia*) produces edible tubers, eaten by the Indians and Chinese in the Pacific Coast States. The plant is sometimes called "tule potato" in California.

¹⁴ Reference: SMITH, JARED G. NORTH AMERICAN SPECIES OF SAGITTARIA AND LOPHOTOCARPUS. 1894. Reprinted in Mo. Bot. Gard. Ann. Rpt. 6: 27-64. 1895.

Key to the species

1. Achenes with a conspicuous, horizontal, straight or slightly curved beak, not winged or crested on the faces, the marginal wing broad, especially at top; terminal leaf lobe commonly equaling or longer than the basal lobes.
 1. S. LATIFOLIA.
1. Achenes minutely or inconspicuously beaked (2).
 2. Basal leaf lobes not longer, usually shorter, than the terminal lobe; achenes with an erect or nearly erect beak, not winged or crested on the faces, the marginal wing broad and rather thick; terminal leaf lobe commonly ovate or broadly lanceolate, acute or slightly acuminate.
 2. S. CUNEATA.
 2. Basal leaf lobes much longer than the terminal lobe; achenes with a minute horizontal or ascending beak (3).
 3. Leaf blades not more than 25 cm. long, the terminal lobe linear or lanceolate, usually long-acuminate, commonly less than half as long as the basal lobes; scape usually simple; bracts 6 to 8 mm. long; achenes without facial wings..... 3. S. LONGILOBA.
 3. Leaf blades 20 to 40 cm. long, the terminal lobe ovate to broadly lanceolate, acute or short-acuminate, more than half as long as the basal lobes; scape sometimes branched; bracts 10 to 30 mm. long; achenes with facial wings..... 4. S. GREGGII.

1. *Sagittaria latifolia* Willd., Sp. Pl. 4: 409. 1806.

Near Tucson, Pima County (*Thornber* 250), 2,400 feet. Throughout most of North America.

2. *Sagittaria cuneata* Sheld., Torrey Bot. Club Bul. 20: 283. 1893.

Sagittaria arifolia Nutt. ex J. G. Smith, *Sagit. and Lophot.* 6 1894.

Sacaton, Pinal County (*Harrison and Peebles* 1999), 1,270 feet. Ontario to British Columbia, south to Michigan, New Mexico, southern Arizona, and California.

3. *Sagittaria longiloba* Engelm. in Torr., U. S. and Mex. Bound. Bot. 212. 1859.

Bonita, Graham County (*Shreve* 5217), 5,200 feet. Kansas to Colorado, Arizona, and Mexico.

4. *Sagittaria greggii* J. G. Smith, *Sagit. and Lophot.* 17. 1894.

Forty miles southwest of Tucson, Pima County (*Harrison* 8937), about 3,000 feet. Arizona, California, and Mexico.

This form apparently intergrades with *S. longiloba*, but the material available is too scanty to permit a decision as to the validity of the species.

7A. HYDROCHARITACEAE. FROGS-BIT FAMILY

After this work went to press, there came to the attention of the authors an unidentified species of *Anacharis*, collected in water near Williams, Coconino County (*M. Wetherill* in 1938). This adds another family to the known flora of Arizona, distinguished from all other aquatic monocotyledons of this State by the inferior ovary. In the genus *Anacharis* the stems are submersed and very leafy, with thin, opposite or whorled, 1-nerved leaves. The small, mostly unisexual flowers are solitary in the axils and are subtended by a tubular, sessile spathe. The perianth of the pistillate flowers consists of a remarkably long, slender tube and a small 6-parted limb.

8. GRAMINEAE.¹⁵ GRASS FAMILY

Contributed by JASON R. SWALLEN

Herbs (woody in *Arundo*); stems (culms) hollow or solid, closed at the nodes; leaves 2-ranked, parallel-veined, composed of a sheath enclosing the culm, and a blade, with a hairy or membranaceous appendage (ligule) between them on the inside; flowers perfect or sometimes unisexual, arranged in spikelets, these consisting of a short axis (rachilla) and 2 to many 2-ranked bracts, the lower two bracts (glumes) empty, the succeeding ones (lemmas) bearing in their axils a single flower, and between the flower and the rachilla a 2-nerved bract (palea), the lemma, palea, and included flower constituting the floret; stamens 1 to 6; anthers 2-celled; pistil 1, with 2 (rarely 1 or 3) styles, and usually plumose stigmas; spikelets mostly aggregate in spikes or panicles at the ends of the main culms and branches.

This very large family contains the most valuable of all plants used by man, the cultivated cereals, such as wheat, barley, maize, and rice. It also includes the most important forage plants, many of which, notably bluegrass, timothy, and fescue, are extensively grown for hay and pasturage. Nearly all grasses of temperate regions are eaten by grazing animals, but some are more nutritious and palatable than others. Some of the native grasses of Arizona, especially species of the genera *Bouteloua* (grama) and *Hilaria*, are outstanding range plants upon which the maintenance of the cattle and sheep industries of the State is largely dependent. Seeds of many of the native species were used as food by the Indians. The sod-forming habit of many grasses makes them preeminent as soil binders. A few of the Arizona species, including the native red sprangletop (*Leptochloa filiformis*) and the introduced species, Johnsongrass (*Sorghum halepense*) and Bermuda grass (*Cynodon dactylon*), are troublesome weeds in cultivated lands. The two latter, however, are of considerable forage value and Bermuda grass, in the long hot summers of southern Arizona, is the only satisfactory grass for lawns. Many people are allergic to the pollen of grasses, one of the commonest causes of "hay fever." Several species are commonly cultivated as ornamentals, notably such large plants as the giantreed (*Arundo*), pampasgrass (*Cortaderia*), and silvergrass (*Miscanthus*). A tribe of large woody grasses, the bamboos, comprises species of great utility, especially in eastern Asia, as substitutes for timber in construction. Another grass of very great economic importance is sugarcane (*Saccharum officinarum*).

Key to the genera

1. Spikelets in groups of 3 to 5, falling entire, sometimes enclosed in spiny burs:
 - Tribe Zoysieae, see also genus *Cenchrus* (2).
2. Spikelets in groups of 2 to 5, sessile on a short zigzag rachis, enclosed in small spiny burs composed of the indurate second glumes of the 2 lower spikelets..... 46. TRAGUS.
2. Spikelets in groups of 3, the central one perfect, the lateral spikelets staminate, not enclosed in burs (3).
 - 3. Rigid perennials; groups of spikelets erect on the stiff axis. 47. HILARIA.
 - 3. Delicate annual; groups of spikelets nodding on one side of the very slender axis..... 48. AEGOPOGON.

¹⁵ Reference: HITCHCOCK, A. S. MANUAL OF THE GRASSES OF THE UNITED STATES. U. S. Dept. Agr. Misc. Pub. 200. 1935.

1. Spikelets not arranged in groups (4).
4. Spikelets dorsally compressed, with one terminal fertile floret and a sterile or staminate floret below, the latter usually without a palea, the articulation below the spikelets, either in the pedicel, the rachis, or at base of a cluster of spikelets: Subfamily Panicoideae (5).
5. Fertile lemma and palea firmer than the glumes, usually indurate: Tribe Paniceae (6).
6. Spikelets subtended by one or more bristles, these distinct or united at base, forming an involucre or spiny bur (7).
7. Bristles distinct, persistent; spikelets deciduous----- 70. SETARIA.
7. Bristles united at base, deciduous, falling with the enclosed spikelets. 71. CENCHRUS.
6. Spikelets not subtended by bristles (8).
8. Spikelets in open panicles (9).
9. Fruit dark brown; lemma with more or less prominent white margins, these not inrolled----- 65. LEPTOLOMA.
9. Fruit pale; margins of the indurate lemma inrolled. 68. PANICUM.
8. Spikelets short-pedicelled on one side of the panicle branches (10).
10. Second glume mucronate, the sterile lemma mucronate or awned. 69. ECHINOCHLOA.
10. Second glume and sterile lemma awnless (11).
11. Spikelets covered with long silky hairs----- 63. TRICHACHNE.
11. Spikelets glabrous or appressed-pubescent (12).
12. Racemes digitate; first glume present; weedy, decumbent, spreading annuals----- 64. DIGITARIA.
12. Racemes panicle (13).
13. First glume and the rachilla joint forming a swollen ringlike callus below the spikelet; back of the fruit turned away from the rachis----- 66. ERIOCHLOA.
13. First glume wanting (occasionally present in *Paspalum distichum*); back of the fruit turned toward the rachis. 67. PASPALUM.
5. Fertile lemma and palea thin, hyaline, the glumes indurate; sterile lemma like the fertile one (14).
14. Spikelets unisexual, the pistillate ones below, the staminate spikelets above in the same inflorescence----- 81. TRIPSACUM.
14. Spikelets in pairs, one sessile, the other pedicellate, both usually fertile, or the sessile spikelet perfect and the pedicellate one sterile or staminate, sometimes much reduced: Tribe Andropogoneae (15).
15. Spikelets all alike, surrounded by a conspicuous tuft of soft hairs (16).
16. Rachis continuous; fertile lemma awnless----- 72. IMPERATA.
16. Rachis breaking into joints at maturity; fertile lemma awned. 73. ERIANTHUS.
15. Spikelets unlike, the sessile one perfect, the pedicellate spikelet usually sterile, but the sessile spikelet staminate and the pedicellate one perfect in genus *Trachypogon* (17).
17. Racemes reduced to one or few joints, these peduncled in a subsimple or compound panicle (18).
18. Pedicellate spikelets staminate----- 75. SORGHUM.
18. Pedicellate spikelet wanting, only the pedicel present. 76. SORGHASTRUM.
17. Racemes of several to many joints, solitary, digitate, or aggregate in panicles (19).
19. Spikelets awnless (20).
20. Rachis joint and pedicel distinct; perfect spikelet lanceolate; tufted perennial; rachis joints and pedicels woolly. 79. ELYONURUS.
20. Rachis joint and pedicel adnate; perfect spikelet globose; freely branching annual with short racemes partly enclosed in the sheaths----- 80. HAEKELCHLOA.
19. Spikelets, or at least some of them, awned (21).
21. Awns delicate, glabrous, not more than 2.5 cm. long. 74. ANDROPOGON.

21. Awns stout, conspicuous, 3 to 12 cm. long or, if rather slender, then plumose on the lower part; racemes solitary (22).
22. Awns glabrous or scabrous; primary spikelet fertile, the pedicellate one sterile; lower pairs of spikelets all staminate or neuter..... 77. HETEROPOGON.
22. Awns plumose; primary spikelet sterile, the pedicellate one fertile..... 78. TRACHYPOGON.
4. Spikelets more or less laterally compressed; sterile florets, if any, above the fertile ones (except in tribe Phalarideae); articulation above the glumes (except in genera *Leersia*, *Sphenopholis*, *Trisetum*, *Lycurus*, *Poly-pogon*, *Alopecurus*, and *Spartina*): Subfamily Festucoideae (23).
23. Spikelets with two sterile or staminate florets below the fertile one: Tribe Phalarideae (24).
24. Lower florets staminate, as large as the fertile floret. 60. HIEROCHLOË.
24. Lower florets sterile, reduced to small scales..... 61. PHALARIS.
23. Spikelets with no sterile florets below the one or more fertile florets (25).
25. Glumes wanting; pedicels articulate below the 1-flowered spikelets; lemma and palea indurate, equal, strongly keeled: Tribe Oryzæe. 62. LEERSIA.
25. Glumes present (26).
26. Spikelets sessile or subsessile in spikes or spike-like racemes (27).
27. Spikelets on opposite sides of the continuous or disarticulating rachis: Tribe Hordeae (28).
28. Spikelets solitary at each node of the rachis (29).
29. First glume present; spikelets placed flatwise to the rachis. 19. AGROPYRON.
29. First glume wanting except on the terminal spikelet; spikelets placed edgewise to the rachis..... 23. LOLIUM.
28. Spikelets more than one at each node of the rachis (30).
30. Spikelets 3 at each node of the rachis, 1-flowered, the lateral ones usually reduced to awns..... 22. HORDEUM.
30. Spikelets 2 at each node of the rachis (31).
31. Rachis usually continuous; glumes acute to aristate, entire. 20. ELYMUS.
31. Rachis readily disarticulating; glumes narrow, extending into long divergent awns..... 21. SITANION.
27. Spikelets subsessile on one side of the continuous rachis; spikes digitate or racemose on a common axis: Tribe Chlorideae (32).
32. Inflorescence very small, enclosed in broad, crowded sheaths at the ends of the branches..... 58. MUNROA.
32. Inflorescence distinctly exerted (33).
33. Plants monoecious or dioecious, or the spikelets unisexual (34).
34. Plants with unisexual, rarely perfect florets, the staminate and pistillate ones in the same spike. 57. CATHESTECUM.
34. Plants monoecious or dioecious; staminate spikes pectinate, the pistillate spikes with the rachis thickened and indurate, this together with the second glumes forming a false involucre around the florets..... 59. BUCHLOË.
33. Plants with perfect flowers (35).
35. Spikelets 1-flowered with no rudimentary florets above the perfect one (36).
36. Spikes digitate..... 51. CYNODON.
36. Spikes racemose (37).
37. Rachilla articulate above the glumes; spikes very slender, elongate, widely spreading. 52. SCHEDONNARDUS.
37. Rachilla articulate below the glumes, the spikelets falling entire; spikes short and thick; glumes unequal, the first shorter, the second longer than the floret..... 53. SPARTINA.
35. Spikelets 2- to several-flowered or, if only 1-flowered, then with 1 or more rudimentary florets above the fertile one (38).
38. Spikes solitary or racemose (39).
39. Lemmas entire or minutely bifid, awnless or 1-awned; spikelets with 2 to several perfect florets. 49. LEPTOCHLOA.

39. Lemmas variously lobed or dentate, 3-awned; spikelets with one perfect floret and 1 or 2 rudimentary florets above it----- 56. *BOUTELOUA*.
38. Spikes digitate or aggregate on a very short axis (40).
40. Lemmas awnless; rachis prolonged beyond the spikelets in a naked point----- 50. *DACTYLOCTENIUM*.
40. Lemmas awned (41).
41. Lemmas 1-awned; spikes digitate--- 54. *CHLORIS*.
41. Lemmas 3-awned; spikes aggregate on a very short axis, but scarcely digitate--- 55. *TRICHLORIS*.
26. Spikelets in open or spikelike panicles (42).
42. Spikelets 1-flowered: Tribe Agrostideae (43).
43. Fruit indurate, terete, awned; callus well developed, oblique, bearded (44).
44. Awn trifid, the lateral awns sometimes minute. 45. *ARISTIDA*.
44. Awn simple, with a distinct line of demarcation between lemma and awn (45).
45. Awn readily deciduous, straight or sometimes bent but not tightly twisted----- 42. *ORYZOPSIS*.
45. Awn persistent, twice geniculate, at least the lower segment tightly twisted (46).
46. Edges of the lemma not meeting, exposing the palea, this projecting from the summit as a minute point; callus short, acute----- 43. *PIPTOCHAETIUM*.
46. Edges of the lemma overlapping, enclosing the palea; callus sharp pointed, usually acuminate-- 44. *STIPA*.
43. Fruit thin or firm but not indurate; callus not well developed (47).
47. Callus bearded (48).
48. Lemma membranaceous, awned from the back. 32. *CALAMAGROSTIS*.
48. Lemma firm, chartaceous, awnless--- 33. *CALAMOVILFA*.
47. Callus not bearded (49).
49. Panicles narrow, dense, spikelike (50).
50. Spikelets in pairs, 1 perfect, the other staminate or neuter, the pair falling together----- 37. *LYCURUS*.
50. Spikelets all alike, not paired (51).
51. Glumes equal, similar, united at base, enclosing the floret; articulation below the glumes, the spikelets falling entire (52).
52. Glumes abruptly awned, hispid-ciliate on the keels. 38. *PHLEUM*.
52. Glumes awnless, pubescent or villous but not hispid-ciliate on the keels----- 35. *ALOPECURUS*.
51. Glumes unequal, dissimilar, not united at base; articulation above the persistent glumes (53).
53. Lemma awned from the tip or mucronate, 3-nerved. 39. *MUHLENBERGIA*.
53. Lemma awnless, 1-nerved----- 40. *SPOROBOLUS*.
49. Panicles open or dense but scarcely spikelike, except in *Polypogon monspeliensis* with long-awned glumes (54).
54. Glumes longer than the lemma; lemma and palea much thinner than the glumes (55).
55. Glumes awnless; palea much shorter than the lemma, sometimes reduced to a small nerveless scale. 34. *AGROSTIS*.
55. Glumes long-awned; palea nearly as long as the lemma. 36. *POLYPOGON*.
54. Glumes shorter than the lemma, or the awn tips exceeding the lemma in *Muhlenbergia racemosa* (56).
56. Lemma densely pubescent on the nerves. 41. *BLEPHARONEURON*.
56. Lemma glabrous or, if pubescent, then not densely so on the nerves (57).
57. Lemma awned from the tip or mucronate, 3-nerved. 39. *MUHLENBERGIA*.
57. Lemma awnless, 1-nerved----- 40. *SPOROBOLUS*.

42. Spikelets 2- to several-flowered (58).
58. Glumes longer than the lowest floret, usually longer than the spikelet (or shorter in genus *Sphenopholis* with a broadly obovate second glume); lemmas awnless or awned from the back: Tribe Aveneae (59).
59. Lemmas awnless or sometimes with a very short awn in genus *Koeleria* (60).
60. Glumes alike, gradually acuminate; spikelets 5- or 6-flowered ----- 24. SCHISMUS.
60. Glumes unlike, the first narrow, the second wider, broadened above the middle; spikelets 2- or 3-flowered (61).
61. Second glume broadened above the middle, then abruptly narrowed to an acute tip, the first glume narrower but not conspicuously so; lemmas pale and shining; spikelets articulate above the glumes.
25. KOELERIA.
61. Second glume broadly obovate, obtuse; lemmas firm, not shining; spikelets articulate below the glumes.
26. SPHENOPHOLIS.
59. Lemmas awned (62).
62. Florets 2, the lower one perfect, awnless, the upper floret staminate with a short hooked awn ----- 30. HOLCUS.
62. Florets all alike (63).
63. Spikelets several-flowered; awns conspicuous, flat, bent.
31. DANTHONIA.
63. Spikelets 2-flowered, sometimes with a rudimentary third floret (64).
64. Spikelets large, the glumes more than 1 cm. long.
29. AVENA.
64. Spikelets small, the glumes much less than 1 cm. long (65).
65. Lemmas keeled, awned from above the middle, the tip minutely bifid ----- 27. TRisetum.
65. Lemmas rounded on the back, awned from below the middle, the tip erose ----- 28. DESCHAMPSIA.
58. Glumes shorter than the first floret; lemmas awnless or awned from the tip or from a minutely bifid apex: Tribe Festuceae (66).
66. Plants dioecious; pistillate lemmas with 3 long, twisted divergent awns, the staminate lemmas mucronate.
18. SCLEROPOGON.
66. Plants with perfect flowers or, if dioecious, then the staminate and pistillate spikelets similar in appearance (67).
67. Lemmas divided at summit into 5 or more awns or awnlike lobes (68).
68. Rachilla disarticulating between the florets; summit of the lemmas with awns intermixed with awned teeth.
16. COTTEA.
68. Rachilla not disarticulating between the florets, all florets falling attached; summit of the lemmas with awns only ----- 17. PAPPOPHORUM.
67. Lemmas awnless, 1-awned or, if 3-awned, then the lateral awns minute (69).
69. Tall stout reeds with plumelike panicles (70).
70. Lemmas hairy; rachilla naked ----- 12. ARUNDO.
70. Lemmas naked; rachilla hairy ----- 13. PHRAGMITES.
69. Low or rather tall grasses; panicles not plumelike (71).
71. Plants dioecious, the staminate and pistillate spikelets similar in appearance; culms erect from creeping rhizomes; plants of saline soil -- 9. DISTICHLIS.
71. Plants with perfect flowers (72).
72. Spikelets of 2 kinds, arranged in fascicles, the terminal one 1-flowered, perfect, the others several-flowered, sterile ----- 11. LAMARCKIA.

72. Spikelets all alike, not arranged in fascicles (73).
73. Lemmas 3-nerved, the nerves usually prominent (74).
74. Lemmas glabrous, awnless (75).
75. Spikelets 3- to several-flowered; lemmas acute or acuminate..... 6. ERAGROSTIS.
75. Spikelets 2-flowered; lemmas truncate, strongly nerved, brown..... 7. CATABROSA.
74. Lemmas densely pubescent on the nerves or callus, mucronate or awned (76).
76. Callus densely bearded; lemmas firm, mucronate, the nerves glabrous.
8. REDFIELDIA.
76. Callus glabrous; lemmas membranaceous, densely pubescent on the nerves.
15. TRIODIA.
73. Lemmas 5-nerved (77).
77. Lemmas mucronate or awned, keeled at least toward apex (78).
78. Spikelets densely clustered toward the ends of the branches; glumes hispid-ciliate on the keel..... 10. DACTYLIS.
78. Spikelets not clustered, rather evenly distributed in narrow or open panicles (79).
79. Lemmas awned from between the teeth of the minutely bifid apex.
1. BROMUS.
79. Lemmas awnless, or awned from the tip.
2. FESTUCA.
77. Lemmas awnless, usually rounded on the back (80).
80. Glumes papery; upper florets reduced to a club-shaped rudiment; spikelets nodding, falling entire..... 14. MELICA.
80. Glumes not papery; upper florets similar to the lower ones (81).
81. Nerves of the lemma converging toward the apex; leaf blades with boat-shaped tips..... 5. POA.
81. Nerves of the lemma parallel, not converging toward the apex (82).
82. Nerves faint; plants usually of saline soil; low annual... 3. PUCCINELLIA.
82. Nerves prominent; plants of freshwater marshes; tall perennials.
4. GLYCERIA.

1. BROMUS. BROME

Annuals or perennials with closed sheaths, flat blades, and open or sometimes rather dense panicles; lemmas keeled or usually rounded on the back, the margins not clasping the palea, awned from between the teeth of the minutely bifid apex; palea thin, ciliate on the keels, usually shorter than the lemma, adhering to the fruit.

Bromes, in the young stage, are relished by all classes of livestock, but at maturity the "beards" cause mouth injuries. Among the best Arizona forage species are the mountain bromes (*B. marginatus*, *B. carinatus*, and *B. polyanthus*) and the fringed brome (*B. ciliatus*). Some of the annual species, such as cheatgrass (*B. tectorum*) and foxtail brome (*B. rubens*), are introduced weeds. Smooth brome (*B. inermis*) is cultivated for hay and pasture in the northern plains region, and rescuegrass (*B. catharticus*) is cultivated for winter forage in the southern United States.

Key to the species

1. Spikelets flattened, the glumes and lemmas compressed-keeled: Section *Cera-
tochloa* (2).
 2. Lemmas awnless or nearly so, light green, the margins usually pale.
 1. B. CATHARTICUS.
 2. Lemmas distinctly awned, dark green throughout (3).
 3. Awns more than 7 mm. long----- 2. B. CARINATUS.
 3. Awns less than 7, usually 5 to 6 mm. long (4).
 4. Sheaths and lemmas pubescent----- 3. B. MARGINATUS.
 4. Sheaths glabrous; lemmas glabrous or scabrous--- 4. B. POLYANTHUS.
1. Spikelets not conspicuously flattened, the lemmas rounded on the back (5).
 5. Plants perennial: Section *Bromopsis* (6).
 6. Rhizomes present; lemmas nearly awnless----- 5. B. INERMIS.
 6. Rhizomes wanting (7).
 7. Lemmas villous-ciliate on the margins, pubescent on the lower part of
the back, the upper portion glabrous----- 6. B. CILIATUS.
 7. Lemmas evenly pubescent or pilose on the back, the pubescence some-
times sparse (8).
 8. Culms usually less than 60 cm. high; panicles less than 10 cm. long,
with lax, few-flowered branches; first glume 3-nerved.
 7. B. ANOMALUS.
 8. Culms usually 80 to 120 cm. high; panicles more than 10 cm. long,
with relatively stiff branches; first glume 1-nerved (9).
 9. Panicle branches short, stiffly ascending or spreading, few-flowered;
spikelets appressed, short-pedicelcd---- 8. B. ORCUTTIANUS.
 9. Panicle branches long, arcuate-spreading; spikelets long pedicelcd
(10).
 10. Lower sheaths glabrous or nearly so; leaf blades mostly less
than 5 mm. wide----- 11. B. FRONDOSUS.
 10. Lower sheaths usually conspicuously retrorse-pilose; leaf
blades more than 5 mm. wide (11).
 11. Culms leafy, many-noded; sheaths much longer than the
internodes; blades often auriculate--- 9. B. LATIGLUMIS.
 11. Culms few-noded; sheaths usually shorter than the inter-
nodes; blades not auriculate----- 10. B. PURGANS.
 5. Plants annual (12).
 12. Awns geniculate; teeth of the lemma aristate----- 20. B. TRINII.
 12. Awns straight or somewhat spreading; teeth of the lemma not aristate
(13).
 13. Lemmas narrow, acuminate, hyaline toward the tip: Section *Eubromus*
(14).
 14. Panicle dense, contracted; culms pubescent below the panicle.
 17. B. RUBENS.
 14. Panicle open, the branches widely spreading (15).
 15. Panicle branches slender; pedicels flexuous; awns 12 to 14 mm.
long----- 18. B. TECTORUM.
 15. Panicle branches relatively stout; pedicels straight; awns 3.5 to
5 cm. long----- 19. B. RIGIDUS.
 13. Lemmas broad, acute (16).
 16. Panicle dense, the branches appressed (17).
 17. Spikelets glabrous----- 12. B. RACEMOSUS.
 17. Spikelets pubescent----- 13. B. MOLLIS.
 16. Panicle open, the branches spreading (18).
 18. Panicle branches stout, stiffly spreading or drooping; lemmas firm.
 14. B. COMMUTATUS.
 18. Panicle branches slender, flexuous; lemmas rather thin (19).
 19. Palea much shorter than the lemma----- 15. B. JAPONICUS.
 19. Palea as long as the lemma----- 16. B. ARVENSIS.

1. *Bromus catharticus* Vahl, Symb. Bot. 2: 22. 1791.*Bromus unioloides* H. B. K., Nov. Gen. et Sp. 1: 151. 1815.

Mohave, Maricopa, and Pima Counties, a weed in waste places, especially around Tucson, May to September. Southern United

States, West Indies, and western South America; introduced from Europe.

2. **Bromus carinatus** Hook. and Arn., Bot. Beechey Voy. 403. 1840.

Bromus carinatus arizonicus Shear, U. S. Dept. Agr., Div. Agrost. Bul. 23: 62. 1900.

Yuma, Cochise, and Pima Counties at relatively low altitudes, March to October. British Columbia, Idaho, and Montana to New Mexico, Arizona, California, and northern Mexico.

3. **Bromus marginatus** Nees in Steud., Syn. Pl. Glum. 1: 322. 1854.

Coconino, Yavapai, Gila, Pinal, and Pima Counties, roadsides, moist meadows, and rocky hills, sometimes common, March to June. British Columbia to Colorado, south to Arizona and northern Mexico.

4. **Bromus polyanthus** Scribn. in Shear, U. S. Dept. Agr., Div. Agrost.

Bul. 23: 56. 1900.

Apache (southern), Coconino, Yavapai, Graham, Cochise, and Pima Counties, moist meadows, August to October. Montana to eastern Oregon, south to Colorado, New Mexico, Arizona, and California.

5. **Bromus inermis** Leyss., Fl. Hal. 16. 1761.

Fairly well established on Pinal Peak (Gila County), 7,800 feet, and in the Pinaleno Mountains (Graham County), 10,030 feet. Escaped from cultivation, Minnesota and Kansas to eastern Washington, Oregon, and Arizona, occasional eastward; introduced from the Old World.

6. **Bromus ciliatus** L., Sp. Pl. 76. 1753.

Bromus richardsoni Link, Hort. Berol. 2: 281. 1833.

Apache, Coconino, Graham, Gila, Cochise, and Pima Counties, up to 11,000 feet, moist woods and rocky slopes, July to October. Labrador to Alaska, south to Tennessee, Iowa, western Texas, Arizona, and southern California.

7. **Bromus anomalus** Rupr. ex Fourn., Bul. Acad. Roy. Belg. Cl.

Sci. 9²: 236. 1840; Mex. Pl. 2: 126. 1886.

Bromus porterii (Coul.) Nash, Torrey Bot. Club Bul. 22: 512. 1895.

Apache, Coconino, Yavapai, Greenlee, Graham, Cochise, Pima, and Santa Cruz Counties, 2,000 to 10,000 feet, open woods, July to September. Saskatchewan and Idaho to western Texas, Arizona, California, and Mexico.

A form with densely lanate sheaths is var. *lanatipes* (Shear) Hitchc. (*B. lanatipes* (Shear) Rydb.).

8. **Bromus orcuttianus** Vasey, Bot. Gaz. 10: 223. 1885.

Huachuca Mountains, Cochise County (*Lemmon* in 1883), open woods. Washington to California and Arizona.

9. **Bromus latiglumis** (Shear) Hitchc., Rhodora 8: 211. 1906.

Bromus purgans latiglumis Shear, U. S. Dept. Agr., Div. Agrost. Bul. 23: 40. 1900.

Dos Cabezas Mountains, Cochise County (*Goodding*), rocky slopes and stream banks. Maine to Montana, south to North Carolina, Texas, and Arizona.

The Arizona specimen belongs to the form known as *B. incanus* Shear. This species is distinguished from *B. anomalus* var. *lanatipes* by the taller, more leafy culms and larger, stiffer panicles.

10. *Bromus purgans* L., Sp. Pl. 76. 1753.

Cochise and Pima Counties, 6,000 to 8,000 feet, moist woods and rocky slopes. Massachusetts to Alberta, south to northern Florida and Arizona.

11. *Bromus frondosus* (Shear) Woot. and Standl., N. Mex. Col. Agr. Bul. 81: 144. 1912.

Bromus porteri frondosus Shear, U. S. Dept. Agr., Div. Agrost. Bul. 23: 37. 1900.

Coconino, Greenlee, Maricopa, Cochise, and Pima Counties, 5,500 to 9,500 feet, rocky hillsides and pine woods. Utah, New Mexico, and Arizona.

12. *Bromus racemosus* L., Sp. Pl. ed. 2, 114. 1762.

A weed along road at Grand Canyon (Coconino County). Waste places, Washington to Idaho and Colorado, south to Arizona and California, rare eastward; introduced from Europe.

13. *Bromus mollis* L., Sp. Pl. ed. 2, 112. 1762.

Roosevelt, Gila County (*Peebles* et al. 5210). A weed in fields and waste places; introduced from Europe.

14. *Bromus commutatus* Schrad., Fl. Germ. 353. 1806.

A weedy species, at Flagstaff and Grand Canyon (Coconino County). Fields and waste places throughout the United States; introduced from Europe.

15. *Bromus japonicus* Thunb., Fl. Japon. 52. 1784.

Joseph City, Navajo County (*Brinkerhoff* in 1936). Fields and waste places throughout the United States; introduced from the Old World.

16. *Bromus arvensis* L., Sp. Pl. 77. 1753.

Flagstaff (Coconino County). A weedy European species introduced in a few scattered localities in the United States.

17. *Bromus rubens* L., Cent. Pl. 1: 5. 1755; Amoen. Acad. 4: 265. 1759.

Coconino, Mohave, Maricopa, and Pinal Counties, roadsides and waste places. Washington to Arizona and California; introduced from Europe.

18. *Bromus tectorum* L., Sp. Pl. 77. 1753.

Coconino and Yavapai Counties. Waste places throughout the United States except in the southeast; introduced from Europe.

A form with glabrous spikelets is var. *glabratus* Spenner.

19. *Bromus rigidus* Roth in Mag. Bot. Roem. and Ust. 10: 21. 1790.

Coconino, Maricopa, Cochise, and Pima Counties, a weed in waste places. British Columbia and Idaho to Arizona and California, rare eastward; introduced from Europe.

20. Bromus trinii Desv. in Gay, Fl. Chil. 6: 441. 1853.

Mohave, Maricopa, and Pinal Counties, dry plains and wooded slopes, March to May. Oregon and Colorado to Arizona and Baja California; introduced from Europe.

2. FESTUCA. FESCUE

Plants annual or perennial; spikelets in narrow or open panicles, few- to several- (rarely 1-) flowered; rachilla disarticulating above the glumes and between the florets; glumes narrow, acute, unequal; lemmas rounded on the back, 5-nerved, usually awned from the tip or rarely from a minutely bifid apex.

Although inclined to become rather tough with age, the fescues are browsed extensively by sheep in the high mountain parks, where Arizona fescue (*F. arizonica*) is particularly abundant. The small annual sixweeks fescue (*F. octoflora*) furnishes winter and spring forage in Arizona. Sheep fescue (*F. ovina*) and red fescue (*F. rubra*) are cultivated to a limited extent in the eastern United States in lawns and pastures. Meadow fescue (*F. elatior*) is cultivated for hay and pasture in the central United States.

Key to the species

1. Plants annual: Section *Vulpia* (2).
 2. Spikelets more than 5-flowered, the florets crowded; lemmas 4 to 5 mm. long, the margins inrolled; awns 2 to 5 mm. long. 1. *F. OCTOFLORA*.
 2. Spikelets usually fewer than 5-flowered or, if more than 5-flowered, then the lemmas 7 to 8 mm. long, and the awns 10 to 13 mm. long (3).
 3. Lemmas ciliate toward apex; first glume usually minute. 2. *F. MEGALURA*.
 3. Lemmas not ciliate; first glume more than half as long as the second (4).
 4. Spikelets glabrous (5).
 5. Pedicels appressed; spikelets mostly 3- to 5-flowered. 3. *F. PACIFICA*.
 5. Pedicels spreading, especially those on the upper part of the main axis; spikelets 1- to 2-flowered. 4. *F. REFLEXA*.
 4. Spikelets pubescent (6).
 6. Pedicels appressed; lower branches of the panicle spreading or reflexed; lemmas hirsute; glumes glabrous or pubescent. 5. *F. GRAYI*.
 6. Pedicels and panicle branches finally spreading or reflexed; glumes and lemmas pubescent. 6. *F. EASTWOODÆ*.
1. Plants perennial: Section *Eufestuca* (7).
 7. Leaf blades flat, 3 to 6 mm. wide, rather thin; lemmas acuminate, sometimes with an awn as much as 2 mm. long (8).
 8. Spikelets mostly not more than 5-flowered. 7. *F. SORORIA*.
 8. Spikelets mostly 8- to 10-flowered. 8. *F. ELATIOR*.
 7. Leaf blades involute, less than 3 mm. wide (9).
 9. Ligule 2 to 4 mm. long or longer. 9. *F. THURBERI*.
 9. Ligule short (10).
 10. Culms loosely tufted, decumbent at base; lower sheaths red, fibrillose; blades soft, glabrous. 10. *F. RUBRA*.
 10. Culms densely tufted; blades hard and firm, usually scabrous (11).
 11. Panicle narrow, the branches appressed; lemmas 4 to 5 mm. long; blades short. 11. *F. OVINA*.
 11. Panicle open, the branches ascending or spreading; lemmas about 7 mm. long; blades elongate (12).
 12. Awns 2 to 4 mm. long. 12. *F. IDAHOENSIS*.
 12. Awns very short or obsolete. 13. *F. ARIZONICA*.

1. **Festuca octoflora** Walt., Fl. Carol. 81. 1788.

Throughout the State, usually at low altitudes, sterile rocky open ground, spring flowering. Southern Canada, throughout the United States, and Baja California.

A form with densely pubescent or hirtellous lemmas is var. *hirtella* Piper.

2. **Festuca megalura** Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 188. 1848.

Fort Huachuca (Cochise County), open ground at low or medium altitudes, spring flowering. British Columbia and Idaho south to Arizona and Baja California; Pacific slope of South America.

3. **Festuca pacifica** Piper, Contrib. U. S. Natl. Herbarium 10: 12. 1906.

Yavapai, Pinal, Maricopa, and Pima Counties, open ground and open woods at low altitudes, spring and early summer. British Columbia and Montana, south to New Mexico, Arizona, and Baja California.

4. **Festuca reflexa** Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 98. 1862.

Jerome Junction, Yavapai County (*Tidestrom* 933), dry or rocky slopes, April to May. Washington and Utah, south to Arizona and southern California.

5. **Festuca grayi** (Abrams) Piper, Contrib. U. S. Natl. Herbarium 10: 14. 1906.

Festuca microstachys var. *grayi* Abrams, Fl. Los Angeles 52. 1904.

Gila, Maricopa, and Pima Counties, dry open ground and rocky slopes, usually spring and early summer. Washington to southern California and Arizona.

6. **Festuca eastwoodae** Piper, Contrib. U. S. Natl. Herbarium 10: 16. 1906.

Pinal and Pima Counties, open wooded slopes, usually April to May. Oregon, California, and Arizona, infrequent.

7. **Festuca sororia** Piper, Contrib. U. S. Natl. Herbarium 16: 197. 1913.

Graham and Pima Counties, 7,500 to 9,500 feet, open woods, August to September, type from the Rincon Mountains (*Nealley* 177). Colorado, Utah, New Mexico, and Arizona.

This is the only species of *Festuca* in Arizona with broad, flat blades.

8. **Festuca elatior** L., Sp. Pl. 75. 1753.

Lakeside, Navajo County (*Harrison* 5511), meadows and waste places. Introduced in the cooler regions of North America; native of Eurasia.

9. **Festuca thurberi** Vasey in Rothr., Cat. Pl. U. S. Geogr. and Geol. Survey West 100th Merid. 56. 1874.

Pinaleno Mountains, Graham County, 9,000 feet (*Shreve* 4334). Dry slopes and rocky hills, Wyoming to New Mexico and Arizona.

10. *Festuca rubra* L., Sp. Pl. 74. 1753.

Baldy Peak, 11,000 feet (Apache County), San Francisco Peaks (Coconino County), also in Pima County, moist meadows and marshes, July to August. Arctic America, south in the mountains to Georgia, Colorado, Arizona, and California; also in the Old World.

11. *Festuca ovina* L., Sp. Pl. 73. 1753.

Apache and Coconino Counties, 7,000 to 12,500 feet, open woods and rocky slopes, August to September. Alaska to Nebraska, New Mexico, Arizona, and California, introduced eastward; circumpolar.

An alpine form with short culms and smooth blades, also found in Arizona, is var. *brachyphylla* (Schult.) Piper (*F. brachyphylla* Schult.).

12. *Festuca idahoensis* Elmer, Bot. Gaz. 36: 53. 1903.

White Mountains (Apache County), San Francisco Peaks (Coconino County), open woods and rocky slopes, July to August. British Columbia to Alberta, south to northern New Mexico, Arizona, and central California.

13. *Festuca arizonica* Vasey, Contrib. U. S. Natl. Herbarium 1: 277. 1893.

Apache, Coconino, Yavapai, Greenlee, Graham, and Pima Counties, 2,500 to 9,500 feet, dry plains and open woods, June to August, type from Flagstaff (*Tracy* 118). Colorado, Nevada, New Mexico, and Arizona.

This is the commonest species of *Festuca* in Arizona.

3. PUCCINELLIA. ALKALI-GRASS

Dwarf annuals; lemmas firm, obtuse, pubescent on the nerves; palea as long as the lemma or a little shorter.

1. *Puccinellia parishii* Hitchc., Biol. Soc. Wash. Proc. 41: 157. 1928.

Tuba, Coconino County (*Peebles* 11842), marsh, 5,000 feet, June. California and Arizona, rare.

4. GLYCERIA. MANNA-GRASS

Aquatic perennials with closed sheaths; lemmas broad, scarious at apex, glabrous; palea as long as or a little longer than the lemma.

These are palatable forage grasses.

Key to the species

1. Spikelets linear, usually more than 1 cm. long; panicles narrow, elongate, 20 to 40 cm. long: Section *Euglyceria*----- 1. *G. BOREALIS*.
1. Spikelets ovate, usually less than 5 mm. long; panicles open, nodding, the branches drooping: Section *Hydropoa* (2).
 2. First glume 0.5 mm. long; culms usually less than 1 meter high.
 2. *G. STRIATA*.
 3. *G. ELATA*.
 2. First glume 1 mm. long; culms 1 to 2 meters high-----

1. *Glyceria borealis* (Nash) Batchelder, Manchester Inst. Proc. 1: 74. 1900.

Panicularia borealis Nash, Torrey Bot. Club Bul. 24: 348. 1897.

Apache, Cochise, and Pima Counties, 8,000 to 9,000 feet, wet places, often in water, August. Newfoundland to Alaska, southward to Massachusetts, New Mexico, Arizona, and California.

2. *Glyceria striata* (Lam.) Hitchc., Biol. Soc. Wash. Proc. 41: 157. 1928.

Poa striata Lam., Tabl. Encycl. 1: 183. 1791.

Panicularia nervata (Willd.) Kuntze, Rev. Gen. Pl. 2: 783. 1891.

White Mountain region (Apache and Navajo Counties), Oak Creek (Coconino County), wet places at medium altitudes, June to August. Newfoundland to British Columbia, southward to Florida, Arizona, and northern California.

3. *Glyceria elata* (Nash) Hitchc. in Jepson, Fl. Calif. 1: 162. 1912.

Panicularia elata Nash in Rydb., N. Y. Bot. Gard. Mem. 1: 54. 1900.

Oak Creek Canyon (Coconino County), Pinaleno Mountains (Graham County), Santa Catalina Mountains (Pima County), 5,000 to 9,000 feet, wet meadows and moist woods, August. Montana to British Columbia, south in the mountains to New Mexico, Arizona, and southern California.

This species closely resembles *G. striata* but has stouter, taller culms and slightly larger spikelets.

5. POA. BLUEGRASS

Annual or perennial cespitose or rhizomatous grasses with open or contracted panicles; leaf blades with boat-shaped tips; spikelets ovate or oblong, few- to several-flowered; lemmas glabrous or pubescent on the nerves, sometimes pubescent on the internerves, the intermediate nerves usually obscure.

The bluegrasses are palatable and nutritious forage grasses. In Arizona, muttongrass (*P. fendleriana*) and Bigelow bluegrass (*P. bigelovii*) furnish good forage during winter and spring. Kentucky bluegrass (*P. pratensis*) is a standard pasture grass and is cultivated in lawns. Canada bluegrass (*P. compressa*) is cultivated in pastures in the northeastern United States. Annual bluegrass (*P. annua*) is a common weed in lawns.

Key to the species

1. Plants annual (2).
 2. Panicles 7 to 15 cm. long, contracted, rather dense; lemmas webbed at base, pubescent below on the internerves..... 1. *P. BIGELOVII*.
 2. Panicles 3 to 7 cm. long, open, the branches rather few-flowered, naked toward base; lemmas densely pubescent on the nerves, glabrous on the internerves, not webbed..... 2. *P. ANNUA*.
1. Plants perennial (3).
 3. Rhizomes present: See also *P. fendleriana* and *P. longiligula* with dense narrow panicles (4).
 4. Culms strongly compressed; panicles narrow, rather dense.
 5. *P. COMPRESSA*.
 4. Culms terete or only slightly compressed; panicles open (5).
 5. Lemmas copiously webbed at base, the intermediate nerves glabrous; panicle pyramidal, the lower branches mostly in 5's, arcuate-spreading..... 3. *P. PRATENSIS*.
 5. Lemmas not webbed at base, the intermediate nerves pubescent; panicles oblong, the lower branches usually in 3's, rather stiffly ascending.
 4. *P. GLAUCIFOLIA*.
 3. Rhizomes wanting (6).

6. Lemmas webbed at base, the web sometimes obscure in *P. interior* (7).
 7. Panicle branches slender, reflexed at maturity, the lower branches in 2's; culms rather soft at base; leaf blades relatively short, flat, mostly 2 to 4 mm. wide..... 6. *P. REFLEXA*.
 7. Panicle branches stiffly ascending, spreading, or drooping but not reflexed; culms firm toward base (8).
 8. Panicles 10 to 30 cm. long, broad, the branches spreading or drooping; culms decumbent at the reddish base; ligule 3 to 5 mm. long.
 7. *P. PALUSTRIS*.
 8. Panicles less than 10 cm. long, the branches short, ascending; culms erect, densely tufted; ligule less than 1 mm. long.
 8. *P. INTERIOR*.
 6. Lemmas not webbed at base (9).
 9. Lemmas glabrous or scabrous; spikelets scarcely flattened, the lemmas rounded on the back at maturity; sheaths usually scabrous.
 12. *P. NEVADENSIS*.
 9. Lemmas pubescent on the nerves and sometimes on the internerves; spikelets flattened, the lemmas keeled at maturity (10).
 10. Leaf blades lax or soft, usually flat; spikelets usually 3-flowered.
 11. *P. RUPICOLA*.
 10. Leaf blades firm, involute, erect; spikelets 5- or 6-flowered, about 8 mm. long; plants incompletely dioecious (11).
 11. Ligule very short..... 9. *P. FENDLERIANA*.
 11. Ligule 5 to 7 mm. long..... 10. *P. LONGILIGULA*.

1. *Poa bigelovii* Vasey and Scribn. in Vasey, Desc. Cat. Grasses U. S. 81. 1885.

Coconino, Mohave, Yavapai, Pinal, Maricopa, and Pima Counties, 1,000 to 3,000 feet, open ground. Oklahoma and western Texas to Nevada, Arizona, southern California, and northern Mexico.

2. *Poa annua* L., Sp. Pl. 68. 1753.

Devil's Canyon and Sacaton (Pinal County), Camp Creek (Maricopa County), Fort Huachuca (Cochise County), 1,200 to 5,000 feet, open ground, lawns, and waste places. Newfoundland to Alaska, south to Florida, Arizona, and California; also in tropical America at higher altitudes; introduced from Europe.

3. *Poa pratensis* L., Sp. Pl. 67. 1753.

Apache County to Coconino County, south to Cochise and Pima Counties, medium to high altitudes, moist meadows and open woods. Canada and throughout the United States, except in dry or hot situations; introduced from Europe.

This, the well-known Kentucky bluegrass, is an extremely variable species differing markedly in appearance depending on the location where it is found. Although the plant is sometimes depauperate and sometimes very tall and coarse, the florets are relatively uniform in having a pronounced cobweb, densely pubescent keel, and lateral nerves.

4. *Poa glaucifolia* Scribn. and Williams, U. S. Dept. Agr., Div. Agrost. Cir. 10: 6. 1899.

San Francisco Peaks (Coconino County), moist places at high altitudes, July to August. Wisconsin to New Mexico and Arizona.

5. *Poa compressa* L., Sp. Pl. 69. 1753.

White Mountains, 8,600 feet (Apache County), Pinaleno Mountains (Graham County), open ground, meadows, and waste places. Newfoundland to Alaska, south to Georgia, Tennessee, Oklahoma, New Mexico, Arizona, and California; introduced from Europe.

6. *Poa reflexa* Vasey and Scribn., Contrib. U. S. Natl. Herbarium 1: 276. 1893.

San Francisco Peaks (Coconino County), 8,000 to 12,000 feet, moist open meadows and stream banks, late June to August. Montana to eastern British Columbia, south to New Mexico and Arizona.

7. *Poa palustris* L., Syst. Nat. ed. 10, 2: 874. 1759.

Pinaleno Mountains, Graham County (*Peebles* et al. 4413). Meadows and moist open ground, at low and medium altitudes. Newfoundland and Quebec to Alaska, south to Virginia, Missouri, New Mexico, Arizona, and California; Eurasia.

8. *Poa interior* Rydb., Torrey Bot. Club Bul. 32: 604. 1905.

San Francisco Peaks (Coconino County), 9,000 to 12,000 feet, moist meadows, grassy slopes, and open woods, July to August. Quebec to British Columbia, south to Vermont, Minnesota, New Mexico, and Arizona.

9. *Poa fendleriana* (Steud.) Vasey, U. S. Dept. Agr., Div. Bot. Bul. 13²: pl. 74. 1893.

Eragrostis fendleriana Steud., Syn. Pl. Glum. 1: 278. 1854.

Poa fendleriana arizonica Williams, U. S. Dept. Agr., Div. Agrost. Cir. 10: 5. 1899.

Apache County to Mohave County, south to Cochise and Pima Counties, 3,500 to 9,000 feet, rocky slopes and open woods, April to August. South Dakota to Idaho, south to western Texas, Arizona, and southern California.

Usually *P. fendleriana* is a tufted grass but sometimes produces rhizomes. Typically the lemmas are pubescent on the keel and nerves, but frequently forms occur with the lemmas nearly or entirely glabrous.

10. *Poa longiligula* Scribn. and Williams, U. S. Dept. Agr., Div. Agrost. Cir. 9: 3. 1899.

Coconino, Mohave, Yavapai, Gila, and Pinal Counties, 3,500 to 7,500 feet, rocky slopes and open woods, April to June. North Dakota to Oregon, south to New Mexico, Arizona, and California.

This species very closely resembles *P. fendleriana*, differing in having a long conspicuous ligule.

11. *Poa rupicola* Nash, N. Y. Bot. Gard. Mem. 1: 49. 1900.

San Francisco Peaks (Coconino County), 11,500 to 12,500 feet, alpine meadows and rocky slopes above timber line, August to September. Montana to Oregon, south to Arizona and California.

Similar in appearance to *P. interior* but usually smaller and the florets without a cobweb at base.

12. *Poa nevadensis* Vasey in Scribn., Torrey Bot. Club Bul. 10: 66. 1883.

Without locality (*Pringle* 44 and 133). Wet places, Montana to Yukon Territory and Washington, south to Colorado, Arizona, and California.

Pringle's specimens are not the typical form, differing in having shorter and relatively broader blades. The ligule is long, as in the common form.

Poa canbyi (Scribn.) Piper. The specimen of this species in the U. S. National Herbarium, which is the basis of the Arizona record in Hitchcock's Manual, is labeled as from Fillmore. There is no locality of this name in Arizona, so it is assumed that the specimen is from Utah and should not be credited to Arizona.

6. ERAGROSTIS. LOVEGRASS

Annuals or perennials with open panicles; florets closely imbricate; rachilla disarticulating above the glumes and between the florets, or continuous; lemmas deciduous; paleas persistent, about as long as the lemmas.

This genus has comparatively little forage value. Probably the best Arizona species in this regard is plains lovegrass (*E. intermedia*). Alkali lovegrass (*E. obtusiflora*) furnishes a large part of the forage locally in extremely saline soils in Cochise County. The seeds of teff (*E. abyssinica*) are utilized for food in Africa. Stinkgrass (*E. cili-anensis*), with an odor of cockroaches, is reported sometimes to poison horses, both the fresh plant and in hay.

Key to the species

1. Plants perennial (2).
 2. Plants with stout creeping rhizomes bearing hard, closely imbricate scales; culms firm, wiry, erect or ascending; lemmas erose. 11. *E. OBTUSIFLORA*.
 2. Plants caespitose, without rhizomes (3).
 3. Nerves of the lemma obscure; lemmas rounded on the back, 1.8 to 2 mm. long ----- 14. *E. INTERMEDIA*.
 3. Nerves of the lemma prominent (4).
 4. Panicles purple, the branches stiffly spreading; culms 30 to 60 cm. high; lemmas about 1.5 mm. long ----- 12. *E. SPECTABILIS*.
 4. Panicles lead colored, the branches slender, drooping; culms usually more than 1 meter high; lemmas about 2.5 mm. long.
 13. *E. CURVULA*.
1. Plants annual (5).
 5. Plants with minute glandular depressions on the branches, or on the keels of the lemmas (6).
 6. Spikelets 2.5 to 3 mm. wide; keels of the lemmas with a few prominent glandular depressions; panicles open, dark gray green or tawny.
 1. *E. CILIANENSIS*.
 6. Spikelets 1 to 1.5 mm. wide; keels of the lemmas without glands; panicles narrow, the branches ascending or appressed, yellowish green.
 2. *E. LUTESCENS*.
 5. Plants not glandular, or with a few scattered glands on the sheaths (7).
 7. Spikelets about 1 mm. wide (8).
 8. Plants delicate; spikelets 3 to 5 mm. long; lemmas 1 to 1.5 mm. long.
 3. *E. PILOSA*.
 8. Plants rather stout; spikelets 5 to 7 mm. long; lemmas about 2 mm. long ----- 4. *E. ORCUTTIANA*.
 7. Spikelets 1.5 mm. wide or wider (9).
 9. Panicles narrow, the short branches stiffly ascending or spreading, few-flowered, bearing spikelets nearly to the base. 5. *E. BARRELIERI*.
 9. Panicles open, diffuse, the branches slender, usually somewhat drooping (10).
 10. Spikelets appressed along the main branches of the panicle or the appressed primary branchlets (11).
 11. Panicle branches simple; spikelets rather distant.
 6. *E. PECTINACEA*.
 11. Panicle branches compound; spikelets somewhat crowded.
 7. *E. DIFFUSA*.
 10. Spikelets on usually slender spreading pedicels (12).
 12. Spikelets linear; pedicels stiff, widely divergent, longer than the spikelets ----- 8. *E. ARIDA*.

12. Spikelets ovate to ovate-oblong; pedicels spreading but not stiffly divergent (13).
 13. Plants up to 1 meter high; panicles 20 to 40 cm. long, with drooping, many-flowered branches; leaf blades up to 1 cm. wide..... 9. E. NEOMEXICANA.
 13. Plants usually less than 30 cm. high; panicles small, few-flowered, the branches relatively short, spreading but not drooping..... 10. E. MEXICANA.

1. *Eragrostis cilianensis* (All.) Link ex Vign. Lut., *Malpighia* 18: 386. 1904.

Eragrostis major Host, *Icon. Gram. Austr.* 4: 14. 1809; *Fl. Austr.* 1: 135. 1827.

Coconino County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, up to 6,000 feet, a common weed in cultivated ground and waste places, May to October. Throughout the United States except at higher altitudes, southward to Argentina; introduced from Europe.

2. *Eragrostis lutescens* Scribn., U. S. Dept. Agr., Div. Agrost. Cir. 9: 7. 1899.

Without locality (*Lemmon* 1321, in 1882). Dry ground and sandy shores, rare. Idaho and Washington to Arizona and California.

3. *Eragrostis pilosa* (L.) Beauv., *Ess. Agrost.* 71, 162, 175. 1812.

Poa pilosa L., *Sp. Pl.* 68. 1753.

Above Superior, Pinal County, 2,730 feet (*Peebles* et al. 2333), open ground and waste places. Massachusetts to Colorado and Arizona, south to Argentina.

4. *Eragrostis orcuttiana* Vasey, *Contrib. U. S. Natl. Herbarium* 1: 269. 1893.

University Campus at Tucson (Pima County), probably introduced, fields and waste places, summer flowering. Colorado and Arizona to Oregon and California.

5. *Eragrostis barrelieri* Daveau in *Morot, Jour. de Bot.* 8: 289. 1894.

Tombstone, Cochise County (*Harrison* and *Kearney* 6081). Waste places, Oklahoma and Texas to California.

6. *Eragrostis pectinacea* (Michx.) Nees, *Fl. Afr. Austr.* 406. 1841.

Poa pectinacea Michx., *Fl. Bor. Amer.* 1: 69. 1803.

Without locality (*Palmer* in 1869). Open ground and waste places, Maine to North Dakota, south to Florida, Texas (and Arizona?), rare westward.

Palmer's specimen is small and immature, and may be only an extreme form of *E. diffusa*.

7. *Eragrostis diffusa* Buckl., *Acad. Nat. Sci. Phila. Proc.* 1862: 97. 1862.

Almost throughout the State, up to 7,000 feet, open ground and waste places, July to September. Texas to Nevada, southern California, and northern Mexico, introduced eastward in a few localities.

8. *Eragrostis arida* Hitchc., *Wash. Acad. Sci. Jour.* 23: 449. 1933.

Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 5,500 feet, dry soil, rocky ground, and waste places, August to October. Missouri (where probably introduced) and Texas to Arizona.

9. **Eragrostis neomexicana** Vasey, Contrib. U. S. Natl. Herbarium 2: 542. 1894.

Coconino, Yavapai, Cochise, Santa Cruz, and Pima Counties, wet ground, fields, and waste places, mostly 4,000 to 5,500 feet, July to September. Oklahoma to Arizona and Mexico.

10. **Eragrostis mexicana** (Hornem.) Link, Hort. Berol. 1: 190. 1827.

Poa mexicana Hornem., Hortus Hafn. 2: 953. 1815.

Coconino and Mohave Counties, south to Cochise, Santa Cruz, and Pima Counties, mostly 4,000 to 7,000 feet, fields and waste places. Texas to Arizona, and southward through Mexico.

11. **Eragrostis obtusiflora** (Fourn.) Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 8: 10. 1897.

Common locally in saline soil around Willecox and in the Chiricahua Mountains (Cochise County), about 4,000 feet, April to September. Southern New Mexico, Arizona, and northern Mexico.

12. **Eragrostis spectabilis** (Pursh) Steud., Nom. Bot. ed. 2, 1: 564. 1840.

Poa spectabilis Pursh, Fl. Amer. Sept. 1: 81. 1814.

Coconino and Pima Counties, sandy or rocky soil, at medium altitudes, September to October. Maine to Minnesota, south to Florida and Arizona.

13. **Eragrostis curvula** (Schrad.) Nees, Fl. Afr. Austr. 397. 1841.

Poa curvula Schrad., Göttingen Gelehrte Anz. 3: 2073. 1821.

Crook National Forest (*Purchase* 283), Pinal Mountains, Gila County, 7,500 feet (*Pebbles* 14098). Introduced from Africa, grown for ornament and forage in several localities in the southern part of the United States.

14. **Eragrostis intermedia** Hitchc., Wash. Acad. Sci. Jour. 23: 450. 1933.

Yavapai, Gila, Pinal, Cochise, Pima, and Santa Cruz Counties, mostly 4,000 to 5,000 feet, rocky hills and canyons, June to September. Missouri to Louisiana and Arizona.

7. CATABROSA. BROOKGRASS

Aquatic perennials; spikelets brown, 2-flowered, the florets distant; glumes nerveless, irregularly toothed; lemmas broad, the apex scarious; palea as long as the lemma.

1. **Catabrosa aquatica** (L.) Beauv., Ess. Agrost. 97, 149, 157. 1812.

Aira aquatica L., Sp. Pl. 64. 1753.

Without locality (*E. Palmer* in 1877), mountain meadows, around springs, and along streams, July to September. Newfoundland to Alberta, south to Colorado, Arizona, and Oregon; Eurasia.

8. REDFIELDIA. BLOWOUT GRASS

Perennial, with extensive rhizomes; panicle large, the branches capillary; spikelets 3- or 4-flowered, the florets closely imbricate; glumes acuminate, 1-nerved; palea as long as the lemma.

1. **Redfieldia flexuosa** (Thurb.) Vasey, Torrey Bot. Club Bul. 14: 133. 1887.

Grappophorum flexuosum Thurb. in A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 78. 1863.

Hopi Indian Reservation, Navajo County (*Hough* 119), sand hills, August to September. South Dakota to Oklahoma, west to Arizona.

This grass is a valuable sand binder but is very rare in Arizona.

9. DISTICHLIS. SALTGRASS

Dioecious perennials with creeping, scaly rhizomes, rigid culms, and dense, few-flowered panicles; glumes broad, acute, keeled, 3- to 7-nerved; lemmas closely imbricate, coriaceous; palea usually a little shorter than the lemma.

Plants of saline soils, of low forage value.

Key to the species

1. Keels of the palea broad, finely dentate; panicle congested, usually overtopped by the leaves..... 1. *D. DENTATA*.
 1. Keels of the palea narrow, entire; panicle relatively loose, usually exceeding the blades..... 2. *D. STRICTA*.

1. **Distichlis dentata** Rydb., Torrey Bot. Club Bul. 36: 536. 1909.

Hopi Indian Reservation, Navajo County (*Hough* 109), Chino Valley, Yavapai County (*Allen* 1131). Idaho and Washington to Colorado, Arizona, and California.

2. **Distichlis stricta** (Torr.) Rydb., Torrey Bot. Club Bul. 32: 602. 1905.

Uniola stricta Torr., Ann. Lyc. N. Y. 1: 155. 1824.

Navajo, Coconino, Pinal, Cochise, Pima, and Yuma Counties, up to 5,000 feet, May to October. Saskatchewan to Texas, Arizona, California, and Mexico.

10. DACTYLIS. ORCHARDGRASS

Densely tufted perennial with flat leaf blades and open panicles; spikelets subsessile in dense clusters at the ends of the branches; spikelets compressed, few-flowered; glumes unequal, acute, hispid, ciliate on the keel; lemmas keeled, mucronate, ciliate on the keel.

Orchardgrass is cultivated in some parts of the United States for hay and pasturage.

1. **Dactylis glomerata** L., Sp. Pl. 71. 1753.

Navajo and Graham Counties, fields, meadows, and waste places. Newfoundland to Alaska, south to Florida, Arizona, and California; introduced from Eurasia.

11. LAMARCKIA. GOLDENTOP

Low annual with dense one-sided panicles; fertile spikelet with 1 perfect floret and a rudimentary floret raised on a long rachilla joint; lemma bearing a delicate awn just below the apex; sterile spikelets composed of numerous imbricate empty lemmas.

1. *Lamarckia aurea* (L.) Moench, Meth. Pl. 201. 1794.

Cynosurus aureus L., Sp. Pl. 73. 1753.

Roosevelt (Gila County), Canyon Lake (Maricopa County), open ground and waste places. Texas, Arizona, southern California, and northern Mexico; introduced from the Mediterranean region.

12. ARUNDO. GIANTREED

Tall perennial with broad linear leaf blades and plumelike panicles; glumes as long as the spikelet, membranaceous, tapering to a slender point; lemma thin, densely pilose, the nerves excurrent, the mid-nerve extending into a straight awn.

1. *Arundo donax* L., Sp. Pl. 81. 1753.

Occasional along irrigation ditches in southern Arizona. Texas to southern California; introduced from the Old World.

The stout culms are used for lattices, mats, and screens, and in the construction of adobe huts. In Europe the culms are utilized for reeds of clarinets and organ pipes. The plants are useful for wind-breaks and for controlling erosion along streams.

13. PHRAGMITES. COMMON REED

Coarse perennial with broad, flat, linear leaf blades and usually large panicles; glumes unequal, the first about half as long as the second; lemmas long-acuminate, glabrous, the summits of all of them about equal; palea much shorter than the lemma.

1. *Phragmites communis* Trin., Fund. Agrost. 134. 1820.

Arundo phragmites L., Sp. Pl. 81. 1753.

Apache, Navajo, Coconino, Maricopa, and Yuma Counties, marshes and wet ground along irrigation canals and river banks, July to October. Distributed throughout the world.

In Arizona and Mexico, where it is known as carrizo, shafts of arrows, Indian prayer sticks, weaving rods, pipe stems, mats, screens, cordage, nets, and thatching have been made from the culms of the common reed.

14. MELICA. MELICGRASS

Perennials with closed sheaths and usually rather narrow panicles of large spikelets; glumes thin, acute or obtuse, nearly as long as the lower floret; lemmas firm with scarious margins, awnless; palea much shorter than the lemma.

Several species are known as oniongrass. Two exotic species, *M. altissima* L. and *M. ciliata* L., are sometimes cultivated as ornamentals.

Key to the species

1. Spikelets not falling entire; pedicels straight; glumes nearly as long as the spikelet; culms somewhat woody; panicles narrow, rather dense.
 3. *M. FRUTESCENS.*
1. Spikelets falling entire; pedicels slender or capillary, recurved (2).
 2. Spikelets 3-flowered, 8 to 10 mm. long; lower panicle branches spreading.----- 1. *M. NITENS.*
 2. Spikelets 4- or 5-flowered, 10 to 15 mm. long; panicle branches narrowly ascending or appressed.----- 2. *M. PORTERI.*

1. **Melica nitens** (Scribn.) Piper, Torrey Bot. Club Bul. 32: 387. 1905.

Melica diffusa var. *nitens* Scribn., Acad. Nat. Sci. Phila. Proc. 1885: 44. 1885.

Arizona, without locality. Rocky open woods. Pennsylvania to Iowa, south to Virginia, Arkansas, Texas, and Arizona.

2. **Melica porteri** Scribn., Acad. Nat. Sci. Phila. Proc. 1885: 44. 1885.

Coconino, Cochise, and Pima Counties, 5,000 to 7,000 feet, moist open woods and canyons, July to October. Missouri to Kansas, south to Texas and Arizona.

3. **Melica frutescens** Scribn., Acad. Nat. Sci. Phila. Proc. 1885: 45. 1885.

Superstition Mountains (Pinal County), up to 5,000 feet, dry hills and canyons, April to May. Arizona, southern California, and Baja California.

15. TRIODIA

Cespitose or stoloniferous perennials with open or contracted panicles; glumes nearly equal; lemmas rounded on the back, the apex toothed or lobed, the midnerve usually excurrent in a short awn, the lateral nerves often excurrent as minute points, all of the nerves pubescent.

Although often very abundant, especially fluffgrass (*T. pulchella*), the species of this genus are not important range plants.

Key to the species

1. Plants widely stoloniferous; panicles small, capitate, exceeded by the fascicles of leaves----- 1. *T. PULCHELLA*.
 1. Plants cespitose, without stolons; panicles narrow or dense, much exceeding the leaves (2).
 2. Lemmas deeply lobed----- 2. *T. GRANDIFLORA*.
 2. Lemmas minutely toothed or subentire (3).
 3. Panicles ovoid, 1 to 2 cm. long; lemmas acute, the awn 1 to 2 mm long.----- 3. *T. PILOSA*.
 3. Panicles elongate, 10 to 25 cm. long; lemmas obtuse, entire or minutely notched, awnless (4).
 4. Glumes acute, usually longer than the lowest floret, the first glume 3-nerved----- 4. *T. ELONGATA*.
 4. Glumes obtuse, shorter than the lowest floret, the first glume 1-nerved.----- 5. *T. MUTICA*.

1. **Triodia pulchella** H. B. K., Nov. Gen. et Sp. 1: 155. 1816.

Dasyochloa pulchella Willd. ex Rydb., Fl. Rocky Mount. 67. 1917.

Throughout the State, up to 5,500 feet, mesas and rocky hills, March to October. Utah and Nevada to western Texas, Arizona, and southern California.

2. **Triodia grandiflora** Vasey, Contrib. U. S. Natl. Herbarium 1: 59. 1890.

Greenlee, Cochise, and Pima Counties, 3,000 to 5,500 feet, dry rocky slopes, August to October. Western Texas to Arizona and northern Mexico.

3. *Triodia pilosa* (Buckl.) Merr., U. S. Dept. Agr., Div. Agrost. Cir. 32: 9. 1901.

Uralepis pilosa Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 94. 1862.

Coconino, Mohave, Yavapai, Gila, and Santa Cruz Counties, up to 5,500 feet, plains and rocky hills. Kansas to Nevada, south to central Mexico.

4. *Triodia elongata* (Buckl.) Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 17 (ed. 2): 210. 1901.

Uralepis elongata Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 89. 1862.

Coconino, Yavapai, and Greenlee Counties, 3,500 to 7,000 feet, plains and rocky slopes, August to October. Missouri and Kansas to Arkansas and Arizona.

5. *Triodia mutica* (Torr.) Scribn., Torrey Bot. Club Bul. 10: 30. 1883.

Tricuspis mutica Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 156. 1857.

Coconino, Mohave, Yavapai, Pinal, Cochise, Santa Cruz, and Pima Counties, up to 5,500 feet, dry plains and rocky hills, April to October. Texas to southeastern California.

16. COTTEA. COTTAGRASS

Small tufted perennial with flat leaf blades and narrow or oblong, rather dense panicles; glumes nearly equal, about as long as the lowest floret, several-nerved; lemmas rounded on the back, villous below, with 9 to 11 prominent nerves extending into teeth or awns; palea a little longer than the body of the lemma.

1. *Cottea pappophoroides* Kunth, Rév. Gram. 1: 84. 1829.

Cochise and Pima Counties, 2,000 to 4,000 feet, dry hills and plains, August to October. Western Texas to southern Arizona and central Mexico; South America.

17. PAPPOPHORUM. PAPPUSGRASS

Tufted perennials with narrow, spikelike, bristly panicles; spikelets 2- to 5-flowered, the rachilla disarticulating above the glumes but not, or only tardily, between the florets, these falling together; glumes nearly equal; lemmas rounded on the back, obscurely many-nerved; palea as long as the body of the lemma.

Key to the species

1. Awns plumose; culms 20 to 40 cm. high, branching, decumbent at base, the nodes pubescent; panicles mostly less than 5 cm. long, plumbeous.
 1. *P. WRIGHTII*.
1. Awns scabrous, not plumose; culms mostly 50 to 100 cm. high, simple, the nodes glabrous; panicles 10 to 20 cm. long, tawny or tinged with purple (2).
 2. Panicle spikelike, tawny or whitish..... 2. *P. MUCRONULATUM*.
 2. Panicle narrow but loose, pinkish..... 3. *P. BICOLOR*.

1. *Pappophorum wrightii* S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 178. 1883.

Navajo County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, rocky hills and plains, July to October. Texas to Arizona and Oaxaca; Peru and Bolivia.

Reported to have considerable forage value.

2. *Pappophorum mucronulatum* Nees, Agrost. Bras. 412. 1829.

Cochise and Pima Counties, open ground and low places on plains, July to September. Texas, Arizona, and northern Mexico; South America.

3. *Pappophorum bicolor* Fourn., Mex. Pl. 2: 133. 1886.

Santa Cruz River at La Noria, Santa Cruz County (*Mearns* 1175), open valley land. Texas, southern Arizona, and Mexico.

18. SCLEROPOGON. BURROGRASS

Monoecious or dioecious, stoloniferous perennial, with short flexuous leaf blades and narrow panicles; staminate spikelets several-flowered; lemma similar to the glumes, mucronate; palea obtuse, shorter than the lemma; pistillate spikelets several-flowered, the florets falling together, the lowest one with a sharp-bearded callus, the upper ones reduced to awns; nerves of the lemmas extending into slender, spreading awns.

1. *Scleropogon brevifolius* Phil., An. Univ. Chile 36: 206. 1870.

Apache, Navajo, Mohave, Graham, Cochise, and Pima Counties, at relatively low altitudes, mesas, open slopes, and valleys, May to October. Texas, Colorado, and Arizona to central Mexico.

Although grazed by livestock before reaching maturity, this grass is inclined to increase on heavily grazed ranges at the expense of more palatable species. The pointed awns penetrate clothing and wool.

19. AGROPYRON. WHEATGRASS

Perennials, often with creeping rhizomes; culms erect or decumbent; spikes usually erect; glumes equal, firm, acute or awned, usually shorter than the first lemma; lemmas firm, rounded on the back, acute or awned, the awn straight or divergent.

Most of the species furnish forage, and some of them are among the most valuable range grasses of the western United States. In the valleys these grasses may grow in sufficient abundance to produce wild hay. Slender wheatgrass (*A. trachycaulum*) has been cultivated in the Northwestern States. Western wheatgrass (*A. smithii*) furnishes a good deal of forage in Arizona and in open depressions is a source of hay. The species with strong creeping rhizomes are valuable soil binders. Quackgrass (*A. repens*) is a troublesome weed. The rhizomes of this species, often adulterated with Bermuda grass, are used in treating urinary disorders.

Key to the species

1. Plants with creeping rhizomes; leaf blades firm, strongly nerved (2).
2. Glumes acuminate or gradually tapering into a short awn, more or less asymmetric, the nerves usually obscure----- 1. *A. SMITHII*.

2. Glumes acute or abruptly awn-pointed, symmetric, the nerves evident (3).
 3. Lemmas glabrous or obscurely pubescent; rhizomes more vigorous and spikelets usually more implicate than in *A. dasystachyum*.
 2. *A. RIPARIUM*.
 3. Lemmas usually densely pubescent..... 3. *A. DASYSTACHYUM*.
 1. Plants cespitose, without rhizomes (4).
 4. Lemmas awnless; internodes of the rachilla villous; glumes broad, nearly as long as the spikelet..... 4. *A. TRACHYCAULUM*.
 4. Lemmas distinctly awned (5).
 5. Awns erect or nearly so..... 5. *A. SUBSECUNDUM*.
 5. Awns divergent, at least when dry (6).
 6. Rachis finally disarticulating; glumes long-awned, the awns often as long as those of the lemmas (7).
 7. Culms prostrate or decumbent-spreading, often flexuous; panicles nodding or flexuous..... 6. *A. SCRIBNERI*.
 7. Culms erect..... 7. *A. SAXICOLA*.
 6. Rachis continuous; glumes acute or with a very short awn (8).
 8. Spike straight, 8 to 15 cm. long; spikelets appressed, the awns abruptly divergent; blades 1 to 2 mm. wide..... 8. *A. SPICATUM*.
 8. Spike flexuous, 15 to 30 cm. long; spikelets somewhat spreading, the awns divergent but not abruptly so; blades 4 to 6 mm. wide.
 9. *A. ARIZONICUM*.

1. Agropyron smithii Rydb., N. Y. Bot. Gard. Mem. 1: 64. 1900.

Apache, Navajo, Coconino, Yavapai, and Pima Counties, 3,000 to 7,000 feet, dry hills, moist open ground, and pine forests, May to September. New York to Alberta and Washington, south to Kentucky, Texas, Arizona, and California.

A form with pubescent lemmas is var. *molle* (Scribn. and Smith) M. E. Jones, and one with densely pubescent sheaths is var. *palmeri* (Scribn. and Smith) Heller.

2. Agropyron riparium Scribn. and Smith, U. S. Dept. Agr., Div. Agrost. Bul. 4: 35. 1897.

Kaibab Plateau, Coconino County (*Storm 225*). Dry or moist meadows and hills. North Dakota to Alberta and Washington, south to Colorado, northern Arizona, and Nevada.

3. Agropyron dasystachyum (Hook.) Scribn., Torrey Bot. Club Bul. 10: 78. 1883.

Triticum repens var. *dasystachyum* Hook., Fl. Bcr. Amer. 2: 254. 1840.

Arizona, without locality. Plains and sandy shores, Michigan to British Columbia, south to Illinois, Nebraska, Colorado, Arizona, and Nevada.

4. Agropyron trachycaulum (Link) Malte, Natl. Mus. Canada Ann. Rpt. 1930: 42. 1932.

Triticum trachycaulum Link, Hort. Berol. 2: 189. 1833.

Agropyron tenerum Vasey, Bot. Gaz. 10: 258. 1885.

Agropyron pauciflorum (Schwein.) Hitchc., Amer. Jour. Bot. 21: 132. 1934.

Apache County to Mohave County, south to Cochise and Pima Counties, 5,000 to 9,000 feet, moist meadows and open woods, May to October. Labrador to Alaska, south to West Virginia, Kansas, Arizona, and California.

5. *Agropyron subsecundum* (Link) Hitchc., Amer. Jour. Bot. 21: 131. 1934.

Triticum subsecundum Link, Hort. Berol. 2: 190. 1833.

San Francisco Peaks (Coconino County), 7,000 feet, moist meadows and open woods. Newfoundland to Alaska, south to West Virginia, Missouri, Arizona, and California.

6. *Agropyron scribneri* Vasey, Torrey Bot. Club Bul. 10: 128. 1893.

San Francisco Peaks (Coconino County), alpine slopes, July to September. Montana and Idaho to New Mexico and Arizona.

7. *Agropyron saxicola* (Scribn. and Smith) Piper, Contrib. U. S. Natl. Herbarium 11: 148. 1906.

Elymus saxicola Scribn. and Smith, U. S. Dept. Agr., Div. Agrost. Bul. 11: 56. 1898.

Low, open ground near Prescott, Yavapai County (*Hitchcock* 13195). South Dakota to Washington, south to Arizona and California.

8. *Agropyron spicatum* (Pursh) Scribn. and Smith, U. S. Dept. Agr., Div. Agrost. Bul. 4: 33. 1897.

Festuca spicata Pursh, Fl. Amer. Sept. 1: 83. 1814.

Cochise County, in the Chiricahua Mountains, 7,500 feet (*Blumer* 1495), also in the Huachuca Mountains (*Peebles* et al. 3421), rocky slopes, plains, and dry open woods, June to October. Michigan to Alaska, south to New Mexico, Arizona, and California.

9. *Agropyron arizonicum* Scribn. and Smith, U. S. Dept. Agr., Div. Agrost. Bul. 4: 27. 1897.

Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,000 feet, rocky slopes, late July to October, type from the Rincon Mountains (*Nealley* 67). Western Texas to Nevada, Arizona, California, and Chihuahua.

20. ELYMUS. WILD-RYE

Cespitose or rhizomatous perennials, with usually broad, flat leaf blades and slender or sometimes dense spikes; spikelets 2- to 6-flowered, more or less dorsio-ventral to the axis; glumes equal, firm or indurate, somewhat asymmetric; lemmas rounded on the back, awnless or awned from the tip.

These grasses are utilized as forage mainly before maturity, when they become too coarse. Mammoth wild-rye (*E. giganteus*) is cultivated occasionally for ornament.

Key to the species

1. Plants with slender creeping rhizomes; spikelets often solitary, rather irregularly placed on the axis..... 1. *E. TRITICOIDES*.
1. Plants without creeping rhizomes, or these short and stout in *E. condensatus* (2).
2. Spikelets awnless; glumes narrow or subulate, obscurely nerved, not broadened above the base (3).
3. Spikes large, thick, often compound; spikelets 2 to 4 at each node; culms usually tall and stout..... 2. *E. CONDENSATUS*.
3. Spikes narrow, slender, loosely flowered; most of the spikelets solitary; culms relatively slender..... 3. *E. SALINA*.

2. Spikelets awned; glumes rather prominently nerved, broadened above the base (4).
 4. Glumes relatively thin, not indurate at base..... 4. *E. GLAUCUS*.
 4. Glumes indurate at base, rather prominently bowed out (5).
 5. Awns flexuous, divergent, implicate; base of the glumes not terete.
 5. Awns straight, erect; base of the glumes terete, usually straw-colored.
 5. *E. CANADENSIS*.
 6. *E. VIRGINICUS*.

1. *Elymus triticoides* Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 99. 1862.

Navajo, Coconino, Yavapai, and Pima Counties, 2,500 to 7,000 feet, rocky hills, canyons, and open woods, May to October. Montana and Washington to Texas, Arizona, California, and Baja California.

2. *Elymus condensatus* Presl, Reliq. Haenk. 1: 265. 1830.

Oak Creek, Yavapai or Coconino County (*Rusby* 908, 909½), near Prescott (*Harrison* 7203), dry plains and slopes, June to September. Minnesota to Washington, south to Arizona and California.

3. *Elymus salina* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 725. 1895.

North end of Carrizo Mountains, Apache County (*Standley* 7466), Bright Angel Trail, Coconino County (*Silveus* 1923), dry hills. Wyoming, Idaho, Utah, and Arizona.

4. *Elymus glaucus* Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 99. 1862.

Coconino, Graham, Gila, Maricopa, and Pima Counties, 1,500 to 7,000 feet, open woods, thickets, and along streams, April to September. Ontario and Michigan to Alaska, south through Montana to Arizona and California.

5. *Elymus canadensis* L., Sp. Pl. 83. 1753.

Apache, Navajo, Coconino, Yavapai, Cochise, and Pima Counties, at medium altitudes, moist ground along streams, thickets, and open ground, July to October. Quebec to Alaska, south to North Carolina, Mississippi, Texas, Arizona, and California.

A form with larger, stouter, scarcely nodding spikes, var. *robustus* (Scribn. and Smith) Mackenz. and Bush (*Elymus robustus* Scribn. and Smith), has been collected on the Hopi Indian Reservation (*Hough* 68).

6. *Elymus virginicus* L., Sp. Pl. 84. 1753.

Oak Creek, Coconino or Yavapai County, 3,200 feet (*Rusby* 909), moist ground, low woods, and along streams. Newfoundland to Alberta, south to Florida and Arizona.

21. SITANION. SQUIRRELTAIL

Tufted perennial with firm, narrow leaf blades and rather dense bushy spikes; spikelets 2- to few-flowered; glumes firm, very narrow, extending into long, scabrous, divergent awns, sometimes with a short bristle from the margins; lemmas firm, rounded on the back, minutely bifid, the midnerve extending into a long divergent awn.

1. **Sitanion hystrix** (Nutt.) J. G. Smith, U. S. Dept. Agr., Div. Agrost. Bul. 18: 15. 1899.

Aegilops hystrix Nutt., Gen. Pl. 1: 86. 1818.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 2,000 to 11,500 feet, open sandy ground, rocky hills, and open pine woods, March to September. South Dakota to British Columbia, south to Missouri, Texas, Arizona, and Mexico.

Eaten when young by livestock. The mature awns penetrate the flesh of grazing animals, causing inflammation.

22. HORDEUM. BARLEY

Annuals or perennials with flat leaf blades and dense, bristly spikes; spikelets 1-flowered, 3 at each node of the articulate rachis, the middle one sessile, the lateral ones pedicelled, usually imperfect, sometimes reduced to bristles; glumes narrow or subulate; lemmas with back turned toward the rachis, rounded, obscurely nerved, tapering into an awn.

The wild barleys are grazed before maturity. Some of them are aggressive weeds. The "beards" and the sharp joints of the spikes injure stock by piercing their mouths and nostrils, and get into wool, causing sores when they penetrate the skin. Common cultivated barley is *H. vulgare* L.

Key to the species

1. Plants perennial (2).
 2. Awns 2 to 5 cm. long; spike nodding----- 1. *H. JUBATUM*.
 2. Awns mostly less than 1 cm. long; spike erect----- 2. *H. NODOSUM*.
1. Plants annual (3).
 3. Glumes ciliate, except the outer ones of the lateral spikelets. 3. *H. MURINUM*.
 3. Glumes not ciliate (4).
 4. Glumes of the central spikelet and first glume of the lateral spikelets dilated above the base----- 4. *H. PUSILLUM*.
 4. Glumes not dilated, setaceous or reduced to awns (5).
 5. Culms freely branching, decumbent-spreading; glumes and awns stout, rigid----- 5. *H. GUSSONIANUM*.
 5. Culms nearly simple, geniculate but not decumbent-spreading at base; glumes and awns slender----- 6. *H. ADSCENDENS*.

1. **Hordeum jubatum** L., Sp. Pl. 85. 1753.

Apache, Navajo, Coconino, and Maricopa Counties, up to 7,500 feet, a common weed in moist open ground, along ditches, and waste places, June to September. Newfoundland to Alaska, south to Maryland, Missouri, Texas, Arizona, and California.

A form with awns 1.5 to 3 cm. long is var. *caespitosum* (Scribn.) Hitchc.

2. **Hordeum nodosum** L., Sp. Pl. ed. 2, 126. 1762.

Apache, Coconino, Greenlee, Maricopa, Cochise, and Pima Counties, up to 9,800 feet, meadows and open ground, June to October. Alaska to Montana, south to New Mexico, Arizona, and California, introduced in a few localities in the Eastern States.

3. **Hordeum murinum** L., Sp. Pl. 85. 1753.

Coconino, Pinal, Maricopa, Cochise, and Pima Counties, a weed in cultivated ground and waste places, mostly April to June. Maine to

Georgia and Alabama; British Columbia to western Texas, Arizona, and California; introduced from Europe.

4. *Hordeum pusillum* Nutt., Gen. Pl. 1: 87. 1818.

Yavapai, Maricopa, and Pima Counties, open ground and waste places, March to June. Delaware to Washington, south to Florida, Arizona, and California; South America.

5. *Hordeum gussonianum* Parl., Fl. Palerm. 1: 246. 1845.

Coconino and Pinal Counties, a weed along ditches, June. British Columbia to Utah, Arizona, and California, also Maine and New Jersey; introduced from Europe.

6. *Hordeum adscendens* H. B. K., Nov. Gen. et Sp. 1: 280. 1816.

Pinal, Maricopa, and Pima Counties, roadsides, along ditches, and in waste places, April to May. Arizona and Mexico.

23. LOLIUM. RYEGRASS

Annuals or perennials with flat leaf blades and usually long, slender spikes; spikelets several-flowered, placed edgewise to the rachis, the first glume wanting; lemmas rounded on the back, obtuse, acute, or awned.

Perennial ryegrass (*L. perenne*) and Italian ryegrass (*L. multiflorum*) are cultivated as forage grasses and in lawns. Darnel (*L. temulentum*), which is presumably the "tares" of the Bible, contains in its grains a narcotic poison, but it is uncertain whether the toxin is elaborated by the plant itself or is due to fungus infection. All of the Arizona species are introductions from the Old World.

Key to the species

- | | |
|--|---------------------------|
| 1. Plant annual; glume exceeding the spikelet..... | 3. <i>L. TEMULENTUM.</i> |
| 1. Plants perennial; glume much shorter than the spikelet (2). | |
| 2. Lemmas awnless..... | 1. <i>L. PERENNE.</i> |
| 2. Lemmas, all or some of them, awned..... | 2. <i>L. MULTIFLORUM.</i> |

1. *Lolium perenne* L., Sp. Pl. 83. 1753.

Kaibab Plateau near the Grand Canyon (Coconino County), Sacaton Experiment Farm (Pinal County), meadows and waste places. Newfoundland to Alaska, south to Virginia, Arizona, and California.

2. *Lolium multiflorum* Lam., Fl. Franç. 3: 621. 1778.

Tempe (Maricopa County), Huachuca Mountains (Cochise County), open ground and waste places. Range about same as that of *L. perenne*.

3. *Lolium temulentum* L., Sp. Pl. 83. 1753.

Pinal and Pima Counties, a weed in cultivated fields and along ditches. Massachusetts and Wisconsin, south to Georgia and Texas; Washington to Arizona, and California.

24. SCHISMUS

Low annual with short, slender leaf blades and small rather dense panicles; spikelets several-flowered; glumes acute, subequal, nearly as long as the spikelets; lemmas broad, rounded on the back, bidentate,

pilose on the lower part of the margins; palea broad, hyaline, the nerves near the margins.

1. **Schismus barbatus** (L.) Thell., *Herbier Boissier Bul.*, ser. 2, 7: 391. 1907.

Festuca barbata L., *Amoen. Acad.* 3: 400. 1756.

Pinal and Maricopa Counties, 1,100 to 2,000 feet, growing in great abundance on the open desert, where it is an important spring range grass. Arizona and California; introduced from the Old World.

25. KOELERIA. JUNEGRASS

Tufted perennial with narrow blades and shining spikelike panicles; spikelets 2- to 4-flowered, the rachilla prolonged beyond the florets as a slender bristle; glumes dissimilar, the first narrow, 1-nerved, the second broadened above the middle, 3- to 5-nerved; lemmas pale, shining, acute, awnless.

1. **Koeleria cristata** (L.) Pers., *Syn. Pl.* 1: 97. 1805.

Aira cristata L., *Sp. Pl.* 63. 1753.

Apache County to Coconino and Yavapai Counties, south to Cochise and Pima Counties, up to 8,500 feet, dry plains, rocky ground, and pine woods, May to October. Ontario to British Columbia, south to Delaware, Missouri, Louisiana, Arizona, California, and Mexico.

The plant affords summer forage in the mountains.

26. SPHENOPHOLIS. WEDGESCALE

Slender perennials with flat leaf blades and narrow, often dense, shining panicles; spikelets 2- or 3-flowered; pedicel disarticulating below the glumes; rachilla produced beyond the upper floret; first glume narrow, acute, the second broadly obovate; lemmas firm, awnless, the first usually a little longer than the second glume.

Key to the species

1. Panicle dense, often spikelike, erect; second glume very broad, obtuse.
 1. Panicle rather loose, nodding, never spikelike; second glume subacute.

1. *S. OBTUSATA.*

2. *S. INTERMEDIA.*

1. **Sphenopholis obtusata** (Michx.) Scribn., *Rhodora* 8: 144. 1906.

Aira obtusata Michx., *Fl. Bor. Amer.* 1: 62. 1803.

Eatonia obtusata A. Gray, *Man. ed.* 2, 558. 1856.

Apache, Navajo, Coconino, Yavapai, Cochise, and Pima Counties, moist ground and open woods at medium altitudes, May to July. Maine to British Columbia, south to Florida, Arizona, California, and Mexico.

2. **Sphenopholis intermedia** (Rydb.) Rydb., *Torrey Bot. Club Bul.* 36: 533. 1909.

Eatonia intermedia Rydb., *ibid.* 32: 602. 1905.

Fort Apache, Navajo County (*Palmer 577*), Fort Huachuca, Cochise County (*Palmer 467*), moist ground and shady places. Newfoundland to British Columbia, south to Florida and Arizona.

27. TRisetum

Tufted perennials with flat leaf blades and open or spikelike, usually shining panicles; spikelets 2- or 3-flowered; rachilla prolonged beyond the upper floret, usually villous; glumes acute, the second a little longer than the first; lemmas 2-toothed, bearing from just below the cleft a bent exerted awn.

Key to the species

1. Plants annual; spikelets disarticulating below the glumes; rachilla pubescent----- 1. *T. INTERRUPTUM*.
 1. Plants perennial; spikelets disarticulating above the glumes; rachilla villous (2).
 2. Panicles dense, spikelike, more or less interrupted below. 2. *T. SPICATUM*.
 2. Panicles open, rather densely flowered but not spikelike. 3. *T. MONTANUM*.
 1. **Trisetum interruptum** Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 100. 1862.

Santa Rita Mountains, Pima County (*Pringle* in 1884). Dry or moist open ground, Texas, Colorado, New Mexico, and Arizona.

2. **Trisetum spicatum** (L.) Richt., Pl. Eur. 1: 59. 1890.

Aira spicata L., Sp. Pl. 64. 1753.

Trisetum subspicatum Beauv., Ess. Agrost. 88, 149. 1812.

Summit of Baldy Peak (Apache County), San Francisco Peaks (Coconino County), alpine slopes and meadows, 10,500 to 12,000 feet. Arctic America, south to Connecticut, Pennsylvania, Minnesota, and in the mountains to New Mexico, Arizona, and California; high mountains of Mexico and South America; alpine regions of the Old World.

3. **Trisetum montanum** Vasey, Torrey Bot. Club Bul. 13: 118. 1886.

Pinaleno Mountains, Graham County, 9,500 feet (*Kearney* and *Peebles* 9970). Mountain slopes and meadows, Colorado, Utah, New Mexico, and Arizona.

28. DESCHAMPSIA. HAIRGRASS

Annuals or perennials with narrow or open, shining panicles; spikelets 2-flowered, the hairy rachilla prolonged beyond the upper floret, sometimes bearing a rudimentary floret; glumes equal, acute; lemmas thin, erose-truncate with a straight or bent and twisted awn from or below the middle.

Key to the species

1. Plants annual; panicle open, the stiffly ascending capillary branches usually in 2's----- 1. *D. DANTHONIOIDES*.
 1. Plants perennial; panicle narrow or open, the slender branches appressed or drooping (2).
 2. Glumes usually longer than the florets; panicle usually narrow, as much as 30 cm. long, the branches appressed; leaf blades filiform, lax. 2. *D. ELONGATA*.
 2. Glumes shorter than the florets; panicle open, nodding, 10 to 25 cm. long, the branches drooping; leaf blades firm, flat or folded. 3. *D. CAESPITOSA*.

1. *Deschampsia danthonioides* (Trin.) Munro in Benth., Pl. Hartw. 342. 1857.

Aira danthonioides Trin., Acad. St. Pétersb. Mém. VI Math. Phys. Nat. 1: 57. 1830.

Arizona, without definite locality (*Lemmon* 386 in 1882). Dry or moist open ground, Alaska to Montana, south to Arizona and Baja California; Texas; Chile.

2. *Deschampsia elongata* (Hook.) Munro in Benth., Pl. Hartw. 342. 1857.

Aira elongata Hook., Fl. Bor. Amer. 2: 243. 1840.

Pinaleno Mountains (Graham County), Santa Catalina Mountains (Pima County), about 7,500 to 9,100 feet, moist or dry open ground. Alaska to Wyoming, Arizona, California, and Mexico.

3. *Deschampsia caespitosa* (L.) Beauv., Ess. Agrost. 91, 149, 160. 1812.

Aira caespitosa L., Sp. Pl. 64. 1753.

Apache, Coconino, and Cochise Counties, up to 9,500 feet, damp or wet mountain meadows, June to September. Greenland to Alaska, south to North Carolina, Illinois, North Dakota, New Mexico, Arizona, and California; also in the Old World.

This species affords excellent forage in mountain meadows.

29. AVENA. OAT

Annuals with relatively broad leaf blades and open panicles of large spikelets; spikelets 2- or 3-flowered; rachilla villous; glumes equal, several-nerved, exceeding the florets; lemmas indurate, bidentate, hairy, bearing a dorsal bent or twisted awn.

The wild oats are often troublesome weeds but occasionally are useful for hay and pasturage. The long-awned fruits are injurious to the mouths of animals. The commonly cultivated oat is *Avena sativa* L.

Key to the species

1. Teeth of the lemma acute; pedicels rather stout----- 1. A. FATUA.
1. Teeth of the lemma setaceous; pedicels curved, capillary--- 2. A. BARBATA.

1. *Avena fatua* L., Sp. Pl. 80. 1753.

Apache, Gila, Pinal, Cochise, and Pima Counties, in waste places. Maine to Pennsylvania, Missouri, South Dakota, New Mexico, Arizona, and California; introduced from Europe.

2. *Avena barbata* Brot., Fl. Lusit. 1: 108. 1804.

Tucson, Pima County (*Toumey* 747). A weed in waste places, Washington to California and Arizona.

30. HOLCUS. VELVET GRASS

Tufted perennial with flat, velvety-pubescent leaf blades and compact panicles; spikelets 2-flowered, the pedicel disarticulating below the glumes; glumes nearly equal, longer than the florets; first floret perfect, the lemma awnless; second floret staminate, the lemma bearing a short recurved awn from the back near the apex.

1. *Holcus lanatus* L., Sp. Pl. 1048. 1753.

Flagstaff (Coconino County), about 7,000 feet, meadows and moist places. Widely distributed in North America, introduced from Europe.

Occasionally cultivated in meadows in the eastern United States. It is reported that the plant, either fresh or wilted, sometimes develops hydrocyanic acid.

31. DANTHONIA. OATGRASS

Tufted perennial with small open panicles of rather large spikelets; spikelets several-flowered; glumes equal, broad, papery, exceeding the florets; lemma rounded on the back, bifid, the lobes acute, with a stout, flat, twisted, geniculate awn from between the lobes.

1. *Danthonia intermedia* Vasey, Torrey Bot. Club Bul. 10: 52. 1883.

White Mountains, Apache County (*Griffiths* 5350). Wet meadows in northern or alpine regions, Quebec to Alaska, south to Michigan, New Mexico, Arizona, and California.

32. CALAMAGROSTIS. REEDGRASS

Erect, rhizomatous perennials with firm, flat or loosely involute leaf blades and spikelike or narrow and open panicles; glumes equal, acute or acuminate; rachilla prolonged beyond the floret, hairy; lemma shorter than the glumes, the callus bearded, the midnerve exerted as an awn.

Several species of this genus are important forage grasses in other regions. Bluejoint reedgrass (*C. canadensis*) is a source of much of the wild hay in Wisconsin and Minnesota. In some parts of the United States, northern reedgrass (*C. inexpansa*) is grazed by horses and cattle.

Key to the species

1. Panicle nodding, rather loose and open; callus hairs copious, about as long as the lemma..... 1. *C. CANADENSIS*.
1. Panicle erect, dense or spikelike (2).
 2. Leaf blades flat; glumes 4 to 6 mm. long; panicle moderately dense. 2. *C. SCOPULORUM*.
 2. Leaf blades involute; glumes 3 to 4 mm. long; panicle spikelike, more or less interrupted below; culms scabrous below the inflorescence. 3. *C. INEXPANSA*.

1. *Calamagrostis canadensis* (Michx.) Beauv., Ess. Agrost. 15, 152, 157. 1812.

Arundo canadensis Michx., Fl. Bor. Amer. 1: 73. 1803.

Kaibab Plateau (Coconino County), Pinaleno Mountains (Graham County), Rincon Mountains (Pima County), 7,400 to 9,500 feet, wet places and open woods. Greenland to Alaska, south to North Carolina, Kansas, New Mexico, Arizona, and California.

2. *Calamagrostis scopulorum* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 722. 1895.

Kaibab Trail to Roaring Springs, Grand Canyon, Coconino County (*Eastwood* and *Howell* 7075). Moist soil, Wyoming, Colorado, Utah, New Mexico, and Arizona.

3. Calamagrostis inexpansa A. Gray, Gram. and Cyp. 1: No. 20. 1834.

White Mountains (Apache County), Willow Spring (Apache or Coconino County), wet meadows above 5,000 feet, July to September. Greenland to Alaska, south to Massachusetts, Indiana, Nebraska, New Mexico, Arizona, and California.

33. CALAMOVILFA. SANDREED

Coarse, tall perennial with stout, creeping rhizomes, long, attenuate leaf blades, and large, open panicles; glumes firm, 1-nerved, the first glume half as long, the second one as long as the floret; lemma chartaceous, acute, awnless, the callus densely bearded with hairs nearly half as long as the lemma.

1. Calamovilfa gigantea (Nutt.) Scribn. and Merr., U. S. Dept. Agr., Div. Agrost. Cir. 35: 2. 1901.

Calamagrostis gigantea Nutt., Amer. Phil. Soc. Trans., n. s., 5: 143. 1837.

Apache, Navajo, and Coconino Counties, sand hills, July to October. Kansas and Utah to Texas and Arizona.

This grass is a valuable sand binder. The reedlike stems are used by the Hopi Indians for various purposes.

34. AGROSTIS. BENTGRASS

Slender perennials with flat or involute leaf blades and dense or very open panicles of small spikelets; glumes equal, acute, longer than the floret; lemma much thinner than the glumes, awnless; palea minute or sometimes nearly as long as the lemma.

Most of the species are important forage grasses. Redtop bentgrass (*A. alba*) and creeping bentgrass (*A. palustris*) are utilized for pastures and lawns. Spike bentgrass (*A. exarata*) is an important forage grass in the western United States.

Key to the species

1. Palea present, at least half as long as the lemma (2).
2. Glumes scabrous over the back; palea nearly as long as the lemma; panicle dense, lobed, the branches short, densely flowered. 1. *A. SEMIVERTICILLATA*.
2. Glumes scabrous only on the keel; palea about half as long as the lemma; panicle open or sometimes contracted but not lobed, the branches loosely flowered (3).
3. Culms erect; rhizomes present; panicle open, the branches ascending. 2. *A. ALBA*.
3. Culms usually decumbent at base; rhizomes none; panicle contracted, the branches appressed. 3. *A. PALUSTRIS*.
1. Palea wanting or only a small nerveless scale, (rarely longer) (4).
4. Panicle open, the usually long, very scabrous branches widely spreading or drooping, bearing spikelets only toward the ends. 4. *A. SCABRA*.
4. Panicle contracted, the short, densely-flowered branches appressed, floriferous from the base or nearly so. 5. *A. EXARATA*.

1. Agrostis semiverticillata (Forsk.) C. Chr., Dansk. Bot. Arkiv. 4³: 12. 1922.

Apache County to Coconino County, south to Cochise and Pima Counties, at low altitudes, wet ground, especially along streams and ditches, May to October. Texas to Washington, Arizona, and California; introduced from the Old World.

2. *Agrostis alba* L., Sp. Pl. 63. 1753; ed. 2, 93. 1762.

Apache, Coconino, Yavapai, and Greenlee Counties, moist ground and waste places. Throughout the cooler regions of North America; apparently introduced from the Old World.

3. *Agrostis palustris* Huds., Fl. Angl. 27. 1762.

Yavapai, Gila, and Pinal Counties, in damp places along streams and ditches, June to August, introduced in Arizona. Newfoundland to Maryland and British Columbia, south to Arizona and northern California; Eurasia.

4. *Agrostis scabra* Willd., Sp. Pl. 370. 1797.

Apache, Coconino, Yavapai, Graham, Cochise, and Pima Counties, moist ground up to 8,500 feet, May to September. Newfoundland to Alaska, south to Maryland, Illinois, Nebraska, New Mexico, Arizona, and California, rarely in the Southeastern States.

This plant has been referred by authors to *A. hiemalis*, which is a distinct species confined to the Southeastern States.

5. *Agrostis exarata* Trin., Gram. Unifl. 207. 1824.

Agrostis filiculmis M. E. Jones, Contrib. West. Bot. 14:13. 1912.

Apache, Coconino, Yavapai, Graham, Cochise, and Pima Counties, moist ground up to 7,000 feet, June to September. Nebraska to Alberta and Alaska, south to California and Mexico.

35. ALOPECURUS. FOXTAIL

Semiaquatic annuals or perennials with flat leaf blades and soft, spikelike panicles; glumes equal, united at base, ciliate on the keel; lemma about as long as the glumes, with margins united at base, bearing from below the middle a straight or geniculate, included or exerted awn; palea wanting.

All of the species are palatable and nutritious, but these grasses are not common enough in Arizona to be important.

Key to the species

1. Awns straight, included or only slightly longer than the glumes; plants perennial.
 1. *A. AEQUALIS*.
1. Awns geniculate, twisted below, much longer than the glumes (2).
 2. Plants perennial; anthers 1.5 mm. long ----- 2. *A. GENICULATUS*.
 2. Plants annual; anthers about 0.5 mm. long ----- 3. *A. CAROLINIANUS*.

1. *Alopecurus aequalis* Sobol., Fl. Petrop. 16. 1799.

Alopecurus fulvus J. E. Smith in Sowerby, Eng. Bot. 21: pl. 1467. 1805.

Apache, Coconino, and Yavapai Counties, 5,000 to 9,000 feet, bogs and wet ground, June to August. Greenland to Alaska, south to Pennsylvania, Kansas, New Mexico, Arizona, and California; Eurasia.

2. *Alopecurus geniculatus* L., Sp. Pl. 60. 1753.

Apache, Coconino, and Pima Counties, 2,000 to 9,000 feet, marshes and wet ground, July to September. Newfoundland to British Columbia, south to Virginia, Arizona, and California; Eurasia.

3. Alopecurus carolinianus Walt., Fl. Carol. 74. 1788.

Payson (Gila County), Rincon Mountains (Pima County), about 5,000 feet, wet ground, May to June. New Jersey to British Columbia, south to Florida, Arizona, and California.

36. POLYPOGON

Decumbent annuals or perennials with flat, scabrous leaf blades, and dense, narrow or spikelike panicles; glumes equal, entire or minutely lobed, awned from the tip or from between the lobes, the awns slender, usually longer than the glumes; lemma thin, hyaline, about half as long as the glumes.

Key to the species

1. Plants annual; glumes minutely lobed, the awns very slender, 6 to 8 mm. long; panicles very dense, spikelike----- 1. *P. MONSPELIENSIS*.
1. Plants perennial; glumes not lobed, the awn not more than 5 mm. long; panicles moderately dense (2).
 2. Glumes abruptly narrowed above, the awn 2.5 to 5 mm. long.
 2. *P. LUTOSUS*.
 3. *P. ELONGATUS*.
 2. Glumes gradually tapering into a short awn, this 1 to 2 mm. long.

1. Polygogon monspeliensis (L.) Desf., Fl. Atlant. 1: 67. 1798.

Alopecurus monspeliensis L., Sp. Pl. 61. 1753.

Coconino, Yavapai, Pinal, Maricopa, Pima, and Cochise Counties, waste places at low altitudes, April to October. New Brunswick to Alaska, south to Virginia, mostly near the coast, and common in the Western States from Washington to Nebraska, south to Texas, Arizona, and California; introduced from Europe.

Sometimes known as rabbitfoot grass.

2. Polygogon interruptus H. B. K., Nov. Gen. et Sp. 1: 134. pl. 44. 1815.

Alopecurus interruptus Peir. in Lam., Encycl. Sup. 5: 495. 1817.

Apache, Navajo, Pima, and Santa Cruz Counties, along ditches and streams at low altitudes, May to September. British Columbia to California and Arizona, east to Louisiana; Mexico to Argentina.

3. Polygogon elongatus H. B. K., Nov. Gen. et Sp. 1: 134. 1815.

Madera Canyon, Santa Rita Mountains, Pima County (*Silveus* 3488), along ditches, streams, and in wet places. Arizona; Mexico to Argentina.

37. LYCURUS. WOLFTAIL

Rather low, slender, tufted perennial with short narrow leaf blades and narrow, bristly spikelike panicles; spikelets in pairs, the lower one sterile; glumes equal, the first usually 2-awned, the second 1-awned; lemma longer than the glumes, tapering into a slender awn, pubescent on the margins; palea acute, nearly as long as the lemma, pubescent.

1. Lycurus phleoides H. B. K., Nov. Gen. et Sp. 1: 142. 1815.

Apache, Yavapai, Pinal, Cochise, Pima, and Santa Cruz Counties, 4,000 to 6,000 feet, dry rocky hills and plains, July to October. Colorado and Utah to Texas, Arizona, and Mexico.

Sometimes called Texas-timothy, a common and important forage grass in Arizona.

38. PHLEUM. TIMOTHY

Densely tufted perennials with flat leaf blades and dense cylindric panicles; glumes equal, abruptly awned, keeled, the keels ciliate; lemma much shorter than the glumes, hyaline, truncate; palea narrow, a little shorter than the lemma.

Common timothy (*P. pratense*) is a very valuable hay plant in the northeastern United States. It has been demonstrated that, under favorable conditions, this grass can be established on depleted western ranges.

Key to the species

1. Culms mostly more than 50 cm. high, erect from a swollen bulblike base; panicle narrow, several times longer than wide----- 1. *P. PRATENSE*.
1. Culms 20 to 50 cm. high from a decumbent somewhat creeping base; panicle usually not more than twice as long as wide, bristly----- 2. *P. ALPINUM*.

1. *Phleum pratense* L., Sp. Pl. 59. 1753.

Flagstaff (Coconino County), Pinal Peak (Gila County), Tucson (Pima County), in wet ground. Escaped from cultivation throughout the United States; introduced from the Old World.

2. *Phleum alpinum* L., Sp. Pl. 59. 1753.

Apache and Coconino Counties, wet meadows at high altitudes, July to September. Greenland to Alaska, south to New Hampshire, Michigan, and in the Western States to New Mexico, Arizona, and California; Eurasia.

39. MUHLENBERGIA. MUHLY

Annuals or (usually) perennials, tufted or rhizomatous, with simple or branching culms and narrow or open panicles; glumes usually much shorter than the lemma, sometimes as long as the lemma in robust species with narrow panicles; lemma firm, 3-nerved, with a very short, usually minutely pilose callus, awned or sometimes only mucronate.

This, the largest genus of grasses in Arizona, comprises several species of high forage value. Among the most important of these on Arizona ranges are mountain muhly (*M. montana*), New Mexican muhly (*M. pauciflora*), ring muhly (*M. torreyi*), and spike muhly (*M. wrightii*). Sandhill muhly (*M. pungens*) furnishes forage in sandy areas in the valley of the Little Colorado River and is used by the Hopi in making brushes. Bush muhly (*M. porteri*) seeks the protection of shrubs, and cattle utilize it mainly in winter when other grasses become scarce. Aparejoggrass (*M. utilis* and *M. repens*) has been used to stuff improvised pack saddles.

Key to the species

1. Plants annual (2).
2. Panicles narrow, few-flowered, the branches appressed; culms usually erect (3).
 3. Lemma awned, the awn 2 to 10 mm. long; glumes as long as the body of the lemma, acuminate; culms 3 to 6 cm. high-- 4. *M. DECAUPERATA*.
 3. Lemma awnless----- 5. *M. FILIFORMIS*.
2. Panicles open, the branches ascending or spreading; culms usually widely decumbent-spreading at base (4).
 4. Glumes pilose----- 3. *M. TEXANA*.

4. Glumes glabrous (5).
 5. Panicle branches closely appressed, densely flowered; spikelets appressed; lemma ciliate, the awn 10 to 30 mm. long; glumes awn-pointed----- 1. *M. PECTINATA*.
5. Panicle branches ascending, loosely flowered; spikelets somewhat spreading; lemma not ciliate, the awn 10 to 30 mm. long; glumes obtuse; lower sheaths inflated, enclosing cleistogamous spikelets.
 2. *M. MICROSPERMA*.
1. Plants perennial (6).
 6. Plants with prominent scaly creeping rhizomes: See also *M. polycaulis* (7).
 7. Panicles open; spikelets on slender, rather long, usually spreading pedicels (8).
 8. Panicle branches 3 to 5, divided into fascicles of capillary, finally spreading, very scabrous branchlets; awn 1 to 1.5 mm. long; leaf blades short, sharp-pointed, involute----- 6. *M. PUNGENS*.
 8. Panicle branches numerous, the branchlets not arranged in fascicles; spikelets 1 to 2 mm. long; lemma acute or mucronate; leaf blades flat, relatively soft (9).
 9. Ligule 1 to 2 mm. long, auriculate----- 7. *M. ARENACEA*.
 9. Ligule minute, without auricles----- 8. *M. ASPERIFOLIA*.
7. Panicles narrow, often condensed; spikelets short pediceled (10).
 10. Leaf blades flat, at least some of them more than 3 mm. wide, lax, spreading (11).
 11. Callus hairs copious, as long as the lemma; panicles silky, often tinged with purple----- 16. *M. ANDINA*.
 11. Callus hairs rather sparse, not more than half as long as the lemma (12).
 12. Glumes awned, the awns exceeding the awnless floret; panicles compact, bristly----- 17. *M. RACEMOSA*.
 12. Glumes acuminate or awn-pointed but not exceeding the lemma; panicles not bristly (13).
 13. Lemma awnless; panicles compactly flowered; blades mostly less than 10 cm. long----- 18. *M. FOLIOSA*.
 13. Lemma awned, the awn 5 to 10 mm. long; panicles rather loosely flowered----- 19. *M. SILVATICA*.
10. Leaf blades involute or, if flat, then less than 2 mm. wide (14).
 14. Culms 1 to 3 meters high, woody at base, as much as 6 mm. thick, freely branching at the middle and upper nodes----- 9. *M. DUMOSA*.
 14. Culms not more than 60 cm. high, usually much less (15).
 15. Leaf blades 5 to 15 cm. long, flat; culms 30 to 60 cm. high, slender, branching from the lower nodes; awn of the lemma 1 to 6 mm. long----- 15. *M. GLAUCA*.
 15. Leaf blades mostly much less than 5 cm. long (16).
 16. Culms widely creeping; blades conspicuously recurved-spreading (17).
 17. Spikelets about 3 mm. long----- 10. *M. REPENS*.
 17. Spikelets about 2 mm. long----- 11. *M. UTILIS*.
 16. Culms erect or decumbent at base, but not widely creeping (18).
 18. Culms nodulose-roughened; glumes about half as long as the floret; ligule 2 to 3 mm. long----- 12. *M. RICHARDSONIS*.
 18. Culms glabrous or pubescent, but not nodulose (19).
 19. Lemma mucronate or short-awned; plants forming dense cushions, the leaves crowded toward base.
 13. *M. THURBERI*.
 19. Lemma with an awn 1 to 5 mm. long; plants forming loose bunches, the leaves not crowded toward base.
 14. *M. CURTIFOLIA*.
6. Plants tufted; rhizomes wanting: See also *M. glauca* (20).
 20. Panicles open or at least loose, the branches naked at base (21).
 21. Culms wiry, freely branching, geniculate, widely spreading.
 29. *M. PORTERI*.
 21. Culms erect or sometimes decumbent at base, but not widely spreading (22).
 22. Leaf blades rarely more (usually much less) than 8 cm. long; culms rather freely branching at the lower nodes (23).
 23. Blades flat or folded, with a conspicuous firm white midnerve and margins----- 30. *M. ARIZONICA*.

23. Blades involute; culms loosely tufted, sometimes forming large cushions, erect from a decumbent base (24).
24. Panicles mostly less than 15 cm. long; blades 1 to 4 cm. long, curled or falcate..... 31. *M. TORREYI*.
24. Panicles mostly more than 20 cm. long; blades commonly 5 to 8 cm. long..... 32. *M. ARENICOLA*.
22. Leaf blades elongate, much more than 8 cm. long (25).
25. Basal sheaths strongly compressed-keeled; glumes nearly as long as the lemma..... 35. *M. EMERSLEYI*.
25. Basal sheaths rounded on the back; glumes much shorter than the lemma (26).
26. Panicles pale or tawny, the slender branches flexuous, ascending or spreading; glumes about half as long as the lemma; awn of the lemma 18 to 25 mm. long..... 33. *M. XEROPHILA*.
26. Panicles dark purple, the capillary branches finally spreading; glumes not more than one-fourth as long as the lemma; awn of the lemma 10 to 15 mm. long..... 34. *M. RIGIDA*.
20. Panicles narrow, dense or spikelike, the branches floriferous from the base (27).
27. Awn usually less than 5 mm. long, occasionally as much as 10 mm. long or the lemma sometimes awnless (28).
28. Panicles spikelike (29).
29. Leaf blades flat, 1 to 3 mm. wide; panicles 5 to 15 cm. long; glumes awn-pointed, distinctly shorter than the lemma.
20. *M. WRIGHTII*.
29. Leaf blades involute; panicles 10 to 30 cm. long; glumes acute or obtuse, nearly as long as the lemma..... 21. *M. RIGENS*.
28. Panicles dense but loosely flowered, never spikelike (30).
30. Spikelets 2 to 3 mm. long; glumes nearly as long as the awnless lemma..... 22. *M. LONGILIGULA*.
30. Spikelets about 4 mm. long; glumes half to two-thirds as long as the lemma, the latter with an awn 3 to 10 mm. long.
23. *M. DUBIODES*.
27. Awn 10 mm. long or longer (31).
31. Second glume 3-toothed; lemma often yellowish; leaves mostly basal, the sheaths becoming flat and loose..... 24. *M. MONTANA*.
31. Second glume entire (32).
32. Old sheaths flat and more or less coiled at base of the plant; spikelets about 5 mm. long; glumes nearly as long as the lemma.
25. *M. VIRESCENS*.
32. Old sheaths never flat or coiled (33).
33. Lemma 4 mm. long, scaberulous; glumes about half as long as the lemma, acuminate or awn-tipped. 28. *M. PATCIFLORA*.
33. Lemma 2.5 to 3 mm. long, pilose on the lower part; glumes at least two-thirds as long as the lemma (34).
34. Culms loosely tufted, hard and wiry at base; floret loosely villous toward base..... 26. *M. POLYCAULIS*.
34. Culms usually densely tufted, slender, not wiry at base; floret densely pilose at base..... 27. *M. MONTICOLA*.

1. *Muhlenbergia pectinata* C. O. Goodding, Wash. Acad. Sci. Jour. 31: 505. 1941.

Mule Mountains (Cochise County) and Sycamore Canyon (Santa Cruz County), wet places below and on the face of cliffs, September. Southeastern Arizona to Jalisco. A delicate spreading annual with narrow panicles and ciliate lemmas, related to *M. ciliata* (DC.) Kunth.

2. *Muhlenbergia microsperma* (DC.) Kunth, R ev. Gram. 1: 64. 1829.

Trichochloa microsperma DC., Cat. Hort. Monsp. 151. 1813.

Mohave, Pinal, Maricopa, Pima, and Yuma Counties, 5,000 feet and lower, rocky slopes and canyons, February to May and at other times after rains. Arizona and southern California to Peru.

3. *Muhlenbergia texana* Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 91. 1862.

West slope of the Mule Mountains, Cochise County (*Goodding* CG 28). Open gravelly ground, western Texas to Arizona and northern Mexico.

4. *Muhlenbergia depauperata* Scribn., Bot. Gaz. 9: 187. 1884.

Muhlenbergia schaffneri Fourn., Mex. Pl. 2: 85. 1886.

Coconino and Cochise Counties, dry gravelly soil and open grassland at medium altitudes, August to October, type from Arizona (*Pringle*). Texas, Colorado, New Mexico, Arizona, and Mexico.

5. *Muhlenbergia filiformis* (Thurb.) Rydb., Torrey Bot. Club Bul. 32: 600. 1905.

Vilfa depauperata var. *filiformis* Thurb. ex S. Wats. in King, Geol. Expl. 40th. Par. 5: 376. 1871.

Apache and Coconino Counties, up to 8,000 feet, meadows and wet places in the mountains. South Dakota and British Columbia, south to Kansas, New Mexico, Arizona, and California.

6. *Muhlenbergia pungens* Thurb. in A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 78. 1863.

Apache, Navajo, and Coconino Counties, 5,000 to 7,000 feet, common on sandy mesas, July to October. South Dakota and Wyoming to New Mexico and Arizona.

7. *Muhlenbergia arenacea* (Buckl.) Hitchc., Biol. Soc. Wash. Proc. 41: 161. 1928.

Sporobolus arenaceus Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 89. 1862.

Sporobolus auriculatus Vasey, Contrib. U. S. Natl. Herbarium 3: 64. 1892.

Dragoon Mountains (Cochise County), Nogales, Santa Cruz County (*Griffiths* 1864). Dry mesas, Texas to Arizona and Sonora.

8. *Muhlenbergia asperifolia* (Nees and Mey.) Parodi, Rev. Buenos Aires Univ. Nac. Facult. Agron. y Vet. 6: 117. 1928.

Vilfa asperifolia Nees and Mey., Acad. St. Pétersb. Mém. VI. Sci. Nat. 4¹: 95. 1840.

Sporobolus asperifolius Nees, Nova Acta Acad. Caes. Leop.-Carol. Nat. Cur. 19: Sup. 1: 9. 1841: 141. 1843.

Apache, Navajo, Coconino, Maricopa, and Pima Counties, dry hills or moist ground at medium altitudes, May to October. Wisconsin to British Columbia south to Mexico; southern South America.

9. *Muhlenbergia dumosa* Scribn. in Vasey, Contrib. U. S. Natl. Herbarium 3: 71. 1892.

Pinal, Maricopa, and Pima Counties, rocky canyon slopes and valleys at low altitudes, March to May, type from the Santa Catalina Mountains (*Pringle* in 1884). Southern Arizona and northwestern Mexico.

10. *Muhlenbergia repens* (Presl) Hitchc. in Jepson, Fl. Calif. 1: 111. 1912.

Sporobolus repens Presl, Reliq. Haenk. 1: 241. 1830.

Apache, Pima, and Santa Cruz Counties, dry open rocky or sandy ground, April to September. Texas to Arizona and Mexico.

- *11. *Muhlenbergia utilis* (Torr.) Hitchc., Wash. Acad. Sci. Jour. 23: 453. 1933.

Vilfa utilis Torr., U. S. Rpt. Expl. Miss. Pacif. 5²: 365. 1857.

Arizona specimens previously referred to *M. utilis* are *M. repens*.

12. *Muhlenbergia richardsonis* (Trin.) Rydb., Torrey Bot. Club Bul. 32: 600. 1905.

Vilfa richardsonis Trin., Acad. St. Pétersb. Mém. VI. Sci. Nat. 4¹: 103. 1840.

Muhlenbergia squarrosa (Trin.) Rydb., Torrey Bot. Club Bul. 36: 531. 1909.

Vicinity of Flagstaff and Kaibab Plateau (Coconino County), low open ground. New Brunswick to Alberta, south to South Dakota, New Mexico, Arizona, California, and Mexico.

13. *Muhlenbergia thurberi* Rydb., Torrey Bot. Club Bul. 32: 601. 1905.

Sporobolus thurberi Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 11: 48. 1898.

Muhlenbergia curtifolia var. *griffithsii* Scribn., Torrey Bot. Club Bul. 38: 328. 1911.

Apache County, about 6,000 feet, dry slopes and sandy ground, July to September. Texas, New Mexico, and Arizona.

14. *Muhlenbergia curtifolia* Scribn., Torrey Bot. Club Bul. 38: 328. 1911.

Apache and Coconino Counties, 7,500 to 8,000 feet, moist or rocky open slopes, July to August, rare. Utah, Nevada, and Arizona.

15. *Muhlenbergia glauca* (Nees) Mez, Repert. Spec. Novarum Regni Veg. 17: 214. 1921.

Podosaemum glaucum Nees, Linnaea 19: 689. 1847.

Muhlenbergia lemmoni Scribn. in Coulter, Contrib. U. S. Natl. Herbarium 1: 56. 1890.

Muhlenbergia huachuca Vasey, Contrib. U. S. Natl. Herbarium 3: 69. 1892.

Dry rocky slopes of the Huachuca and Mule Mountains (Cochise County), about 5,000 feet. Western Texas to California and Mexico.

16. *Muhlenbergia andina* (Nutt.) Hitchc., U. S. Dept. Agr. Bul. 772: 145. 1920.

Calamagrostis andina Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 187. 1848.

Muhlenbergia comata Thurb. ex Benth., Linn. Soc. London Jour. Bot. 19: 83. 1881.

Apache, Navajo, and Coconino Counties, 6,000 to 9,000 feet, moist open ground, August to September. Montana and Washington to New Mexico, Arizona, and California.

17. *Muhlenbergia racemosa* (Michx.) B. S. P., Prelim. Cat. N. Y. 67. 1888.

Agrostis racemosa Michx., Fl. Bor. Amer. 1: 53. 1803.

Apache and Coconino Counties, 4,000 to 8,000 feet, moist ground in canyons and meadows, June to September. Newfoundland to British Columbia, south to Maryland, Kentucky, Oklahoma, and Arizona.

18. *Muhlenbergia foliosa* (Roem. and Schult.) Trin., Gram. Unifl. 190. 1824.

Agrostis foliosa Roem. and Schult., Syst. Veg. 2: 373. 1817.

Chiricahua Mountains, Cochise County, in springy soil along creek, 5,500 feet (*Blumer* 1784). Maine and Quebec to Washington, south to North Carolina, Arkansas, New Mexico, and Arizona.

19. *Muhlenbergia sylvatica* Torr. ex Trin., Acad. St. Pétersb. Mém. VI. Sci. Nat. 4¹: 292. 1841.

Agrostis sylvatica Torr., Fl. North. and Mid. U. S. 1: 87. 1823.

Grapevine Creek, Grand Canyon (*Toumey* 169). Moist woods, Maine to South Dakota, south to Alabama, Texas, and Arizona.

20. *Muhlenbergia wrightii* Vasey in Coulter, Man. Rocky Mount. 409. 1895.

Apache, Coconino, Yavapai, and Pima Counties, plains and open slopes at medium altitudes, July to October. Colorado and Utah to northern Mexico.

21. *Muhlenbergia rigens* (Benth.) Hitchc., Wash. Acad. Sci. Jour. 23: 453. 1933.

Epicampes rigens Benth., Linn. Soc. London Jour. Bot. 19: 88. 1881.

Apache, Coconino, Pinal, Cochise, and Pima Counties, open slopes, canyons, and forests, July to October. Texas to southern California and northern Mexico.

22. *Muhlenbergia longiligula* Hitchc., Amer. Jour. Bot. 21: 136. 1934.

Epicampes ligulata Scribn. in Vasey, Contrib. U. S. Natl. Herbarium 3: 58. 1892.

Epicampes distichophylla var. *mutica* Scribn. in Beal, Grasses North Amer. 2: 308. 1896.

Apache, Navajo, Coconino, Graham, Cochise, and Pima Counties, up to 8,500 feet, canyons and rocky slopes, July to October, type from the Santa Rita Mountains (*Pringle* in 1884). Western New Mexico, Arizona, southern Nevada, and northern Mexico.

23. *Muhlenbergia dubioides* C. O. Goodding, Wash. Acad. Sci. Jour. 30: 20. 1940.

Santa Rita and Santa Catalina Mountains (Pima County), type from Box Canyon (*Silveus* 3490). Known only from these localities.

24. *Muhlenbergia montana* (Nutt.) Hitchc., U. S. Dept. Agr. Bul. 772: 145, 147. 1920.

Calycodon montanum Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 186. 1848.

Muhlenbergia gracilis var. *major* Vasey in Rothr., U. S. Survey West 100th Merid. Rpt. 6: 284. 1878.

Apache, Coconino, Yavapai, Graham, Cochise, and Santa Cruz Counties, 5,000 to 8,500 feet, dry mesas and rocky hills, August and September. Montana and central California to western Texas, Arizona, and southern Mexico.

25. *Muhlenbergia virescens* (H. B. K.) Kunth, Rév. Gram. 1: 64. 1829.

Podosalum virescens H. B. K., Nov. Gen. et Sp. 1: 132. 1815.

Coconino, Gila, Cochise, and Pima Counties, 5,000 to 8,000 feet, rocky hills and mesas, April to June. New Mexico and Arizona to Central Mexico.

26. *Muhlenbergia polycaulis* Scribn., Torrey Bot. Club Bul. 38: 327. 1911.

Santa Catalina and Santa Rita Mountains (Pima County), on rocky slopes. Texas, southern Arizona, and Mexico.

27. *Muhlenbergia monticola* Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 91. 1862.

Cochise and Pima Counties, 6,000 to 8,000 feet, rocky hills and canyons, August to October. Texas to Arizona and central Mexico.

28. *Muhlenbergia pauciflora* Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 91. 1862.

Coconino, Yavapai, Graham, Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,000 feet, dry rocky slopes and canyons, August to October. Western Texas to Colorado, Arizona, and northern Mexico.

29. *Muhlenbergia porteri* Scribn. in Beal, Grasses North Amer. 2: 259. 1896.

Navajo County to Mohave County, south to Cochise, Pima, and Yuma Counties, 1,800 to 5,000 feet, mesas and rocky slopes, August to October. Colorado and Nevada to western Texas, Arizona, California, and northern Mexico.

30. *Muhlenbergia arizonica* Scribn., Torrey Bot. Club Bul. 15: 8. 1888.

Cochise, Pima, and Santa Cruz Counties, 3,500 to 5,500 feet, dry rocky hills and open woods, August to October, type from Arizona near the Mexican boundary (*Pringle*). Arizona and northwestern Mexico.

31. *Muhlenbergia torreyi* (Kunth) Hitchc. in Bush, Amer. Midland Nat. 6: 84. 1919.

Agrostis torreyi Kunth, Rév. Gram. 1: Sup. XVII. 1830.

Muhlenbergia gracillima Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 155. 1856.

Peach Springs (Mohave County), dry open ground around Prescott (Yavapai County), Willow Spring (Apache County), July to September. Western Kansas and Colorado to Texas and Arizona.

32. Muhlenbergia arenicola Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 91. 1862.

Mohave, Yavapai, Cochise, Pima, and Santa Cruz Counties, 4,000 to 7,000 feet, dry mesas and open ground, often forming "fairy rings," August to October. Western Kansas and Colorado to Arizona and northern Mexico.

33. Muhlenbergia xerophila C. O. Goodding, Wash. Acad. Sci. Jour. 30: 19. 1940.

Pima and Santa Cruz Counties, canyons, September to November, type from Sycamore Canyon near Ruby (*L. N. Goodding* M262). Known only from southern Arizona.

34. Muhlenbergia rigida (H. B. K.) Kunth, Rév. Gram. 1: 63. 1829.

Podosaeum rigidum H. B. K., Nov. Gen. et Sp. 1: 129. 1815.

Pima County, 5,000 to 6,000 feet, rocky slopes, September to October. Texas, New Mexico, Arizona, and Mexico.

35. Muhlenbergia emersleyi Vasey, Contrib. U. S. Natl. Herbarium 3: 66. 1892.

Muhlenbergia vaseyana Scribn., Mo. Bot. Gard. Ann. Rpt. 10: 52. 1899.

Yavapai, Pinal, Cochise, Pima, and Santa Cruz Counties, rocky slopes and canyons at medium altitudes, July to October, type from southern Arizona (*Emersley*). Texas to Arizona and Mexico.

40. SPOROBOLUS. DROPSEED

Annuals or perennials with open or spikelike panicles of small spikelets; glumes equal or (usually) unequal, the second often as long as the lemma; lemma membranaceous, 1-nerved, awnless; palea as long as the lemma; fruit free from the lemma and palea.

The perennial species are useful forage plants. Two large coarse bunch grasses, alkali sacaton (*S. airoides*) and sacaton (*S. wrightii*), are important elements of some Arizona ranges, but they are grazed mainly when more succulent grasses are not available. Alkali sacaton thrives on the plains and can withstand rather strongly saline soil conditions. Sacaton reaches its highest development in the bottom lands in the southeastern part of the State. Both species are utilized for hay. Black dropseed (*S. interruptus*), abundant on the plateau south of Flagstaff and in the White Mountains, is one of the most valuable forage grasses in its range. Sand dropseed (*S. cryptandrus*) furnishes some forage. The seeds of several species have been used for food by the Indians of Arizona.

Key to the species

1. Plants annual (2).
 2. Panicles usually included in the sheaths, narrow, few-flowered, spikelike (3).
 3. Spikelets 3 to 5 mm. long; lemma pubescent----- 1. *S. VAGINIFLORUS*.
 3. Spikelets 2 to 3 mm. long; lemma glabrous----- 2. *S. NEGLECTUS*.
 2. Panicles exerted, open, many-flowered (4).
 4. Glumes glabrous; pedicels short, stiff, appressed along the main branches.
 3. *S. RAMULOSUS*.
 4. Glumes pubescent, the pubescence sometimes sparse; pedicels slender, spreading, club-shaped below the spikelets--- 4. *S. MICROSPERMUS*.

1. Plants perennial (5).
5. Spikelets 4 to 6 mm. long (6).
6. Panicle contracted, more or less included in the sheaths; second glume shorter than the glabrous lemma----- 5. *S. ASPER*.
6. Panicle open, exerted; second glume about as long as the lemma.
 6. *S. INTERRUPTUS*.
5. Spikelets 1 to 3 mm. long (7).
7. Spikelets about 1 mm. long; lower panicle branches in distinct whorls.
 7. *S. PYRAMIDATUS*.
7. Spikelets 1.5 to 3 mm. long; lower panicle branches not whorled (8).
8. Sheaths glabrous or nearly so at the mouth (9).
9. Panicle loose, 1 to 2 times as long as broad, the branches naked below, the branchlets spreading; leaf blades mostly involute.
 12. *S. AIROIDES*.
9. Panicle relatively dense, 30 to 60 cm. long, the numerous, relatively short, crowded, densely flowered branches floriferous nearly to base, the branchlets appressed; leaf blades usually flat.
 13. *S. WRIGHTII*.
8. Sheaths with a conspicuous tuft of hairs at summit (10).
10. Panicles open, the branches spreading, naked at base (11).
11. Panicle branches loosely flowered, the branchlets and pedicels implicate, spreading----- 8. *S. FLEXUOSUS*.
11. Panicle branches densely flowered, the branchlets and short pedicels appressed----- 9. *S. CRYPTANDRUS*.
10. Panicles contracted, spikelike (12).
12. Spikelets 2 to 2.5 mm. long; culms slender, usually less than 1 meter high----- 10. *S. CONTRACTUS*.
12. Spikelets 2.5 to 3 mm. long; culms robust, 1 to 2 meters high.
 11. *S. GIGANTEUS*.

1. ***Sporobolus vaginiflorus*** (Torr.) Wood, Class-book, ed. 3, 775. 1861.

Vilfa vaginiflora Torr. in A. Gray, Gram. and Cyp. 1: no. 3. 1834.

Fort Huachuca and Willecox (Cochise County), sandy soil or open waste ground. Maine and Ontario to Minnesota and Nebraska, south to Georgia, Texas, and Arizona.

2. ***Sporobolus neglectus*** Nash, Torrey Bot. Club Bul. 22: 464. 1895.

Black Springs, Coconino National Forest, Coconino County, in deep black gravelly loam (*Talbot* C-13). Quebec and Maine to North Dakota south to Maryland, Tennessee, and Texas; Washington and Arizona.

3. ***Sporobolus ramulosus*** (H. B. K.) Kunth, Rév. Gram. 1: 68. 1829.

Vilfa ramulosa H. B. K., Nov. Gen. et Sp. 1: 137. 1815.

Coconino, Cochise, and Pima Counties, 5,400 to 8,000-feet, dry or moist open ground, August to September. Colorado, New Mexico, and Arizona, to Guatemala.

4. ***Sporobolus microspermus*** (Lag.) Hitchc., Wash. Acad. Sci. Jour. 23: 453. 1933.

Milium microspermum Lag., Gen. et Sp. Nov. 2. 1816.

Sporobolus confusus Vasey, Torrey Bot. Club Bul. 15: 293. 1888.

Navajo County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 8,000 feet, dry or usually moist open ground and borders of marshes, August to October. Nebraska to Montana and eastern Washington, south to Costa Rica.

5. *Sporobolus asper* (Michx.) Kunth, Rév. Gram. 1: 68. 1829.

Agrostis aspera Michx., Fl. Bor. Amer. 1: 52. 1803.

South of Beklohito, Apache County, 6,000 feet, in red sandy loam (Howell 56). Vermont to Iowa, North Dakota, Utah, and Washington, south to Louisiana and Arizona.

6. *Sporobolus interruptus* Vasey, Torrey Bot. Club Bul. 15: 8. 1888.

Navajo, Coconino, and Yavapai Counties, 5,000 to 7,000 feet, dry rocky hillsides, July to September, type from near Flagstaff (Rusby 885). Known only from Arizona.

*7. *Sporobolus pyramidatus* (Lam.) Hitchc., U. S. Dept. Agr. Misc. Pub. 243: 84. 1936.

Agrostis pyramidata Lam., Tabl. Encycl. 1: 161. 1791.

Sporobolus argutus (Nees) Kunth, Rév. Gram. 1, Sup. XVII. 1830.

Arizona specimens previously referred to this species are *S. pulvinatus* Swallen. Kansas and Colorado to Louisiana, Texas, southern Florida, and tropical America.

8. *Sporobolus flexuosus* (Thurb.) Rydb., Torrey Bot. Club Bul. 32: 601. 1905.

Sporobolus cryptandrus var. *flexuosus* Thurb. in S. Wats., Bot. Calif. 2: 269. 1880.

Apache, Navajo, and Coconino Counties, 3,600 to 5,300 feet, dry or moist, open sandy soil, June to October. Western Texas to southern Utah, Arizona, southeastern California, and northern Mexico.

9. *Sporobolus cryptandrus* (Torr.) A. Gray, Man. 576. 1848.

Agrostis cryptandra Torr., Ann. Lyc. N. Y. 1: 151. 1824.

Apache County to Mohave County, south to Cochise and Pima Counties, 1,200 to 6,500 feet, dry open sandy ground and rocky slopes, April to September. Maine and Ontario to Alberta and Washington, south to North Carolina, Indiana, Louisiana, Arizona, and Mexico.

10. *Sporobolus contractus* Hitchc., Amer. Jour. Bot. 2: 303. 1915.

Sporobolus cryptandrus var. *strictus* Scribn., Torrey Bot. Club Bul. 9: 103. 1882.

Sporobolus strictus (Scribn.) Merr., U. S. Dept. Agr., Div. Agrost. Cir. 32: 6. 1901. Not Franch., 1893.

Apache County to Mohave County, south to Cochise and Pima Counties, 1,400 to 5,500 feet, dry mesas, bluffs, and sandhills, August to October, type from Camp Lowell, Pima County (Pringle). Colorado to Nevada, south to western Texas, Arizona, southeastern California, and Sonora.

11. *Sporobolus giganteus* Nash, Torrey Bot. Club Bul. 25: 88. 1898.

Apache, Navajo, and Cochise Counties, 4,500 to 6,000 feet, dry open ground, June to October. Western Texas to Arizona.

12. *Sporobolus airoides* Torr., U. S. Rpt. Expl. Miss. Pacif. 7: 21. 1856.

Agrostis airoides Torr., Ann. Lyc. N. Y. 1: 151. 1824.

Apache, Navajo, Coconino, Yavapai, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,000 to 5,500 feet, often in saline soil, June to October. South Dakota to eastern Washington, south to Texas, Arizona, and southern California.

13. *Sporobolus wrightii* Munro ex Scribn., Torrey Bot. Club Bul. 9: 103. 1882.

Navajo, Coconino, Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,600 feet, dry sandy open ground, rocky slopes, and river banks, July to October, type from Pantano, Pima County (*Pringle*). Western Texas to southern California and central Mexico.

41. BLEPHARONEURON

Densely tufted perennial with slender, flat or involute, more or less flexuous blades, and narrow, open panicles; glumes subobtusely, nearly equal or the second a little longer and broader; lemma broad, abruptly pointed, densely pubescent on the nerves; palea slightly longer than the lemma, densely villous between the nerves.

1. *Blepharoneuron tricholepis* (Torr.) Nash, Torrey Bot. Club Bul. 25: 88. 1898.

Vilfa tricholepis Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 155. 1857.

Apache, Coconino, Graham, Cochise, and Pima Counties, 2,300 to 9,500 feet, dry or moist open woods, July to October. Colorado to Utah, south to Texas, Arizona, and Mexico.

This grass, sometimes known as pine-dropseed, is valuable for forage.

42. ORYZOPSIS. RICEGRASS

Slender perennials with flat or involute blades and narrow or open panicles; glumes equal, gradually or abruptly acuminate; lemma firm, terete, glabrous or villous, with a short rather blunt callus, and a short, straight or weakly geniculate, deciduous awn.

Indian ricegrass (*O. hymenoides*) sometimes known as Indian-millet, furnishes much forage on arid sandy plains in northern Arizona. In former times it was cut for hay and the seeds were utilized for food by the Indians. The other species are palatable but less abundant.

Key to the species

1. Spikelets 3 to 4 mm. long; fruit glabrous or rarely pubescent, 2 to 2.5 mm. long; panicle branches slender, finally spreading, spikelet bearing toward the ends----- 3. *O. MICRANTHA*.
1. Spikelets 6 to 10 mm. long; fruit densely villous, 3 to 5 mm. long (2).
2. Panicle diffuse, the branches in pairs, the branchlets and pedicels divaricately spreading, flexuous; fruit 3 mm. long----- 1. *O. HYMENOIDES*.
2. Panicle rather narrow, the branches stiffly ascending, the branchlets and pedicels usually appressed; fruit 5 mm. long----- 2. *O. BLOOMERI*.

1. **Oryzopsis hymenoides** (Roem. and Schult.) Ricker in Piper, Contrib. U. S. Natl. Herbarium 11: 109. 1906.

Stipa hymenoides Roem. and Schult., Syst. Veg. 2: 339. 1817.
Eriocoma cuspidata Nutt., Gen. Pl. 1: 40. 1818.

Apache, Navajo, Coconino, Mohave, Yavapai, and Pima Counties, dry open woods and sandy plains at medium altitudes, June to August. Manitoba to British Columbia, south to Texas, Arizona, California, and northern Mexico.

2. **Oryzopsis bloomeri** (Boland.) Ricker in Piper, Contrib. U. S. Natl. Herbarium 11: 109. 1906.

Stipa bloomeri Boland., Calif. Acad. Sci. Proc. 4: 168. 1872.

Bright Angel Trail, Grand Canyon, Coconino County (*Silveus* 1927), on a gravelly bank. Dry ground at medium altitudes, Montana to eastern Washington, south to New Mexico, Arizona, and California.

3. **Oryzopsis micrantha** (Trin. and Rupr.) Thurb., Acad. Nat. Sci. Phila. Proc. 1863: 78. 1863.

Urachne micrantha Trin. and Rupr., Acad. St. Pétersb. Mém. VI. Sci. Nat. 5¹: 16. 1842.

Navajo, Coconino, Maricopa, and Pima Counties, 1,800 to 7,000 feet, rocky slopes and dry, open woods, June to August. Saskatchewan to Montana, south to New Mexico and Arizona.

43. PIPTOCHAETIUM. PINYON-RICEGRASS

Densely tufted perennial with narrow or involute leaf blades and open few-flowered panicles; glumes subequal, acute; fruit obovate, dark brown, asymmetric, glabrous or hispid; awn deciduous or persistent, more or less geniculate, often twisted below; palea firm except near the margins, its apex projecting above the lemma as a minute point.

1. **Piptochaetium fimbriatum** (H. B. K.) Hitchc., Wash. Acad. Sci. Jour. 23: 453. 1933.

Stipa fimbriata H. B. K., Nov. Gen. et Sp. 1: 126. 1815.

Cochise, Santa Cruz, and Pima Counties, mostly 5,000 to 6,000 feet, rocky hills, limestone cliffs, and open woods. Western Texas, Arizona, and Mexico.

This grass is reported to make excellent forage.

44. STIPA. NEEDLEGRASS

Tufted perennials with usually involute leaf blades and narrow or sometimes open panicles; spikelets disarticulating above the glumes, the articulation oblique, leaving a sharp, bearded callus on the floret; glumes equal, thin, narrow, longer than the floret; lemma indurate, terete, terminating in a prominent geniculate awn, this twisted below.

These plants, known variously also as feathergrass, speargrass, and porcupinegrass, make good forage while young, but some of the species when mature are injurious, especially to sheep, on account of the sharp-pointed fruits which penetrate the flesh and injure the mouths and eyes of grazing animals. They are a nuisance in wool and damage the hides. Sleepygrass (*S. robusta*) in certain districts

in New Mexico has been reported as having a narcotic effect on horses and slightly on sheep, but not on cattle. The toxic principle is unknown. An Old World species, esparto (*S. tenacissima* L.), is used in the manufacture of fine paper and cordage.

Key to the species

1. Terminal segment of the awn plumose, flexuous, up to 12 cm. long.
 1. *S. NEOMEXICANA*.
1. Terminal segment of the awn not plumose (2).
 2. Lower segment of the once-geniculate awn conspicuously plumose, the hairs 5 to 8 mm. long----- 2. *S. SPECTOSA*.
 2. Lower segment of the awn glabrous, scabrous, or pubescent, but not plumose (3).
 3. Lemma densely villous with white hairs 3 to 4 mm. long; awn once-geniculate----- 3. *S. CORONATA*.
 3. Lemma pubescent or sometimes villous toward the apex, the hairs not more than 2 mm. long (4).
 4. Panicles open, the slender branches ascending or spreading; lemma more than 7 mm. long (5).
 5. Ligule about 2 mm. long; mature lemma dark brown, 7 to 8 mm. long, papillose-pubescent; callus acute, 1 mm. long; awn about 3 cm. long, the terminal segment straight---- 4. *S. PRINGLEI*.
 5. Ligule 3 mm. long or longer; mature lemma pale (6).
 6. Mature lemma 8 to 12 mm. long, glabrous or sparsely pubescent above the callus; callus acuminate, 3 mm. long; awn 10 to 15 cm. long, the terminal segment long and flexuous- 5. *S. COMATA*.
 6. Mature lemma 5 to 7 mm. long, pubescent----- 6. *S. EMINENS*.
 4. Panicles narrow, usually rather dense, the branches appressed, floriferous from the base (7).
 7. Lemma conspicuously villous toward the apex, the hairs 2 mm. long (8).
 8. Apex of the lemma with lobes 0.8 to 1.5 mm. long, the lemma evenly villous all over----- 7. *S. LOBATA*.
 8. Apex of the lemma not lobed or obscurely so, the lemma conspicuously villous above, less so below----- 8. *S. SCRIBNERI*.
 7. Lemma pubescent, the hairs not more than 1 mm. long (9).
 9. Awn 4 to 6 cm. long, obscurely geniculate, the terminal segment flexuous----- 9. *S. ARIDA*.
 9. Awn 2 to 3 cm. long, twice-geniculate, the terminal segment straight (10).
 10. Sheaths villous at the mouth; panicle as much as 30 cm. long and 2 cm. thick, the lower nodes villous-- 10. *S. ROBUSTA*.
 10. Sheaths glabrous at the mouth; panicle 5 to 15 cm. long, rather narrow, the lower nodes glabrous (11).
 11. Hairs at apex of the lemma about as long as the others; awn mostly more than 2 cm. long ----- 11. *S. COLUMBIANA*.
 11. Hairs at apex of the lemma longer than the others; awn mostly 1.5 to 2 cm. long; leaf blades slender, involute, crowded toward the base of the plant.
 12. *S. LETTERMANI*.

1. *Stipa neomexicana* (Thurb.) Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 17: 132. 1899.

Stipa pennata var. *neomexicana* Thurb. in Coult., Man. Rocky Mount. 408. 1885.

Apache, Navajo, Coconino, Mohave, Yavapai, and Pima Counties, 3,500 to 5,500 feet, dry, sandy or rocky hills and plains, May to August. Western Texas and Colorado to Utah and Arizona.

2. *Stipa speciosa* Trin. and Rupr., Acad. St. Pétersb. Mém. VI. Sci. Nat. 5¹: 45. 1842.

Apache, Navajo, Coconino, Mohave, Yavapai, Pinal, and Pima Counties, 3,000 to 7,000 feet, dry rocky hills and canyons, April to

June. Colorado and Nevada to Arizona and southern California; southern South America.

3. *Stipa coronata* Thurb. in S. Wats., Bot. Calif. 2: 287. 1880.

Only a variety of this species, var. *depauperata* (M. E. Jones) Hitchc. (*S. parishii* var. *depauperata* M. E. Jones) is found in Arizona, along Bright Angel Trail, Coconino County, growing in large clumps on slopes, 5,000 feet (Hitchcock 13063), June to July.

This variety, which ranges from Utah and Nevada to Arizona and southern California, differs from the species in the once- rather than twice-geniculate awn. *Stipa coronata*, excluding the variety, is confined to the Coast Range of California from Monterey to Baja California.

4. *Stipa pringlei* Scribn. in Vasey, Contrib. U. S. Natl. Herbarium 3: 54. 1892.

Coconino, Cochise, and Pima Counties, 5,000 to 8,000 feet, rocky, mostly wooded, slopes, June to September. Texas to Arizona and Chihuahua.

5. *Stipa comata* Trin. and Rupr., Acad. St. Pétersb. Mém. VI. Sci. Nat. 5¹: 75. 1842.

Apache, Navajo, Coconino, and Pima Counties, 5,500 to 7,500 feet, dry hills, open woods, and sandy soil, often with juniper, May to August. Indiana to Yukon Territory, south to Texas, Arizona, and California.

The var. *intermedia* Scribn. and Tweedy, a form in which the third segment of the awn is relatively short and straight, has been found in Apache, Coconino, and Yavapai Counties.

6. *Stipa eminens* Cav., Icon. Pl. 5: 42. 1799.

Camp Grant, Graham County (*Rothrock* in 1874), rocky hills, August to October. Texas to Arizona and central Mexico.

7. *Stipa lobata* Swallen, Wash. Acad. Sci. Jour. 23: 199. 1933.

On a rocky bank along Bright Angel Trail, Grand Canyon, Coconino County (*Silveus* 1928). Western Texas to Arizona.

8. *Stipa scribneri* Vasey, Torrey Bot. Club Bul. 11: 125. 1884.

Grand Canyon (Coconino County), dry, rocky banks along Bright Angel Trail (Hitchcock 10448) and Kaibab Trail to Roaring Springs (*Eastwood* and *Howell* 991), 5,000 to 7,000 feet, May to September. Colorado, Utah, New Mexico, and Arizona.

9. *Stipa arida* M. E. Jones, Calif. Acad. Sci. Proc., ser. 2, 5: 725. 1895.

Navajo and Coconino Counties, 5,000 to 7,000 feet, dry rocky hills and canyons, May to June. Southwestern Colorado, Utah, and northern Arizona.

10. *Stipa robusta* Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 5: 23. 1897.

Stipa vaseyi Scribn., *ibid.* Bul. 11: 46. 1898.

Apache, Coconino, and Yavapai Counties, 6,000 to 8,000 feet, dry plains, hills, and open woods, June to September. Colorado to western Texas, Arizona, and northern Mexico.

11. *Stipa columbiana* Macoun, Cat. Canad. Pl. 2⁴: 191. 1888.

Stipa minor Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 11: 46. 1898.

Ten miles south of Jacob Lake, Kaibab Plateau, Coconino County (Forest Service 29047, *Kearney* and *Pebbles* 13743), about 8,000 feet. Dry plains and open woods at medium and higher altitudes, Wyoming to Yukon Territory, south to Texas, northern Arizona, and California.

A form differing from the species in being larger, with broader blades and longer, denser panicles, var. *nelsonii* (Scribn.) Hitchc., was collected in Grand Canyon National Park (*Merkle* 19, in 1937).

12. *Stipa lettermani* Vasey, Torrey Bot. Club Bul. 13: 53. 1886.

Franks Lake, Kaibab Plateau, Coconino County (Forest Service 62594). Open ground and open woods at upper altitudes, Wyoming to Montana and Oregon, south to New Mexico, northern Arizona, and California.

45. ARISTIDA. THREE-AWN

Tufted annuals or perennials with firm, usually involute leaf blades and narrow or open panicles; glumes equal or unequal, acute, acuminate, or awn-tipped; lemma indurate with a sharp bearded callus, 3-awned, the lateral awns sometimes much reduced, the base sometimes undivided, twisted, forming a column.

Several species of this genus are very abundant in Arizona, but their forage value is relatively small. The purple three-awn (*A. purpurea*) and other species are grazed in the immature stage. The sharp-pointed fruits, like those of *Stipa*, are troublesome to livestock and become entangled in wool.

Key to the species

1. Lemma articulate with the column of the awns; awns nearly equal; plants perennial (2).
 2. Culms pubescent..... 1. *A. CALIFORNICA*.
 2. Culms glabrous..... 2. *A. GLABRATA*.
1. Lemma not articulate (3).
 3. Lateral awns minute or wanting; panicles open, the branches stiffly spreading to drooping, naked at base (4).
 4. Column of the awn twisted at base; panicle branches often drooping.
 3. *A. ORCUTTIANA*.
 4. *A. TERNIPES*.
 4. Column of the awn not twisted; panicle branches rather stiffly spreading.
 3. Lateral awns nearly as long as the central awn (5).
 5. Plants annual (6).
 6. Awns mostly 4 to 7 cm. long, terete, spreading..... 5. *A. OLIGANTHA*.
 6. Awns 10 to 15 mm. long, flattened at base..... 6. *A. ADSCENSIONIS*.
 5. Plants perennial (7).
 7. Panicles open, the branches spreading, naked at base (8).
 8. Panicle branches stiffly ascending; panicle narrow, stiffly erect, 10 to 20 cm. long..... 10. *A. PANSA*.
 8. Panicle branches stiffly and abruptly spreading at base (9).
 9. Branchlets divaricate and implicate..... 7. *A. BARBATA*.
 9. Branchlets appressed (10).
 10. Summit of the lemma narrowed into a twisted neck 2 to 5 mm. long..... 8. *A. DIVARICATA*.
 10. Summit of the lemma not twisted..... 9. *A. HAMULOSA*.
 7. Panicles narrow, often rather dense, the branches ascending or appressed, at least some of them floriferous nearly to the base (11).
 11. Glumes nearly equal or the first sometimes a little longer (12).
 12. Column of the awn distinctly twisted, 3 to 5 mm. long; panicle narrow, the branches appressed, floriferous nearly to the base..... 16. *A. ARIZONICA*.

12. Column of the awn straight or obscurely twisted; panicle somewhat open, the branches rather distant, stiffly ascending, naked at base----- 17. *A. PARISHII*.
11. Glumes unequal, the first half as long as the second, or as much as two-thirds as long in *A. glauca* (13).
13. Lemma narrowed into a slender beak 5 to 6 mm. long; awns 1.5 to 2.5 cm. long, widely spreading----- 11. *A. GLAUCA*.
13. Lemma not narrowed above (14).
14. Panicle branches very slender, more or less flexuous; lemma conspicuously scabrous in lines; awns terete at base. 12. *A. PURPUREA*.
14. Panicle branches stiffly ascending or appressed, or sometimes rather lax in *A. longiseta*, but then the lemma nearly glabrous and the awns flattened toward base (15).
15. Culms rather stout, 30 to 60 cm. high; panicle 15 to 20 cm. long, densely flowered; awns 2 cm. long. 15. *A. WRIGHTII*.
15. Culms rather slender, 20 to 30 cm. high; panicle mostly 10 to 15 cm. long, relatively few-flowered; awns 2 to 8 cm. long (16).
16. Leaves crowded toward the base in a dense cluster; lemma scabrous toward the summit, the awns 2 to 5 cm. long; panicle rather stiff----- 13. *A. FENDLERIANA*.
16. Leaves not crowded toward the base; lemma glabrous or nearly so, the awns 6 to 8 cm. long; panicle lax. 14. *A. LONGISETA*.

1. ***Aristida californica*** Thurb. in S. Wats., Bot. Calif. 2: 289. 1880.

Yuma County, common along roadsides, on desert plains and mesas, apparently flowering as favorable conditions permit. Southwestern Arizona, southern California, and northern Mexico.

2. ***Aristida glabrata*** (Vasey) Hitchc., Contrib. U. S. Natl. Herbarium 22: 522. 1924.

Aristida californica var. *glabrata* Vasey, Calif. Acad. Sci. Proc. ser. 2, 3: 178. 1891.

Maricopa, Pinal, Pima, and Yuma Counties, dry ground and mesas, common in the foothills of the Santa Rita Mountains, apparently flowering whenever conditions are favorable. Southern Arizona to Baja California.

3. ***Aristida orcuttiana*** Vasey, Torrey Bot. Club Bul. 13: 27. 1886.

Navajo, Yavapai, Graham, Cochise, Santa Cruz, and Pima Counties, mostly about 5,000 feet, dry rocky hills and canyons, August to September. Texas to southern California and northwestern Mexico.

4. ***Aristida ternipes*** Cav., Icon. Pl. 5: 46. 1799.

Cochise, Santa Cruz, and Pima Counties, up to 6,000 feet, rocky hills and mesas, August to October. New Mexico and Arizona to northern South America and West Indies.

The name spidergrass is sometimes applied to this species. The var. *minor* (Vasey) Hitchc. is a smaller form with less diffuse panicles, the shorter branches usually stiffly spreading. It is more common than the species and occurs in Mohave, Yavapai, Pinal, Cochise, Santa Cruz, and Pima Counties.

5. ***Aristida oligantha*** Michx., Fl. Bor. Amer. 1: 41. 1803.

Coconino National Forest, Coconino County (Forest Service 32581), the only specimen known from Arizona and possibly introduced. Dry open ground, Massachusetts to South Dakota, south to Florida and Texas, also Oregon to California and Arizona.

6. *Aristida adscensionis* L., Sp. Pl. 82. 1753.

Aristida bromoides H. B. K., Nov. Gen. et Sp. 1: 122. 1815.

Mohave and Yavapai Counties to the southern boundary, up to 6,000 feet but usually lower, dry mesas, deserts, and rocky slopes, flowering whenever conditions are favorable. Western Missouri and Texas to California and southward; warmer parts of the Old World.

7. *Aristida barbata* Fourn., Mex. Pl. 2: 78. 1886.

Aristida havardii Vasey, Torrey Bot. Club Bul. 13: 27. 1886.

Coconino and Cochise Counties, dry slopes and mesas at medium altitudes, May to October. Western Texas to Arizona and central Mexico.

8. *Aristida divaricata* Humb. et Bonpl. in Willd., Enum. Pl. 1: 99. 1809.

Navajo and Coconino Counties to Santa Cruz and Pima Counties, mostly 5,000 to 6,000 feet, rocky hills, July to September. Kansas to southern California, south to Texas and Guatemala.

9. *Aristida hamulosa* Henr., Meded. Rijks Herbarium Leiden 54: 219. 1926.

Cochise, Santa Cruz, and Pima Counties, 2,400 to 5,300 feet, dry slopes and mesas, June to September, type from Tucson (*Toumey*). Western Texas to southern California, south to Guatemala.

10. *Aristida pansa* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 112. 1913.

Coconino and Santa Cruz Counties, up to 5,000 feet, dry plains and open ground, July to October. Texas to Arizona.

11. *Aristida glauca* (Nees) Walp., Ann. Bot. 1: 925. 1849.

Chaetaria glauca Nees, Linnæa 19: 688. 1847.

Aristida vaseyi Woot. and Standl., N. Mex. Col. Agr. Bul. 81: 55. 1912.

Coconino and Mohave Counties to Cochise and Pima Counties, 1,000 to 5,200 feet, dry rocky slopes and plains, March to September. Western Texas to Utah, Nevada, Arizona, and southern California, south to central Mexico.

12. *Aristida purpurea* Nutt., Amer. Phil. Soc. Trans. n. s. 5: 145. 1837.

Mohave, Gila, Pinal, Maricopa, Cochise, Santa Cruz, Pima, and Yuma Counties, up to 5,000 feet, dry rocky hills and plains. Arkansas and Kansas to Utah, Arizona, southern California, and northern Mexico.

The var. *laxiflora* Merr., with capillary branches bearing 1 or 2 spikelets, is found in Cochise County (*Griffiths* 1880).

13. *Aristida fendleriana* Steud., Syn. Pl. Glum. 1: 420. 1855.

Apache, Navajo, Coconino, Yavapai, Gila, and Cochise Counties, 4,000 to 7,000 feet, mesas, dry hills, and open rocky ground, May to August. South Dakota to Montana, south to Texas, Utah, Arizona, and southern California.

14. *Aristida longiseta* Steud., Syn. Pl. Glum. 1: 420. 1855.

Apache, Navajo, Coconino, Mohave, Yavapai, Greenlee, Graham, and Pima Counties, 3,000 to 5,000 feet, dry hills and plains, April to October. Texas to Colorado and Arizona.

Two varieties are recognized, var. *rariflora* Hitchc., which differs in the few-flowered panicles with long capillary flexuous branches; and var. *robusta* Merr., which differs in being a larger plant with a rather dense panicle, the branches relatively short and stiffly ascending. The former has been collected in Yavapai, Cochise, and Pima Counties, and the latter in Coconino, Mohave, and Pima Counties.

15. *Aristida wrightii* Nash in Small, Fl. Southeast. U. S. 116. 1903.

Mohave, Pinal, Maricopa, Santa Cruz, and Pima Counties, 1,000 to 5,000 feet, dry plains and rocky slopes, flowering apparently whenever conditions are favorable. Texas, Colorado, and Utah, to southern California and central Mexico.

16. *Aristida arizonica* Vasey, Torrey Bot. Club Bul. 13: 27. 1886.

Navajo, Coconino, and Cochise Counties, 4,500 to 8,000 feet, dry plains, rocky slopes, and open woods, May to September, type from Arizona (*Rusby* 875). Colorado and western Texas to Arizona, and southward through Mexico.

17. *Aristida parishii* Hitchc. in Jepson, Fl. Calif. 1: 101. 1912.

Yavapai, Maricopa, Yuma, and Pima Counties, 1,500 to 4,000 feet, dry rocky hills, February to May. Arizona and southern California.

46. TRAGUS. BURGRASS

Low annuals with flat leaf blades, the spikes closely arranged on a slender axis; spikes subsessile, falling entire, composed of 2 to 5 spikelets on a short zigzag rachis; first glumes small or wanting, the second glumes of the 2 lower spikelets bearing stout hooked spines along each side; lemma and palea thin, the lemma flat, the palea convex.

Key to the species

- | | |
|---|------------------------------|
| 1. Spikes or burs subsessile; spikelets 2 to 3 mm. long, scarcely exceeding the spines..... | 1. <i>T. BERTERONIANUS</i> . |
| 1. Spikes or burs pedicelled; spikelets 4 to 5 mm. long, projecting beyond the spines..... | 2. <i>T. RACEMOSUS</i> . |

1. *Tragus berteronianus* Schult., Mant. 2: 205. 1824.

Nazia aliena Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 17: 28. 1899.

Mohave, Pinal, Cochise, Santa Cruz, and Pima Counties, up to 5,500 feet, dry open ground, September to October. Texas to Arizona, south to Argentina; warmer parts of the Old World.

2. *Tragus racemosus* (L.) All., Fl. Pedem. 2: 241. 1785.

Cenchrus racemosus L., Sp. Pl. 1049. 1753.

Nazia racemosa Kuntze, Rev. Gen. Pl. 2: 780. 1891.

On campus of the University of Arizona (Pima County). Waste ground, occasionally from Maine to North Carolina, also Texas to Arizona; introduced from the Old World.

47. HILARIA

Stiff perennials with solid culms and narrow leaf blades, the groups of spikelets in rather narrow, dense terminal spikes; spikelets in groups of 3, the central spikelet fertile, 1-flowered, the lateral ones staminate, 2-flowered; glumes of the 3 spikelets firm, forming a false involucre; lemma and palea equal, hyaline.

On Arizona ranges this genus is second in importance only to the grammas (*Bouteloua* spp.). Although not so palatable as the latter, the plants are better able to withstand close grazing and trampling. Curly-mesquite (*H. belangeri*) abounds on dry open foothills. Galleta (*H. jamesii*) is perhaps the most characteristic and important forage grass on the Navajo Indian Reservation and is inferior only to blue grama (*Bouteloua gracilis*) on the higher grasslands in the northern part of the State. Its place is taken in the southeastern grassland by tobosa (*H. mutica*). This species and big galleta (*H. rigida*) attain fullest development in depressions or on heavy alluvial soil. *H. jamesii* is used by the Hopi Indians as a fill for basketry and in making ceremonial articles.

Key to the species

1. Culms tufted, sending out slender, wiry stolons, the internodes 5 to 15 cm. long..... 1. *H. BELANGERI*.
1. Culms not stoloniferous, erect from a stout decumbent or rhizomatous base (2).
 2. Culms felty pubescent..... 2. *H. RIGIDA*.
 2. Culms glabrous (3).
 3. Glumes of the lateral spikelets narrowed toward the apex.
 3. *H. JAMESII*.
 3. Glumes of the lateral spikelets conspicuously widened toward the subhyaline apex..... 4. *H. MUTICA*.

1. *Hilaria belangeri* (Steud.) Nash, North Amer. Fl. 17: 135. 1912.

Anthephora belangeri Steud., Syn. Pl. Glum. 1: 111. 1854.

Yavapai, Gila, Pinal, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,500 to 6,000 feet, mesas and foothills, May to September. Texas to Arizona and northern Mexico.

The var. *longifolia* (Vasey) Hitchc., a form with erect culms, elongate blades, and without rhizomes, is found on rocky hills around Tucson. The species is referred to *H. cenchroides* in Woot. and Standl., Flora of New Mexico. (Contrib. U. S. Natl. Herbarium 19: 53. 1915.)

2. *Hilaria rigida* (Thurb.) Benth. ex Scribn., Torrey Bot. Club Bul. 9: 86. 1882.

Pleuraphis rigida Thurb. in S. Wats., Bot. Calif. 2: 293. 1880.

Mohave, Yavapai, Pinal, Maricopa, and Yuma Counties, up to 4,000 feet, deserts, plains, and rocky hills, February to September. Southern Utah and Nevada to Arizona, southern California, and Sonora.

3. *Hilaria jamesii* (Torr.) Benth., Linn. Soc. London Jour. Bot. 19: 62. 1881.

Pleuraphis jamesii Torr., Ann. Lye. N. Y. 1: 148. 1824.

Apache, Navajo, Coconino, Mohave, and Cochise Counties, 4,500 to 7,000 feet, dry hills, rocky canyons, and sandy plains, May to September. Wyoming to Nevada, south to Texas, Arizona, and California.

4. *Hilaria mutica* (Buckl.) Benth., Linn. Soc. London Jour. Bot. 19: 62. 1881.

Pleuraphis mutica Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 95. 1862.

Yavapai, Gila, Cochise, and Pima Counties, 2,000 to 5,600 feet, dry soil, mesas and hills, May to October. Texas to Arizona and northern Mexico.

48. AEGOPOGON

Low, delicate, decumbent, spreading annual with flat, narrow leaf blades and loose racemes of spreading spikelets; spikelets in groups of 3, the central one perfect, the lateral spikelets staminate or neuter, falling entire; glumes membranaceous, toothed at apex, the midnerve extending into a delicate awn; lemma and palea thin, longer than the glumes, the nerves extending into awns.

1. *Aegopogon tenellus* (DC.) Trin., Gram. Unifl. 164. 1824.

Lamarckia tenella DC., Cat. Hort. Monsp. 120. 1813.

Cochise, Santa Cruz, and Pima Counties, open ground in the mountains, August to September, 5,000 to 6,000 feet. Southern Arizona to northern South America.

49. LEPTOCHLOA. SPRANGLETOP

Annuals or perennials with flat leaf blades and numerous spikes scattered along the common axis; spikelets few- to several-flowered, the upper floret reduced to a small awnless rudiment; glumes 1-nerved, the second usually longer and broader than the first; lemmas acute to obtuse, pubescent or pilose on the nerves and sometimes on the internerves.

Key to the species

- 1. Plants perennial; lemmas notched at apex, awnless, the lobes broad, obtuse.
 - 1. *L. DUBIA.*
- 1. Plants annual; lemmas mucronate or awned from between the teeth of a minutely bifid apex, if awnless then not with broad obtuse lobes (2).
 - 2. Sheaths sparsely papillose-pilose; spikelets 1 to 2 mm. long, 3- or 4-flowered.
 - 2. *L. FILIFORMIS.*
 - 2. Sheaths glabrous or scabrous; spikelets 3 to 12 mm. long, 5- to 12-flowered (3).
 - 3. Lemmas 5 to 7 mm. long, mucronate only, scarcely narrowed toward the apex, the lateral nerves excurrent..... 5. *L. UNINERVIA.*
 - 3. Lemmas 3 to 5 mm. long, awned, the awns sometimes minute (4).
 - 4. Lemmas 2 mm. long, acute, viscid on the back; panicle usually less than 10 cm. long, tinged with purple..... 3. *L. VISCIDA.*
 - 4. Lemmas 4 to 5 mm. long, acuminate, not viscid; panicle more than 10 cm. long, not tinged with purple..... 4. *L. FASCICULARIS.*

1. *Leptochloa dubia* (H. B. K.) Nees, Syll. Pl. Ratisb. 1: 4. 1824.

Chloris dubia H. B. K., Nov. Gen. et Sp. 1: 169. 1816.

Yavapai, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, mostly 3,000 to 5,000 feet, rocky hills and open ground, July to October. Oklahoma to Arizona, Mexico, and southern Florida; Argentina.

This species affords good grazing and is sometimes cut for hay.

2. **Leptochloa filiformis** (Lam.) Beauv., Ess. Agrost. 71, 161, 166. 1812.

Festuca filiformis Lam., Tabl. Encycl. 1: 191. 1791.

Coconino, Yavapai, Pinal, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,200 to 5,000 feet, cultivated land, along streams, etc., May to September. Virginia to eastern Kansas, south to Florida, Texas, Arizona, southern California, Mexico, and Argentina.

3. **Leptochloa viscida** (Scribn.) Beal, Grasses North Amer. 2: 434. 1896.

Diplachne viscida Scribn., Torrey Bot. Club Bul. 10: 30. 1883.

Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,000 to 3,500 feet, open ground and waste places, June to October, type from Tucson (*Pringle* in 1881). Western Texas (El Paso) to California and northern Mexico.

4. **Leptochloa fascicularis** (Lam.) A. Gray, Man. 588. 1848.

Festuca fascicularis Lam., Tabl. Encycl. 1: 189. 1791.

Navajo and Pima Counties, along ditches and in moist waste places, often in brackish marshes, July to October. Throughout the United States, south to Argentina.

5. **Leptochloa uninervia** (Presl) Hitchc. and Chase, Contrib. U. S. Natl. Herbarium 18: 363. 1917.

Megastachya uninervia Presl, Reliq. Haenk. 1: 283. 1830.

Pinal, Maricopa, Pima, and Yuma Counties, along ditches, roadsides, and moist waste places. Mississippi to Colorado, Arizona, southern California, and northern Mexico; Peru to Argentina.

50. DACTYLOCTENIUM. CROWFOOTGRASS

Decumbent, spreading annual with short, broad leaf blades and 2 to several thick, digitate, ascending or spreading spikes, the rachis extending beyond the spikelets; spikelets compressed, 3- to 5-flowered, horizontally spreading; glumes subequal, the second bearing a short, stout spreading awn; lemmas thin, acute, 3-nerved, awnless.

1. **Dactyloctenium aegyptium** (L.) Richt., Pl. Eur. 1: 68. 1890.

Cynosurus aegyptius L., Sp. Pl. 72. 1753.

A weed on the University campus, Tucson (Pima County). North Carolina to Florida, California, and tropical America; introduced from the Old World.

51. CYNODON. BERMUDAGRASS

Stoloniferous perennial with narrow, often short leaf blades and few to several, slender, digitate spikes; spikelets 1-flowered, the rachilla prolonged beyond the spikelet in a naked stipe; glumes subequal, the first lunate, the second lanceolate; lemma acute, awnless, pubescent on the nerves; palea as long as the lemma.

A very abundant grass in the irrigated valleys of southern Arizona, where it is hard to eradicate except by frequent cultivation or shading.

Lawns and old pastures usually become Bermudagrass sod. Indeed, a large proportion of the lawns are planted with this grass, although its abundant production of pollen makes it the commonest cause of hay fever in that region. The bulk of the world supply of Bermudagrass seed is produced near Yuma, Ariz.

1. **Cynodon dactylon** (L.) Pers., Syn. Pl. 1: 85. 1805.

Panicum dactylon L., Sp. Pl. 58. 1753.

Capriola dactylon Kuntze, Rev. Gen. Pl. 2: 764. 1891.

Throughout the State, at low altitudes, lawns and waste places. New Hampshire to Michigan, south to Florida, Arizona, and southern California; introduced in America.

52. SCHEDONNARDUS. TUMBLEGRASS

Slender, freely branching perennial, with few to several stiffly spreading spikes, distant on a slender, triangular axis; spikelets sessile, appressed, in 1 row on each of 2 sides of a triangular rachis; glumes abruptly narrowed into stiff awn-points, the second longer than the first; lemma 3-nerved, acuminate, a little longer than the glumes, awnless.

1. **Schedonnardus paniculatus** (Nutt.) Trel. in Branner and Coville, Geol. Survey Ark. Rpt. 1888⁴: 236. 1891.

Lepturus paniculatus Nutt., Gen. Pl. 1: 81. 1818.

Apache, Navajo, Coconino, and Yavapai Counties, up to 7,100 feet, on plains. Illinois to Saskatchewan and Montana, south to Texas and Arizona; Argentina.

53. SPARTINA. CORDGRASS

Rather coarse perennial with strong, scaly rhizomes, and several ascending or spreading spikes, these racemose on a common axis, the rachis produced beyond the spikelets; spikelets 1-flowered, disarticulating below the glumes; first glume shorter, the second longer than the floret; lemma firm but thinner than the glumes, keeled, subobtusely; palea as long as, or longer than the lemma, with thin, very wide margins.

1. **Spartina gracilis** Trin., Acad. St. Pétersb. Mém. VI, Sci. Nat. 4¹: 110. 1840.

Apache and Navajo Counties, at medium altitudes, plains and in saline soil, August. Saskatchewan to British Columbia, south to Kansas, Arizona, and California.

54. CHLORIS

Annuals or perennials, sometimes stoloniferous, with several digitate spikes; spikelets with 1 perfect floret, the rachilla prolonged beyond the floret, bearing a club-shaped rudiment composed of 1 or more reduced sterile lemmas; fertile lemma 3-nerved, awned from the back just below the apex.

C. virgata, sometimes known as feather fingergrass, is a common annual weed, especially in alfalfa fields. It furnishes appreciable quantities of forage on the cattle ranges in the southeastern counties,

where in favorable seasons it is cut for hay. Rhodesgrass (*C. gayana*) is grown to a very limited extent in the irrigated districts of southern Arizona as a pasture and hay crop.

Key to the species

1. Plants annual; margins of the lemma short-ciliate on the lower part, long-ciliate on the upper third, the hairs as much as 4 mm. long - 1. *C. VIRGATA*.
1. Plants perennial; margins of the lemma rather evenly ciliate or, if longer, ciliate above, then the hairs much less than 4 mm. long (2).
 2. Plants coarse, sparingly stoloniferous; rudiment composed of 2 sterile florets, the lower nearly as long as the fertile one, the upper floret very much reduced; spikes ascending ----- 2. *C. GAYANA*.
 2. Plants slender, tufted, not stoloniferous; rudiment composed of 1 reduced floret; spikes widely spreading ----- 3. *C. LATISQUAMEA*.

1. ***Chloris virgata*** Swartz, Fl. Ind. Occ. 1: 203. 1797.

Chloris elegans H. B. K., Nov. Gen. et Sp. 1: 166. 1816.

Mohave, Pinal, Cochise, Santa Cruz, and Pima Counties, a common weed in open ground and waste places. Nebraska to Texas, west to Nevada, Arizona, and southern California, introduced in a few eastern localities; tropical America.

2. ***Chloris gayana*** Kunth, Rév. Gram. 1: 89. 1829.

Pinal and Pima Counties, escaped from cultivation near Sacaton and Tucson. North Carolina and Florida, west to southern California; tropical America; introduced from Africa.

3. ***Chloris latisquamea*** Nash, Torrey Bot. Club Bul. 25: 439. 1898.

Santa Cruz River at La Noria, Santa Cruz County (*Mearns* 1205). Texas, Arizona, and northeastern Mexico.

55. TRICHLORIS

Tufted, leafy perennial with several narrowly ascending spikes crowded on a short axis; spikelets 2-flowered, the upper one reduced; glumes acuminate, 1-nerved, persistent; lemmas rounded on the back, obscurely 3-nerved, 3-awned; palea broad, slightly exceeding the lemma.

1. ***Trichloris mendocina*** (Phil.) Kurtz, Univ. Córdoba Facult. Cienc. Exact. Mem. 1896: 37. 1897.

Chloris mendocina Phil., An. Univ. Chile 36: 208. 1870.

Trichloris fasciculata Fourn., Mex. Pl. 2: 142. 1886.

Pinal, Maricopa, Cochise, and Pima Counties, up to 4,000 feet, mesas and rocky hills. Texas to Arizona and northern Mexico; southern South America.

A rather large showy grass, rarely cultivated as an ornamental.

56. BOUTELOUA. GRAMA

Cespitose or sometimes stoloniferous annuals or perennials with slender culms and one to many short 1-sided spikes, these racemose on a short or often elongate axis; spikelets with 1 fertile floret, and 1 or 2 rudimentary florets above it; fertile lemma 3-nerved, variously lobed or dentate at apex, the nerves usually excurrent in short awns; rudiment reduced to 3 awns, glumaceous and lobed, or dentate with 3 usually conspicuous awns.

This is Arizona's most important genus of forage grasses. Rothrock grama (*B. rothrockii*) and sideoats grama (*B. curtispindula*) are sometimes cut for hay in the southeastern part of the State. Blue grama (*B. gracilis*) is highly valued and often predominant in "short-grass" areas north of the Mogollon Escarpment. When too heavily grazed these areas are encroached upon by noxious weeds and grasses of lower palatability. Three annual grammas furnish a large quantity of forage, but this is of poorer quality and shorter duration than that produced by the perennial species. Of these, sixweeks grama (*B. barbata*) and needle grama (*B. aristidoides*) are abundant in the foothills and plains of the southern counties, and mat grama (*B. simplex*) is important on the northern plateaus.

Key to the species

1. Spikes deciduous, falling entire; spikelets not pectinate or obscurely so (2).
2. Plant annual; spikes very narrow, abruptly spreading above, the rachis sharp-pointed at base; spikelets appressed..... 10. *B. ARISTIDOIDES*.
2. Plants perennial; spikes relatively broad, the rachis not sharp-pointed at base (3).
3. Spikes 20 to 40; spikelets appressed or somewhat spreading. 15. *B. CURTISPINDULA*.
3. Spikes fewer than 15 (4).
4. Second glume hairy (5).
5. Spikes 3 to 8, rhomboid, the margins of the rachis densely ciliate; spikelets obscurely pectinate..... 11. *B. CHONDROSIODES*.
5. Spikes 10 to 13, triangular, the margins of the rachis not conspicuously ciliate; spikelets not pectinate..... 12. *B. ELUDENS*.
4. Second glume glabrous (6).
6. Base of the plant hard and rhizomatous; sheaths usually broad and conspicuous..... 13. *B. RADICOSA*.
6. Base of the plant comparatively soft, not rhizomatous; sheaths inconspicuous..... 14. *B. FILIFORMIS*.
1. Spikes persistent; spikelets pectinate (7).
7. Plants annual (8).
8. Spike 1, ascending or spreading, curved..... 1. *B. SIMPLEX*.
8. Spikes 4 to 7, finally spreading, straight (9).
9. Second glume papillose-hispid on the keel; rachis papillose-hispid-ciliate..... 2. *B. PARRYI*.
9. Second glume scabrous on the keel; rachis not ciliate. 3. *B. BARBATA*.
7. Plants perennial (10).
10. Rachis produced beyond the spikelets, pointed; second glume tuberculate-hispid (11).
11. Culms glabrous..... 4. *B. HIRSUTA*.
11. Culms retrorsely hirsute below the nodes..... 5. *B. GLANDULOSA*.
10. Rachis terminating in a spikelet, this often rudimentary; second glume glabrous, scabrous, or pubescent, sparsely papillose-pilose in *B. gracilis* (12).
12. Spikes normally 2, rarely 1 or 3; second glume sparsely papillose-pilose..... 6. *B. GRACILIS*.
12. Spikes 3 to 8; second glume not at all papillose-pilose (13).
13. Culms felty-pubescent, wiry, straggling, sparingly stoloniferous. 7. *B. ERIPODA*.
13. Culms glabrous, erect, cespitose, not stoloniferous (14).
14. Culms branching; awns of the fertile lemma 2 to 3 mm. long; plant often appearing annual..... 8. *B. ROTHROCKII*.
14. Culms simple; awns of the fertile lemma about 5 mm. long. 9. *B. TRIFIDA*.

1. *Bouteloua simplex* Lag., Var. Cienc. 2⁴: 141. 1805.

Bouteloua prostrata Lag., Gen. et Sp. Nov. 5. 1816.

Apache, Coconino, and Yavapai Counties, up to 7,000 feet, dry plains and open woods, August to September. Texas to Colorado, Utah, Arizona, and Mexico.

2. **Bouteloua parryi** (Fourn.) Griffiths, Contrib. U. S. Natl. Herbarium 14: 381. 1912.

Chondrosium parryi Fourn., Mex. Pl. 2: 150. 1886.

Pinal, Cochise, and Pima Counties, mostly 3,000 to 5,000 feet, mesas and rocky hills, August to October. New Mexico, Arizona, and northern Mexico.

3. **Bouteloua barbata** Lag., Var. Cienc. 2⁴: 141. 1805.

Bouteloua polystachya Torr., U. S. Rpt. Expl. Miss. Pacif. 5²: 366. 1857.

Apache County to Coconino County, south to Cochise, Pima, and Yuma Counties, 1,000 to 5,500 feet, dry mesas and rocky hills, July to October. Texas to southern Utah, Arizona, southeastern California, and Mexico.

4. **Bouteloua hirsuta** Lag., Var. Cienc. 2⁴: 141. 1805.

Mohave, Yavapai, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 5,500 feet, dry, rocky hills and mesas, August to October. Wisconsin and South Dakota to Texas, Arizona, southern California, and Mexico.

5. **Bouteloua glandulosa** (Cerv.) Swallen, North Amer. Fl. 17: 621. 1939.

Erucaria glandulosa Cerv., Naturaleza 1: 347. 1870.

Near Ruby, Santa Cruz County (*Goodding et al.* 3582), rocky hills and plains. Arizona and Mexico.

6. **Bouteloua gracilis** (H. B. K.) Lag. ex Steud., Nom. Bot. ed. 2, 1: 219. 1840.

Chondrosium gracile H. B. K., Nov. Gen. et Sp. 1: 176. 1816.

Bouteloua oligostachya Torr. in A. Gray, Man. ed. 2, 553. 1856.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 1,200 to 5,000 (rarely 8,000) feet, dry plains, July to October. Wisconsin to Manitoba and Alberta, south to Missouri, Texas, Arizona, southern California, and Mexico.

7. **Bouteloua eriopoda** Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 155. 1856.

Chondrosium eriopodum Torr. in Emory, Mil. Recon. 154. 1848.

Apache County to Mohave County, south to Cochise and Pima Counties, 3,200 to 5,300 feet, dry hills, mesas, and open ground, July to October. Texas to southern Utah, Arizona, and Mexico.

8. **Bouteloua rothrockii** Vasey, Contrib. U. S. Natl. Herbarium 1: 268. 1893.

Mohave, Yavapai, Pinal, Cochise, Santa Cruz, Pima, and Yuma Counties, up to 5,200 feet, mesas and rocky foothills, August to October, type from Cottonwood (*Rothrock* 347). Arizona, southern California, and northern Mexico.

9. *Bouteloua trifida* Thurb. in S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 177. 1883.

Mohave, Maricopa, Pima, and Santa Cruz Counties, mostly 2,000 to 4,000 feet, mesas and dry rocky hillsides, March to June, and sometimes in October. Texas to southwestern Utah, Arizona, southern California, and Mexico.

10. *Bouteloua aristidoides* (H. B. K.) Griseb., Fl. Brit. West Indies 537. 1864.

Dinebra aristidoides H. B. K., Nov. Gen. et Sp. 1: 171. 1816.
Bouteloua aristidoides var. *arizonica* M. E. Jones, Contrib. West. Bot. 14: 13. 1912.

Greenlee County to Mohave County, south to the southern border, up to 5,500 feet, deserts, dry mesas, and rocky hillsides, June to October. Texas to southern California and northern Mexico; Argentina.

11. *Bouteloua chondrosioides* (H. B. K.) Benth. ex S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 179. 1883.

Dinebra chondrosioides H. B. K., Nov. Gen. et Sp. 1: 173. 1816.

Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,200 feet, rocky hills, August to October. Western Texas, southern Arizona, and Mexico.

12. *Bouteloua eludens* Griffiths, Contrib. U. S. Natl. Herbarium 14: 401. 1912.

Rocky hills in the Santa Catalina and Santa Rita Mountains (Pima County), August to September, type from the Santa Rita Mountains (Griffiths 7269). Arizona and Sonora.

13. *Bouteloua radicata* (Fourn.) Griffiths, Contrib. U. S. Natl. Herbarium 14: 411. 1912.

Atheropogon radicosus Fourn., Mex. Pl. 2: 140. 1886.

Apache, Cochise, Santa Cruz, and Pima Counties, 3,700 to 6,800 feet, rocky hills and canyons, August to September. New Mexico to southern California and Mexico.

14. *Bouteloua filiformis* (Fourn.) Griffiths, Contrib. U. S. Natl. Herbarium 14: 413. 1912.

Atheropogon filiformis Fourn., Mex. Pl. 2: 140. 1886.

Mohave, Greenlee, Cochise, Santa Cruz, and Pima Counties, below 5,000 feet, mesas and rocky foothills, July to October. Texas to Arizona and Mexico.

15. *Bouteloua curtispindula* (Michx.) Torr. in Emory, Mil. Recon. 154. 1848.

Chloris curtispindula Michx., Fl. Bor. Amer. 1: 59. 1803.

Navajo and Coconino Counties south to Cochise, Santa Cruz, and Pima Counties, up to 7,000 feet, dry rocky hills and canyons, April to October. Maine and Ontario to Montana, south to Maryland, Alabama, Texas, Arizona, and southern California.

57. CATHESTECUM

Stoloniferous perennial with relatively short, flat leaf blades and several V-shaped or rhomboid spreading spikes arranged on opposite

sides of the slender, flattened axis; spikes falling entire, consisting of 3 spikelets, the lateral ones 2-flowered, staminate or sterile, the central spikelet 3-flowered, the lowest floret pistillate or rarely perfect, the upper florets staminate or sterile; lemmas dissimilar, the lower ones cleft about one-fourth their length, awned from between the lobes, the awns equaling or slightly exceeding them, the upper lemmas deeply cleft, their awns villous in the lower part, extending as much as 3 mm. beyond the lobes.

1. *Cathestecum erectum* Vasey and Hack., Torrey Bot. Club Bul. 11: 37. 1884.

Southern Arizona, without locality (*E. Palmer* in 1869), dry hills and plains. Western Texas, southern Arizona, and northern Mexico.

58. MUNROA. FALSE-BUFFALOGRASS

Freely branching, widely decumbent-spreading annual with short, firm, pungent leaf blades and short spikes hidden in the crowded sheaths at the ends of the branches; spikes composed of 2 or 3 spikelets, the lower one or two 3- or 4-flowered, the upper spikelet 2- or 3-flowered; glumes of the lower 1 or 2 spikelets equal, 1-nerved, those of the upper spikelet much shorter, the first about half as long as the second; lemmas 3-nerved, excurrent in short awns, the central awn longer and stouter than the lateral awns.

1. *Munroa squarrosa* (Nutt.) Torr., U. S. Rpt. Expl. Miss. Pacif. 4⁵: 158. 1857.

Crypsis squarrosa Nutt., Gen. Pl. 1: 49. 1818.

Apache, Navajo, Coconino, Mohave, and Yavapai Counties, 4,000 to 5,500 feet, open plains and hills, June to October. Alberta to Texas and Arizona.

Not infrequently plants are found with a white weblike covering, the remains of egg cases of a woolly aphid.

59. BUCHLOË. BUFFALOGRASS

Stoloniferous perennial with short slender culms and flat narrow leaf blades; plants monoecious or dioecious, sometimes with perfect flowers; staminate spikes 1 to 4, pectinate, the spikelets 2- or 3-flowered, the glumes acute, the second glume about twice as long as the first, the lemmas acute or subobtusate, 3-nerved, awnless; pistillate spikes 1 or 2, falling entire, the short, thickened, indurate rachis and second glumes forming a false involucre around the spikelets, the spikelets 1-flowered, the first glume thin, acuminate, sometimes obsolete, the lemma indurate, 3-toothed, with margins overlapping and enclosing the palea, the palea firm, about as long as the lemma.

1. *Buchloe dactyloides* (Nutt.) Engelm., Acad. Sci. St. Louis Trans. 1: 432. 1859.

Sesleria dactyloides Nutt., Gen. Pl. 1: 65. 1818.

Bulbilis dactyloides Raf. ex Kuntze, Rev. Gen. Pl. 2: 763. 1891.

Rocky limestone soil on ridge running from Promontory to Tonto Creek, Gila County (Forest Service 58246). Minnesota to Montana, south to Iowa, western Louisiana, and Arizona.

A dominant forage grass in the Great Plains region, but very rare in Arizona.

60. HIEROCHLOË. SWEETGRASS

Slender, erect, sweet-smelling perennial, with slender creeping rhizomes, flat leaf blades, and small, open panicles of bronze-colored spikelets; spikelets with 1 terminal fertile floret and 2 staminate florets, these falling attached to the fertile one; staminate lemmas as long as the glumes, boat-shaped, hispidulous; fertile lemma a little shorter than the others, indurate, awnless.

1. *Hierochloë odorata* (L.) Beauv., Ess. Agrost. 62, 164. 1812.

Holcus odoratus L., Sp. Pl. 1048. 1753.

Savastana odorata Scribn., Torrey Bot. Club Mem. 5: 34. 1894.

Coconino and Pima Counties, wet places, 7,000 feet or higher, June to July. Labrador to Alaska, south to New Jersey, Oregon, and in the mountains to New Mexico and Arizona; Eurasia.

Sweetgrass, also known as holygrass, vanillagrass, and senecagrass, is used by the Indians in some parts of the United States for making fragrant baskets.

61. PHALARIS. CANARYGRASS

Annuals or perennials with flat leaf blades and erect, spikelike, sometimes interrupted panicles; spikelets laterally compressed, with one fertile floret and 1 or 2 much-reduced sterile florets below the fertile one; fertile lemma coriaceous, shorter than the glumes.

The canary seed of commerce is obtained from *P. canariensis*. A form of *P. arundinacea*, reed canarygrass (var. *picta* L.), is cultivated as a garden ornamental under the name ribbongrass.

Key to the species

1. Plants perennial with creeping rhizomes; panicle interrupted below, the branches spreading in anthesis----- 1. *P. ARUNDINACEA*.
1. Plants annual (2).
 2. Glumes broadly winged; panicle ovate or ovate-oblong (3).
 3. Sterile lemma 1; fertile lemma 3 mm. long----- 2. *P. MINOR*.
 3. Sterile lemmas 2; fertile lemma 4 to 6 mm. long---- 3. *P. CANARIENSIS*.
 2. Glumes wingless or nearly so (4).
 4. Panicles mostly 2 to 6 cm. long, tapering to each end; glumes 5 to 6 mm. long----- 4. *P. CAROLINIANA*.
 4. Panicles mostly 6 to 15 cm. long, subcylindric; glumes 3.5 to 4 mm. long----- 5. *P. ANGUSTA*.

1. *Phalaris arundinacea* L., Sp. Pl. 55. 1753.

Crater Lake, Coconino County, 8,000 feet (*McDougal* 834). Moist places, New Brunswick to southeastern Alaska, south to North Carolina, Kentucky, Oklahoma, New Mexico, Arizona, and northeastern California; Eurasia.

2. *Phalaris minor* Retz., Observ. Bot. 3: 8. 1783.

Tempe, Maricopa County (*McLellan* and *Stitt* 765). Introduced in a few scattered localities in the United States, rather common in California; native of the Mediterranean region.

3. *Phalaris canariensis* L., Sp. Pl. 54. 1753.

Near Government Hill, Gila County (Forest Service 39185). Waste places, Nova Scotia to Alaska, south to Virginia, Texas, Arizona, and California; introduced from the Mediterranean region.

4. *Phalaris caroliniana* Walt., Fl. Carol. 74. 1788.

Yavapai, Gila, Pinal, Maricopa, and Pima Counties, 1,000 to 6,000 feet, moist ground, April to August. Virginia to Colorado, south to Florida and Texas, west to Arizona, California, and Oregon.

5. *Phalaris angusta* Nees in Trin., Gram. Icon. 1: pl. 78. 1827.

Sacaton, Pinal County (*Harrison* 5266). Open ground at low altitudes, Mississippi, Louisiana, Texas, Arizona, and California; southern South America.

62. LEERSIA. CUTGRASS

Slender, erect or decumbent perennial with creeping rhizomes and flat, scabrous leaf blades; spikelets 1-flowered, laterally compressed, disarticulating from the pedicel; glumes wanting; lemma chartaceous, boat-shaped, hispid; palea as long as the lemma but much narrower, the margins firmly held by the margins of the lemma.

1. *Leersia oryzoides* (L.) Swartz, Prodr. Veg. Ind. Occ. 21. 1788.

Phalaris oryzoides L., Sp. Pl. 55. 1753.

Greenlee and Pima Counties, a weed along irrigation ditches. Quebec and Maine to eastern Washington, south to northern Florida, Arizona, and southern California; Europe.

63. TRICHACHNE. COTTONTOP

Perennial, with flat leaf blades and slender, erect or ascending racemes forming a white silky inflorescence; first glume minute; second glume and sterile lemma equal, covering the fruit, conspicuously villous with long hairs; fertile lemma acuminate, brown.

1. *Trichachne californica* (Benth.) Chase, Wash. Acad. Sci. Jour. 23: 455. 1933.

Panicum californicum Benth., Bot. Voy. Sulph. 55. 1840.

Valota saccharata (Buckl.) Chase, Biol. Soc. Wash. Proc. 19: 188. 1906.

Mohave County to Cochise, Santa Cruz, Pima, and Yuma Counties, 1,000 to 6,000 feet, mesas and rocky hills in open ground. Texas to Colorado, Arizona, and Mexico.

Cottontop furnishes a considerable quantity of palatable forage for a short period following spring or summer rain.

64. DIGITARIA. CRABGRASS

Decumbent spreading annual with flat leaf blades and rather slender, ascending or spreading, digitate racemes; spikelets usually in pairs on one side of a flat, winged rachis; first glume evident; second glume shorter than the sterile lemma, exposing the fruit, more or less pubescent; fertile lemma cartilaginous, pale, with hyaline margins.

1. *Digitaria sanguinalis* (L.) Scop., Fl. Carn. ed. 2, 1: 52. 1772.

Panicum sanguinale L., Sp. Pl. 57. 1753.

Syntherisma sanguinalis Dulac, Fl. Haut. Pyr. 77. 1867.

Sacaton (Pinal County) and western base of Patagonia Mountains (Santa Cruz County). A common weed in waste places in temperate and tropical regions of the world.

Where it is sufficiently abundant this grass supplies forage of good quality.

65. LEPTOLOMA. FALL-WITCHGRASS

Slender perennial, felty-pubescent at base, with branching brittle culms, flat leaf blades, and diffuse panicles; first glume minute or obsolete; second glume and sterile lemma nearly equal, appressed-hairy on the internerves and margins; fertile lemma elliptic, acute, brown.

1. *Leptoloma cognatum* (Schult.) Chase, Biol. Soc. Wash. Proc. 19: 192. 1906.

Panicum cognatum Schult., Mant. 2: 235. 1824.

Cochise, Santa Cruz, and Pima Counties, up to 5,000 feet, rocky slopes and gravelly plains, August to September. New Hampshire to Minnesota, south to Florida, Texas, southern Arizona, and northern Mexico.

The mature panicles break away and become "tumbleweeds." The species is a fairly palatable forage plant.

66. ERIOCHLOA. CUPGRASS

Erect or decumbent annuals with flat leaf blades and several to numerous erect or ascending racemes, approximate on a common axis; spikelets usually solitary in two rows on one side of a narrow rachis; second glume and sterile lemma equal, longer than the fruit, the lemma sometimes enclosing a palea or a staminate flower; fertile lemma indurate, minutely rugose, mucronate or awned.

Key to the species

1. Pedicels with erect hairs at least half as long as the spikelets.
 1. E. LEMMONI.
1. Pedicels pubescent or scabrous (2).
 2. Second glume and sterile lemma awned; spikelets, including the awns, 7 to 10 mm. long ----- 2. E. ARISTATA.
 2. Second glume and sterile lemma awnless or mucronate; spikelets not more than 6 mm. long (3).
 3. Fruit 3 mm. long, apiculate ----- 3. E. GRACILIS.
 3. Fruit 2 to 2.5 mm. long, with an awn 0.5 to 1 mm. long (4).
 4. Spikelets 3 to 3.5 mm. long, the second glume merely acute; rachis slender, pubescent ----- 4. E. PROCERA.
 4. Spikelets, including the awn of the second glume, 4.5 to 5 mm. long; rachis relatively stout, scabrous ----- 5. E. CONTRACTA.

1. *Eriochloa lemmoni* Vasey and Scribn., Bot. Gaz. 9: 185. 1884.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, rocky, grassy slopes, August to September, type from the Huachuca Mountains (*Lemmon* 2910). Southern Arizona and northern Mexico.

2. *Eriochloa aristata* Vasey, Torrey Bot. Club Bul. 13: 229. 1886.

Open ground around Tucson, Pima County (*Thorner* 98, *Griffiths* 1612, 6943). Arizona, California, and northern Mexico.

3. *Eriochloa gracilis* (Fourn.) Hitchc., Wash. Acad. Sci. Jour. 23: 455. 1933.

Helopus gracilis Fourn., Mex. Pl. 2: 13. 1886.

Yavapai, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,200 feet, moist open ground, June to October. Texas, New Mexico, and Arizona.

A smaller form with more crowded less acuminate spikelets, and fertile lemma as long as the second glume and sterile lemma, is var. *minor* (Vasey) Hitchc. This species is of some value as a forage plant.

4. **Eriochloa procera** (Retz.) Hubbard, Kew Roy. Bot. Gard. Bul. Misc. Inform. 1930: 256. 1930.

Agrostis procera Retz., Observ. Bot. 4: 19. 1786.

On campus of the University of Arizona, Tucson, Pima County (*Griffiths* 1516). Cuba; introduced from Asia.

5. **Eriochloa contracta** Hitchc., Biol. Soc. Wash. Proc. 41: 163. 1928.

Sycamore Canyon near Ruby, Santa Cruz County, about 3,600 feet (*Kearney* and *Peebles* 14484). Open ground, ditches, and wet places, Kansas to Louisiana and Arizona, introduced in Missouri and Virginia.

67. PASPALUM

Perennials, with flat leaf blades and 2 to several spike-like racemes paired or racemose on a common axis; spikelets solitary or paired in two rows on one side of the rachis; first glume usually wanting; second glume and the sterile lemma equal, covering the fruit; fertile lemma indurate, smooth, usually obtuse.

These grasses are good forage plants. Dallisgrass (*P. dilatatum*) has been cultivated as a pasture grass in the southern United States and elsewhere. Knotgrass (*P. distichum*) serves as a soil binder along streams.

Key to the species

1. Racemes 2, paired; first glume often developed; plants often with extensively creeping stolons..... 1. *P. DISTICHUM*.
1. Racemes 1 to 5, never paired; first glume obsolete; plants caespitose, without stolons (2).
2. Culms with terminal inflorescence only; spikelets 3 to 3.5 mm. long, the margins ciliate-fringed..... 2. *P. DILATATUM*.
2. Culms with terminal and axillary inflorescences; spikelets 2.1 to 2.2 mm. long, glabrous or densely pubescent, the margins not fringed.
 3. *P. STRAMINEUM*.

1. **Paspalum distichum** L., Syst. Nat. ed. 10, 2: 855. 1759.

Yavapai, Maricopa, Cochise, Santa Cruz, and Pima Counties, at low altitudes, moist ground along streams and ditches, June to September. New Jersey to Florida, west to California and northwest to Idaho and Washington.

2. **Paspalum dilatatum** Poir. in Lam., Encycl. 5: 35. 1804.

In the grass garden at Tucson, Pima County (*Hitchcock* 3474), perhaps merely cultivated; introduced from South America.

3. **Paspalum stramineum** Nash in Britton, Man. 74. 1901.

Cochise and Santa Cruz Counties, about 4,000 feet, sandy open ground, June to September. Indiana to Minnesota, south to Texas, Arizona, and northwestern Mexico.

68. PANICUM

Annuals or perennials, with spikelets usually in open panicles; first glume minute to more than half as long as the spikelet; second glume and the sterile lemma equal, usually covering the fruit, the sterile

lemma sometimes enclosing a staminate flower; fertile lemma indurate, typically obtuse.

Bulb panicum (*P. bulbosum*), vine-mesquite (*P. obtusum*), and switchgrass (*P. virgatum*) yield forage and are sometimes cut for hay. Vine-mesquite is an excellent plant for controlling too rapid erosion in gulleys, but is sometimes looked upon as a weed. The seeds of several species were used for food by the Indians of Arizona.

Key to the species

1. Plants annual (2).
 2. Fruit transversely rugose; spikelets obscurely arranged in spike-like racemes (3).
 3. Spikelets dark brown, strongly reticulate-veined, glabrous.
 1. *P. FASCICULATUM*.
 3. Spikelets green, reticulate-veined only at the apex, pubescent (4).
 4. Spikelets 3.5 to 3.8 mm. long; sheaths and blades glabrous to papillose-hispid..... 2. *P. ARIZONICUM*.
 4. Spikelets 5 to 6 mm. long; sheaths and blades soft-pubescent.
 3. *P. TEXANUM*.
 2. Fruit smooth and shining (5).
 5. First glume short, truncate..... 4. *P. DICHOTOMIFLORUM*.
 5. First glume usually as much as half the length of the spikelet, acute or acuminate (6).
 6. Panicles usually more than half the height of the culm, the branches stiffly spreading..... 5. *P. CAPILLARE*.
 6. Panicles not more than one-third the height of the culm, the branches ascending (7).
 7. First glume subacute or blunt, about one-third the length of the spikelet..... 6. *P. STRAMINEUM*.
 7. First glume acuminate, usually more than half the length of the spikelet (8).
 8. Spikelets 4 mm. long..... 7. *P. PAMPINOSUM*.
 8. Spikelets not more than 3.3 mm. long..... 8. *P. HIRTICAULE*.
 1. Plants perennial (9).
 9. Basal leaves distinctly different from those of the culm, forming a winter rosette; culms at first simple, later becoming much branched (10).
 10. Spikelets 3.2 to 3.3 mm. long, glabrous or very sparsely pubescent.
 11. *P. SCRIBNERIANUM*.
 10. Spikelets 1.6 to 1.8 mm. long, pubescent; ligule of conspicuous hairs 4 to 5 mm. long (11).
 11. Blades glabrous on the upper surface, with rather conspicuous firm white margins..... 9. *P. TENNESSEENSE*.
 11. Blades pilose on the upper surface, sometimes near the base only.
 10. *P. HUACHUCAE*.
 9. Basal leaves similar to those of the culm, not forming a winter rosette (12).
 12. Plants caespitose; rhizomes and stolons wanting (13).
 13. Fruit transversely rugose (14).
 14. Culms distinctly bulbous at base..... 12. *P. BULBOSUM*.
 14. Culms not bulbous..... 13. *P. PLENUM*.
 13. Fruit smooth (15).
 15. Spikelets 3 to 3.7 mm. long; leaves crowded toward base, the blades becoming curled or twisted with age..... 14. *P. HALLII*.
 15. Spikelets 4 to 4.2 mm. long; leaves not crowded toward base, the blades not curled..... 15. *P. LEPIDULUM*.
 12. Plants rhizomatous or with widely creeping stolons (16).
 16. Plants without rhizomes; first glume obtuse; fruit as long as the spikelet; culms erect from a knotty crown, with long, widely spreading stolons, the nodes of the stolons densely bearded.
 18. *P. OBTUSUM*.
 16. Plants rhizomatous; first glume acute; fruit much shorter than the spikelet (17).
 17. Spikelets densely villous, 6 to 7 mm. long; nodes densely bearded.
 16. *P. URVILLEANUM*.
 17. Spikelets glabrous, 3.5 to 5 mm. long; nodes glabrous.
 17. *P. VIRGATUM*.

1. *Panicum fasciculatum* Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Pinal and Pima Counties, in open sandy ground and waste places, mostly around Tucson. Arkansas and Louisiana to Arizona, Mexico, and tropical America.

This species typically has broad blades and open panicles with spikelets 2.1 to 2.5 mm. long. Only the var. *reticulatum* (Torr.) Beal, with narrow blades, narrow condensed panicles, and spikelets 2.6 to 3 mm. long, is found in Arizona.

2. *Panicum arizonicum* Scribn. and Merr., U. S. Dept. Agr., Div. Agrost. Cir. 32: 2. 1901.

Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 4,000 feet, sandy ground and open rocky slopes, July to October, type from Camp Lowell, Pima County (*Pringle* 465). Texas to southern California and Mexico.

3. *Panicum texanum* Buckl., Prelim. Rpt. Geol. and Agr. Survey Tex. App. 3. 1866.

Introduced at Wilmot, Pima County (*Thorner* 39, in 1903). Moist open ground, Texas and northern Mexico, introduced in a few localities eastward.

4. *Panicum dichotomiflorum* Michx., Fl. Bor. Amer. 1: 48. 1803.

Tempe, Maricopa County (*McLellan* and *Stitt* 576). Moist ground, a weed in waste places, Maine to Nebraska, south to Florida and Texas, occasionally introduced westward.

5. *Panicum capillare* L., Sp. Pl. 58. 1753.

Apache, Navajo, Coconino, Yavapai, and Cochise Counties, 5,000 to 5,400 feet, moist open ground, July to October. Prince Edward Island to British Columbia, south to New Jersey, Missouri, Texas, Arizona, and California.

Only var. *occidentale* Rydb. (*P. barbipulvinatum* Nash) occurs in Arizona, differing from the species in the shorter, less pubescent leaf blades crowded toward the base, and more exerted panicles of somewhat larger spikelets.

6. *Panicum stramineum* Hitchc. and Chase, Contrib. U. S. Natl. Herbarium 15: 67. 1910.

Tucson (Pima County), and moist sandy plains near the Mexican border, August to September. Southern Arizona and northwestern Mexico.

7. *Panicum pampinosum* Hitchc. and Chase, Contrib. U. S. Natl. Herbarium 15: 66. 1910.

Pima County, at Wilmot (*Thorner* 193, the type collection), and Tucson Mountains (*Griffiths* 6939½). New Mexico, Arizona, and Mexico.

8. *Panicum hirticaule* Presl, Reliq. Haenk. 1: 308. 1830.

Mohave, Yavapai, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 4,000 feet, dry open ground and waste places, June to September. Arkansas and western Texas to southern California, Mexico, and Colombia.

9. ***Panicum tennesseense*** Ashe, Elisha Mitchell Sci. Soc. Jour. 15: 52. 1898.

Santa Catalina Mountains, Pima County (*Harrison* and *Kearney* 7256). Open ground and borders of woods, Maine to Minnesota, south to Georgia and Texas, also at a few localities in Colorado, Utah, New Mexico, and Arizona.

10. ***Panicum huachucae*** Ashe, Elisha Mitchell Sci. Soc. Jour. 15: 51. 1898.

Bright Angel Trail (Coconino County), Fort Huachuca (Cochise County), about 4,000 feet, open ground, type from the Huachuca Mountains (*Lemmon* in 1882). Nova Scotia to Montana, south to Florida and Texas, also westward in a few scattered localities.

The var. *fasciculatum* (Torr.) F. T. Hubb., which is more slender and less pubescent, with thin lax spreading blades sparsely pilose on the upper surface, occurs near Tucson (*Toumey* 781). It has about the same general range as the species.

11. ***Panicum scribnerianum*** Nash, Torrey Bot. Club Bul. 22: 421. 1895.

Apache, Coconino, and Yavapai Counties, 4,500 to 5,500 feet, open sandy ground, June to September. Maine to British Columbia, south to Maryland, Tennessee, Texas, Arizona, and northern California.

12. ***Panicum bulbosum*** H. B. K., Nov. Gen. et Sp. 1: 99. 1815.

Coconino, Yavapai, Cochise, Santa Cruz, and Pima Counties, 5,300 to 8,000 feet, moist canyons and open woods, July to October. Western Texas to Arizona and Mexico.

The var. *minus* Vasey (*Panicum bulbosum* var. *sciaphilum* Hitchc. and Chase) is a smaller slender form with narrow blades and spikelets 2.8 to 3.2 mm. long. The variety is as common as the species and has the same range.

13. ***Panicum plenum*** Hitchc. and Chase, Contrib. U. S. Natl. Herbarium 15: 80. 1910.

Cochise and Santa Cruz Counties, at medium altitudes, along streams and on rocky hills, August to September. Texas to Arizona and Mexico.

14. ***Panicum hallii*** Vasey, Torrey Bot. Club Bul. 11: 61. 1884.

Coconino, Yavapai, Greenlee, Cochise, Santa Cruz, and Pima Counties, 3,400 to 5,700 feet, dry prairies and rocky hills, August to October. Texas to Arizona and Mexico.

15. ***Panicum lepidulum*** Hitchc. and Chase, Contrib. U. S. Natl. Herbarium 15: 75. 1910.

Nogales, Santa Cruz County (*Peebles* et al. 4621). New Mexico, southern Arizona, and Mexico.

This is the only typical specimen of this species from the United States. A collection in the Santa Catalina Mountains (*Griffiths* 7063) was doubtfully referred to this species by Hitchcock and Chase in their revision of *Panicum*.

16. ***Panicum urvilleanum*** Kunth, Rév. Gram. 2: 403. 1831.

Locality uncertain (*Lemmon* 4665, in 1884). Sandy deserts, Arizona and southern California; Argentina, Chile.

17. *Panicum virgatum* L., Sp. Pl. 59. 1753.

Coconino, Yavapai, and Pima Counties, 2,000 to 7,000 feet, moist canyons and open, sometimes rocky ground, June to September. Quebec and Maine to Montana, south to Central America.

18. *Panicum obtusum* H. B. K., Nov. Gen. et Sp. 1: 98. 1815.

Navajo, Mohave, Yavapai, Cochise, Santa Cruz, and Pima Counties, 1,200 to 5,000 feet, low, open ground, May to October. Missouri to Colorado, south to Texas and Arizona.

69. ECHINOCHLOA. COCKSPUR

Slender or stout annuals, with flat leaf blades and few to several spikelike racemes along a common axis; spikelets hispid, densely arranged on one side of the rachis; first glume acute, about half as long as the spikelet; second glume and sterile lemma equal, pointed, the lemma often with a long conspicuous awn.

These grasses are readily grazed by livestock. Forms of barnyard grass (*E. crusgalli*) and jungle-rice (*E. colonum*) are cultivated in Asia and Africa for the seeds, which are used for human food.

Key to the species

1. Culms slender, 20 to 40 cm. high; leaf blades 3 to 5 mm. wide; spikelets 2 mm. long, arranged in about 4 rows, awnless, weakly hispid-scabrous on the nerves..... 1. *E. COLONUM*.
 1. Culms stout, up to 150 cm. high; leaf blades 5 to 15 mm. wide; spikelets 3 mm. long, irregularly fasciated, awned or awnless, strongly papillose-hispid on the nerves, the internerves hispid-scabrous..... 2. *E. CRUSGALLI*.

1. *Echinochloa colonum* (L.) Link, Hort. Berol. 2: 209. 1833.

Panicum colonum L., Syst. Nat. ed. 10, 2: 870. 1759.

Pinal, Maricopa, Cochise, Santa Cruz, and Pima Counties, up to 5,500 feet, moist weedy places, May to October. Virginia to Missouri, southward and southwestward to Florida, Arizona, and southeastern California; tropical regions of both hemispheres; introduced in America.

2. *Echinochloa crusgalli* (L.) Beauv., Ess. Agrost. 53, 161. 1812.

Panicum crusgalli L., Sp. Pl. 56. 1753.

Apache County to Coconino County, south to the southern border, 1,100 to 7,000 feet, moist ground along ditches and in waste places, July to September. New Brunswick to Washington, south to Florida. Arizona, and California; temperate and subtropical regions of both hemispheres.

The var. *zelayensis* (H. B. K.) Hitchc. differs from the species in having an awnless or mucronate sterile lemma. The var. *mitis* (Pursh) Peterm. differs from the preceding in having mostly simple, more spreading racemes and less strongly hispid spikelets. Both varieties occur throughout most of the range of the species in Arizona.

70. SETARIA. BRISTLEGRASS

Annuals or perennials, with flat leaf blades and spikelike or somewhat open panicles; spikelets subtended by one or more scabrous bristles, the spikelets deciduous, the bristles persistent; first glume

broad, less than half as long as the spikelet; second glume and the sterile lemma equal or the glume a little shorter; fruit smooth or transversely rugose.

Plains bristlegrass (*S. macrostachya*) is Arizona's best forage species. Foxtail-millet (*S. italica*), which is grown in the United States for hay, has been cultivated for food by primitive peoples in Europe since prehistoric times.

Key to the species

1. Plants annual (2).
 2. Bristles yellowish or golden, more than 5 below each spikelet; spikelets 3 mm. long; second glume much shorter than the coarsely rugose fertile lemma.
 1. *S. LUTESCENS*.
 2. Bristles green, 1 to 3 below each spikelet; spikelets 2 to 2.5 mm. long (3).
 3. Fertile lemma coarsely transverse-rugose; panicle loosely flowered.
 2. *S. LIEBMANNI*.
 3. Fertile lemma finely crosslined or nearly smooth (4).
 4. Panicle rather loose, tapering toward the apex.----- 3. *S. GRISEBACHII*.
 4. Panicle dense, cylindric, scarcely tapering toward the apex.
 4. *S. VIRIDIS*.
 1. Plants perennial (5).
 5. Spikelets 3 mm. long; leaf blades villous.----- 5. *S. VILLOSISSIMA*.
 5. Spikelets 2 to 2.5 mm. long; leaf blades scabrous or pubescent (6).
 6. Panicle spike-like, interrupted, with branches usually not more than 1 cm. long, appressed; blades mostly less than 1 cm. wide.
 6. *S. MACROSTACHYA*.
 6. Panicle rather loose, the lower branches spreading, up to 3 cm. long; blades flat, up to 1.5 cm. wide.----- 7. *S. SCHEELEI*.

1. *Setaria lutescens* (Weigel) F. T. Hubbard, *Rhodora* 18: 232. 1916.

Panicum lutescens Weigel, *Observ. Bot.* 20. 1772.

Chaetochloa glauca (L.) Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 4: 39. 1897.

Maricopa County, at Tempe (*McLellan* and *Stitt* 549) and Scottsdale (*Peebles* 14421). Cultivated ground and waste places, New Brunswick to South Dakota, south to Florida and Texas, occasional from British Columbia to California, Arizona, and New Mexico; introduced from Europe.

2. *Setaria liebmanni* Fourn., *Mex. Pl.* 2: 44. 1886.

West slope of the Baboquivari Mountains, Pima County (*Goodding* in 1938), open sandy or rocky soil. Arizona to Nicaragua.

3. *Setaria grisebachii* Fourn., *Mex. Pl.* 2: 45. 1886.

Chaetochloa grisebachii var. *ampla* Scribn. and Merr., U. S. Dept. Agr., Div. Agrost. Bul. 21: 36. 1900.

Yavapai, Gila, Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,000 feet, sandy or stony ground, June to October. Texas to Arizona and Mexico.

4. *Setaria viridis* (L.) Beauv., *Ess. Agrost.* 51, 178. 1812.

Panicum viride L., *Syst. Nat.* ed. 10, 2: 870. 1759.

Chaetochloa viridis Scribn., U. S. Dept. Agr., Div. Agrost. Bul. 4: 39. 1897.

Apache, Coconino, Pinal, Cochise, and Pima Counties, 2,000 to 8,000 feet, fields and open woods. Temperate regions of both hemispheres; introduced from Europe.

5. *Setaria villosissima* (Scribn. and Merr.) Schum., Just's Bot. Jahresber. 28¹: 417. 1902.

Chaetochloa villosissima Scribn. and Merr., U. S. Dept. Agr., Div. Agrost. Bul. 21: 34. 1900.

Arizona without definite locality (*Emersley* 19 and 21 C, in 1890). Texas and Arizona.

6. *Setaria macrostachya* H. B. K., Nov. Gen. et Sp. 1: 110. 1815.

Coconino, Yavapai, Greenlee, Cochise, Santa Cruz, and Pima Counties, 2,000 to 7,000 feet, dry, rocky soil, May to October. Texas to Colorado, Arizona, and Mexico.

This species is referred to *Chaetochloa composita* in Woot. and Standl., Flora New Mexico.

7. *Setaria scheelei* (Steud.) Hitchc., Biol. Soc. Wash. Proc. 41: 163. 1928.

Panicum scheelei Steud., Syn. Pl. Glum. 1: 51. 1854.

Near base of the Baboquivari Mountains, Pima County (*Harrison* and *Kearney* 8018). Texas and Arizona.

71. CENCHRUS. SANDBUR

Decumbent or geniculate spreading annuals, with flat leaf blades and rather dense spikelike racemes of burs; burs composed of numerous coalescing bristles, enclosing 2 to 4 spikelets, falling entire; first glume usually half to two-thirds as long as the spikelet; second glume and sterile lemma equal, subacute or acuminate; fruit acuminate, about as long as the second glume and the sterile lemma.

The plants make good forage when young, but become troublesome after maturity. The burs are especially obnoxious when mixed with hay, their barbed spines being painful to human beings and animals, difficult to extract, and sometimes causing inflammation and infection.

Key to the species

1. Burs with a ring of slender bristles at base; spikelets usually 4 in each bur.
 1. *C. ECHINATUS*.
 1. Burs with no ring of slender bristles at base; spikelets usually 2 in each bur.
 2. *C. PAUCIFLORUS*.

1. *Cenchrus echinatus* L., Sp. Pl. 1050. 1753.

Maricopa and Yuma Counties, a troublesome weed in irrigated land and cultivated fields. Open ground and waste places, South Carolina to Florida and Arizona; tropical America.

2. *Cenchrus pauciflorus* Benth., Bot. Voy. Sulph. 56. 1840.

Navajo, Yavapai, Greenlee, Maricopa, Santa Cruz, and Pima Counties, up to 5,500 feet, open sandy ground, July to September. Maine to Oregon, south to Mexico; coastal regions of tropical America and southern South America.

72. IMPERATA. SATINTAIL

Slender erect perennials from hard scaly rhizomes, with linear leaf blades narrowed toward base to the thickened midrib, and narrow terminal silky panicles; spikelets all alike, paired, awnless, unequally

pedicellate on a continuous rachis, surrounded by long silky hairs; glumes about equal, membranaceous; sterile lemma, fertile lemma, and palea thin and hyaline.

1. *Imperata hookeri* Rupr. in Anderss., Svenska Vetensk. Akad. Öfversigt af... Förh. 12: 160. 1855.

Coconino, Yavapai, and Pima Counties, rocky canyons, May to August. Western Texas to Nevada, Arizona, California, and northern Mexico.

73. ERIANTHUS. PLUMEGRASS

Coarse perennials with long narrow leaf blades and large silvery panicles; spikelets all alike, in pairs along a slender axis, one sessile, the other pedicellate; rachis disarticulating below the spikelets; glumes coriaceous, with long silky hairs at base; sterile and fertile lemma hyaline, the latter with a short slender awn.

1. *Erianthus ravennae* (L.) Beauv., Ess. Agrost. 14, 162, 177. 1812.

Andropogon ravennae L., Sp. Pl. ed. 2, 1481. 1763.

Sparingly naturalized along the Arizona canal, Maricopa County (*Harrison* 5835). Introduced from Europe.

Occasionally cultivated for ornament under the name ravennagrass.

74. ANDROPOGON. BLUESTEM

Perennials, with flat or folded leaf blades and few to numerous racemes, these solitary, paired, digitate, or several to numerous and approximate on a short or somewhat elongate axis; sessile spikelet perfect, the pedicellate one staminate and similar to the sessile one, or sterile and much reduced; glumes of the fertile spikelet coriaceous, the first rounded, flat, or concave on the back, several-nerved; sterile lemma shorter than the glumes, empty, hyaline; fertile lemma hyaline, narrow, entire or bifid, usually bearing from the tip a bent and twisted awn.

The bluestems, sometimes known as beardgrasses, furnish a good deal of the summer forage in the hills and mountains of southern Arizona, but the plants tend to become woody as they approach maturity.

Key to the species

1. Racemes few to numerous, approximate on a relatively long axis; culms sparingly branched from the base only (2).
2. Spikelets 5 to 6 mm. long; panicle short-exserted or partly enclosed in the sheath; racemes relatively few on a short axis; nodes densely bearded.
 7. *A. BARBINODIS.*
2. Spikelets about 4 mm. long; panicle usually long-exserted; racemes numerous on a relatively long axis; nodes glabrous or appressed-hispid.
 8. *A. SACCHAROIDES.*
1. Racemes solitary, paired, or digitate; culms branching toward the summit (3).
3. Racemes solitary on each peduncle (4).
4. Racemes flexuous; internodes of the rachis relatively slender; sterile pedicel and spikelet usually spreading..... 3. *A. SCOPARIUS.*
4. Racemes straight; internodes of the rachis relatively thick (5).
5. First glume of the sessile spikelet pubescent; rachis joints and sterile pedicels pubescent..... 1. *A. HIRTIFLORUS.*

5. First glume of the sessile spikelet glabrous; sterile pedicel glabrous or ciliate only near apex..... 2. *A. CIRRATUS*.
3. Racemes paired or digitate on each peduncle (6).
6. Pedicellate spikelet much reduced, the pedicel not always developed; racemes 2, slender, partly enclosed in the narrow spathe, aggregate in a dense silky inflorescence..... 6. *A. GLOMERATUS*.
6. Pedicellate spikelet staminate, similar to the sessile one; racemes 5 to 10 cm. long, 2 to 6 on each peduncle, long-exserted (7).
7. Rhizomes short or wanting; racemes inconspicuously hairy, pale or tinged with purple; awn of the sessile spikelet 1 to 2 cm. long.
4. *A. FURCATUS*.
7. Rhizomes well developed; racemes conspicuously villous with golden hairs; awn of the sessile spikelet rarely more than 0.5 cm. long.
5. *A. HALLII*.

1. *Andropogon hirtiflorus* (Nees) Kunth, Rév. Gram. 1: Sup. XXXIX. 1830.

Schizachyrium hirtiflorum Nees, Agrost. Bras. 334. 1829.

Coconino, Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,000 feet, canyons and rocky slopes, June to October. Western Texas to Arizona and Mexico.

The species is represented in Arizona by var. *jeensis* (Fourn.) Hack. (*A. jeensis* Fourn.).

2. *Andropogon cirratus* Hack., Flora 68: 119. 1885.

Schizachyrium cirratum Woot. and Stand., N. Mex. Col. Agr. Bul. 81: 30. 1912.

Greenlee, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,500 feet, canyons and rocky slopes, August to October. Western Texas to Arizona, southern California, and northern Mexico.

3. *Andropogon scoparius* Michx., Fl. Bor. Amer. 1: 57. 1803.

Schizachyrium scoparium Nash in Small, Fl. Southeast. U. S. 59, 1326. 1903.

Navajo, Coconino, and Pima Counties, at medium altitudes, dry plains and rocky hills, July to September. Quebec and Maine to Alberta and Idaho, south to Florida and Arizona.

The var. *neomexicanus* (Nash) Hitchc. (*Schizachyrium neomexicanum* Nash) is a form with nearly straight racemes, the rachis and pedicels conspicuously villous. It is found in Apache, Coconino, Yavapai, and Cochise Counties.

4. *Andropogon furcatus* Muhl. in Willd., Sp. Pl. 4: 919. 1806.

White Mountains, Apache County (*Griffiths* 5407). Dry rocky hills, prairies, and open woods, Maine and Quebec to Saskatchewan and Montana, south to Arizona and Mexico.

5. *Andropogon hallii* Hack., Akad. Wiss. Wien Math.-Nat. Kl. Sitzber. 89¹: 127. 1884.

Andropogon chrysocomus Nash in Britton, Man. 70. 1901.

Coconino and Cochise Counties, at medium altitudes, sandy plains, dry hills, and open pine woods, July to September. North Dakota and eastern Montana to Texas, Wyoming, Utah, and Arizona.

6. *Andropogon glomeratus* (Walt.) B. S. P., Prelim. Cat. N. Y. 67. 1888.*Cinna glomerata* Walt., Fl. Carol. 59. 1788.

Coconino and Maricopa Counties, at low altitudes, moist ground and rocky slopes, July to September. Massachusetts to Florida, west to Kentucky, Arizona, and southern California.

7. *Andropogon barbinodis* Lag., Gen. et Sp. Nov. 3. 1816.*Amphilophis leucopogon* (Nees) Nash, North Amer. Fl. 17: 126. 1912.

Coconino, Yavapai, Pinal, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,000 to 5,300 feet, open sandy or gravelly ground and rocky slopes, May to October. Oklahoma and Texas to California and Mexico.

8. *Andropogon saccharoides* Swartz, Prodr. Veg. Ind. Occ. 26. 1788.*Amphilophis saccharoides* Nash, North Amer. Fl. 17: 125. 1912.

Coconino, Yavapai, Santa Cruz, and Pima Counties, 2,000 to 4,000 feet, prairies and rocky slopes, June to October. Missouri to Colorado, Alabama, Arizona, and southern California.

75. SORGHUM

Coarse rhizomatous perennial with flat leaf blades and open panicles of short few-flowered racemes; sessile spikelet ovate with a twisted geniculate awn, the glumes indurate; pedicellate spikelet lanceolate, awnless, the glumes membranaceous.

Johnsongrass (*S. halepense*), because of the large size of the plant, rank growth, and difficulty of eradication, is a very costly pest in the irrigated valleys of southern Arizona where it thrives to the detriment of all summer field crops. The seeds were formerly eaten by the Pima Indians. The plant produces much pollen, to which many persons are allergic. Many varieties of *S. vulgare* Pers. are cultivated for grain, ensilage, or sirup. Sudan grass (*S. vulgare* var. *sudanense*) yields large quantities of forage on irrigated lands in this State. Under certain conditions the sorghums (including Johnsongrass) cause prussic-acid poisoning in livestock.

1. *Sorghum halepense* (L.) Pers., Syn. Pl. 1: 101. 1805.*Holcus halepensis* L., Sp. Pl. 1047. 1753.

Throughout the State, up to 5,000 feet, a weed in waste places, fields, and along irrigation ditches, flowering April to November. Massachusetts to Iowa, south to Florida, Texas, Arizona, and southern California; naturalized from the Old World.

76. SORGHASTRUM. INDIAN-GRASS

A rather tall, tufted, rhizomatous perennial, with flat, narrow leaf blades and narrow rather dense terminal panicles of 1- to 3-jointed racemes; sessile spikelet perfect, the glumes coriaceous, brownish, the first glume sparsely hirsute, the fertile lemma hyaline, extending into

a tightly twisted, once-geniculate awn; pedicellate spikelet wanting, only the hairy pedicel present.

1. **Sorghastrum nutans** (L.) Nash in Small, Fl. Southeast. U. S. 66. 1903.

Andropogon nutans L., Sp. Pl. 1045. 1753.

Apache, Navajo, Coconino, and Cochise Counties, at medium altitudes, dry slopes and canyons, August to October. Quebec and Maine to Manitoba and North Dakota, south to Florida, Arizona, and Mexico.

This grass affords fairly good forage.

77. HETEROPOGON. TANGLEHEAD

Annuals or perennials, with flat leaf blades and solitary terminal racemes; lower few pairs of spikelets alike, staminate, awnless, the remaining sessile spikelets fertile, long-awned, the pedicellate spikelets staminate like the lower ones; rachis continuous below, bearing the fertile spikelets above, disarticulating at base of each joint, the joint forming a sharp, barbed callus below the fertile spikelet; glumes of the fertile spikelet dark brown, coriaceous, the first glume enclosing the second one; glumes of the staminate spikelet membranaceous, broad, obscuring the fertile spikelets; lemmas hyaline, the fertile one with a long, stout, twisted, geniculate awn.

The mature fruits of tanglehead are injurious to sheep, but in the young stage the plants make good forage. Sweet tanglehead (*H. melanocarpus*) owes its common name to the fragrance of the fresh foliage.

Key to the species

1. Plant annual; culms usually more than 1 meter high; first glume of the staminate spikelet with a row of conspicuous glands on the back. 1. *H. MELANOCARPUS*.
1. Plant perennial; culms slender, usually less than 1 meter high; first glume of the staminate spikelet glandless, papillose-hispid.----- 2. *H. CONTORTUS*.

1. **Heteropogon melanocarpus** (Ell.) Benth., Linn. Soc. London Jour. Bot. 19: 71. 1881.

Andropogon melanocarpus Ell., Bot. S. C. and Ga. 1: 146. 1816.

Santa Cruz and Pima Counties, fields and waste places. Georgia, Florida, Alabama, and Arizona; tropical and semitropical regions of both hemispheres.

2. **Heteropogon contortus** (L.) Beauv. in Roem. and Schult., Syst. Veg. 2: 836. 1817.

Andropogon contortus L., Sp. Pl. 1045. 1753.

Mohave, Yavapai, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 5,000 feet, rocky slopes and canyons, September to October, occasionally January to April. Texas to Arizona; warmer regions of both hemispheres.

78. TRACHYPOGON. CRINKLE-AWN

Densely tufted perennial with flat or subinvolute leaf blades and solitary terminal racemes; spikelets in pairs on a continuous rachis, the sessile one staminate, awnless, persistent, the pedicellate spikelet

perfect with a long, geniculate, villous awn, its pedicel obliquely disarticulating, forming a sharp pointed callus below the spikelet; first glume firm, rounded on the back, obtuse.

1. **Trachypogon montufari** (H. B. K.) Nees, Agrost. Bras. 342. 1829.
Andropogon montufari H. B. K., Nov. Gen. et Sp. 1: 184. 1816.

Mohave, Gila, Cochise, Santa Cruz, and Pima Counties, 1,000 to 6,000 feet, rocky hills, September to October. Southern Texas, New Mexico, and Arizona, south to Argentina.

79. ELYONURUS

Rather slender, erect perennial with involute leaf blades and solitary, erect, woolly racemes; spikelets in pairs at each joint of the tardily disarticulating rachis, the sessile spikelet perfect, the pedicellate one staminate, similar to the sessile one; first glume firm, flattened, acute, the margins enclosing the second glume; lemmas thin, hyaline, awnless.

1. **Elyonurus barbiculmis** Hack. in D. C., Monog. Phan. 6: 339. 1889.

Elyonurus barbiculmis parviflorus Scribn., U. S. Dept. Agr., Div. Agrost. Cir. 32: 1. 1901.

Mohave, Cochise, Santa Cruz, and Pima Counties, mostly 4,000 to 6,000 feet, rocky slopes and canyons, July to October, type from Arizona (*Lemmon* 2926). Western Texas to Arizona and northern Mexico.

This grass, where sufficiently abundant, affords good grazing.

80. HACKELOCHLOA

Erect or spreading, freely branching annual with short, solitary, exerted or partly included racemes; spikelets in pairs, awnless, very dissimilar, the sessile one perfect, the pedicellate one staminate, conspicuous; first glume of the sessile spikelet broad, alveolate, the margins clasping the fused rachis joint and pedicel of the staminate spikelet.

1. **Hackelochloa granularis** (L.) Kuntze, Rev. Gen. Pl. 2: 776. 1891.

Cenchrus granularis L., Mant. 2: 575. 1771.

Cochise, Santa Cruz, and Pima Counties, sandy plains and waste places, August to October. Georgia and Florida to Louisiana, New Mexico, and Arizona; tropics of both hemispheres, introduced in America.

81. TRIPSACUM. GAMAGRASS

Robust perennials with broad, flat leaf blades and monoecious terminal and axillary inflorescences, the pistillate part below, the staminate part above on the same rachis; staminate spikelets 2-flowered, in pairs, one sessile, the other sessile or pedicellate; pistillate spikelets solitary on opposite sides at each joint of the thick, hard, articulate lower part of the rachis, sunken in hollows, consisting of 1 perfect floret and a sterile lemma.

This genus is of interest mainly on account of its relationship to Indian-corn or maize.

1. *Tripsacum lanceolatum* Rupr. in Fourn., Mex. Pl. 2: 68. 1886.

Tripsacum lemmoni Vasey, Contrib. U. S. Natl. Herbarium 3:6. 1892.

Mule Mountains and Huachuca Mountains (Cochise County), 15 miles from Patagonia (Santa Cruz County), rocky hills, type of *T. lemmoni* from the Huachuca Mountains (*Lemmon* 2932). Southern Arizona to Guatemala.

9. CYPERACEAE. SEDGE FAMILY

Plants herbaceous, grasslike or rushlike; flowering stems often triangular, usually solid, from fibrous roots or from rootstocks, these sometimes bulblike or bearing tubers; leaves with narrow sometimes terete blades, the sheaths closed, the blades sometimes wanting; flowers subtended by 2-ranked or spirally imbricate scales (some of these often empty), arranged in spikelets; stamens 1 to 3; ovary 1-celled; ovule 1; fruit an achene.

A family of large size but very little economic importance, the commonly tough and wiry herbage giving the plants small forage value as compared with that of the grasses. The fact that most of the gregarious species occur in marshes makes their value as soil binders negligible.

Key to the genera

1. Achene enclosed in a perigynium (saclike, often beaked envelope with an apical opening through which the styles protrude); flowers none of them perfect, the staminate and pistillate ones in separate spikes or in the same spike----- 8. CAREX.
1. Achene not enclosed in a perigynium; flowers all perfect or, if some of them imperfect, then the staminate and pistillate ones not sharply segregated as above (2).
2. Spikelets with scales in 2 rows, the spikelets often strongly flattened; empty basal scales not more than 2; perianth bristles none----- 2. CYPERUS.
2. Spikelets with scales mostly spirally imbricate around the axis in several rows, the spikelets terete or not strongly flattened (3).
3. Base of the style noticeably enlarged (4).
4. Thickened base deciduous with the rest of the style; spikelets several, in capitate or umbellate clusters; perianth bristles none; achenes biconvex or lenticular----- 5. FIMBRISTYLIS.
4. Thickened base persistent after the rest of the style has fallen (5).
5. Stems leafless or their leaves reduced to sheaths; spikelet solitary; perianth bristles usually present; style base conic or bulbous, large; achenes biconvex, lenticular, or triangular.----- 4. ELEOCHARIS.
5. Stems usually bearing one or more leaves with filiform blades; spikelets solitary or several in cymose clusters; perianth bristles none; style base apiculate, small; achenes triangular.----- 6. BULBOSTYLIS.
3. Base of the style not noticeably enlarged (6).
6. Stamen 1; bristles none; achene nearly cylindrical; plant dwarf, with filiform stems and leaves; spikelets not more than 3 mm. long.----- 1. HEMICARPHA.
6. Stamens 2 or 3; perianth, if any, represented by 1 or more bristles (7).
7. Flowers all perfect; spikelets with not more than 2 empty basal scales; perianth bristles usually present; achene triangular, lens-shaped, or plano-convex; leaf margins not spinulose.----- 3. SCIRPUS.
7. Flowers often partly staminate, only the one or two uppermost ones perfect; spikelets with 3 or more empty basal scales; perianth bristles none; achene ovoid or globose; leaf margins spinulose-serrate----- 7. CLADIUM.

1. HEMICARPHA

Plants annual, dwarf, with tufted slender stems; spikelets terminal, solitary or in clusters of 2 to 4, not more than 3 mm. long, terete, subtended by 1 to 3 leaf-like bracts; flowers all perfect, subtended by spirally imbricate scales; stamen 1.

Key to the species

1. Scales oblong or narrowly obovate, with a short recurved tip; achenes cylindric, brown, with many crowded papillae.----- 1. *H. MICRANTHA*.
1. Scales broadly obovate or rhombic, with a blunt appressed tip; achenes narrowly obovoid, ashy, with fewer and less crowded papillae.----- 2. *H. DRUMMONDII*.

1. **Hemicarpha micrantha** (Vahl) Pax in Engler und Prantl, Pflanzenfam. 2²: 105. 1887.

Scirpus micranthus Vahl, Enum. Pl. 2: 254. 1806.

Cochise, Santa Cruz, and Pima Counties, 2,400 to 4,000 feet, in wet sand along streams. New Hampshire to Florida, west to the Pacific and southward to South America.

2. **Hemicarpha drummondii** Nees in Mart., Fl. Bras. 2¹: 62. 1842.

Camp Lowell, Pima County (*Rothrock* 715). Western Ontario to Indiana, Texas, and southern Arizona.

Specimens from the foot of the Rincon Mountains, Pima County, (*Kearney* and *Peebles* 10476), and from Sycamore Canyon near Ruby, Santa Cruz County (*Kearney* and *Peebles* 14482), seem to be intermediate between this species and *H. micrantha*.

2. CYPERUS. FLAT-SEDGE

Plants annual or perennial; stems triangular; leaves mostly basal, with 1 or more apical leaves forming an involucre to the inflorescence; spikelets in simple or compound umbels or heads, often flat, with the scales in 2 ranks; stamens 1 to 3; achene lenticular or triangular, not subtended by bristles.

Most of the species inhabit marshes and banks of streams but a few occur in pine woods. They flower in summer. Nutgrass (*C. rotundus*) and chufa (*C. esculentus*) are troublesome weeds in irrigated land in southern Arizona and are difficult to eradicate, because of the nut-like underground tubers by which they propagate. These tubers are greatly relished by pigs.

Key to the species

1. Achene lenticular (biconvex); style branches 2; scales obtuse, sometimes mucronulate (2).
2. Scales loosely imbricate, broadly white-margined toward the apex; inflorescence open, not appearing lateral, more than 2 cm. long, the rays elongate.----- 10. *C. ALBOMARGINATUS*.
2. Scales closely imbricate; inflorescence dense, subcapitate, not more than 2 cm. long, the rays almost none (3).
3. Spikelets rather turgid; scales less than 2 mm. long, thin, whitish, often blotched with liver color; flowering stems from slender, creeping rootstocks; inflorescence appearing lateral, the longest bract of the involucre erect and resembling a continuation of the stem.----- 8. *C. LAEVIGATUS*.
3. Spikelets flat; scales 2 mm. long or longer, light brown or chestnut-colored; flowering stems from creeping rootstocks, or caespitose and the plant appearing annual; inflorescence usually not appearing lateral, the bracts more or less spreading.----- 9. *C. NIGER*.

1. Achene triangular; style branches 3, or sometimes only 2, in *C. seslerioides* (4).
4. Rachilla of the spikelet with numerous articulations, one below each scale, the joints separating readily at maturity; stems usually tall and stout; inflorescence typically large, compound, with some of the rays elongate; spikelets very slender, mostly 8 mm. long or longer, pale yellowish brown to reddish brown when mature----- 21. *C. FERAX*.
4. Rachilla not articulated or with only one articulation just above the base, the joints not separating (5).
5. Scales cuspidate to aristate, the tips spreading in age (6).
6. Plant stoloniferous; stamens 3; stems seldom less than 30 cm. long; scales strongly several-nerved (7).
7. Scales broadly ovate, merely cuspidate, the spikes not appearing bristly; central spike oblong or ovoid-oblong, usually much longer than the lateral ones, all sessile or nearly so; stolons thick and hard, tuberlike, mostly not more than 1 cm. long.----- 13. *C. FENDLERIANUS*.
7. Scales ovate-lanceolate, long-aristate, giving the spikes a bristly appearance; spikes all broadly ovoid or globose, some of them on more or less elongate, slender rays; stolons slender, thickened at the distal end, mostly 2 cm. long or longer.----- 15. *C. WRIGHTII*.
6. Plant not stoloniferous; stamen normally only 1 (8).
8. Spikelets very slender, usually less than 2 mm. wide, more than 3 times as long as wide, spreading, in umbelike clusters, these either sessile or borne on slender rays; scales merely cuspidate, bright reddish brown; plant annual----- 6. *C. AMABILIS*.
8. Spikelets more than 2 mm. wide, not more than 3 times as long as wide (9).
9. Scales 5- to 9-nerved, with reddish or brownish margins, ending in a slender, wide-spreading or recurved awn more than one-third as long as the body of the scale; plant annual, strong scented when dry----- 17. *C. ARISTATUS*.
9. Scales 3-nerved, pale green when fresh, becoming yellowish brown, with broad, white or only slightly colored margins, ending in a stout, moderately spreading cusp much less than one-third as long as the body of the scale (10).
10. Plant annual; bracts of the involucre suberect; inflorescence usually with one or more slender rays; achene narrow, acuminated, light-colored----- 4. *C. ACUMINATUS*.
10. Plant perennial; bracts more or less reflexed; inflorescence contracted, subcapitate; achene broad, obtuse and often abruptly apiculate, becoming nearly black; stems bulbous-thickened at base----- 7. *C. SESLERIODES*.
5. Scales muticous or mucronate, the tips not or but slightly spreading (11).
11. Plant stoloniferous, the stolons longer than thick (12).
12. Scales loosely imbricate, wider than long, greenish or olive brown, prominently several-nerved; plants of relatively dry situations (13).
13. Stolons mostly more than 1 cm. long, slender at the proximal end, thickened at the distal end; inflorescence usually contracted, the spikes dense, most of them sessile or nearly so; stems and leaves often scabrous or hispid----- 12. *C. MANIMÆ*.
13. Stolons mostly less than 1 cm. long, uniformly thick, hard, tuberlike; inflorescence open, the spikes usually loose, some of them borne on long, slender rays; stems and leaves smooth.----- 14. *C. RUSBYI*.
12. Scales closely imbricate, longer than wide, golden brown or mahogany-colored; stolons elongate, slender most of their length but often tuberous-thickened toward the distal end; plants of marshes, stream beds, and irrigated fields (14).
14. Scales mahogany-colored, the lateral nerves inconspicuous; rachis of the spike usually shorter than the spikelets.----- 2. *C. ROTUNDUS*.
14. Scales golden brown (exceptionally reddish brown) the lateral nerves conspicuous; rachis usually as long as or longer than the spikelets----- 3. *C. ESCULENTUS*.

11. Plant not stoloniferous; flowering stems often bulbous-thickened at base or arising from rootstocks (15).
15. Flowering stems not bulbous-thickened at base; plant annual (16).
16. Scales less than 1 mm. long, orbicular-obovate, rounded at apex; stamens 1 or 2; achene nearly as long as the scale; inflorescence often appearing lateral, the longest bract of the involucre more or less erect----- 5. *C. DIFFORMIS*.
16. Scales not less than 1 mm. long, lanceolate or ovate-lanceolate, acutish or mucronulate at apex; stamens 3; achene about half as long as the scale; inflorescence not appearing lateral (17).
17. Spikes elongate, the rachis much longer than the spikelets, the latter seldom more than 10 mm. long; scales not more than 1.5 mm. long, 3-nerved, the sides becoming gold- or copper-colored----- 1. *C. ERYTHRORHIZOS*.
17. Spikes very short, the rachis shorter than the spikelets, the latter usually more than 10 mm. long; scales 2 to 3.5 mm. long, 7- to 9-nerved, the sides becoming red or mahogany-colored; inflorescence often umbelliform----- 11. *C. PARISHII*.
15. Flowering stems bulbous-thickened at base, often arising from a rootstock, this usually very short; plant perennial (18).
18. Inflorescence normally contracted, the spikes sessile or borne on rays not more than 1 cm. long; spikelets with only 1 to 3 fertile flowers (19).
19. Lateral nerves of the scales inconspicuous or obsolete; spikelets 4 to 5 mm. long; achene ovate-oblong in outline.----- 19. *C. SUBAMBIGUUS*.
19. Lateral nerves of the scales conspicuous; spikelets 3 mm. long; achene ovate or obovate in outline----- 20. *C. FLAVUS*.
18. Inflorescence normally expanded, with some of the rays at least 2 cm. long; spikelets with 1 to several fertile flowers (20).
20. Scales usually about twice as long as the achene, greenish or pale brown on the sides; stems usually stout; spikes cylindrical; fertile flowers 2 or more----- 16. *C. PRINGLEI*.
20. Scales considerably less than twice as long as the achene; stems slender; spikes broadly ovoid or subglobose; spikelets slender, acuminate; fertile flowers 1 or 2----- 18. *C. UNIFLORUS*.

1. *Cyperus erythrorhizos* Muhl., Gram. 20. 1817.

Picacho Lake, Pinal County, 1,600 feet (*Taylor* in 1934), also collected at Fort Yuma, Calif., on the western bank of the Colorado River, 140 feet. Massachusetts to Florida, west to California.

The form occurring in Arizona may be var. *cupreus* (Presl) Kükenthal.

2. *Cyperus rotundus* L., Sp. Pl. 45. 1753.

Salt and Gila River Valleys (Pinal, Maricopa, and Yuma Counties). Widely distributed in tropical and subtropical America, presumably of Old World origin.

Nutgrass. A common and troublesome weed in irrigated lands.

3. *Cyperus esculentus* L., Sp. Pl. 45. 1753.

Central and southern Arizona (Navajo and Yavapai Counties to Cochise, Santa Cruz, Pima, and probably Yuma Counties), up to 5,000 feet. Widely distributed in America, as far north as Ontario and Alaska; Eastern Hemisphere.

Chufa, yellow nutgrass. Common in wet soil, often a weed in cultivated fields and pastures. A form with exceptionally short rachis and long spikelets, var. *leptostachyus* Boeckl., was collected near Scottsdale, Maricopa County (*Peebles* 14420), and in Baboquivari Canyon, Pima County (*Gilman* A26).

4. *Cyperus acuminatus* Torr. and Hook., Ann. Lyc. N. Y. 3: 435. 1836.

Graham, Gila, Cochise, and Pima Counties, 5,000 feet or lower. Illinois to North Dakota, Florida, Arizona, and California.

The form occurring in Arizona is var. *cyrtolepis* (Torr. and Hook.) Kükenthal (*C. cyrtolepis* Torr. and Hook.) with taller stems, less compact inflorescence, and broader spikelets and scales than in typical *C. acuminatus*.

5. *Cyperus difformis* L., Centuria Pl. II. 6. 1756; Amoen. Acad. 4: 302. 1760.

Cyperus lateriflorus Torr., U. S. and Mex. Bound. Bot. 226. 1859.

Not known definitely to occur in Arizona but has been collected at Santa Cruz, Sonora, about 10 miles south of the international boundary (Wright 1950, the type of *C. lateriflorus*). Mexico; tropical and subtropical regions of the Old World.

6. *Cyperus amabilis* Vahl, Enum. Pl. 2: 318. 1806.

Sonoita Valley and foothills of the Patagonia Mountains, Santa Cruz County, 4,000 to 6,000 feet (Rothrock 599, Harrison and Peebles 4733). Widely distributed in the tropical and subtropical parts of America; Eastern Hemisphere.

7. *Cyperus seslerioides* H. B. K., Nov. Gen. et Sp. 1: 209. 1816.

Huachuca Mountains, Cochise County (Wilcox 361, Epling and Stewart in 1936), Sonoita Valley, Santa Cruz County, 6,500 feet (Rothrock 614). Texas and southern Arizona to northern South America.

8. *Cyperus laevigatus* L., Mant. 179. 1771.

San Bernardino Ranch, Cochise County, 4,000 feet (Mearns 820). Texas, southern Arizona, southern California, Mexico, and Tropics of both the Eastern and the Western Hemispheres.

An imperfect specimen collected at Quitobaquito, Pima County (Mearns 2785), is probably of this species.

9. *Cyperus niger* Ruiz and Pavon, Fl. Peruv. Chil. 1: 47. 1798.

Cyperus melanostachys H. B. K., Nov. Gen. et Sp. 1: 207. 1816.

McNary (Apache County), Rye Creek (Gila County), and mountains of Cochise and Santa Cruz Counties, 3,500 to 7,500 feet. Texas to California and southward to South America.

The forms occurring in Arizona are var. *castaneus* (S. Wats.) Kükenthal and var. *robustus* (Liebm.) Kükenthal.

10. *Cyperus albomarginatus* Mart. and Schrad. ex Nees in Mart., Fl. Bras. 2¹: 9. 1842.

Cyperus flavicomus Vahl, Enum. Pl. 2: 360. 1806. Not Michx. 1803.

Near Ruby, Santa Cruz County, 3,600 to 4,300 feet (Kearney and Peebles 13785, 14480). Virginia to Florida west to southern Arizona, and southward; widely distributed in tropical and subtropical parts of both the Eastern and the Western Hemispheres.

11. *Cyperus parishii* Britton, South. Calif. Acad. Sci. Bul. 3: 52. 1904.

Cyperus sphacelatus Britton, Torrey Bot. Club Bul. 13: 212. 1886. Not Rottb., 1773.

Cyperus congestus Vahl var. *parishii* Kükenthal, Pflanzenreich IV. 101: 446. 1936.

Prescott (Yavapai County), near Phoenix (Maricopa County), Sulphur Springs Valley (Cochise County), 1,000 to 5,300 feet. New Mexico to Washington and California.

12. *Cyperus manimae* H. B. K., Nov. Gen. et Sp. 1: 209. 1816.

Sonoita Valley, Santa Cruz County, 5,850 feet (*Rothrock* 600). Texas to Arizona, southward to Argentina.

The Arizona form apparently is var. *asperrimus* (Liebm.) Kükenthal.

13. *Cyperus fendlerianus* Boeckl., Linnaea 35: 520. 1868.

Apache to Coconino Counties southward to Cochise, Santa Cruz, and Pima Counties, 4,500 to 9,500 feet. Western Texas to Arizona and northern Mexico.

Common in forests of yellow pine. It is stated that the tuberous roots were eaten by the Apache Indians.

14. *Cyperus rusbyi* Britton, Torrey Bot. Club. Bul. 11: 29. 1884.

Cyperus schweinitzii Torr. var. *debilis* Britton, *ibid.* 13: 208. 1886.

Cyperus fendlerianus Boeckl. var. *debilis* Kükenthal, Pflanzenreich IV. 101: 465. 1936.

Pinal Mountains (Gila County) to the Chiricahua Mountains (Cochise County) and Nogales (Santa Cruz County), 4,000 to 5,500 feet. Western Texas to Arizona, southward to Guatemala.

Grows on dry slopes, usually with grasses, at lower elevations than *C. fendlerianus*.

15. *Cyperus wrightii* Britton, Torrey Bot. Club Bul. 13: 215. 1886.

Mountains of Cochise, Pima, and Santa Cruz Counties, 3,500 to 5,000 feet, in rich soil of wooded canyons. Texas to Arizona, southward into Mexico.

A form apparently related to *C. wrightii*, but with a more lax inflorescence and longer spikelets, was collected near Ruby, Santa Cruz County (*Kearney* and *Peebles* 14906).

16. *Cyperus pringlei* Britton, Torrey Bot. Club Bul. 12: 7. 1885.

Cyperus tetragonus Ell. var. *pringlei* Kükenthal, Pflanzenreich IV. 101: 493. 1936.

Mountains of Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 3,600 to 7,000 feet, on slopes and in canyons, often among pines. Arizona and northern Mexico.

The roots are strongly camphor scented.

17. *Cyperus aristatus* Rottb., Desc. et Icon. 23. 1773.

Grand Canyon (Coconino County) to the mountains of Cochise, Santa Cruz, and Pima Counties, 2,500 to 7,000 feet. Throughout most of North America, also in South America; Tropics of the Eastern Hemisphere.

The form occurring in Arizona is var. *inflexus* (Muhl.) Boeckl. (*C. inflexus* Muhl.). The plant when dry has a strong odor of the bark of slippery elm (*Ulmus fulva* Michx.).

18. *Cyperus uniflorus* Torr. and Hook., Ann. Lyc. N. Y. 3: 431. 1836.

Beaver Creek, Yavapai County (*Purpus* 8294), perhaps also in the Santa Catalina Mountains, Pima County (*Thornber* in 1910). Arkansas to New Mexico, Arizona, and northeastern Mexico.

19. *Cyperus subambiguus* Kükenthal, Pflanzenreich IV. 101: 527. 1936.

Pinal Mountains (Gila County), Chiricahua Mountains (Cochise County), Santa Rita Mountains (Pima County), 5,000 to 6,000 feet. Southern Arizona to Guatemala.

The Arizona form is var. *pallidicolor* Kükenthal.

20. *Cyperus flavus* (Vahl) Nees, Linnaea 19: 698. 1847.

Cyperus flavomarisceus Griseb., Fl. Brit. West Indies 467. 1864.

Cyperus cayennensis Britton, Dept. Agr. Jamaica Bul. 5: suppl. 1, 8. 1907.

Santa Catalina Mountains, Pima County (*Ove Paulsen, Kearney* and *Peebles* 10293). Louisiana to California, southward to South America.

Paulsen's collection, not seen by the writers, is cited in Pflanzenreich under the typical form. The Kearney and Peebles collection seems to be var. *peduncularis* (Britton) Kükenthal.

21. *Cyperus ferax* L. C. Rich., Actes Soc. Hist. Nat. Paris 1: 106. 1792.

Yavapai and Gila Counties to Cochise, Pima, and Yuma Counties, 4,000 feet or lower, common along streams and ditches. Massachusetts to Ontario, southward and southwestward to Florida, Texas, California, and Mexico; Tropics of the Eastern Hemisphere.

The seeds of *C. ferax*, as reported by E. Palmer, were eaten by the Cocopa Indians along the lower course of the Colorado River. The species is represented in Arizona by the typical form and probably by var. *speciosus* (Vahl) Kükenthal (*C. speciosus* Vahl), which has a more condensed inflorescence and more crowded and more highly colored spikelets. The var. *squarrosus* (Britton) Kükenth. (*C. ferruginescens* Boeckl.), with very short inflorescence rays and rust-colored, finally spreading scales, may also occur.

A species, apparently related to *C. digitatus* Roxb. but with much shorter spikelets, was collected in an immature condition in 1939 in Separation Canyon near Mead Lake, Mohave County (*Clover* 4236). Miss Clover reported it to be "abundant in pools."

3. SCIRPUS. BULRUSH

Plants (in Arizona) perennial, with terete or triangular, mostly leafy flowering stems from creeping rootstocks; spikelets solitary or in heads or compound panicles; scales spirally imbricate, all fertile or the lowest empty; flowers perfect; stamens 2 or 3; achene lenticular, plano-convex, or triangular, usually subtended by 1 or more bristles representing the perianth.

Plants of marshes, stagnant ponds, and ditches. The tough stems of an Old World species (*S. lacustris* L.) are used for making mats,

cane chair seats, etc. The bases of the stalks of one species (*S. acutus*?) are eaten raw by the Hopi Indians.

The writers are indebted to Alan A. Beetle (personal communication) for the characterizations of the first two species.

Key to the species

1. Stems terete or nearly so, tall and stout, leafless except near base, the stem leaves mostly reduced to sheathing scales; primary inflorescence subtended by 1 or 2 bracts; spikelets several or numerous; bristles 4 to 6, slender, terete or nearly so, retrorsely barbed (2).
2. Roots fibrous; spikelets ovoid, acutish; scales little longer than the mature achenes..... 1. *S. VALIDUS*.
2. Roots swollen, spongy; spikelets subcylindric; scales considerably longer than the mature achenes..... 2. *S. ACUTUS*.
1. Stems triangular (3).
3. Inflorescence a once- or twice-compound panicle of umbels with numerous unequal rays; spikelets usually numerous (many more than 10), seldom more than 6 mm. long, greenish or blackish (4).
4. Achene plano-convex; style branches 2; inflorescence usually twice compound; spikelets commonly in loose clusters.... 6. *S. MICROCARPUS*.
4. Achene triangular; style branches 3; inflorescence usually once compound; spikelets commonly in dense clusters..... 7. *S. PALLIDUS*.
3. Inflorescence a single head or compact umbel; spikelets few (seldom more than 10), usually 10 mm. long or longer, brown or yellowish (5).
5. Involucral bracts 2 or more, leaflike, flat; leaves equaling or surpassing the stems; inflorescence appearing terminal; spikelets straw-colored or pale brown, up to 25 mm. long..... 3. *S. PALUDOSUS*.
5. Involucral bract solitary, appearing like a prolongation of the stem; leaves usually much shorter than the stems; inflorescence appearing lateral; spikelets seldom more than 15 mm. long (6).
6. Stems slender, wiry; leaves commonly half or more as long as the stems; spikelets very few (commonly not more than 4), frequently solitary; involucral bract commonly 4 cm. long or longer; scales long-cuspidate or aristate..... 4. *S. AMERICANUS*.
6. Stems stout, not wiry; leaves much less than half as long as the stem; spikelets usually 4 or more; involucral bract commonly less than 4 cm. long; scales mucronate or short-cuspidate.... 5. *S. OLNEYI*.

1. *Scirpus validus* Vahl, Enum. Pl. 2: 268. 1806.

Coconino, Yavapai, Gila, Pinal, and Cochise Counties, up to 5,000 feet. Almost throughout the United States and Canada.

The largest of the Arizona species, the stems reaching a height of 2.4 m. (8 feet) or more.

2. *Scirpus acutus* Muhl. ex Bigel., Fl. Bost. 15. 1814.

Scirpus occidentalis (S. Wats.) Chase, Rhodora 6: 68. 1904.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 2,300 to 9,000 feet. Widely distributed in Canada and the United States.

Very similar to *S. validus*, with which this species apparently intergrades in Arizona. Both species are known in California as "tule." According to E. Palmer (MS.) the Indians of Arizona used the roots of this or a related species as food.

3. *Scirpus paludosus* A. Nels., Torrey Bot. Club Bul. 26: 5. 1899.

Scirpus campestris Britton in Britton and Brown, Illus. Fl. 1: 267. 1896. Not Roth, 1795.

Apache and Navajo Counties to Pinal and Maricopa Counties, 1,000 to 5,000 feet. Quebec to British Columbia southward to New Jersey, Arizona, and California.

4. *Scirpus americanus* Pers., Syn. Pl. 1: 68. 1805.

Apache, Navajo, and Coconino Counties, southward to Cochise and Maricopa Counties, 1,000 to 5,000 feet. Throughout the temperate part of North America; South America.

This wiry-stemmed plant occurs often in saline marshes.

5. *Scirpus olneyi* A. Gray, Bost. Jour. Nat. Hist. 5: 238. 1845.

Apache and Coconino Counties southward to Cochise and Pima Counties, 1,000 to 7,000 feet. New Hampshire to Florida, westward to Oregon, California, and Mexico.

6. *Scirpus microcarpus* Presl, Reliq. Haenk. 1: 195. 1828.

Oak Creek, Coconino County (*Fulton* 9680), Chiricahua Mountains, Cochise County (*Blumer* 1552), Rincon Mountains, Pima County (*Nealley* 162), 4,000 to 6,000 feet. Nova Scotia to Alaska, southward to New Mexico, Arizona, and California.

7. *Scirpus pallidus* (Britton) Fernald, Rhodora 8: 163. 1906.

Scirpus atrovirens Muhl., var. *pallidus* Britton, N. Y. Acad. Sci. Trans. 9: 14. 1889.

White Mountains, Apache County (*Griffiths* 5422). Manitoba to Kansas, Colorado, and Arizona.

4. ELEOCHARIS.¹⁶ SPIKERUSH

Contributed by H. K. SVENSON.

Plants leafless, glabrous throughout; inflorescence a single spikelet, bractless, with spiral to distichous scales, the lowermost frequently sterile; stamens 3 or 2; style with 3 or 2 branches, fimbriate; achenes, trigonous to biconvex, usually with a prominent style base (tubercle), this articulated or constricted at base; surface of the achene smooth to reticulate.

This genus differs from *Fimbristylis* in the glabrous, always single-headed inflorescence; and from single-headed species of *Scirpus* in the fimbriate style, bractless inflorescence, and firm (not spongy) achene surface. The plants grow mostly in wet soil, in marshes, springy places, and along streams.

Key to the species

1. Achenes biconvex (lenticular); styles normally bifid but frequently trifid in *E. engelmanni* and *E. nodulosa* (2).
2. Plants annual; style base (tubercle) much less than one-third as high as the achene (3).
 3. Spikelets ovate to lanceolate; mature achene brown; style base very low, about as wide as the truncate achene and not differentiated in color.
 1. *E. ENGELMANNI*.
 3. Spikelets globose; mature achene black; style base whitened, usually pointed, less than one-third as wide as the achene.
 2. *E. GENICULATA*.
2. Plants perennial, with creeping rootstocks, often stoloniferous; style base much narrower than the achene, deltoid to elongate; species difficult to distinguish (4).

¹⁶ References: FERNALD, M. L., and BRACKETT, A. E. THE REPRESENTATIVES OF ELEOCHARIS PALUSTRIS, IN NORTH AMERICA. Rhodora 31: 57-77. 1929.
SVENSON, H. K. MONOGRAPHIC STUDIES IN THE GENUS ELEOCHARIS. Rhodora 31: 121-135, 152-163, 167-191, 199-219, 224-242. 1929. Ibid. 34: 192-203, 215-227. 1932. Ibid. 36: 377-389. 1934. Ibid. 39: 210-231, 236-273. 1937. Ibid. 41: 1-19, 43-77, 90-110. 1939.

4. Culms septate, i. e. with bars extending across the culm, these sometimes very obscure; upper sheaths horizontal at summit, with a conspicuous rigid mucro; achenes pitted-reticulate; spikelets 1 to 2 cm. long, commonly pale brown, with numerous rigid acute scales----- 3. *E. NODULOSA*.
4. Culms not septate; upper sheaths usually oblique, rarely mucronate; achenes smooth (5).
5. Empty basal scales of the spikelet normally 2 or 3; culms soft, compressed; spikelets narrow-cylindric or lanceolate, 1 to 3 cm. long; scales pale to dark brown----- 4. *E. MACROSTACHYA*.
5. Empty basal scale solitary, encircling the base of the spikelet. 5. *E. CALVA*.
1. Achenes trigonous to nearly terete; styles trifid (6).
6. Style base confluent with the apex of the achene; achene trigonous, green to olivaceous, obovoid to elongate, reticulate or slightly verrucose under high magnification, not with longitudinal ribs and cross bars (7).
7. Culms capillary, 2 to 5 (rarely 7) cm. long, few-flowered; achenes 1 to 1.5 mm. long, without bristles; minute tubers frequently present among the roots: var. *anachaeta*----- 6. *E. PARVULA*.
7. Culms 1 mm. (or more) wide, at least 20 cm. long; achenes 2 to 3 mm. long (8).
8. Achenes elongate, strongly reticulate; spikelets not proliferous; tubers frequently present: var. *suksdorfiana*----- 7. *E. PAUCIFLORA*.
8. Achenes obovoid, with a smooth (almost greasy) surface; spikelets frequently proliferous; tubers none----- 8. *E. ROSTELLATA*.
6. Style base not confluent with the apex of the achene, usually constricted at base (9).
9. Achenes not cross-ribbed, trigonous, dark brown when mature; plants perennial, with creeping rootstocks (10).
10. Spikelets linear to narrowly-lanceolate, acuminate; scales acute, appressed, dark brown (frequently mottled with white); achene smooth under magnification----- 9. *E. PARISHII*.
10. Spikelets ovoid to oblong, usually obtuse; scales very obtuse, dull brown; achene pitted-reticulate under magnification. 10. *E. MONTEVIDENSIS*.
9. Achenes cross-ribbed between the longitudinal ribs, terete to obscurely trigonous; plants with capillary culms, annual, or perennial with filiform rootstocks; lowest scale fertile (11).
11. Anthers 0.8 to 1.2 mm. long; scales with a greenish center and reddish brown sides; bristles none; plant perennial: var. *occidentalis*. 11. *E. ACICULARIS*.
11. Anthers less than 0.5 mm. long (12).
12. Plant perennial, with light-green spongy culms and filiform creeping rootstocks; bristles exceeding the achenes, rarely lacking. 14. *E. RADICANS*.
12. Plant annual, forming tufts (i. e. caespitose); anthers 0.2 to 0.5 mm. long (13).
13. Achenes elliptic to fusiform; cross bars about 30 in a longitudinal series----- 12. *E. BELLA*.
13. Achenes ovoid; cross bars about 15 in a longitudinal series. 13. *E. CANCELLATA*.

1. *Eleocharis engelmanni* Steud., Syn. Pl. Glum. 2: 79. 1855.

Flagstaff, Coconino County (*Jones* 4058), White Mountains, Apache County (*Griffiths* 5271). Maine to Arizona and California.

Represented in Arizona by var. *monticola* (Fernald) Svenson, characterized chiefly by pale spikelets.

2. *Eleocharis geniculata* (L.) Roem. and Schult., Syst. Veg. 2: 150. 1817.

Scirpus geniculatus L., Sp. Pl. 1: 48. 1753. Not of recent authors.

Eleocharis caribaea (Rottb.) Blake, *Rhodora* 20: 24. 1918.

Rye Creek near the Mazatzal Mountains, Gila County (*Harrison* and *Kearney* 8369). Throughout the world, in tropical and subtropical regions.

3. *Eleocharis nodulosa* (Roth) Schult., Mant. 2: 87. 1824.

Scirpus nodulosus Roth, Nov. Pl. 29. 1821.

Pima County, Santa Catalina Mountains (*Pringle* in 1881, *Thornber* 309), Rincon Mountains (*Peebles* and *Kearney* 10463). Florida and Arizona to Argentina.

4. *Eleocharis macrostachya* Britton in Small, Fl. Southeast. U. S. 184, 1327. 1903.

Eleocharis palustris of authors. Not *Scirpus palustris* L.

Eleocharis ryridiformis Fern. and Brackett, Rhodora 31: 76. 1929.

The most variable and abundant species in northern and central Arizona (Apache, Coconino, and Yavapai Counties), wet places. Missouri to British Columbia, Arizona, and Mexico.

5. *Eleocharis calva* Torr., Fl. N. Y. 2: 346. 1843.

Eleocharis glaucescens of authors. Not *Scirpus glaucescens* Willd.

Willow Spring, Apache County (*Palmer* 551), Camp Grant, Graham County (*Rothrock* 380). Quebec to Washington, south to Mexico.

The Arizona collections are doubtfully distinct from *E. macrostachya*.

6. *Eleocharis parvula (Roem. and Schult.) Link ex Bluff, Nees, and Schauer in Bluff and Fingerhuth, Comp. Fl. Germ., ed. 2, 1¹: 93. 1836.

Scirpus parvulus Roem. and Schult., Syst. Veg. 2: 124. 1817.

Not definitely known from Arizona, but var. *anachaeta* (Torr.) Svenson, with characters as given in the key, is likely to be found there. This variety ranges from South Dakota to Idaho, southward to Venezuela.

7. *Eleocharis pauciflora* (Lightf.) Link, Hort. Berol. 1: 284. 1827.

Scirpus pauciflorus Lightf., Fl. Scot. 2: 1078. 1777.

Flagstaff, Coconino County, (*Hitchcock* in 1915), wet calcareous places. North America and northern Eurasia, Andes of South America.

The Arizona specimen belongs to the well-marked var. *suksdorfiana* (Beauverd) Svenson, which closely simulates *E. rostellata*.

8. *Eleocharis rostellata* Torr., Fl. N. Y. 2: 347. 1843.

Grand Canyon, Coconino County (*Wootton* 2012), Fort Huachuca, Cochise County (*Lemmon* 2907), wet saline places. North and South America; West Indies.

9. *Eleocharis parishii* Britton, N. Y. Micros. Soc. Jour. 5: 110. 1889.

Eleocharis montana of authors. Not H. B. K.

Widely distributed in Arizona from desert areas to mountain meadows, Apache to Mohave and Cochise Counties. Oregon to Arizona, California, and northern Mexico.

10. *Eleocharis montevidensis* Kunth, Enum. Pl. 2: 144. 1837.

Eleocharis arenicola Torr. ex. Engelm. and Gray, Bost. Jour. Nat. Hist. 5: 237. 1847.

Eleocharis montana of authors. Not H. B. K.

Huachuca and Chiricahua Mountains (Cochise County), bed of the Santa Cruz River near Tucson (Pima County), wet sandy places. South Carolina to California and Mexico; South America.

11. *Eleocharis acicularis* (L.) Roem. and Schult., Syst. Veg. 2: 154. 1817.

Scirpus acicularis L., Sp. Pl. 48. 1753.

White Mountains, Apache County (*Goodding* 1107, *Griffiths* 5269), Coconino County, at Crater Lake (*MacDougal* 339) and Jacobs Lake, Kaibab Plateau (*Kearney* and *Peebles* 13714), in wet soil, 8,000 to 9,000 feet, perhaps also in Pima County at much lower elevations. North America and Eurasia.

The var. *occidentalis* Svenson, to which the Arizona specimens belong, is not always well marked but is characterized by rigid culms, brown-margined scales, achenes with depressed tubercles, and constant lack of bristles.

12. *Eleocharis bella* (Piper) Svenson, Rhodora 31: 201. 1929.

Eleocharis acicularis var. *bella* Piper, Fl. Palouse Region 35. 1901.

Coconino County, at Mormon Lake (*Toumey* 524) and Flagstaff (*Hitchcock* in 1915), Rucker Valley, Cochise County (*Lemmon* 481). Montana to Washington southward to New Mexico and Arizona.

*13. *Eleocharis cancellata* S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 170. 1883.

Not definitely known from Arizona but C. Wright's No. 1937, labelled as from New Mexico, may have been collected in what is now Arizona. New Mexico to central Mexico.

14. *Eleocharis radicans* (Poir.) Kunth, Enum. Pl. 2: 142. 1837.

Scirpus radicans Poir. in Lam., Encycl. 6: 751. 1804.

Eleocharis lindheimeri (Clarke) Svenson, Rhodora 31: 199. 1929.

Grand Canyon, Coconino County (*Tracy* 363), along the San Pedro River, Cochise County (*Toumey* in 1894). Michigan, southern United States, and Arizona; West Indies and temperate parts of South America.

5. FIMBRISTYLIS

Plants annual or perennial; spikelets terete, in heads or umbellike inflorescences; scales spirally imbricate, all fertile; achenes (in the Arizona species) lenticular or biconvex, the apical tubercle deciduous.

Key to the species

1. Plant perennial; stems wiry, 30 to 50 cm. long; spikelets in open simple or compound umbellike inflorescences; style pubescent --- 1. F. THERMALIS.
1. Plants annual or, if perennial, then the stems not wiry, less than 20 cm. long (2).
 2. Spikelets in small dense heads subtended by long leaflike bracts; style glabrous or minutely puberulent; stems densely tufted, not more than 15 cm. long ----- 2. F. VAHLII.

2. Spikelets few in loose umbels with unequal rays, or solitary (3).

3. Umbels mostly simple; spikelets commonly more than 5 mm. long; achenes fully 1 mm. long, the ribs noticeably tuberculate. 3. *F. BALDWINIANA*.

3. Umbels compound; spikelets less than or barely 5 mm. long; achenes less than to barely 1 mm. long, not or obscurely tuberculate.

4. *F. ALAMOSANA*.

1. *Fimbristylis thermalis* S. Wats. in King, Geol. Expl. 40th Par. 5: 360. 1871.

Grand Canyon, Coconino County, foot of Bright Angel Trail (*Toumey, Wooton, Leiberg*). Nevada, northern Arizona, and California.

2. *Fimbristylis vahlii* (Lam.) Link, Hort. Berol. 1: 287. 1827.

Scirpus vahlii Lam., Tabl. Encycl. 1: 139. 1791.

Yuma, in sand along the Colorado River, "very abundant, forming small dense cushions" (*Thornber* in 1912). North Carolina to Florida, westward to California.

3. *Fimbristylis baldwiniana* (Schult.) Torr., Ann. Lyc. N. Y. 3: 344. 1836.

Scirpus baldwinianus Schult., Mant. 2: 85. 1824.

Bowie, Cochise County (*Jones* 4317), Sycamore Canyon near Ruby, Santa Cruz County (*Kearney* and *Peebles* 14476), September. Pennsylvania to Florida, west to Kansas and southeastern Arizona.

4. *Fimbristylis alamosana* Fernald, Amer. Acad. Arts and Sci. Proc. 36: 491. 1901.

Sycamore Canyon near Ruby, Santa Cruz County (*Goodding* 6633, *Kearney* and *Peebles* 14475), in moist sand, August to September. Southern Arizona and Sonora.

6. BULBOSTYLIS

Plants annual or perennial; stems and leaves filiform; spikelets terete, in small umbels or heads, or solitary; scales spirally imbricate; achenes triangular, more or less distinctly rugose transversely, the apical tubercle persistent.

Key to the species

1. Stems up to 40 cm. long, becoming hardened and bulblike at base; spikelets in a small cluster, or sometimes solitary, at the apex of the culm, none strictly basal; achenes 1 to 1.2 mm. long.----- 1. *B. JUNCOIDES*.

1. Stems not more than 8 cm. long, not becoming bulblike at base; spikelets both at the apex of the culm and at the base of the plant among the leaves, usually solitary; achenes less than 1 mm. long.----- 2. *B. FUNCKII*.

1. *Bulbostylis juncoides* (Vahl) Kükenthal ex Osten., An. Mus. Hist. Nat. Montevideo ser. 2, 3: 185. 1932.

Schoenus juncoides Vahl, Enum. Pl. 2: 211. 1806.

In moist sand, Yavapai, Cochise, Santa Cruz, and Pima Counties, 3,000 to 6,000 feet. Western Texas to Arizona and Mexico; South America.

The Arizona form is var. *ampliceps* Kükenthal, with more expanded inflorescence than in the typical form. Small apparently annual specimens, from the northern limits of the range, with stems not hardened and bulblike at base, simulate *B. capillaris* (L.) C. B. Clarke

(*Stenophyllus capillaris* Britton), but probably represent a reduced state of *B. juncooides*. As was pointed out by H. K. Svenson (personal communication), *B. juncooides*, in addition to the perennial habit, differs from *B. capillaris* in having larger achenes, these becoming slate-colored at maturity, whereas in *B. capillaris*, as represented in the eastern United States, the mature achenes are straw-colored or pale brown. It is doubtful that *B. capillaris* occurs in Arizona.

2. *Bulbostylis funckii* (Steud.) C. B. Clarke in Urban, Symb. Ant. 5: 290. 1907.

Isolopis funckii Steud., Syn. Pl. Glum. 2: 91. 1855.

Stenophyllus funckii Britton, Torrey Bot. Club Bul. 21: 30. 1894.

Hualpai Mountain, Mohave County (*Kearney* and *Peebles* 12721), Pinal Mountains, Gila County (*Peebles* et al. 3231), Chiricahua Mountains, Cochise County (*Blumer* 1646), 5,000 to 7,500 feet. New Mexico and Arizona, southward to South America; West Indies.

7. CLADIUM. SAWGRASS

Plants perennial, tall; stems leafy; spikelets terete, fusiform, in small clusters forming an ample cymose panicle; scales imbricate, only the uppermost ones usually subtending perfect flowers, the lowest scales empty; anthers elongate, aristate-acuminate; achenes obovoid, without an apical tubercle.

1. *Cladium mariscus* (L.) R. Br., Prodr. Fl. Nov. Holl. 1: 236. 1810.

Schoenus mariscus L., Sp. Pl. 42. 1753.

Grand Canyon, Coconino County, about 2,000 feet. Arizona and California, south to Central America.

The Arizona form is var. *californicum* Wats. (*Mariscus californicus* Fernald), which is probably specifically distinct from *C. mariscus*.

8. CAREX.¹⁷ SEDGE

Contributed by J. W. STACEY.

Plants grasslike, perennial, monoecious or sometimes dioecious; culms mostly triangular; leaves three-ranked, the upper ones (bracts) elongate, or short, or wanting; spikes one to many, sessile or peduncled, either wholly pistillate, wholly staminate, androgynous (staminate above), or gynaeandrous (staminate below); flowers solitary in the axils of the glumes; perianth none; stamens 3 (rarely 2); pistil single, the style 1, the stigmas 2 or 3; achene triangular, lenticular, or planoconvex, completely surrounded by the perigynium.

The members of this genus that occur in the State of Arizona are generally found in the mountains, seldom growing below 5,000 feet, except in shady canyons. The southwestern part of the State, comprising southern Mohave, southwestern Yavapai, western Maricopa, and western Pima Counties, together with the whole of Yuma County, does not contain a single *Carex*, as far as is known. Of the 40 species

¹⁷ The artificial key to the Arizona species has been somewhat adapted from that of K. K. Mackenzie (Carex. North Amer. Flora 18: 9-471. 1931, 1935), to whom credit should be given for the most modern treatment of this genus.

known to occur in the State, several have been collected in only one locality. More intensive collecting of this genus will, without doubt, extend the range of these species, and will result in the addition of other species to the known flora.

Key to the species

1. Spike one; stigmas 3; achenes triangular (2).
 2. Spike entirely staminate or pistillate; plants dioecious. 28. *C. CURATORIUM*.
 2. Spike androgynous (3).
 3. Leaf blades flattened, canaliculate, 1.5 to 2 mm. wide toward the base. 23. *C. OREOCHARIS*.
 3. Leaf blades acicular, 0.25 to 2 mm. wide toward the base. 24. *C. FILIFOLIA*.
1. Spikes more than one (4).
 4. Stigmas 3; achenes triangular (5).
 5. Perigynia pubescent (6).
 6. Pistillate spikes many-flowered; achenes with concave sides. 31. *C. LANUGINOSA*.
 6. Pistillate spikes few-flowered; achenes with the sides convex above (7).
 7. Plants with no basal spikes----- 25. *C. LEUCODONTA*.
 7. Plants with basal spikes (8).
 8. Bracts leaflike; culms not strongly filamentose at base. 26. *C. ROSSII*.
 8. Bracts squamiform when present; culms strongly filamentose at base----- 27. *C. GEOPHILA*.
 5. Perigynia glabrous (9).
 9. Spikes blackish; style jointed to the achene, at length withering (10).
 10. Lateral spikes linear, the lower ones nodding on long peduncles. 32. *C. BELLA*.
 10. Lateral spikes oblong or ovoid (11).
 11. Scales black, with a conspicuous white-hyaline margin. 33. *C. ALBO-NIGRA*.
 11. Scales brown or copper-colored----- 34. *C. CHALCIOLEPIS*.
 9. Spikes not blackish; style continuous with the achene, not withering (12).
 12. Leaves not septate-nodulose; perigynia nerveless or nearly so. 37. *C. ULTRA*.
 12. Leaves septate-nodulose; perigynia strongly ribbed (13).
 13. Perigynia coarsely ribbed----- 40. *C. ROSTRATA*.
 13. Perigynia finely and closely ribbed (14).
 14. Perigynia 5 to 7 mm. long, the beak 2 mm. long. 38. *C. HYSTRICINA*.
 14. Perigynia 4 to 5 mm. long, the beak 15 mm. long. 39. *C. THURBERI*.
 4. Stigmas 2; achenes lenticular (15).
 15. Lateral spikes peduncled; terminal spike staminate (16).
 16. Perigynia few, pulverulent or golden yellow at maturity (17).
 17. Perigynia whitish-pulverulent at maturity----- 29. *C. HASSEI*.
 17. Perigynia golden yellow or brownish at maturity--- 30. *C. AUREA*.
 16. Perigynia many, not pulverulent or golden yellow at maturity (18).
 18. Lower sheaths of the flowering culms not breaking and becoming filamentose at maturity----- 35. *C. NEBRASKENSIS*.
 18. Lower sheaths of the flowering culms breaking and becoming filamentose at maturity----- 36. *C. SENTA*.
 15. Lateral spikes sessile, short; terminal spikes androgynous or gynaeceandrous, or rarely pistillate or staminate (19).
 19. Perigynia whitish-puncticulate; spikes gynaeceandrous. 12. *C. CANESCENS*.
 19. Perigynia not whitish-puncticulate (20).
 20. Culms arising singly or few together from long creeping rootstocks; terminal spikes androgynous, or tending to be dioecious (21).
 21. Perigynia wing-margined, flattened, plano-convex. 5. *C. SICCATATA*.

- 21. Perigynia not wing-margined, plano-convex or unequally biconvex (22).
- 22. Culms obtusely angled or obtusely triangular, the rootstocks slender; leaf blades narrowly involute or canaliculate (23).
- 23. Perigynia long-beaked; heads dioecious or nearly so.
 - 1. *C. DOUGLASSII*.
 - 23. Perigynia short-beaked; spikes androgynous.
 - 2. *C. ELEOCHARIS*.
- 22. Culms sharply triangular; leaf blades flat or channeled (24).
- 24. Rootstocks slender; lower sheaths light brownish; perigynia chestnut-colored, unequally biconvex, 1.75 to 2.25 mm. long----- 3. *C. SIMULATA*.
- 24. Rootstocks stout; lower sheaths dark brown or black; perigynia blackish in age, plano-convex, 3 to 4 mm. long.
 - 4. *C. PRAEGRACILIS*.
- 20. Culms from loosely to densely cespitose, the rootstocks sometimes short-prolonged, but not long-creeping (25).
- 25. Spikes androgynous (26).
- 26. Perigynia with the body tapering into the beak.
 - 11. *C. STIPATA*.
- 26. Perigynia with the body abruptly contracted into the beak (27).
- 27. Spikes 10 or fewer, appearing greenish (28).
- 28. Beak of the perigynium obliquely cleft dorsally, little or not at all bidentate; perigynia usually 1 to 5.
 - 6. *C. RUSBYI*.
- 28. Beak of the perigynium bidentate; perigynia usually 5 to 10----- 7. *C. OCCIDENTALIS*.
- 27. Spikes numerous, appearing yellowish (29).
- 29. Scales not at all or but little hyaline-margined.
 - 10. *C. VULPINOIDEA*.
- 29. Scales strongly hyaline-margined (30).
- 30. Perigynia sharp-margined above, blackish at maturity.
 - 8. *C. ALMA*.
- 30. Perigynia sharp-margined to the base, straw-colored.
 - 9. *C. AGROSTOIDES*.
- 25. Spikes gynaeceandrous (31).
- 31. Perigynia at most thin-edged (32).
- 32. Perigynia spreading at maturity----- 13. *C. INTERIOR*.
- 32. Perigynia appressed (33).
- 33. Perigynia shallowly bidentate----- 14. *C. LEPTOPODA*.
- 33. Perigynia deeply bidentate----- 15. *C. BOLANDERI*.
- 31. Perigynia wing-margined (34).
- 34. Bracts conspicuously exceeding the head.
 - 22. *C. ATHROSTACHYA*.
- 34. Bracts not conspicuously exceeding the head (35).
- 35. Perigynia with the beak flattened----- 21. *C. SCOPARIA*.
- 35. Perigynia with the beak slender and nearly terete (36).
- 36. Perigynia 3 to 3.5 mm. long, plano-convex, ovate.
 - 19. *C. SUBFUSCA*.
- 36. Perigynia 3.75 to 7.5 mm. long, flattened (37).
- 37. Perigynia 3.75 to 6 mm. long (38).
- 38. Culms erect; perigynia greenish.
 - 16. *C. FESTIVELLA*.
- 38. Culms low, ascending or decumbent; perigynia blackish----- 18. *C. HAYDENIANA*.
- 37. Perigynia 6 to 7.5 mm. long (39).
- 39. Perigynia finely many-nerved ventrally; scales brownish-black or blackish----- 17. *C. EBENEA*.
- 39. Perigynia nerveless ventrally; scales chestnut brown----- 20. *C. WOOTONI*.

1. *Carex douglasii* Boott in Hook., Fl. Bor. Amer. 2: 213. 1839.

Kaibab Plateau and San Francisco Peaks (Coconino County), apparently rare. Manitoba to British Columbia, south to New Mexico, Arizona, and California.

2. *Carex eleocharis* L. H. Bailey, Torrey Bot. Club Mem. 1: 6. 1889.

Lukachukai Mountains (Apache County), Kayenta or Tyende (Navajo County), Grand Canyon (Coconino County), 6,000 to 8,000 feet, rare. Manitoba to Yukon, south to Iowa, New Mexico, Arizona, and Oregon.

3. *Carex simulata* Mackenz., Torrey Bot. Club Bul. 34: 604. 1908.

Willow Spring, southern Apache County, 7,200 feet (*Palmer* 553). Montana to Washington, south to New Mexico, Arizona, and California.

4. *Carex praeegracilis* W. Boott, Bot. Gaz. 9: 87. 1884.

Carex latebrosa Mackenz., Torrey Bot. Club Bul. 34: 603. 1908.

Carex camporum Mackenz., Torrey Bot. Club Bul. 37: 244. 1910.

Apache County to Mohave County, south to Pima and Cochise Counties, 7,000 to 8,000 feet (?), rather common. Manitoba to Yukon, south to central Mexico and California; South America.

This is a very variable species, and is one of the most widespread in the western United States. It is sometimes confused with *C. siccata* Dewey, but that species has slender brown rootstocks, whereas *C. praeegracilis* has stout blackish rootstocks.

5. *Carex siccata* Dewey, Amer. Jour. Sci. 10: 278. 1826.

Apache, Coconino, Yavapai, Greenlee, and Cochise Counties, 8,000 to 11,500 feet, rather common. Maine to Mackenzie and Washington, south to New Jersey, Illinois, New Mexico, and Arizona.

6. *Carex rusbyi* Mackenz., Smithsn. Inst. Misc. Collect. 65⁷: 2. 1915.

Graham County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 7,000 to 9,500 feet, fairly common, especially in the southeastern part of the State, type from Yavapai County (*Rusby* 859). New Mexico and Arizona.

7. *Carex occidentalis* L. H. Bailey, Torrey Bot. Club Mem. 1: 14. 1889.

Carex neomexicana Mackenz., Torrey Bot. Club Bul. 34: 153. 1907.

Apache County to Coconino County, south to Cochise and Pima Counties, 8,300 to 9,200 feet, common, especially in Coconino County. Wyoming and Utah to New Mexico and Arizona.

This species is related to *C. rusbyi*, but may be distinguished at once by its larger spikes and by the fact that its perigynia are hidden by the scales, not exposed as in *C. rusbyi*.

8. *Carex alma* L. H. Bailey, Torrey Bot. Club Mem. 1: 50. 1889.

Gila, Maricopa, and Cochise Counties, 2,000 to 6,000 feet, not rare. Arizona, Nevada, and California.

9. *Carex agrostoides* Mackenz., Torrey Bot. Club Bul. 34: 607. 1908.

Gila, Maricopa, Cochise, and Pima Counties, 3,800 to 5,000 feet. New Mexico, Arizona, and northern Mexico.

This species has about the same range as *C. alma* and is related to it, but may be distinguished by its lighter colored spikes and much lighter colored perigynia.

10. *Carex vulpinoidea* Michx., Fl. Bor. Amer. 2: 169. 1803.

White Mountains, Apache County (*Griffiths* 5426); also collected somewhere in Arizona by Rothrock in 1884. Newfoundland to British Columbia, south to Florida, Texas, Arizona, and Oregon.

11. *Carex stipata* Muhl. ex Willd., Sp. Pl. 4: 233. 1805.

McNary, Apache County, 7,400 feet (*Peebles* and *Smith* 12478). Newfoundland to Alaska, south to North Carolina, New Mexico, Arizona, and California; Japan.

12. *Carex canescens* L., Sp. Pl. 974. 1753.

Head of the Little Colorado River, Apache County (*Goodding* 1154). Throughout the cooler parts of North America; South America, Eurasia, Australia.

13. *Carex interior* L. H. Bailey, Torrey Bot. Club Bul. 20: 426. 1893.

Apache County, in the Lukachukai Mountains (*Peebles* 14380) and at Willow Spring (*Palmer* 548), 7,000 to 8,000 feet. Labrador to British Columbia, south to Pennsylvania, Kansas, northern Mexico, and northern California.

14. *Carex leptopoda* Mackenz. in Rydb., Fl. Rocky Mount. 124. 1917.

Greer (Apache County), San Francisco Peaks (Coconino County), Santa Catalina Mountains (Pima County), 8,000 to 10,000 feet, not common. Idaho to British Columbia, south to Arizona and California.

15. *Carex bolanderi* Olney, Amer. Acad. Arts and Sci. Proc. 7: 393. 1868.

Coconino, Pinal, Cochise, Santa Cruz, and Pima Counties. Montana to British Columbia, south to New Mexico, Arizona, and California.

16. *Carex festivella* Mackenz., Torrey Bot. Club Bul. 42: 609. 1915.

Carex festiva of authors. Not Dewey, 1836.

Apache, Coconino, Greenlee, Graham, and Cochise Counties, 8,500 to 9,500 feet, rather common. Manitoba to British Columbia, south to northern Mexico and California.

17. *Carex ebenea* Rydb., Torrey Bot. Club Bul. 28: 266. 1901.

Common on the San Francisco Peaks (Coconino County), also summit of Baldy Peak (Apache County), 10,500 to 12,000 feet. Wyoming and Utah to New Mexico and northern Arizona.

18. *Carex haydeniana* Olney ex S. Wats. in King, Geol. Expl. 40th Par. 5: 366. 1871.

Carex nubicola Mackenz., Torrey Bot. Club Bul. 36: 480. 1909.

San Francisco Peaks, 11,500 feet (*E. L. Little, Jr.* 4771). Alberta to Oregon, south to northern Arizona and California.

19. *Carex subfusca* W. Boott in S. Wats., Bot. Calif. 2: 234. 1880.

Coconino, Yavapai, Gila, Graham, Pinal, and Pima Counties, 7,000 to 9,500 feet, common and variable. Arizona to Oregon and California.

20. *Carex wootoni* Mackenz., Smithsn. Inst. Misc. Collect. 657: 1. 1915.

Apache, Coconino, and Graham Counties, 8,000 to 11,500 feet. New Mexico and Arizona.

May be at once recognized and differentiated from related species by the fact that the scales are broadly hyaline-margined.

21. *Carex scoparia* Schkuhr in Willd., Sp. Pl. 4: 230. 1805.

McNary, Apache County, 7,400 feet (*Peebles* and *Smith* 12477). Newfoundland to British Columbia, south to South Carolina, New Mexico, Arizona, and Oregon.

22. *Carex athrostachya* Olney, Amer. Acad. Arts and Sci. Proc. 7: 393. 1868.

Carex tenuirostris Olney in Parry, Amer. Nat. 8: 214. 1874.

Coconino County, 6,700 to 8,400 feet, not rare. Saskatchewan to Alaska, south to Colorado, Arizona, and California.

23. *Carex oreocharis* Holm, Amer. Jour. Sci. ser. 4, 9: 358. 1900.

Carex filifolia var. *valida* Olney ex L. H. Bailey in Coult., Man. Rocky Mount. 374. 1885.

Summit Ranch, San Francisco Peaks (*Thorner* 2955). Colorado and Arizona.

24. *Carex filifolia* Nutt., Gen. Pl. 2: 204. 1818.

San Francisco Peaks (Coconino County), rare in Arizona. Manitoba to Yukon, south to Texas, Arizona, and Oregon.

25. *Carex leucodonta* Holm, Amer. Jour. Sci. ser. 4, 16: 461. 1903.

Cochise, Santa Cruz, and Pima Counties, about 6,000 feet, type from the Huachuca Mountains (*Lemmon* 2904). Southern Arizona and northern Mexico.

26. *Carex rossii* Boott in Hook., Fl. Bor. Amer. 2: 222. 1839.

Coconino County, at the Grand Canyon (*Eastwood* and *Howell* 688) and on the San Francisco Peaks (*M. E. Jones* in 1890). Northern Michigan, South Dakota to Yukon, south to Colorado, northern Arizona, and California.

27. *Carex geophila* Mackenz., Torrey Bot. Club Bul. 40: 546. 1913.

Apache County, near the New Mexico border. New Mexico and eastern Arizona.

28. *Carex curatorium* Stacey, Leaflets West. Bot. 2: 13. 1937.

Known only from the type locality, Kaibab Trail to Roaring Springs, Grand Canyon (types *Eastwood* and *Howell* 1100, 1101, also *Eastwood* and *Howell* 7073).

29. *Carex hassei* L. H. Bailey, Bot. Gaz. 21: 5. 1896.

Navajo and Coconino Counties, about 8,000 (?) feet, rare. New Brunswick to Yukon, south to Pennsylvania, northern Arizona, and California.

30. *Carex aurea* Nutt., Gen. Pl. 2: 205. 1818.

Apache and Coconino Counties, more common than *C. hassei*, but rare in Arizona. Newfoundland to British Columbia, south to Pennsylvania, New Mexico, northern Arizona, and California.

31. *Carex lanuginosa* Michx., Fl. Bor. Amer. 2: 175. 1803.

Apache County to Mohave and Yavapai Counties, up to 8,700 feet, rather common. New Brunswick to British Columbia, south to Tennessee, Texas, Arizona, and California.

32. *Carex bella* L. H. Bailey, Bot. Gaz. 17: 152. 1892.

Apache, Navajo, Coconino, and Graham Counties, 9,000 to 11,000 feet. Colorado, Utah, New Mexico, and Arizona.

This is the most frequently collected *Carex* in Arizona, not because it is the most common species, but because of its striking beauty, hence its specific name *bella*.

33. *Carex albo-nigra* Mackenz. in Rydb., Fl. Rocky Mount. 137. 1917.

San Francisco Peaks (Coconino County) up to 12,000 feet, common. Alberta to Washington, south to northern Arizona and California.

34. *Carex chalciolepis* Holm, Amer. Jour. Sci. ser. 4, 16: 28, 29. 1903.

San Francisco Peaks (Coconino County) about 11,000 feet, common. Wyoming, Colorado, Utah, and northern Arizona.

This species and *C. albo-nigra* are often found growing together, and specimens of both sometimes are mounted on the same sheet. They are easily differentiated, as the heads of *C. albo-nigra* are nearly black, whereas the heads of *C. chalciolepis* are brownish copper-colored.

35. *Carex nebraskensis* Dewey, Amer. Jour. Sci. ser. 2, 18: 102. 1854.

Apache, Coconino, and Mohave Counties, up to 11,500 feet, rather common. South Dakota to British Columbia, south to Kansas, New Mexico, Arizona, and California.

36. *Carex senta* Boott, Illus. Carex 174. 1867.

Apache, Coconino, Maricopa, and Cochise Counties, 2,000 feet or higher. Arizona and California.

37. *Carex ultra* L. H. Bailey, Amer. Acad. Arts and Sci. Proc. 22: 83. 1886.

Apache and Cochise Counties, type from southern Arizona (*Lemmon* 2901, 2902). New Mexico and southern Arizona.

A related species, *Carex spissa* L. H. Bailey, has been accredited to Arizona by Mackenzie on the basis of a specimen collected by Pringle. This particular sheet is probably mislabeled. There are three different handwritings on the sheet, and the word "Arizona" has evidently been added later. The specimen was probably collected near San Diego, Calif., where *C. spissa* is common. At any rate, no other collection of *C. spissa* in Arizona has been detected.

38. *Carex hystricina* Muhl. ex Willd., Sp. Pl. 4: 282. 1805.

Apache, Navajo, Coconino, and Maricopa Counties, up to about 6,000 feet, rather common. New Brunswick to Washington, south to Virginia, Texas, Arizona, and California.

39. *Carex thurberi* Dewey in Torr., U. S. and Mex. Bound. Bot. 232. 1859.

Coconino, Gila, Cochise, Santa Cruz, and Pima Counties, 5,000 to 6,000 feet, common, especially in the southern counties. Arizona to Guatemala; West Indies.

Related to *C. hystricina*, but that species does not seem to extend farther south in Arizona than Maricopa County.

40. *Carex rostrata* Stokes in With., Bot. Arr. Veg. Brit. ed. 2, 2: 1059. 1787.

Apache and Coconino Counties, also reported from Pima County, about 7,500 feet. Greenland to Alaska, south to Delaware, Indiana, New Mexico, Arizona, and California.

10. PALMAE. PALM FAMILY

1. WASHINGTONIA. CALIFORNIA-PALM

Tree; leaves clustered at apex of the columnar trunk around the terminal bud, the petioles long, stout, with hooked marginal spines, the blades very large, splitting longitudinally into numerous narrow segments, these fibrous-margined; inflorescences axillary, subtended by spathes, many-flowered, drooping; flowers perfect or unisexual; perianth segments 6, in 2 series.

1. *Washingtonia filifera* Wendl. ex. S. Wats., Bot. Calif. 2: 211. 1880.

Kofa Mountains, Yuma County, about 2,500 feet. Southwestern Arizona, southeastern California, and northern Baja California.

Although California-palms are extensively planted in the southern part of the State, the approximately 100 individuals growing in small lateral canyons or pockets in the walls of a larger canyon in the Kofa Mountains are the only plants of this species known in the wild in Arizona. The trees here reach a maximum height of about 30 feet (9 m.) and the trunk soon becomes naked. The inflorescences, including the peduncle, reach a length of 12 feet (3.6 m.). Some of the botanists who have studied these palms believe that the Arizona form is not identical with the California plant, but Bailey refers it to *W. filifera*.¹⁸

11. ARACEAE. ARUM FAMILY

1. PISTIA. WATERLETTUCE

Plant aquatic; stem very short; leaves in a rosette floating on the water surface, the petioles short, the blades broadly obovate; inflorescence axillary, few-flowered, enclosed in a small white spathe; flowers monoecious, the staminate ones above; perianth none; pistil solitary; ovary 1-celled.

1. *Pistia stratiotes* L., Sp. Pl. 963. 1753.

Yuma, in an irrigation canal (*Sister Mary Noel* 44), perhaps adventive. Southeastern United States and widely distributed in the Tropics.

12. LEMNACEAE. DUCKWEED FAMILY

Plants minute, floating on the surface of ponds and slow streams, thalluslike, without differentiation of stem and leaf; flowers (rarely produced) borne on the edges of the fronds in a minute spathe, monoecious; perianth none; stamen and pistil each solitary; fruit a utricle.

Key to the genera

1. Rootlets several; fronds prominently several-nerved----- 1. SPIRODELA.
1. Rootlet solitary; fronds few-nerved, often very obscurely so---- 2. LEMNA.

Species of the genus *Wolffiella*, characterized by the absence of rootlets and spathes and by the elongate, very thin fronds, are to be looked for in Arizona.

¹⁸ BAILEY, L. H. WASHINGTONIA. Gentes Herbarium 4: 53-81. 1936. (Pp. 72, 73.)

1. SPIRODELA. DUCKWEED

Thallus broadly obovate, 7- to 15-nerved; anthers longitudinally dehiscent; ovules 2; fruit rarely seen.

1. *Spirodela polyrhiza* (L.) Schleiden, *Linnaea* 13: 392. 1839.

Lemna polyrhiza L., *Sp. Pl.* 970. 1753.

Huachuca Mountains (*Lemmon* in 1882). Almost cosmopolitan.

2. LEMNA. DUCKWEED

Thallus orbicular to oblong or lanceolate, 1- to 5-nerved or almost nerveless; anthers transversely dehiscent; ovules 1 to 6; fruit ovoid.

Key to the species

1. Blades long-stalked at base, remaining connected in chains, 6 to 10 mm. long, oblong or lanceolate, mostly submerged----- 1. *L. TRISULCA*.
1. Blades sessile or nearly so, soon separating, not more than 5 mm. long, floating (2).
 2. Lower surface of the blades strongly gibbous and much paler than the upper surface; blades suborbicular or obovate, asymmetric---- 2. *L. GIBBA*.
 2. Lower surface of the blades flat or nearly so (3).
 3. Blades oblong-obovate or suborbicular, symmetric or nearly so, obscurely 3-nerved; fruit approximately lenticular----- 3. *L. MINOR*.
 3. Blades oblong or elliptic, indistinctly 1-nerved or nerveless; fruit more or less elongate (4).
 4. Papillae present on the blades, these symmetric, 1.5 to 3 mm. long.
 4. *L. MINIMA*.
 5. *L. VALDIVIANA*.
 4. Papillae absent, the blades asymmetric at base, 2.5 to 4 mm. long.

1. *Lemna trisulca* L., *Sp. Pl.* 970. 1753.

Willow Spring, southern Apache County, 7,200 feet (*Palmer* 531). Nova Scotia to New Jersey, Texas, and west to the Pacific coast; in all continents except South America.

2. *Lemna gibba* L., *Sp. Pl.* 970. 1753.

Pinal, Maricopa, Cochise, and Pima Counties. Nebraska to Texas, Arizona, and California; almost cosmopolitan.

3. *Lemna minor* L., *Sp. Pl.* 970. 1753.

Apache, Pinal, Maricopa, and Pima Counties. In the greater part of North America; almost cosmopolitan.

4. *Lemna minima* Phil. ex Hegelm., *Lemn.* 138. 1868.

Ruby to Nogales, Santa Cruz County, 4,200 feet (*Kearney* and *Peebles* 14486). Southwestern United States to South America.

5. *Lemna valdiviana* Phil., *Linnaea* 23: 239. 1864.

Oak Creek Canyon, Coconino or Yavapai County (*Goodding* 13). Widely distributed in North and South America.

13. BROMELIACEAE. PINEAPPLE FAMILY

1. TILLANDSIA

Plant epiphytic (growing on the branches of trees but not parasitic); leaves 2-ranked, crowded, awl-shaped from an enlarged base, scurfy-canescenscent; inflorescence spike; flowers perfect, regular, the

perianth segments 6, the inner ones petallike, violet-colored; stamens 6; stigmas 3, spreading.

1. *Tillandsia recurvata* L., Sp. Pl. ed. 2, 410. 1762.

Santa Cruz County, in Sycamore Canyon, near Ruby (*Phillips* in 1910), and in Flux Canyon, Patagonia Mountains (*E. B. Bartram*, *Peebles* and *Bartram* 10611), 4,000 to 5,000 feet. Florida to Texas, southeastern Arizona; widely distributed in tropical America.

Ballmoss. This is the only flowering epiphytic plant in Arizona. In Flux Canyon it grows on the branches of live oaks (*Quercus emoryi* and *Q. toumeyii*). The Arizona specimens have exceptionally short peduncles.

14. COMMELINACEAE. SPIDERWORT FAMILY

Leaves alternate, with sheathing bases; flowers perfect, regular or irregular, subtended by bracts, these spathe-like or leaf-like; outer perianth segments sepallike, the inner ones petallike, showy, fugacious; stamens 6, all perfect or some of them sterile; capsule 3-celled.

Key to the genera

1. Inflorescences subtended by a single bract, this spathe-like; flowers irregular; fertile stamens usually 3; filaments naked----- 1. COMMELINA.
1. Inflorescences subtended by several bracts, these not spathe-like; flowers regular; stamens 6, all perfect; filaments bearded below----- 2. TRADESCANTIA.

1. COMMELINA.¹⁹ DAYFLOWER

Stems weak, erect to procumbent; bract strongly compressed, the two halves folded together; flowers irregular, the petallike inner perianth segments blue or white, unequal, the lateral ones larger; sterile stamens with 4-lobed, empty anthers.

Some of the species are said to have the property of stopping blood flow.

Key to the species

1. Floral bracts 3 to 6 cm. long, not connate at base, long-acuminate (the tip usually equaling or longer than the body of the bract), glabrous, puberulent, or sparsely pubescent with short, mostly appressed hairs; roots tuberous thickened; stems simple to much branched, usually erect but sometimes decumbent; all of the petals blue----- 1. C. DIANTHIFOLIA.
1. Floral bracts not more than 3 cm. long, connate below, acute or short-acuminate (the tip much shorter than the body of the bract), pubescent with short, subappressed hairs and (especially toward base) with long, more spreading, flaccid hairs; roots thick but scarcely tuberous; stems much branched, decumbent or spreading; one petal white----- 2. C. CRISPA.

1. *Commelina dianthifolia* Delile in Redout., Liliac. 7: pl. 390. 1801.

Apache and Coconino Counties, southward to Cochise, Santa Cruz, and Pima Counties, 4,500 to 9,500 feet, commonly in pine woods. New Mexico, Arizona, and nearly throughout Mexico.

2. *Commelina crispa* Wooton, Torrey Bot. Club Bul. 25: 451. 1898.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet. Missouri to Colorado and Arizona.

¹⁹ Reference: PENNELL, F. W. THE GENUS COMMELINA (PLUMIER) 1. IN THE UNITED STATES. Torrey Bot. Club Bul. 43: 96-111. 1916.

2. TRADESCANTIA.²⁰ SPIDERWORT

Plants perennial, with thickened roots; outer one or more of the bracts leaflike, the inner ones scarious; inner perianth segments purple, all alike.

These plants were used by the Indians as potherbs and the tuberous roots of *T. pinetorum* are said to have been eaten also.

Key to the species

1. Roots partly tuberous-thickened, fasciated at base of the stem or borne on a creeping rootstock; stems slender, hispidulous, commonly unbranched; sheaths pubescent or puberulent, especially on the margins; corolla not more than 2 cm. in diameter----- 1. *T. PINETORUM*.
1. Roots thick but not tuberlike, the rootstock none; stems stout, glabrous, often branched; sheaths glabrous; corolla often more than 2 cm. in diameter.
 2. *T. OCCIDENTALIS*.

1. *Tradescantia pinetorum* Greene, Erythea 1: 247. 1893.

Apache and Coconino Counties to Cochise and Pima Counties, often in pine woods, 4,500 to 9,300 feet. New Mexico and Arizona, probably also in northern Mexico.

Flowers handsome, the inner perianth segments violet or purple.

2. *Tradescantia occidentalis* (Britton) Smyth, Kansas Acad. Sci. Trans. 16: 163. 1899.

Tradescantia virginiana L., var. *occidentalis* Britton in Britt. and Brown, Illus. Flora 1:377. 1896.

Apache, Navajo, and Coconino Counties, south to Graham and Pima Counties, 2,500 to 7,000 feet. Wisconsin to Montana, Texas, and Arizona.

The var. *scopulorum* (Rose) Anderson and Woodson (*T. scopulorum* Rose) is about as frequent and as widely distributed in Arizona as the typical form, which has the sepals and pedicels more or less glandular-pubescent, whereas they are glabrous in the variety. The type of *T. scopulorum* was collected in the Santa Catalina Mountains, Pima County (*Pringle* in 1884).

15. PONTEDERIACEAE. PICKERELWEED FAMILY

1. HETERANTHERA. MUD-PLANTAIN

Plants herbaceous, aquatic or semiaquatic; leaves alternate, with broad blades or narrow and grasslike; flowers perfect, somewhat irregular, the perianth corollalike, of 6 segments; stamens 3, inserted on the perianth; ovary fusiform, 1-celled or incompletely 3-celled.

Key to the species

1. Leaves linear, grasslike; perianth yellow----- 1. *H. DUBIA*.
 1. Leaves with long stout petioles and ovate blades rounded at base; perianth commonly blue, sometimes white----- 2. *H. LIMOSA*.
- 1. *Heteranthera dubia* (Jacq.) MacMillan, Met. Minn. 138. 1892.**

Commelina dubia Jacq., Observ. Bot. 3: 9. 1768.

Irrigation canals in the Salt River Valley, Maricopa County (*Loomis* 5537). Ontario to Washington, North Carolina, and Arizona.

²⁰ Reference: ANDERSON, E., and WOODSON, R. E. THE SPECIES OF TRADESCANTIA INDIGENOUS TO THE UNITED STATES. Arnold Arboretum Contrib. 9: 1-132. 1935.

Water-stargrass. This plant sometimes grows so profusely in the canals and ditches as to obstruct the flow of water, causing considerable expense for removal. It is strictly aquatic.

2. *Heteranthera limosa* (Swartz) Willd., Neue Schr. Gesell. Naturf. Freund. Berlin 3: 439. 1801.

Pontederia limosa Swartz, Prodr. Veg. Ind. Occ. 57. 1788.

San Bernardino Ranch, Cochise County, 4,000 feet (*Mearns* 609). Virginia to South Dakota, southward to Florida, Louisiana, and southeastern Arizona; tropical America.

16. JUNCACEAE. RUSH FAMILY

Plants herbaceous, mostly perennial, grasslike, with narrow sheathing leaves; perianth regular, the 6 divisions glumelike; stamens 3 to 6; ovary 1-celled or 3-celled; stigmas 3; fruit a capsule.

Key to the genera

1. Plants glabrous; leaf sheaths open; ovary usually more or less 3-celled; ovules many, attached to the axis or walls of the ovary (the placentas axial or parietal)..... 1. *JUNCUS*.
1. Plants with long soft hairs (these sometimes very few); leaf sheaths closed; ovary 1-celled; ovules 3, attached to the base of the ovary (the placentas basal)..... 2. *LUZULA*.

1. *JUNCUS*. RUSH

Contributed by F. J. HERMANN

Principally perennial, grasslike herbs of wet habitats, with glabrous, pithy or hollow, usually simple, stems; leaves glabrous, the sheaths open, the blades terete or flattened, sometimes wanting; inflorescence cymose, paniculate, or glomerate, often unilateral; flowers small, greenish or brownish, glumaceous; capsule 3-celled with a central placenta, or 1-celled with parietal placentas; seeds numerous, reticulate or ribbed, sometimes appendaged.

Plants bearing mature fruit and the persistent perianth and stamens are essential for identification of most of the species in this genus. Occasionally *Juncus saximontanus* is sufficiently abundant in moist meadows to become a principal ingredient of the "grasses" cut for hay, and other species may be locally so plentiful as to have an appreciable forage value, but otherwise the rushes of Arizona are of no economic importance.

Key to the species

1. Inflorescence appearing lateral, the involucrel bract terete, stiffly erect, resembling a continuation of the stem; leaves all basal or nearly so, never septate (2).
2. Flowers 1 to 3 (rarely 4 or 5); seeds conspicuously tailed; low alpine plant, 5 to 20 cm. high..... 1. *J. DRUMMONDII*.
2. Flowers many; seeds not tailed; plants usually taller, of the Sonoran and Transition Zones (3).
3. Stems relatively slender, not very rigid; inflorescence not glomerate; each flower with 2 bracteoles at base in addition to the bractlet at base of the pedicel (4).
4. Stems compressed; leaf blades usually present; perianth usually greenish or straw-colored..... 4. *J. MEXICANUS*.

4. Stems terete; leaf blades none or reduced to filiform rudiments (5).
5. Perianth segments 2 to 3 mm. long, straw-colored to pale brown; stamens 3; anthers not longer than the filaments; capsule obovoid, obtuse or retuse..... 2. *J. EFFUSUS*.
5. Perianth segments 3.5 to 5 mm. long, purplish brown; stamens 6; anthers much longer than the filaments; capsule narrowly ovoid, acute, mucronate..... 3. *J. BALTICUS*.
3. Stems very coarse, stout and rigid; flowers in headlike clusters arranged in open panicles, from the axil of a single bractlet but without bracteoles (6).
6. Perianth segments acutish to acuminate, narrowly scarious-margined, greenish or straw-colored, 4 to 6 mm. long, nearly equaling the narrowly ovoid, acute or acuminate capsule..... 5. *J. COOPERI*.
6. Perianth segments (at least the inner ones) obtuse or truncate, broadly scarious-margined, brown, 2 to 4 mm. long, much shorter than the subglobose, obtuse, mucronate capsule..... 6. *J. ACUTUS*.
1. Inflorescence obviously terminal (or, if not, then the leaves septate and the involucrel bracts flat or channeled along the upper side); involucrel bracts leaflike, not stiffly erect or resembling a continuation of the stem (7).
7. Leaf blades transversely flattened (inserted with the flat surface facing the stem), or in age involute, not septate (8).
8. Flowers in heads, not bracteolate, i. e., with only the bract at base of the pedicel (9).
9. Stamens 3; perianth 2 to 3 mm. long..... 13. *J. MARGINATUS*.
9. Stamens 6; perianth 5 to 6 mm. long (10).
10. Outer perianth segments equaling or slightly exceeding the inner ones; auricles of the leaf sheaths 0.5 to 1.5 mm. long; leaf blades flat; anthers cream-colored or pale yellow... 14. *J. LONGISTYLIS*.
10. Outer perianth segments shorter than the inner ones; auricles of the leaf sheaths 1.5 to 3 mm. long; leaf blades channelled; anthers brownish..... 15. *J. MACROPHYLLUS*.
8. Flowers inserted singly on the branches of the inflorescence (not in heads), each with a pair of bracteoles at base in addition to the bractlet at base of the pedicel (11).
11. Inflorescence more than half the height of the plant; flowers scattered along the loose forking branches; low annuals (12).
12. Capsule oblong, 3 to 4.5 mm. long; perianth 4 to 6 mm. long. 7. *J. BUFONIUS*.
12. Capsule subglobose to broadly ovoid; perianth 3 to 4 mm. long. 8. *J. SPHAEROCARPUS*.
11. Inflorescence much less than half the height of the plant; perennials (13).
13. Capsule completely 3-celled, retuse..... 9. *J. CONFUSUS*.
13. Capsule 1-celled with septa extending halfway to the center, acutish to obtuse, not retuse (14).
14. Auricles at summit of the sheaths very thin, white and scarious, conspicuously produced beyond the point of insertion, 1 to 3.5 mm. long; bracteoles blunt..... 12. *J. MACER*.
14. Auricles at summit of the sheaths firm, not conspicuously produced beyond the point of insertion (15).
15. Bracteoles blunt; auricles cartilaginous, yellow, very rigid and glossy, especially the short produced portion. 10. *J. DUDLEYI*.
15. Bracteoles acuminate to aristate; auricles with the very slightly produced portion membranaceous, not rigid, easily broken. 11. *J. INTERIOR*.
7. Leaf blades terete or ensiform (flattened and inserted with one edge facing the stem), not transversely flattened (16).
16. Leaf blades terete, the septa complete (17).
17. Capsule subulate; stamens 6 (18).
18. Plant low, 10 to 40 cm. high; leaf blades erect or ascending; flowers 3 to 4 mm. long; inner perianth segments equaling or exceeding the outer ones..... 16. *J. NODOSUS*.
18. Plant taller, 40 to 100 cm. high; leaf blades divaricate; flowers 4 to 5 mm. long; inner perianth segments shorter than the outer ones. 17. *J. TORREYI*.

17. Capsule oblong or ovoid to obovoid; stamens 3 or 6 (19).
 19. Perianth greenish or straw-colored; rhizomes very short or obsolete; stamens 3; capsule ovate-lanceolate in outline.
 18. *J. ACUMINATUS.*
19. Perianth chestnut-colored or dark brown; rhizomes well developed; stamens 6 (rarely only 3 in *J. mertensianus*); capsule oblong, ovate, or obovate in outline (20).
 20. Anthers shorter than the filaments; heads usually solitary; styles included; capsule obovoid, obtuse; plant alpine.
 19. *J. MERTENSIANUS.*
20. Anthers much longer than the filaments; heads usually 2 or more; styles exerted; capsule oblong to ovoid, acutish.
 20. *J. BADIUS.*
16. Leaf blades ensiform, the septa incomplete (21).
 21. Stamens 3; bract ensiform, more than half the length of the inflorescence..... 21. *J. ENSIFOLIUS.*
21. Stamens 6; bract narrower, less than half the length of the inflorescence (22).
 22. Perianth segments equal in length, very narrow and thin, often shorter than the oblong, acute capsule, spreading, overlapping only near base, thus exposing about three-fourths of the capsule; blades of the larger leaves 7 to 12 mm. wide; stems stout.
 22. *J. XIPHIODES.*
22. Perianth segments unequal, the inner ones shorter, the segments broader, firmer in texture, usually exceeding the oblong-obovoid capsule, appressed, overlapping most of their length, thus exposing little of the capsule; valves of the capsule more rigid than in the preceding species; blades of the larger leaves seldom more than 5 mm. wide; stems relatively slender (23).
 23. Seeds tailed; styles long-exserted..... 23. *J. TRACYI.*
23. Seeds not tailed; styles little if at all exerted.
 24. *J. SAXIMONTANUS.*

1. *Juncus drummondii* E. Mey. in Ledeb., Fl. Ross. 4: 235. 1853.

Represented from the State by a single collection only, above timber line on the San Francisco Peaks, Coconino County, 11,500 feet (*Little* 4758). Alaska to California, northern Arizona, and New Mexico; Europe and Asia.

2. *Juncus effusus* L., Sp. Pl. 326. 1753.

The typical form of this European species is not known from America. In Arizona it is represented by the following 2 varieties, each known in the State from a single collection only. The var. *brunneus* Engelm. is characterized by a very dark-brown perianth which is firm to almost rigid in texture, appressed to, and from slightly shorter than to slightly exceeding the capsule, its segments with narrow scarious margins which are scarcely if at all involute. In var. *eriguus* Fern. and Wieg. the pale-brown perianth is thin in texture, spreading, about 1½ times the length of the capsule, with the broadly scarious-margined segments becoming more or less involute. The var. *brunneus* has been collected in the Rincon Mountains, Pima County, 7,500 feet (*Nealley* 158), and ranges from British Columbia to California and southern Arizona. The var. *eriguus* was collected on Pinal Peak, Gila County, 7,700 feet (*Smith* 14066), and is limited to California and central Arizona.

3. *Juncus balticus* Willd., Mag. Gesell. Naturf. Freund. Berlin. 3: 298. 1809.

A European and Asiatic species represented in Arizona by var. *montanus* Engelm. Common throughout the State in moist habitats, 3,600 to 9,500 feet, July to September. Kansas to Alaska, Arizona, and California.

4. *Juncus mexicanus* Willd. in Roem. and Schult., Syst. Veg. 7: 178. 1829.

Navajo, Coconino, Yavapai, Cochise, and Santa Cruz Counties, frequent, especially in slightly saline soils, 3,000 to 7,100 feet, July and later. Texas, Arizona, California, and Mexico.

*5. *Juncus cooperi* Engelm., Acad. Sci. St. Louis Trans. 2: 590. 1868.

A species of alkaline flats of the Colorado and Mohave Deserts, California, and of southern Nevada, reported also from southern Utah. It should be looked for in western Arizona.

6. *Juncus acutus* L., Sp. Pl. 325. 1753.

The Arizona representative of this European rush of saline habitats is var. *sphaerocarpus* Engelm. The single collection known from the State is from the Grand Canyon, Coconino County (*Rusby*, 849). The variety is found in northern Arizona, southern California, and Baja California.

7. *Juncus bufonius* L., Sp. Pl. 328. 1753.

Frequent throughout Arizona at low altitudes (chiefly 2,000 to 3,000 feet) on stream banks and in dried-up pools, April to July. The var. *halophilus* Fern. and Buch., of brackish situations, has been collected at Hance's Ranch, Coconino (?) County (*Wooton* in 1892). Nearly throughout North America; cosmopolitan.

8. *Juncus sphaerocarpus* Nees in Funk, Flora 1: 521. 1818.

Coconino and Yavapai Counties, chiefly at about 7,000 feet, on borders of pools and streams, July to August. Idaho and Oregon to Arizona and southern California; also in the Old World.

9. *Juncus confusus* Coville, Biol. Soc. Wash. Proc. 10: 127. 1896.

Collections from the north wall of the Grand Canyon (*Eastwood* and *Howell* 7027) and from the Kaibab Plateau (*Kearney* and *Peebles* 13732) are the only Arizona material of this species seen. Montana to Washington, south to Arizona and California.

10. *Juncus dudleyi* Wieg., Torrey Bot. Club Bul. 27: 524. 1900.

Grand Canyon (Coconino County), Oak Creek Valley (Yavapai County), Verde River Valley (Maricopa County), and Pinal County, frequent in damp soil, 1,000 to 6,500 feet, May to August. Maine to Washington, south to Missouri, Arizona, and California.

11. *Juncus interior* Wieg., Torrey Bot. Club Bul. 27: 516. 1900.

Juncus arizonicus Wieg., *ibid.* p. 517.

Juncus arizonicus var. *curtiflorus* Wieg., *ibid.* p. 518.

Juncus neomexicanus Wieg., Torrey Bot. Club Bul. 30: 447. 1903.

Key to the varieties

1. Perianth 3 to 4 mm. long, equaling the capsule----- *J. interior* (typical).
1. Perianth 4 to 5 mm. long, exceeding the capsule (2).
 2. Bracteoles lanceolate, acuminate; perianth segments erect, rigid, lanceolate, acuminate, with narrow, relatively opaque, hyaline margins----- var. *arizonicus*.
 2. Bracteoles broadly ovate, acute to abruptly aristate; perianth segments spreading, not rigid, broadly ovate, acuminate, with broad, transparent, scarious margins and brown lateral bands bordering the green center----- var. *neomexicanus*.

The typical form has been seen from Coconino County and the Santa Catalina Mountains (Pima County), about 7,000 feet, July to September, ranging from Illinois and Missouri to Washington and Arizona. The var. *arizonicus* (Wieg.) Hermann is known from the Grand Canyon (Coconino County), and from Maricopa, Gila, Pinal, and Pima Counties, 1,300 to 6,500 feet, June to September, ranging from Colorado to Texas and Arizona. The var. *neomexicanus* (Wieg.) Hermann is represented from the Grand Canyon, from Cochise County, and from the Santa Catalina Mountains (Pima County), approximately 7,000 feet, July to August, ranging from Kansas to Texas and Arizona.

12. *Juncus macer* S. F. Gray, Nat. Arr. Brit. Pl. 2:164. 1821.

Juncus tenuis of American authors, not Willd.

Chiricahua Mountains (Cochise County), Rincon Mountains (Pima County), 7,000 to 8,000 feet, June to September. Newfoundland to Washington, south to Florida, Arizona, and Oregon.

13. *Juncus marginatus* Rostk., Monog. Junc. 38. 1801.

Juncus setosus (Coville) Small, Fl. Southeast. U. S. 258. 1903.

Rincon and Santa Catalina Mountains (Pima County), along streams, about 3,000 feet, June to August.

Typical *J. marginatus*, with dull, lusterless capsules and blunt inner perianth segments, is known in Arizona only from a collection at Camp Lowell (*Parish* in 1884). It ranges from Maine to Ontario and Nebraska southward to Florida and southern Arizona. The commoner form in Arizona, var. *setosus* Coville, which has glossy capsules and aristate inner perianth segments, ranges from Kansas to Louisiana, Arizona, and Mexico.

14. *Juncus longistylis* Torr., U. S. and Mex. Bound. Bot. 223. 1859.

Grand Canyon and San Francisco Peaks (Coconino County), and in Apache, Navajo, Yavapai, and Greenlee Counties, chiefly in the White Mountains, in montane meadows, 4,500 to 9,500 feet, late June to September. Nebraska to British Columbia, south to New Mexico, Arizona, and California.

The commoner form in this State is var. *scabratus* Hermann which has the vegetative parts (particularly the pedicels and the terminal portions of the leaf blades) strongly scabrous and the auricles showing a tendency to be prolonged, free, and acute.

15. *Juncus macrophyllus* Coville, Calif. Univ. Pubs. Bot. 1: 65. 1902.

Yavapai and Maricopa Counties, rare, on damp slopes below 5,500 feet, July to August. Southern California to Baja California and Arizona.

16. *Juncus nodosus L., Sp. Pl., ed. 2, 466. 1762.

A species to be sought in the northern counties. It has been collected at Farmington, N. Mex., about 45 miles east of the northeastern border of Arizona, and in the Charleston Mountains, Nevada, about 50 miles west of the western border. Nova Scotia to British Columbia south to Virginia, New Mexico, and Nevada.

17. *Juncus torreyi* Coville, Torrey Bot. Club Bul. 22:303. 1895.

Navajo, Coconino, Yavapai, Maricopa, Pinal, Pima, and Yuma Counties, very common in wet soil below 5,000 feet, July to August.

Massachusetts to Washington, south to Alabama, Texas, Arizona, and California.

18. *Juncus acuminatus* Michx., Fl. Bor. Amer. 1:192. 1803.

Locally common in the Santa Catalina and Rincon Mountains (Pima County), 3,000 feet or higher, late March to October. Maine to British Columbia, south to Georgia, southern Arizona, and Oregon.

19. *Juncus mertensianus* Bong., Acad. St. Pétersburg Mém. VI. Math., Phys., Nat. 2:167. 1832.

Known in Arizona from one collection only, in De Motte Park, Kaibab Plateau, Coconino County, 9,000 feet (*M. E. Jones* 6056). Alaska to New Mexico, northern Arizona, and California.

20. *Juncus badius* Suksd., Deut. Bot. Monatschr. 19:92. 1901.

Juncus truncatus Rydb., Torrey Bot. Club Bul. 31:399. 1904.

Common in Coconino County, Grand Canyon and vicinity, 6,500 to 9,000 feet, also collected once in Yavapai County, July to September. Wyoming to Washington, south to New Mexico and northern Arizona.

21. *Juncus ensifolius* Wikstr., K. Vetensk. Akad. Handl. 2:274. 1823.

Represented from Arizona by a single collection from Square Lake, 4,800 feet (*P. A. South* in 1910). Saskatchewan to Alaska, south to northern Arizona and California.

22. *Juncus xiphioides* E. Mey., Syn. June. 50. 1822.

Common in the Santa Rita Mountains (Pima County), along streams, 5,000 feet or higher, occurring also in the Bradshaw Mountains (Yavapai County), July to August. Arizona, California, and northern Baja California.

23. *Juncus tracyi* Rydb., Fl. Rocky Mount. 155. 1917.

The only known collection of this species from Arizona is from Kaibab Trail to Roaring Springs, Grand Canyon, Coconino County (*Eastwood* and *Howell* 7072). Idaho to northern Arizona and Nevada.

24. *Juncus saximontanus* A. Nels., Torrey Bot. Club Bul. 29: 401. 1902.

Juncus xiphioides var. *montanus* Engelm., St. Louis Acad. Sci. Trans. 2:481. 1902.

Juncus parous Rydb., Torrey Bot. Club Bul. 31:401. 1904.

Juncus brunnescens Rydb., *ibid.* p. 400.

Yavapai, Greenlee, Graham, and Cochise Counties, common along streams and in meadows, 4,000 to 9,500 feet, July to October. Colorado to British Columbia, south to New Mexico, Arizona, and Oregon.

Forma *brunnescens* (Rydb.) Hermann is by far the commonest rush in Arizona and is known from Apache, Navajo, Coconino, Yavapai, Greenlee, Gila, Cochise, and Pima Counties. It has numerous (usually more than 10) heads which are few- (5- to 12-) flowered, averaging 5 to 6 mm. in diameter, whereas in typical *J. saximontanus* the few (seldom more than 10) heads are many- (15- to 25-) flowered, averaging 7 to 10 mm. in diameter.

2. LUZULA. WOODRUSH

Plants perennial, leafy stemmed; leaves flat, channeled, or involute; flowers in heads, spikes, or loose cymes, these forming dense or open compound inflorescences; flower bracteolate; stamens 6.

Plants eaten by livestock and sometimes a fairly important element in mountain pastures.

Key to the species

1. Flowers on slender pedicels in a loose, somewhat drooping, many-flowered, cymose panicle; herbage glabrous except for a few long hairs near the throat of the sheath; sepals about 2 mm. long, shorter than or barely equaling the capsule----- 1. *L. PARVIFLORA*.
1. Flowers crowded, subsessile, in few headlike or spikelike glomerules; herbage sparsely villous with long, loose hairs; sepals longer than the capsule (2).
2. Inflorescence erect; glomerules capitate, borne on elongate branches; leaves flat; sepals about 3 mm. long----- 2. *L. MULTIFLORA*.
2. Inflorescence nodding; glomerules short-spicate, sessile or nearly so, forming an interrupted spike or a small, compact panicle of spikes; leaves channeled, often involute; sepals about 2 mm. long----- 3. *L. SPICATA*.

1. *Luzula parviflora* (Ehrh.) Desv., Jour. de Bot. 1:144. 1808.

Juncus parviflorus Ehrh., Beitr. 6:139. 1791.

Juncoides parviflorum Coville, Contrib. U. S. Natl. Herbarium 4:209. 1893.

San Francisco Peaks (Coconino County), Baldy Peak, White Mountains (Apache County), 10,000 to 11,500 feet, June to September. Labrador to Alaska, southward to New York, New Mexico, Arizona, and California; Eurasia.

The name *Luzula parviflora* probably covers a species complex; but until the group has received a complete modern revision it seems best to include the forms under this name.

2. *Luzula multiflora* (Retz.) Lejeune, Fl. Envir. Spa 169. 1811.

Juncus campestris γ L., Sp. Pl. ed. 2, 469. 1762.

Juncoides intermedium Rydb., Torrey Bot. Club Bul. 32: 610. 1905.

Rincon and Santa Catalina Mountains (Pima County), about 7,500 feet. Throughout temperate North America; Eurasia.

3. *Luzula spicata* (L.) DC. and Lam., Fl. Franc. 3:161. 1805.

Juncus spicatus L., Sp. Pl. 330. 1753.

Juncoides spicatum Kuntze, Rev. Gen. Pl. 725. 1891.

San Francisco Peaks (Coconino County), 10,000 to 12,000 feet. Greenland to Alaska, New Mexico, northern Arizona, and California; Eurasia.

17. LILIACEAE. LILY FAMILY

Plants perennial, herbaceous or in a few genera woody; flowers mostly perfect, regular or nearly so, often showy; stamens commonly 6; ovary superior or nearly so; stigmas usually 3; fruit a capsule or a berry.

Some of the handsomest and showiest plants of Arizona, notably the lemon lily (*Lilium parryi*), the mariposas (*Calochortus* spp.), and species of *Yucca*, belong to this family. A substitute for soap is

made from the leaves of the yuccas and the strong fibers obtained from them were much used by the Indians, who also ate the fruits of the fleshy-fruited species. The bulbs of wild onions (*Allium* and related genera) were eaten by the natives of Arizona. The Liliaceae are mostly innocuous, but a few species—deathcamas (*Zygadenus*) and false-hellebore (*Veratrum*)—are poisonous. The most important cultivated food plants of this family are onion and asparagus, the latter occasionally growing wild as an escape from gardens.

Key to the genera

1. Plants with a large woody caudex, this mainly subterranean or largely above ground and trunklike; leaves numerous, in large rosettes at apex of the caudex or of its branches, narrow, elongate, mostly rigid and spine-tipped (2).
 2. Flowers seldom less than 2 cm. long, all perfect; capsules large, not lobed or winged; seeds very numerous in each cell of the capsule, flattened; leaf margins usually filamentous..... 14. YUCCA.
 2. Flowers much less than 1 cm. long, all or many of them unisexual; capsules small, 3-lobed or winged; seed solitary in each cell of the capsule, turgid; inflorescences with small scarious bracts (3).
 3. Leaves not very rigid, the margins not spiny (sometimes serrulate); plants incompletely dioecious, some of the flowers perfect; capsule 3-celled, 3-lobed; seeds round..... 15. NOLINA.
 3. Leaves very rigid, the margins armed with sharp curved spines; plant completely dioecious; capsule 1-celled, winged; seeds trigonous; staminate flowers in dense catkinlike spikes..... 16. DASYLIRION.
1. Plants herbaceous, without a large woody caudex; leaves not in large rosettes, never rigid or spine-tipped (4).
 4. Styles 3, separate; flowers in racemes or panicles; perianth greenish or whitish (5).
 5. Leaves linear or narrowly lanceolate; perianth segments each with a gland near the base..... 1. ZYGADENUS.
 5. Leaves broadly elliptic or ovate; perianth segments not gland-bearing.
 2. VERATRUM.
 4. Style 1 or the styles united, at least toward base (6).
 6. Perianth segments very unlike, the 3 outer ones much narrower, sepallike, the 3 inner ones broad, petallike, bearing a large, variously fringed or bordered gland near the base; fruit a septical capsule (dehiscing through the partitions)..... 13. CALOCHORTUS.
 6. Perianth segments all alike or nearly so, none bearing glands; fruit a loculicidal capsule (dehiscing between the partitions), or berrylike (7).
 7. Fruits berrylike, indehiscent; flowering stems from (usually horizontal) rootstocks (8).
 8. Stems much branched with very slender branches; leaves small, scalelike..... 17. ASPARAGUS.
 8. Stems simple or sparingly branched; leaves large, with broad blades (9).
 9. Flowers not nodding, in terminal racemes or panicles; perianth rotate, the segments not more than 7 mm. long.
 18. SMILACINA.
 9. Flowers nodding, axillary or subaxillary or, if terminal, in very few-flowered umbellike clusters; perianth campanulate, the segments 8 mm. long or longer, separate or nearly so; stems usually dichotomously branched (10).
 10. Flowers terminal; peduncle or pedicel not jointed or bent; perianth segments not recurved; fruit 3-lobed, depressed-globose, papillate..... 19. DISPORUM.
 10. Flowers not terminal; peduncles filiform, jointed and abruptly twisted or bent; perianth segments becoming recurved; fruit entire, ellipsoid, smooth..... 20. STREPTOPUS.
 7. Fruits capsular, dehiscent; flowering stems from bulbs, corms, short vertical rootstocks, or tuberlike roots (11).

11. Stems scaly but scarcely bulbous at base; roots more or less tuberous-thickened; leaves long and narrow, all basal or nearly so; flowers in racemes; perianth segments separate or very nearly so; capsules transversely rugose (12).
12. Raceme loose, elongate; perianth orange; anthers straight or nearly so ----- 3. ANTHERICUM.
12. Raceme rather dense; perianth whitish with green veins; anthers becoming strongly incurved ----- 4. EREMOCRINUM.
11. Stems bulbous at base; roots not tuberous-thickened, or exceptionally so in *Hesperocallis* (13).
13. Plants caulescent, the stems more or less leafy (14).
14. Bulbs tunicate, the coats thin and dry; leaf margins conspicuously undulate; flowers in scarious-bracted racemes ----- 5. HESPEROCALLIS.
14. Bulbs with fleshy scales; leaf margins not undulate; flowers solitary or few, terminal or subterminal (15).
15. Perianth segments 5 to 9 cm. long, bright yellow or orange red, usually with darker spots ----- 11. LILIUM.
15. Perianth segments not more than 2 cm. long, dull yellow, veined and mottled with brownish purple ----- 12. FRITILLARIA.
13. Plants scapose, the leaves all basal; flowers in umbels, these subtended by scarious bracts, or the flower solitary (16).
16. Perianth segments separate to the base or nearly so, pink or whitish (17).
17. Ovules 2 in each cell of the ovary; seeds 1 or 2 in each cell; plants with an odor of onions ----- 6. ALLIUM.
17. Ovules several and seeds usually more than 2 in each cell; plant without odor of onions ----- 7. NOTHOSCORDUM.
16. Perianth segments united below into a funnellform tube (18).
18. Filaments partly united into a tube, this with toothlike lobes between the anthers ----- 9. ANDROSTEPHIUM.
18. Filaments not united into a tube (19).
19. Umbels several- to many-flowered; perianth funnellform or funnellform-campanulate; stigma small, capitate. ----- 8. BRODIAEA.
19. Umbels 2- or 3-flowered, or the flower solitary; perianth salverform; stigma large, somewhat funnellform. ----- 10. MILLA.

1. ZYGADENUS. DEATHCAMAS

Plants glabrous; flowering stems from bulbs, subscapose; leaves narrow, grasslike; flowers in racemes or narrow panicles; perianth segments each with a gland near the base, separate or united below; styles 3, separate; ovary superior or partly inferior; fruit a 3-lobed capsule.

These plants are poisonous (*Z. elegans* perhaps only slightly so) and sometimes cause heavy loss of sheep in spring and early summer when other forage is scarce. Cattle and horses seldom eat deathcamas. The toxic principle (zygadenin?) is found in all parts of the plant, even in the seeds.

Key to the species

1. Perianth segments not more than 5 mm. long, pale yellow, abruptly contracted into the claw and often subcordate at base, the glands obovate with the upper margin not sharply defined; stamens much exserted; ovary superior ----- 1. *Z. PANICULATUS*.
1. Perianth segments not less (commonly more) than 5 mm. long, not abruptly contracted, more or less cuneate at base, the glands obovate with a sharply defined upper margin; stamens not or only moderately exserted; ovary partly inferior (2).
2. Branches of the inflorescence erect or ascending; pedicels commonly ascending, seldom decurved; perianth yellowish white ----- 2. *Z. ELEGANS*.
2. Branches of the inflorescence spreading; pedicels divergent, often decurved; perianth greenish white, sometimes tinged with purple. ----- 3. *Z. VIRESCENS*.

1. **Zygadenus paniculatus** (Nutt.) S. Wats. in King, Geol. Expl. 40th Par. 5: 343. 1871.

Helonias paniculata Nutt., Acad. Nat. Sci. Phila. Jour. 7: 57. 1834.

Toxicoscordion paniculatum Rydb., Torrey Bot. Club Bul. 30: 272. 1903.

Apache County to Coconino County, 5,500 to 7,500 feet, May. Montana to Washington, New Mexico, northern Arizona, and California.

Sometimes known as sandcorn.

2. **Zygadenus elegans** Pursh, Fl. Amer. Sept. 241. 1814.

Articlea elegans Rydb., Torrey Bot. Club Bul. 30: 273. 1903.

Coconino County and southern Apache County, 5,000 to 10,000 feet, rich soil in pine woods, July to August. Saskatchewan to Alaska, New Mexico, and Arizona.

3. **Zygadenus virescens** (H. B. K.) Macbride, Contrib. Gray Herb. 53: 4. 1918.

Helonias virescens H. B. K., Nov. Gen. et Sp. 1: 267. 1816.

Zygadenus mexicanus (Kunth) Hemsl., Biol. Cent. Amer. Bot. 3: 382. 1885.

Zygadenus porrifolius Greene, Torrey Bot. Club Bul. 8: 123. 1881.

Articlea porrifolia Rydb., Torrey Bot. Club Bul. 30: 273. 1903.

White Mountains (Apache County), Huachuca Mountains (Cochise County), 6,500 to 11,000 feet, in rich soil in coniferous forests, July to September. New Mexico and Arizona to Central America.

2. VERATRUM. FALSE-HELLEBORE

A coarse pubescent herb with tall leafy stems from thick rootstocks; leaves clasping, broad, strongly veined; flowers numerous in an ample panicle, many of them unisexual; perianth glandless, greenish yellow; anthers cordate; styles 3, separate; fruit a 3-lobed capsule.

1. **Veratrum californicum** Durand, Acad. Nat. Sci. Phila. Jour. ser. 2, 3: 103. 1855.

Veratrum speciosum Rydb., Torrey Bot. Club Bul. 27: 531. 1900.

White Mountains (Apache County), Mogollon Mesa (Coconino County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), 7,500 to 9,500 feet, in bogs and wet meadows, July to August. Montana to Washington, south to New Mexico, Arizona, and California.

This plant is known in New Mexico as "skunkcabbage." The root and young shoots, which contain an alkaloid, veratrin, are poisonous to stock, although seldom eaten. The flowers are poisonous to insects, sometimes causing heavy losses in honeybees.

3. ANTHERICUM

Roots thick, cylindric, fascicled; stems scapose; leaves narrow, grass-like; flowers in a slender raceme; perianth orange yellow, the segments narrow, separate or nearly so; fruit an oblong capsule.

1. **Anthericum torreyi** Baker, Linn. Soc. London Jour. Bot. 15: 318. 1876.

Apache and Coconino Counties south to Cochise, Santa Cruz, and Pima Counties, 6,000 to 9,000 feet, commonly in pine woods, August. New Mexico, Arizona, and southward.

4. EREMOCRINUM

Roots tuberous-thickened; stems scapose, not more than 30 cm. long; leaves long and narrow; flowers few, in a short, rather dense raceme; perianth whitish with green veins, the segments separate or nearly so; anthers becoming strongly incurved; fruit a dehiscent capsule.

1. **Eremocrinum albomarginatum** M. E. Jones, Zoe 4: 53. 1893.

North of Kayenta, Navajo County (*Peebles* and *Fulton* 11950), west of Carrizo, Apache County (*Peebles* and *Smith* 13578), 5,000 to 5,500 feet, June. Southern Utah and northern Arizona.

The starlily or sandlily, *Leucocrinum montanum* Nutt., is to be looked for in northern Arizona. It is readily distinguishable from *Eremocrinum* by having the peduncles originating underground and the perianth segments united below into a long tube.

5. HESPEROCALLIS. DESERTLILY

Roots often slightly thickened and coated with sand; flowering stems from a large tunicate bulb, with few large, undulate-margined leaves; flowers large, in a scarious-bracted raceme; perianth segments whitish with a green central stripe, 5 to 6 cm. long, united at base; fruit a dehiscent capsule.

1. **Hesperocallis undulata** A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 39. 1868.

Western part of Maricopa and Pima Counties, and in Mohave and Yuma Counties, mostly below 2,000 feet, in sandy soil of deserts, March to April. Southwestern Arizona and southeastern California, probably in northwestern Sonora.

The bulbs are eaten by the Indians of southwestern Arizona. This is one of the showiest of the Arizona desert wildflowers.

6. ALLIUM.²¹ ONION

Flowering stems scapose, from a tunicate bulb, this sometimes borne on a short rootstock; leaves sheathing, usually narrowly linear; flowers regular, perfect, in a terminal simple umbel; perianth more or less persistent, rose purple to nearly white, the segments separate or nearly so; ovary more or less completely 3-celled, often crested; ovules 2 in each cell (in the Arizona species).

Such important culinary herbs as onion, garlic, leek, and chives belong to this genus. The bulbs of the Arizona native species were formerly much utilized by the Indians for food and seasoning, being consumed raw or after heating in ashes. Sometimes they were stored for use in winter.

²¹ The writers are indebted to C. V. Morton, of the Smithsonian Institution, for the privilege of examining his notes on the western North American species.

Key to the species

1. Outer bulb coats traversed by coarse, interwoven fibers (2).
2. Flowers mostly transformed into bulblets; perianth about 6 mm. long, rose-colored, the segments acuminate..... 1. *A. SABULICOLA*.
2. Flowers not transformed into bulblets; ovary and capsule crested; outer bulb coats copiously fibrous (3).
3. Scapes from an elongate, horizontal to vertical rootstock, this bearing the oblong or narrowly ovoid bulb at its base; leaf blades 4 mm. wide or wider..... 2. *A. PLUMMERAE*.
3. Rootstock short, or none; bulbs broadly ovoid; leaf blades 3 (rarely 4) mm. wide or narrower (4).
4. Crests of the ovary low and inconspicuous; scapes seldom less than 25 cm. long; perianth segments 5 to 7 mm. long, pale to rather deep pink, not conspicuously striped..... 3. *A. GEYERI*.
4. Crests fairly prominent; scapes not more than 20 cm. long; perianth segments 7 to 10 mm. long, pale pink or nearly white, with a conspicuous, darker-colored, central stripe..... 4. *A. DESERTICOLA*.
1. Outer bulb coats not coarsely fibrous (5).
5. Umbel nodding, the scape more or less recurved at apex; scapes from an elongate, horizontal to vertical rootstock, bearing the oblong or narrowly ovoid bulb at its base; perianth segments about 5 mm. long, obtuse or acutish; ovary and capsule crested..... 5. *A. CERNUUM*.
5. Umbel erect; rootstock none (except in *A. kunthii*); bulbs broadly ovoid or subglobose (6).
6. Outer bulb coats distinctly alveolate, the alveolas more or less rectangular (7).
7. Alveolas of the outer bulb coats about equally long and wide, relatively large, the ridges thick; perianth 8 to 12 mm. long, the segments obscurely serrulate, long-acuminate, with recurved tips; ovary and capsule not prominently crested..... 6. *A. ACUMINATUM*.
7. Alveolas small, the ridges thin; perianth segments not serrulate, not or but slightly recurved at the tip; ovary and capsule prominently crested (8).
8. Perianth 8 to 11 mm. long; scapes usually less than 15 cm. long; outer bulb coats very dark brown, the alveolas mostly elongate vertically and often with very sinuous walls..... 7. *A. BIGELOVII*.
8. Perianth 5 to 8 mm. long; scapes usually more than 15 cm. long; outer bulb coats lighter brown, the alveolas mostly elongate horizontally..... 8. *A. PALMERI*.
6. Outer bulb coats not or obscurely alveolate, but sometimes finely and sinuously striate (9).
9. Scapes tall, seldom less than 25 cm. long; leaves 2 or more, shorter than to little surpassing the scape; ovary and capsule not crested or obscurely so; rootstock usually well developed; perianth segments ochroleucous, with a dark central stripe..... 9. *A. KUNTHII*.
9. Scapes low, not more than 15 cm. long; leaf solitary, much surpassing the scape; ovary and capsule prominently crested; rootstock none (10).
10. Crests of the ovary narrowly triangular, acute or acuminate, 1 mm. long or longer; perianth usually bright pink, commonly about twice as long as the stamens..... 10. *A. CRISTATUM*.
10. Crests of the ovary broadly triangular, truncate to acutish, less than 1 mm. long; perianth pale pink or nearly white, commonly much less than twice as long as the stamens..... 11. *A. NEVADENSE*.

1. **Allium sabulicola** Osterh., Torrey Bot. Club Bul. 27: 539. 1900.

White Mountains (Apache and Greenlee Counties), at Black River (Goodding 526), and Hannigan Meadow, 9,500 feet (Kearney and Peebles 12291). New Mexico and eastern Arizona.

Aven Nelson reduced *A. sabulicola* to a synonym of *A. nuttallii* Wats. and possibly it is only an abnormal, bulblet-bearing form of that species, but the problem calls for further study.

2. **Allium plummerae** S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 195. 1883.

Bonito Creek, White Mountains, Apache County (*Goodding* 1233), Chiricahua and Huachuca Mountains (Cochise County), Baboquivari Mountains (Pima County), 4,000 to 8,000 feet, June to August, type from the Huachuca Mountains (*Lemmon* 2893). Southern Arizona and northern Mexico.

This species is still imperfectly known. Although differing from *A. cernuum* Roth in several important characters, it seems related to that species. The *Goodding* collection is from far outside the principal range and may not belong to this species.

3. **Allium geyeri** S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 227. 1879.

Apache, Navajo, and Coconino Counties, southward to the Rincon Mountains (Pima County), 5,000 to 8,000 feet, commonly in pine woods, July to August. South Dakota to Washington, New Mexico, and Arizona.

A. funiculosum A. Nels. is stated by the author of the species to be closely related to *A. geyeri*, differing in the shape of the bulb. A collection in the Huachuca Mountains (*Goodding* 2426) is cited.

4. **Allium deserticola** (M. E. Jones) Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 114. 1913.

Allium reticulatum Don var. *deserticola* M. E. Jones, Contrib. West. Bot. 10: 30. 1902.

Apache County to Coconino County, south to Cochise and Pima Counties, 1,000 to 6,500 feet, March to May. Western Colorado and eastern Utah to Texas, New Mexico, and Arizona.

One of the most widely distributed of the wild onions in Arizona and sometimes very abundant, covering the ground in places with its orchid-pink flowers.

5. **Allium cernuum** Roth in Roem., Arch. Bot. 1³: 40. 1798.

Allium neomexicanum Rydb., Torrey Bot. Club Bul. 26: 541. 1899.

Allium recurvatum Rydb., N. Y. Bot. Gard. Mem. 1: 94. 1900.

Apache and Coconino Counties to Cochise and Pima Counties, mostly in pine forests, 5,000 to 8,500 feet, August to September. Almost throughout the United States.

Nodding onion. The commonest woodland species of the State, easily distinguished by its relatively tall scapes recurved at apex, and pale pink or nearly white flowers.

6. **Allium acuminatum** Hook, Fl. Bor. Amer. 2: 184. 1840.

Yavapai, Gila, Maricopa, Pinal, and Graham Counties, 2,000 to 5,000 feet, April to May. Montana to British Columbia, south to Arizona and California.

Flowers deep lavender pink or rose pink.

7. *Allium bigelovii* S. Wats. in King, Geol. Expl. 40th Par. 5: 487. 1871.

Coconino and Yavapai Counties, from the north rim of the Grand Canyon to Ash Fork, 5,000 to 8,000 feet, June to July. New Mexico and Arizona.

8. *Allium palmeri* S. Wats. in King, Geol. Expl. 40th Par. 5: 487. 1871.

Apache, Navajo, and Coconino Counties south to Pima County, 4,000 to 7,500 feet, often in pine forests, May to July. Southern Utah, New Mexico, and Arizona.

Apparently much more common in Arizona than the related *A. bigelovii*.

9. *Allium kunthii* Don, Wern. Nat. Hist. Soc. Mem. 6: 82. 1827.

Allium scaposum Benth., Pl. Hartw. 26. 1840.

Gila, Pinal, Cochise, and Pima Counties, 3,000 to 5,000 feet, April to May and again August to September. Western Texas to Arizona, south to Central America.

Flowers cream-colored, fading pink.

10. *Allium cristatum* S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 232. 1879.

Grand Canyon, Coconino County (*Lemmon* in 1884), Chemehuevi, Mohave County, 3,800 feet (*Jones* in 1903), April to June. Utah and Arizona to southern California.

11. *Allium nevadense* S. Wats. in King, Geol. Expl. 40th Par. 5: 351. 1871.

Known in Arizona only by a collection made probably near Kanab, Utah (*Mrs. Thompson* in 1872). Utah, Nevada, northern Arizona, and eastern California.

7. NOTHOSCORDUM

Very similar to *Allium*, differing chiefly in having more than 2 ovules in each cell of the ovary and in the absence of onionlike odor.

1. *Nothoscordum texanum* M. E. Jones, Contrib. West. Bot. 17: 21. 1930.

Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, growing in the open on hillsides and plains in shallow hard gravelly soil, April to May. Western Texas and southern Arizona, probably also in southwestern New Mexico and northern Mexico.

The type (*Jones* in 1930) was collected in Cochise County, Ariz., near Rodeo, N. Mex. The flowers are yellowish white, tinged with purple externally, and are somewhat fragrant.

8. BRODIAEA

Flowering stems from tunicate bulbs, scapose; leaves all basal, narrow, grasslike; flowers in umbels subtended by scarious bracts; perianth segments united below into a funnellform tube; filaments separate; fruit a dehiscent capsule.

The Arizona species are excluded from the genus *Brodiaea* as defined by Hoover.²²

²² HOOVER, ROBERT F. A DEFINITION OF THE GENUS BRODIAEA. Torrey Bot. Club Bul. 66: 161-166. 1939.

Key to the species

1. Inflorescence subcapitate or, if more open, then the rays very unequal; bracts large, ovate or ovate-lanceolate, white or tinged with blue; perianth blue violet, the lobes ovate, obtuse, less than twice as long as (often little longer than) the broadly campanulate tube..... 1. *B. CAPITATA*.
1. Inflorescence umbellate, the rays all elongate and nearly equal; bracts small, lanceolate or oblong, purplish; perianth bright yellow, turning purplish, the lobes lanceolate, acutish, much more than twice as long as the turbinate tube..... 2. *B. LEMMONAE*.

1. *Brodiaea capitata* Benth., Pl. Hartw. 339. 1857.

Coconino, Mohave, Gila, Maricopa, Pinal, Cochise, Santa Cruz, and Pima (doubtless also Yuma) Counties, 5,000 feet or (usually) lower, very common and abundant, February to May (rarely in late summer). Southwestern New Mexico to Oregon and California.

Bluedicks, coveena, grassnuts. The violet-colored flowers of this species are conspicuous on the mesas and open slopes in early spring. The bulbs were eaten by the Pima and Papago Indians. The form occurring in Arizona is var. *pauciflora* Torrey (*Dipterostemon pauciflorus* Rydb.) with a looser inflorescence and paler colored bracts than in the common California form of *B. capitata*.

2. *Brodiaea lemmonae* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 376. 1885.

Flagstaff and edge of the Mogollon Mesa (Coconino County), and in northern Gila County, 5,000 to 7,000 feet, in partial shade of pines, May to August, type from Oak Creek, Coconino County (*Lemmon* in 1884). Known only from Arizona.

9. ANDROSTEPHIUM

Flowering stems from a bulb, scapose; leaves all basal, few, narrow, grasslike; perianth funnellform, the segments united below; filaments partly united into a tube, this with short lobes or teeth between the anthers; capsule 3-celled, obtusely 3-angled.

1. *Androstephium breviflorum* S. Wats., Amer. Nat. 7: 303. 1873.

Northern Arizona, Apache County to Mohave County, in sandy soil, 1,800 to 5,500 feet, March to April. Western Colorado to northern Arizona and southeastern California.

10. MILLA. MEXICAN-STAR

Flowering stems from a tunicate bulb; leaves all basal, narrow, grasslike; flowers solitary or in umbellike clusters of 2 or 3; perianth large, salverform, the lobes about 2 cm. long, white with a green midvein.

1. *Milla biflora* Cav., Icon. Pl. 2: 76. 1793.

Cochise, Santa Cruz, and Pima Counties, near the Mexican boundary, 4,000 to 7,000 feet, mostly in open woods of oak or pine, August to September. Southern New Mexico and Arizona, southward to Oaxaca, Mexico.

11. LILIUM. LILY

Flowering stems tall, leafy, from thick-scaled bulbs; leaves mostly in whorls, linear or lanceolate; flowers large, 5 to 9 cm. long, yellow or

orange, often spotted with brown or purple; perianth funnellform or campanulate, the segments separate; anthers linear, versatile; stigma capitate, 3-lobed; capsule 3-celled, dehiscent.

Key to the species

1. Perianth clear lemon yellow, usually finely spotted inside with darker color, the segments lanceolate, very acuminate, tapering gradually into the claws, 8 to 10 cm. long.-----1. *L. PARRYI*.
1. Perianth red or reddish orange, coarsely purple-spotted inside, the segments lanceolate to ovate and somewhat rhombic, obtuse or acutish, abruptly contracted into the claws, 5 to 7 cm. long.-----2. *L. UMBELLATUM*.

1. *Lilium parryi* S. Wats., Davenport Acad. Sci. Proc. 2: 189. 1878.

Huachuca Mountains, Cochise County (*Palmer, Pringle, Goodding*), Santa Rita Mountains, Pima County (*Pringle* in 1881), growing in rich soil along streams, May to July. Southern Arizona and southern California.

Lemon lily. One of the handsomest and showiest plants of Arizona, apparently rare. The flowers are fragrant.

2. *Lilium umbellatum* Pursh, Fl. Amer. Sept. 229. 1814.

A specimen collected by E. Palmer in 1869, labeled "Arizona," without definite locality, seems to be the only basis for including this lily in the flora of the State. The range of the species is Ohio to Alberta, south to Arkansas, New Mexico (and Arizona?).

12. FRITILLARIA. FRITILLARY

Flowering stem from a thick-scaled bulb, leafy, bearing 1 or few nodding flowers; leaves alternate, linear; perianth campanulate, of 6 separate segments not more than 2 cm. long, greenish yellow mottled with maroon; style 3-cleft, the linear lobes introrsely stigmatic.

Several species of this genus are cultivated as ornamentals. A California species, *F. biflora*, is known as missionbells.

1. *Fritillaria atropurpurea* Nutt., Acad. Nat. Sci. Phila. Jour. 7: 54. 1834.

Navajo, Coconino, and Gila Counties, rich soil in woods, 6,000 to 8,500 feet, April to May. North Dakota to Washington, south to New Mexico, Arizona, and California.

13. CALOCHORTUS.^{22A} MARIPOSA

Flowering stems from tunicate bulbs, subscapose, simple or sparingly branched; leaves few, narrow, alternate; flowers solitary, or few in a terminal inflorescence, large and showy; outer perianth segments green, sepallike, glandless, the inner segments larger, petallike, each with a large hairy gland near the base.

The mariposas are among the most beautiful of Arizona wild flowers, their petals exhibiting a range of colors from pale yellow to nearly scarlet, and from whitish to deep lavender. The rather large bulbs were eaten by the Hopi and Navajo Indians. It is stated that the Mormon pioneers of Utah also used the bulbs of the sego-lily (*C. nuttallii*) as food in times of scarcity.

^{22A} Reference: OWNBEY, MARION. A MONOGRAPH OF THE GENUS CALOCHORTUS. Mo. Bot. Gard. Ann. 27: 371-560. 1940.

Key to the species

1. Stem usually decumbent and flexuous, often branched; inflorescence, if more than 1-flowered, with a distinct main axis (monochasial); petal gland not depressed (rarely slightly so), not surrounded by a membranaceous border, transversely elongate to nearly circular.----- 1. *C. FLEXUOSUS*.
1. Stem erect or nearly so, usually simple; inflorescence subumbellate; petal gland more or less depressed, surrounded by a membranaceous border (2).
 2. Petal gland not transversely elongate, the bordering membrane broad, usually continuous (3).
 3. Hairs of the petals near the gland slender; petals whitish, purple, or yellow; stem often bearing bulblets toward the base.---- 2. *C. NUTTALLII*.
 3. Hairs of the petals thickened apically; petals yellow to nearly scarlet; stem rarely bulbiferous.----- 3. *C. KENNEDYI*.
 2. Petal gland usually elongate transversely, the bordering membrane narrow, discontinuous; petals whitish to deep lavender purple, the hairs thickened apically and often branched (4).
 4. Anthers obtuse or (exceptionally) acutish; petal gland only slightly elongate transversely, or nearly circular; stem often bulbiferous toward the base.----- 4. *C. AMBIGUUS*.
 4. Anthers acute or acuminate; petal gland distinctly elongate transversely; stem rarely bulbiferous.----- 5. *C. GUNNISONII*.

1. *Calochortus flexuosus* S. Wats., Amer. Nat. 7:303. 1873.

Coconino and Mohave Counties, south to the Pinal and Mazatzal Mountains (Gila County), 1,800 to 7,000 feet, open ground or in chaparral, April to June. Southwestern Colorado to southeastern California and central Arizona.

Petals pale purple to nearly white. The bent or twisted stems are characteristic.

2. *Calochortus nuttallii* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2: 124. 1855.

Apache County to northern Mohave County and eastern Yavapai County, 5,000 to 8,000 feet, mesas, slopes, and open pine forests, May to July. Western North Dakota to eastern Oregon, south to Nebraska, northern New Mexico and Arizona, and eastern California.

Sego-lily, the State flower of Utah. The typical form, with whitish to lavender-blue petals, is known in Arizona only from the Kaibab Plateau and the Grand Canyon (Coconino County), and from the mountains of northern Mohave County. The var. *aureus* (S. Wats.) Ownbey (*C. aureus* S. Wats.), with lemon-yellow petals, occurs in Apache, Navajo, and eastern Coconino Counties, and is known elsewhere only from northwestern New Mexico and southern Utah.

3. *Calochortus kennedyi* Porter, Bot. Gaz. 2: 79. 1877.

Yavapai and Mohave Counties, south to Cochise, Pima, Santa Cruz, and Yuma Counties, 5,000 feet or (usually) lower, March to May. Arizona, Nevada, southern California, and northern Sonora.

Desertmariposa. In favorable seasons and localities this plant gives a gorgeous display of color, rivaling that of the California poppy (*Eschscholtzia*). The usual color of the petals is a deep rich orange, but in var. *munzii* Jepson they are clear yellow. This form is occasional in most parts of the range of the species.

4. *Calochortus ambiguus* (M. E. Jones) Ownbey, Mo. Bot. Gard. Ann. 27: 505. 1940.

Calochortus watsoni var. *ambiguus* M. E. Jones, Contrib. West. Bot. 14: 27. 1912.

Northern Coconino County and eastern Mohave County, south to southern Navajo, Cochise, Santa Cruz, and Pima Counties, 3,000 to 8,000 feet, dry slopes, chaparral, and open pine forests, April to August. New Mexico and Arizona.

The most widely distributed and generally the most abundant of the Arizona mariposas, closely resembling *C. nuttallii* in general appearance.

5. *Calochortus gunnisonii* S. Wats. in King, Geol. Expl. 40th Par. 5: 348. 1871.

Keet Seel (northern Navajo County) and White Mountains (Apache County), 6,500 to 8,000 feet, June to August. Western South Dakota and Montana to New Mexico and northeastern Arizona.

14. YUCCA,²³ SOAPWEED, SPANISH-BAYONET, DATIL

Large plants with a thick, branching, mainly subterranean caudex or a distinct trunk above ground; leaves numerous, clustered at the ends of the branches, narrow, elongate, commonly spine-tipped; flowers large, perfect, numerous or many in terminal racemes or panicles; perianth segments rather thick, whitish; ovary 3-celled; fruit dry or fleshy; seeds many, flat.

The yuccas are an important resource of the Indians of the Southwest. The buds, flowers, and emerging flower stalks are eaten raw or boiled, or the last roasted like mescal. The large pulpy fruits of the baccate species (*Y. baccata*, etc.) are eaten raw or roasted, dried for winter use, or ground into meal, and the seeds also are used for food. A fermented beverage was made from these fruits. Fiber from the leaves furnishes material for rope, mats, sandals, baskets, and cloth. The roots, known as amole, have saponifying properties and are used as a sort of soap and as a laxative. The seeds are the natural food of the larvae of small moths, which pollinate the flowers by gathering the pollen into a mass that is pushed into the tube of the stigma.

Key to the species

1. Fruit dehiscent, thin walled, dry (2).
 2. Inflorescence racemiform (3).
 3. Peduncle short, not exceeding the leaves..... 2. *Y. BAILEYI*.
 3. Peduncle longer than the leaves..... 3. *Y. ANGUSTISSIMA*.
 2. Inflorescence amply paniculate; peduncle greatly exceeding the foliage (4).
 4. Leaves denticulate, 8 to 15 (occasionally 20) mm. wide; plant acaulescent or nearly so; style slender; stigma capitate..... 1. *Y. WHIPPLEI*.
 4. Leaves filiferous on the margins, 4 to 10 (rarely 13) mm. wide; plant caulescent, 1 to 4 meters high; style stout; stigma not capitate.
 4. *Y. ELATA*.
1. Fruit indehiscent, fleshy or spongy (5).
 5. Leaves denticulate, very rigid; plant arborescent; branches repeatedly forking to form a spreading crown..... 5. *Y. BREVIFOLIA*.

²³ References: TRELEASE, W. THE YUCCAE. Mo. Bot. Gard. Ann. Rpt. 13. 1902.
MCKELVEY, S. D. YUCCAS OF THE SOUTHWESTERN UNITED STATES I. 1938.
The writers are indebted to Mrs. McKelvey for identifying many of their specimens.

5. Leaves with filiferous margins, rarely less than 20 mm. wide, never very rigid; stems sparingly branched above ground or simple (6).
6. Inflorescence usually tomentose; leaves bluish green, thin and flexible, 20 to 65 cm. long, the margins tardily filiferous, the marginal fibers straight and very fine; stems erect or ascending, 1 to 5.5 meters long; pistil 2 to 2.5 cm. long----- 6. *Y. SCHOTTII*.
6. Inflorescence glabrous or exceptionally puberulent; leaves soon freely filiferous (7).
7. Flowers 2.5 to 5 cm. long; pistil 2 to 3.25 cm. long; stems erect, 1 to 4.5 meters high; leaves yellow green, 30 to 60 or even 150 cm. long, the marginal fibers very coarse, strongly curled-- 7. *Y. MOHAVENSIS*.
7. Flowers 6 to 8 or even 10 cm. long; pistils 4.5 to 8 cm. long (8).
8. Plant acaulescent or with procumbent stems not more than 1 meter long; inflorescence barely exceeding or included within the foliage; peduncle 10 to 15 cm. long; leaves usually pale grayish green, more or less rough to the touch, 50 to 75 cm. long, rigid except at base, commonly more or less twisted, the marginal fibers usually coarse, strongly curled----- 8. *Y. BACCATA*.
8. Plant with erect or strongly ascending stems, these often as many as 25 and up to 2.5 meters long; inflorescence well exerted; leaves essentially smooth, dark yellowish green, the marginal fibers moderately coarse----- 9. *Y. ARIZONICA*.

1. *Yucca whipplei* Torr., U. S. and Mex. Bound. Bot. 222. 1859.

Hesperoyucca whipplei Baker, Kew Roy. Bot. Gard. Bul. Misc. Inform. 1892: 8. 1892.

Reported by McKelvey from Diamond Creek, a tributary of the Colorado River (Mohave County). Western Arizona, southern California, and Baja California, May and June.

Our-Lord's-candle, Spanish-bayonet, Spanish-dagger.

2. *Yucca baileyi* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 114. 1913.

Apache, Navajo, and Coconino Counties, 4,500 to 7,500 feet, sandy plains, hillsides, and pine forests, May to June. Northwestern New Mexico and Arizona.

The raceme is always unbranched and short, sometimes not exceeding the foliage.

Hopi Indians utilize the fibers for basket material. The flowers are browsed by livestock, as also are the young leaves when other forage is scarce.

An unnamed variety with exceptionally short and rather coarsely filiferous leaves, occasional in northern Arizona, is represented by a collection from the Gorge of the Little Colorado River, 5,500 feet (Kearney and Peebles 12819).

3. *Yucca angustissima* Engelm. ex Trel., Mo. Bot. Gard. Ann. Rpt. 13: 58. 1902.

Coconino, Mohave, and Yavapai Counties, 2,700 to 7,500 feet, May to June. Southern Utah and Nevada, northwestern New Mexico, and Arizona.

The typical form, found in Coconino and Yavapai Counties, has leaves 4 to 7 mm. in width and often develops short lateral branches toward the base of the inflorescence. A form with leaves 12 to 14 mm. wide has been observed at several localities in northern Mohave County.

4. *Yucca elata* Engelm., Bot. Gaz. 7: 17. 1882.

Central and southern Arizona, 1,500 to 6,000 feet, grassland and desert, May to July. Western Texas to southern Arizona and northern Mexico.

Soaptree yucca, palmilla. In Arizona, mature plants usually have well-developed stems and often are very tall, but a stemless form has been found at Camp Verde, Yavapai County (*Pebbles* 14413).

This species has proved useful as emergency ration for stock during periods of drought. The chopped stems mixed with concentrated food, such as cottonseed meal, are nourishing and palatable. Plants sprout from the roots but cannot be cropped too often because of the slow rate of growth. The roots, known as amole, are detergent and have been used in the manufacture of shampoo soap. A substitute for jute has been manufactured from the leaf fiber. Indians eat the young flower stalks and lower portion of the stem.

5. *Yucca brevifolia* Engelm. in S. Wats. in King, Geol. Expl. 40th Par. 496. 1871.

Clistoyucca arborescens (Torr.) Trelease, Mo. Bot. Gard. Ann. Rpt. 13: 41. 1902.

Western Mohave County, southwestern Yavapai County, and northern Yuma County, up to about 3,500 feet, deserts, March to May. Extreme southwestern Utah, southern Nevada, Arizona, and southeastern California.

Joshua-tree. Plant 5 to 12 m. high; leaves 15 to 37 cm. long, 8 to 15 mm. wide. In var. *jaegeriana* McKelvey (*Y. brevifolia* var. *wolfei* Jones), which has been found in extreme northwestern Mohave County (*Jones* 5008, *McKelvey* 4160), the plant is 3 to 3.5 m. or rarely 6 m. high, branching near the ground, the branches short, rarely spreading, the leaves 10 to 22 cm. long.

6. *Yucca schottii* Engelm., Acad. Sci. St. Louis Trans. 3: 46. 1873.

Greenlee, Pinal, Cochise, Pima, and Santa Cruz Counties, 4,000 to 6,000 feet, hillsides and canyons, April to August, type from mountains west of the Santa Cruz River, probably in Santa Cruz County. Extreme southwestern New Mexico, Arizona, and northern Mexico.

Hoary yucca. A large, handsome species, often cultivated.

7. *Yucca mohavensis* Sarg., Gard. and Forest 9: 104. 1896.

Western Mohave County, up to 3,500 feet, deserts, March and April. Southern Nevada, Arizona, California, and Baja California.

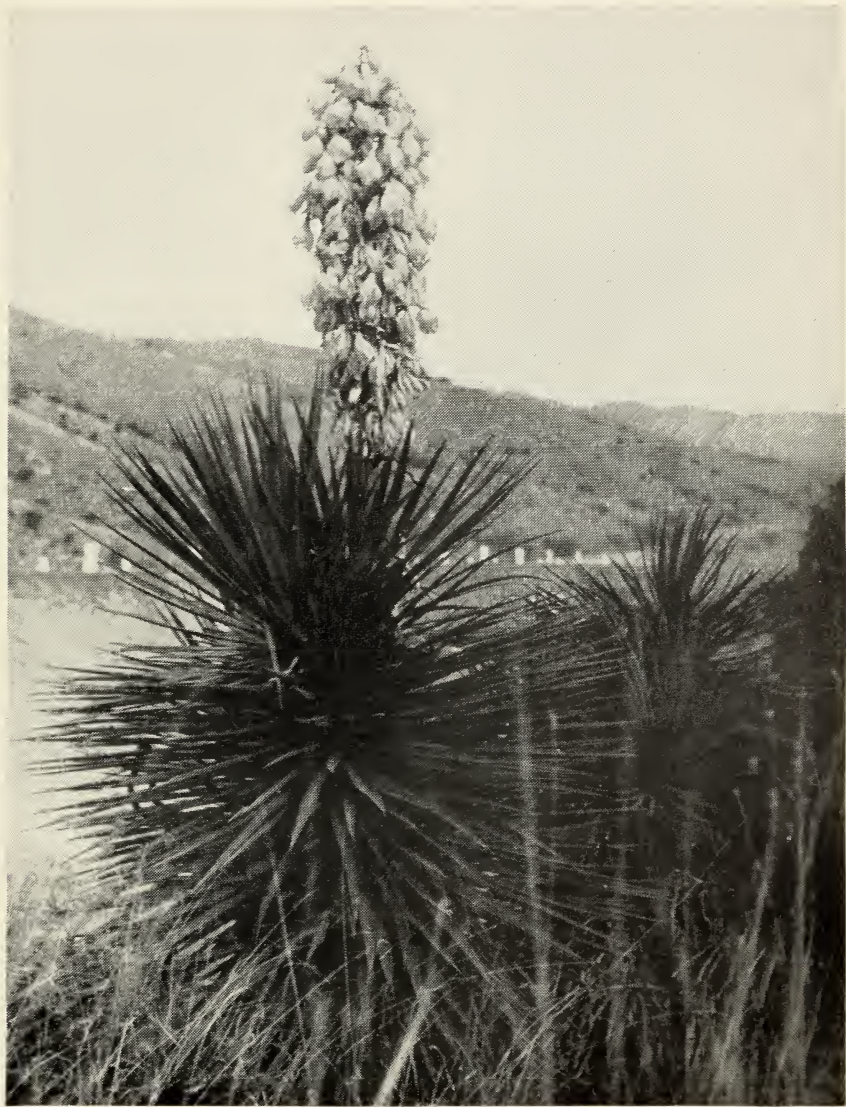
Mohave yucca. According to McKelvey's interpretation, the valid name for this species is *Yucca schidigera* Roehl.

8. *Yucca baccata* Torr., U. S. and Mex. Bound. Bot. 221. 1859.

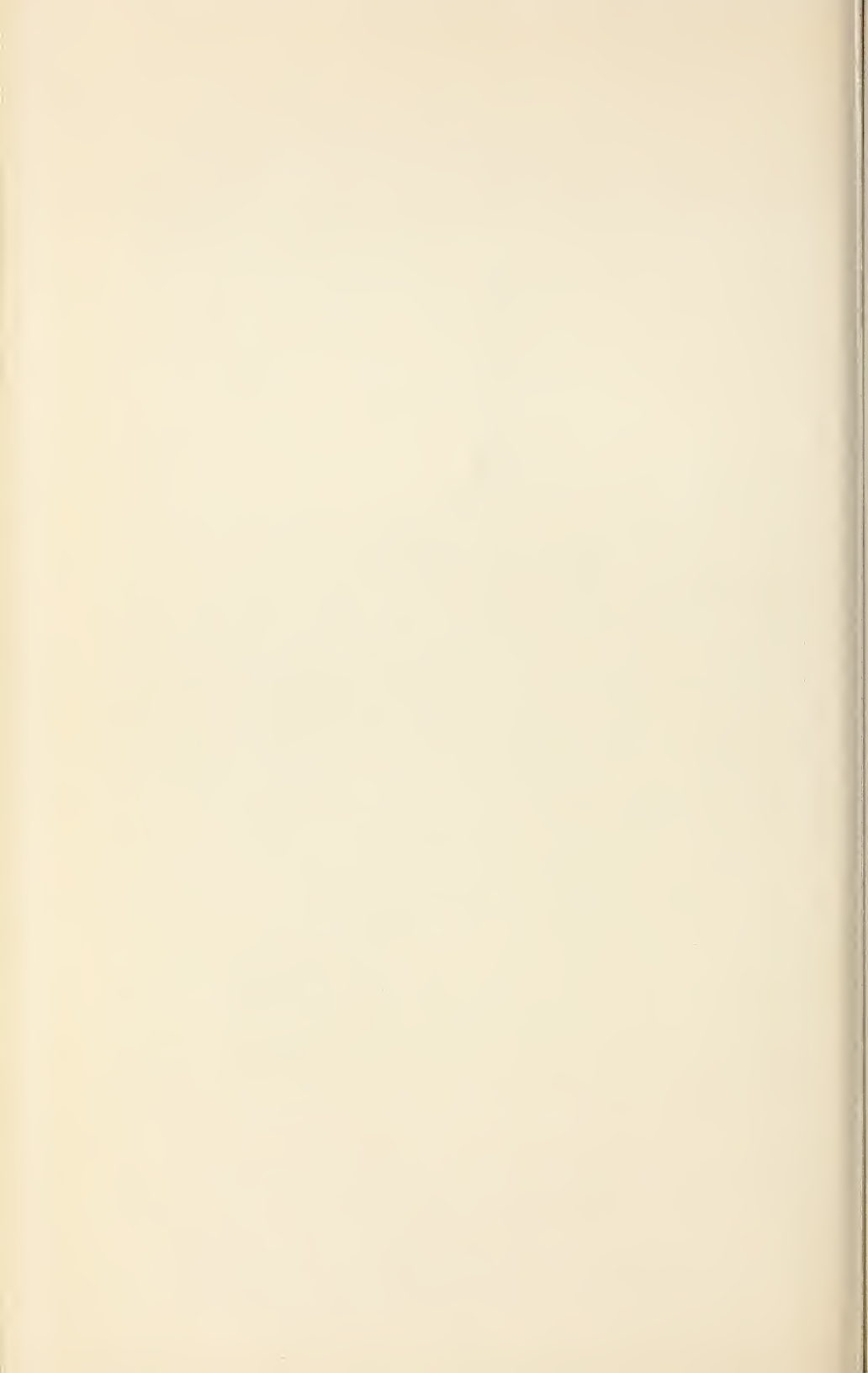
Common and well distributed throughout the State, except in the lower desert regions, 3,000 to 8,000 feet, April to July. Southern Colorado to Nevada, western Texas, Arizona, and southern California.

Blue yucca. Plant acaulescent, or with a few procumbent stems. In var. *vespertina* McKelvey the plant is cespitose with many short, procumbent to erect stems. The variety, which is common in northern Mohave County, also has been collected in Yavapai, Graham, and Apache Counties.

Yucca confinis McKelvey is characterized by few or solitary stems, inflorescence well exerted, peduncle 30 to 45 cm. long, often flexuous, leaves smooth to the



Yucca arizonica near Nogales, Santa Cruz County, altitude 4,000 feet. Flowers creamy white.



touch, 60 to 75 cm. long, rigid, not twisted, the marginal fibers loosely curled and moderately fine. Type from about 15 miles northeast of Douglas, Cochise County, 4,500 feet (*McKelvey* 2099).

9. *Yucca arizonica* *McKelvey*, *Arnold Arboretum Jour.* 16: 270. 1935.

Yucca treleasei *Macbride*, *Gray Herbarium Contrib.* 56: 15. 1918. Not *Sprengr*, 1901.

Pinal, Cochise, Pima, and Santa Cruz Counties, 3,500 to 5,000 feet, abundant in the Baboquivari Mountains and around Nogales, April and May, type from Santa Cruz County. Southern Arizona and Sonora.

Stems up to 2.5 m. long; leaves 30 to 60 cm. long, 15 to 25 mm. wide, rather rigid; panicle obovoid (pl. 12).

Yucca thornberi *McKelvey*, occupying nearly the same general range as *Y. arizonica*, is distinguished by the following characters: stems only up to 1.5 m. long; the leaves up to 100 or even 130 cm. long, more flexible than in *Y. arizonica*; and the inflorescence less exerted, ellipsoidal.

15. NOLINA.²⁴ BEARGRASS

Plants with a large woody caudex, this subterranean or forming a distinct trunk above ground; leaves numerous, clustered, long and narrow; flowers perfect and unisexual, very numerous, in ample terminal panicles; capsule 3-lobed; seed 1 in each cell, turgid.

It is reported that sheep and goats sometimes are poisoned by these plants.

Key to the species

1. Plant acaulescent; leaves 3 to 12 mm. wide; fruit 6 to 8 mm. long, the seed exposed after dehiscence..... 1. *N. MICROCARPA*.
1. Plant caulescent; leaves 15 to 35 mm. wide; fruit up to 15 mm. in diameter, greatly inflated, the seed not exposed; trunk 1 to 2 meters high, clothed with dead leaves..... 2. *N. BIGELOVII*.

1. *Nolina microcarpa* *S. Wats.*, *Amer. Acad. Arts and Sci. Proc.* 14: 247. 1879.

Nearly throughout the State, common in the central and southeastern counties, usually in exposed situations on mountainsides, about 3,000 to 6,500 feet, May and June, type from southeastern Arizona. New Mexico, Arizona, and northern Mexico.

The caudex and emerging flower stalk apparently were prepared for food by the Indians in the same way that the corresponding parts of *Agave* and *Yucca* were used. The leaves are browsed in times of drought.

Nolina affinis *Trelease* (*N. caudata* *Trelease*) related to *N. texana* *Wats.*, is distinguished from *N. microcarpa* by the seed protruding conspicuously after dehiscence, inflorescence usually scabrous, and leaves often with smooth margins. Several collections from Santa Cruz and Cochise Counties are cited by *Trelease*.

2. *Nolina bigelovii* (*Torr.*) *S. Wats.*, *Amer. Acad. Arts and Sci. Proc.* 14: 247. 1879.

Dasyllirion bigelovii *Torr.*, *U. S. Rpt. Expl. Miss. Pacif.* 4: 151. 1857.

Mohave, western Yavapai, and Yuma Counties, not uncommon, up to at least 3,400 feet, hills and canyons, type from Williams River.

²⁴ Reference: *TRELEASE, W. THE DESERT GROUP NOLINEAE. Amer. Phil. Soc. Proc.* 50: 404-426. 1911.

Western Arizona, southeastern California, Baja California, and Sonora.

It is somewhat doubtful whether *Nolina parryi* S. Wats. is specifically distinct from *N. bigelovii*. Authorities do not agree as to the characters that distinguish these forms and apparently there is intergradation. The writers have seen no Arizona specimens that could be referred with assurance to *N. parryi*.

16. DASYLIRION. SOTOL

Plant with a thick, woody, mostly subterranean caudex; leaves in large clusters, very rigid, the margins armed with sharp curved spines; flowers dioecious, in large terminal panicles, these on the staminate plants composed of dense catkinlike spikes; capsule 1-celled, 3-winged.

1. **Dasyilirion wheeleri** S. Wats. in Wheeler, U. S. Survey West 100th Merid. Rpt. 6: 378. 1878.

Greenlee, Graham, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, May to August. Western Texas to Arizona and northern Mexico.

Cattle feed upon the short round heads of plants that have been burned or split open. The heads contain much sugar and have been used in the manufacture of alcohol. From the roasted hearts the natives prepared an article of food similar to that obtained from mescal (*Agave*) and also a potent beverage generally known as sotol.

17. ASPARAGUS

Stems simple, fleshy and scaly in the juvenile (edible) state, becoming tall, slender, much branched; leaves minute, scalelike, with filiform branchlets in their axils; flowers commonly solitary, nodding, small; perianth campanulate, greenish white; fruit a few-seeded berry, red at maturity.

1. **Asparagus officinalis** L., Sp. Pl. 313. 1753.

The well-known garden vegetable, occasionally escaping from cultivation, as at Sacaton, Pinal County, but scarcely naturalized. Native of Europe.

18. SMILACINA

Flowering stems from horizontal rootstocks, unbranched, leafy; leaves alternate, mostly sessile or subsessile, with ample lanceolate to ovate blades; flowers small, whitish, in terminal racemes or panicles; perianth rotate; ovary 3-celled; fruit a few-seeded berry.

Key to the species

1. Inflorescence a many-flowered panicle; perianth segments not more than 2.5 mm. long, shorter than the stamens; berries red, with purplish dots; leaves ovate or lance-ovate..... 1. *S. RACEMOSA*.
1. Inflorescence a few-flowered raceme; perianth segments 5 to 7 mm. long, longer than the stamens; berries green with vertical dark-brown stripes, becoming black; leaves lanceolate or oblong-lanceolate..... 2. *S. STELLATA*.

1. **Smilacina racemosa** (L.) Desf., Ann. Paris Mus. d'Hist. Nat. 9: 51. 1807.

Convallaria racemosa L., Sp. Pl. 315. 1753.

Vagnera racemosa Morong, Torrey Bot. Club Mem. 5: 114. 1894.

Apache, Coconino, Greenlee, Graham, Gila, Cochise, and Pima Counties, 6,000 to 10,000 feet, rich soil in coniferous forests, May to July. Throughout most of temperate North America.

False-Solomonseal. The commoner form in Arizona is var. *amplexicaulis* (Nutt.) Wats. (*Smilacina amplexicaulis* Nutt., *Vagnera amplexicaulis* Greene), with leaves sessile or subsessile and often slightly clasping. This intergrades with the typical form, in which the leaves are short-petioled, and with var. *cylindrata* Fernald, a reduced form with a relatively small and narrow panicle.

2. *Smilacina stellata* (L.) Desf., Ann. Paris Mus. d'Hist. Nat. 9: 52. 1807.

Convallaria stellata L., Sp. Pl. 316. 1753.

Vagnera stellata Morong, Torrey Bot. Club Mem. 5: 114. 1894.

San Francisco Peaks and Bill Williams Mountain (Coconino County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), Santa Catalina Mountains (Pima County), 7,500 to 9,000 feet, rich woods, May and June. Throughout most of temperate North America; Europe. Starflower.

19. DISPORUM

Herbage pubescent or puberulent; flowering stems from rootstocks, leafy, dichotomously branched; leaves broad, sessile or clasping; flowers terminal, solitary or 2 or 3 in an umbellike cluster, nodding, the perianth yellowish white; fruit somewhat lobed, its surface papillate.

1. *Disporum trachycarpum* (S. Wats.) Benth. and Hook., Gen. Pl. 3: 832. 1883.

Prosartes trachycarpa S. Wats. in King, Geol. Expl. 40th Par. 5: 344. 1871.

San Francisco Peaks and Bill Williams Mountain (Coconino County), White Mountains (Apache County), Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), 7,500 to 8,000 feet, in rich woods, May. Manitoba and British Columbia to New Mexico and Arizona.

The Arizona specimens are mostly referable to var. *subglabrum* Kelso, the type of which was collected near Flagstaff (*MacDougal* 64).

20. STREPTOPUS. TWISTEDSTALK

Herbage glabrous; flowering stems from rootstocks, leafy, branched; leaves broad, cordate-clasping; flowers lateral, extra-axillary, solitary or in pairs, nodding, the perianth greenish white; fruit entire, smooth.

1. *Streptopus amplexifolius* (L.) DC. and Lam., Fl. Franç. 3: 174. 1805.

Uvularia amplexifolia L., Sp. Pl. 304. 1753.

Baldy Peak, White Mountains, Apache County (*Goodding* 625, *Peebles* and *Smith* 12510), 10,000 to 11,000 feet, springy places in forests, July and August. Greenland to Alaska, south to North Carolina, New Mexico, Arizona, and California.

Represented in Arizona by var. *americanus* Roem. et Schult.

18. AMARYLLIDACEAE. AMARYLLIS FAMILY

Plants herbaceous or somewhat woody under ground; flowering stems from bulbs or rootstocks, scapose; flowers perfect, regular or

nearly so; perianth segments united below into a tube adnate to the ovary (the ovary inferior); stamens 6, inserted on the perianth; ovary 3-celled; style 3-lobed; fruit a capsule.

Key to the genera

1. Plants with a large woody caudex; leaves very thick, rigid, spine-tipped and often spiny-margined; flowers numerous in elongate racemes or panicles; perianth fleshy.----- 3. AGAVE.
1. Plants without a woody caudex, the flowering stems from a bulb or a cormlike rootstock; leaves grasslike, not rigid or spine-tipped; flowers solitary or few in an umbellike inflorescence; perianth not fleshy (2).
2. Plant glabrous; scape from a large tunicate bulb, 1-flowered, not much shorter than to surpassing the leaves; perianth funnellform. 1. ZEPHYRANTHES.
2. Plant hairy; scape from a small cormlike rootstock, often bearing more than 1 flower, much shorter than the leaves; perianth spreading. 2. HYPOXIS.

1. ZEPHYRANTHES. ZEPHYRILLY

Plants herbaceous, glabrous; flowering stems from a tunicate bulb; leaves narrow, somewhat fleshy; flower solitary, large, subtended by a spathe-like bract; perianth funnellform, white or tinged with pink; anthers versatile; capsule subglobose, 3-lobed, dehiscent by valves.

1. *Zephyranthes longifolia* Hemsl., Diagn. Pl. Mex. 55. 1880.

Atamosco longifolia Cockerell, Canad. Ent. 1901: 283. 1901.

San Bernardino Ranch, Tombstone, and Fort Huachuca (Cochise County), foothills of the Rincon, Santa Catalina, and Santa Rita Mountains (Pima County), 4,000 to 5,800 feet, in gravelly soil on hillsides, June and July. Western Texas to Arizona and Mexico.

2. HYPOXIS.²⁵ GOLDEYE-GRASS

Plant herbaceous, pubescent; flowering stems from a cormlike rootstock; leaves narrow, grasslike, not fleshy; flowers few, subumbellate; perianth segments spreading, green outside, yellow within; anthers erect, sagittate; capsule somewhat elongate, irregularly dehiscent.

1. *Hypoxis mexicana* Schult. in Roem. and Schult., Syst. Veg. 7: 761. 1830.

Known in Arizona only from a collection in the Huachuca Mountains (*Lemmon* 2891), September. Arizona to southern Mexico.

3. AGAVE²⁶

Flowering stems from a more or less woody caudex or a short erect rootstock; leaves succulent, numerous, imbricate, forming a basal rosette; scapes tall and stout, ending in an elongate, bracted raceme or panicle; flowers numerous; perianth tubular or funnellform; stamens exerted, the anthers versatile; capsule thick-walled, many-seeded.

The names centuryplant and mescal are applied to the large paniculate species, and some of the small species are referred to as lechuguilla and amole. In Mexico and Central America species of *Agave* are culti-

²⁵ Reference: BRACKETT, A. REVISION OF THE AMERICAN SPECIES OF HYPOXIS. *Rhodora* 25: 120-163. 1923.

²⁶ References: MULFORD, A. I. A STUDY OF THE AGAVES OF THE UNITED STATES. *Mo. Bot. Gard. Ann. Rpt.* 7: 47-100. 1896.
TRELEASE, W. AGAVE. In Standl., *Contrib. U. S. Natl. Herbarium* 23: 107-142. 1920.

vated for the fibers known in commerce as henequen and sisal. Other species yield intoxicating beverages. Pulque is the fermented juice, and mescal or tequila is a potent drink obtained by distillation of mash made from the caudex. The name "mescal" also is applied to the food obtained by roasting the caudex and emerging flower stalk. This food was of importance to the Indians of Arizona, who had access to such large species as *A. palmeri*, *A. chrysantha*, and *A. parryi*. Numerous pits in which mescal and sotol were roasted are still in evidence on the mountainsides, and even at the present time a small quantity of mescal is made by the Papagos. The juice of certain Mexican species is said to be emmenagogic, laxative, and diuretic, also toxic to live stock. The fresh juice of *A. parryi* irritates the skin of some persons

Key to the species

1. Inflorescence spicate, narrowly cylindric (2).
 2. Leaf margins beset with prickles; leaves 2 to 4 cm. wide, 15 to 35 cm. long; scapes 2 to 4 meters high; flowers yellow, 22 to 30 mm. long including the ovary; filaments inserted near the middle of the short, broadly funnel-form perianth tube; capsules 2.5 to 3 cm. long.----- 1. *A. UTAHENSIS*.
 2. Leaf margins filiferous, occasionally serrulate toward base; leaves commonly narrower, more or less falcate; scapes 1 to 2 meters high (3).
 3. Filaments inserted at base of the perianth tube, the latter cylindric and much longer than the rounded lobes; leaves with coarse marginal fibers and conspicuous glaucous markings, flat or even slightly convex on the upper surface except near the apex, oblong-linear, 5 to 10 cm. long, 7 to 10 mm. wide, dark green; flowers somewhat red-tinged, glaucous, 12 mm. long including the ovary; capsules globose, about 10 mm. in diameter----- 2. *A. PARVIFLORA*.
 3. Filaments inserted at or near the summit of the perianth tube; perianth lobes longer than the tube; leaves with fine marginal fibers and glaucous markings only when immature (4).
 4. Flowers 18 to 25 mm. long including the ovary, greenish or pale yellow; perianth tube broadly funnel-form, 5 mm. long; leaves subulate to linear, 10 to 25 mm. wide, 15 to 35 cm. long, concave on the upper surface; capsules 11 to 15 mm. long.----- 3. *A. TOUMEYANA*.
 4. Flowers 30 to 50 mm. long including the ovary, yellow; perianth tube narrowly funnel-form, 8 to 11 mm. long; leaves linear; capsules 10 to 25 mm. long.----- 4. *A. SCHOTTII*.
1. Inflorescence amply paniculate; scapes 3 to 8 m. high; leaves usually more or less constricted near the base, with prickles on the margins (5).
 5. Filaments inserted at base of the perianth lobes; leaves rarely more than 45 cm. long (6).
 6. Flower buds greenish; scapes rarely stout; panicle lanceolate in outline or reduced and confined to the upper part of the scape, the lateral branches ascending; clusters comparatively few-flowered, hemispheric or subglobose; leaves not closely imbricate, often with conspicuous transverse markings, lanceolate or occasionally oblong-lanceolate, attenuate-acuminate, 30 to 50 cm. long, the end spine slender, the prickles commonly stout, up to 10 mm. long; flowers pale yellow.----- 5. *A. DESERTI*.
 6. Flower buds strongly charged with red; scapes stout; panicle elliptic in outline, occupying one-third to one-half or more of the total length of the scape, the lateral branches horizontal; clusters many-flowered, horizontally flattened; leaves without conspicuous markings, the marginal prickles commonly 3 to 5 mm. long; flowers yellow.----- 6. *A. PARRYI*.
5. Filaments inserted near the middle of the perianth tube; leaves usually 40 to 80 (up to 150) cm. long, lanceolate to linear, one-twelfth to one-fourth as wide as long (7).
 7. End spine stout, 12 to 15 mm. long; leaves not greatly thickened at base, up to 65 cm. long, dark green, linear, strongly concave toward apex, the naked acumination, including the spine, 30 to 35 mm. long; inflorescence proliferous, the branches strongly ascending, the bulbils long-persistent; flowers greenish yellow.----- 9. *A. MURPHEYSII*.

7. End spine slender, 20 to 50 mm. long; leaves greatly thickened at base, the naked acumination, including the spine, 50 to 150 mm. long; inflorescence rarely proliferous (8).
8. Flowers greenish or yellowish, more or less tinged with purple; leaves green, lanceolate to linear; prickles usually not more than 5 mm. long, at the middle of the leaf margin 7 to 20 mm. apart; branches of the panicle horizontal, twice as long as the flower clusters; flowers not especially numerous or congested. 7. *A. PALMERI*.
8. Flowers yellow, not purple tinged; leaves glaucous, lanceolate or linear-lanceolate; prickles stouter, 7 to 10 mm. long, at the middle of the leaf margin 20 to 35 mm. apart; branches of the panicle ascending, about as long as the flower clusters; flowers congested, occasionally as many as 300 in one cluster.----- 8. *A. CHRYSANTHA*.

1. ***Agave utahensis*** Engelm. in King, Geol. Expl. 40th Par. 5: 497. 1871.

? *Agave newberryi* Engelm., Acad. Sci. St. Louis Trans. 3: 310. 1875.

Agave utahensis var. *discreta* M. E. Jones, Contrib. West. Bot. 17: 19. 1930 (in part).

Coconino and Mohave Counties, 3,000 to 7,500 feet, May and June. Southern Utah and northern Arizona to southeastern California.

2. ***Agave parviflora*** Torr., U. S. and Mex. Bound. Bot. 214. 1859.

Mountainous region west of Nogales (Santa Cruz County) along the Mexican boundary, type from Pajarito Mountains (*Schott*), Arivaca to Ruby, 4,600 feet (*Peebles* and *Fulton* 11444), June and July. Arizona, Chihuahua, and Sonora.

3. ***Agave toumeyana*** Trel. in Bailey, Stand. Cycl. Hort. 1: 238. 1917; Contrib. U. S. Natl. Herbarium 23: 140. 1920.

Pinal Mountains, Pinal or Gila County, 3,500 feet (*Toumey* 442, the type collection, *Peebles* 12937, 13008), Fish Creek Hill, Maricopa County, about 2,000 feet (*Peebles* 10773), May. Known only from Arizona.

4. ***Agave schottii*** Engelm., Acad. Sci. St. Louis Trans. 3: 305. 1875.

Agave mulfordiana Trel., Contrib. U. S. Natl. Herbarium 23: 140. 1920.

Gila, Pinal, Pima, and Santa Cruz Counties, exposed mountainsides, 4,000 to 7,000 feet, May to October. Southern Arizona and Sonora.

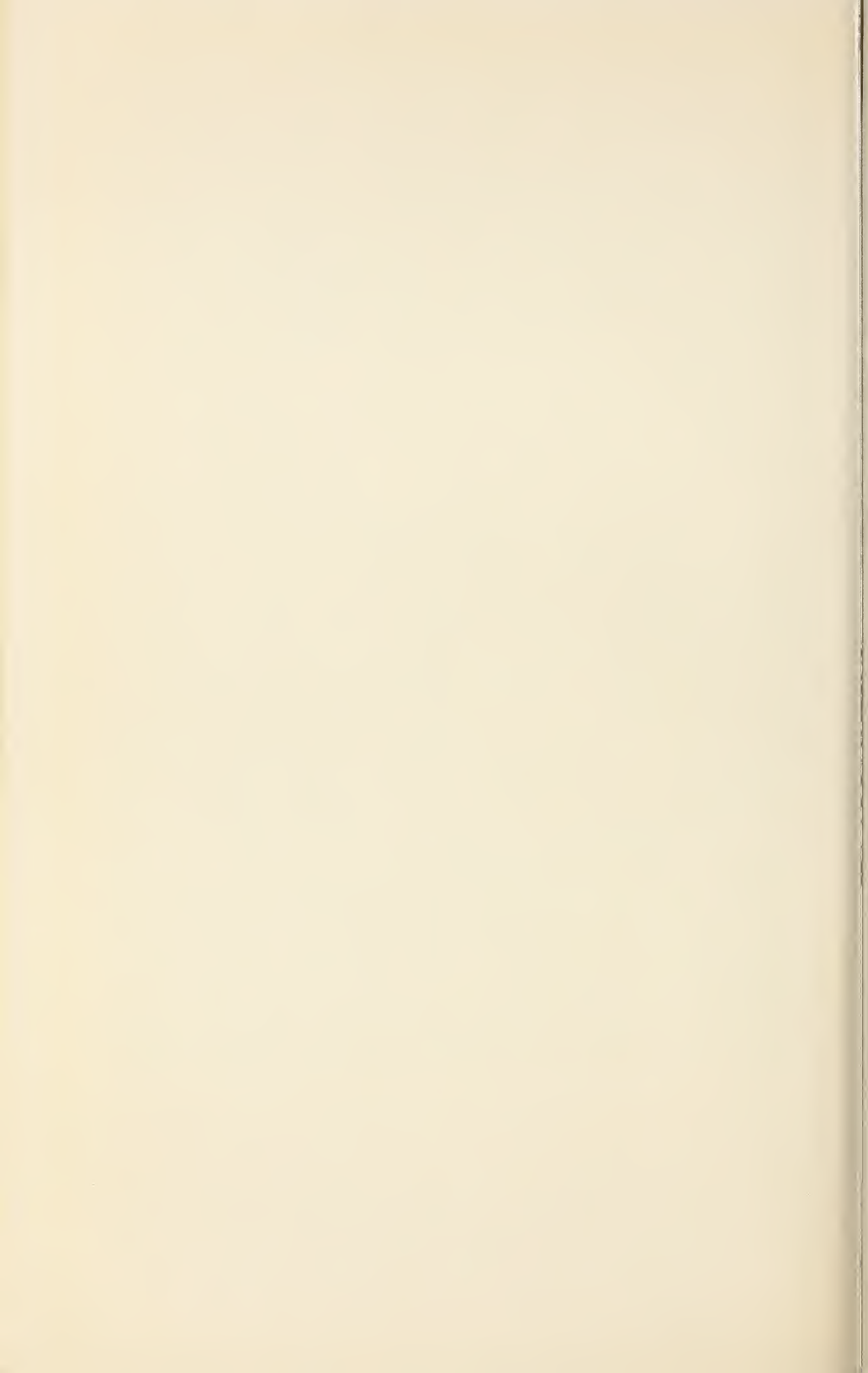
Leaves in the typical form yellowish green, 6 to 9 or rarely 12 mm. wide, 15 to 35 cm. long, concave on the upper surface; capsules 10 to 15 or even 25 mm. long. The var. *treleasei* (*Toumey*) Kearney and *Peebles* (*A. treleasei* (sic) *Toumey*), is known only from one station on the southern slopes of the Santa Catalina Mountains, 6,500 feet, where *Toumey* found it growing with the typical form. The stamens are inserted as in the typical form, and the variety differs only in the character of the leaves, which are dark green, 15 to 25 mm. wide, 20 to 40 cm. long, and nearly flat on the upper surface.

5. ***Agave deserti*** Engelm., Acad. Sci. St. Louis Trans. 3: 310. 1875.

Sierra Estrella, Maricopa County (*Peebles* 14415), Cunningham Pass, Harcuvar Mountains, Yuma County (*Peebles* and *Smith* 13881, etc.), 2,500 feet; and apparently also in southern Mohave and southwestern



Agave parryi near Sonoita, Santa Cruz County, altitude 4,800 feet. A robust form, sometimes known as *A. huachucensis*.



Yavapai Counties, arid hills, 2,000 to 4,500 feet, June. Western Arizona, southern California, and Baja California.

In Arizona the species does not colonize appreciably, although the plants produce offsets freely.

6. *Agave parryi* Engelm., Acad. Sci. St. Louis Trans. 3: 311. 1875.

Agave huachuensis Baker, Handb. Amaryllid. 172. 1882.

Central and southeastern Arizona, mountains, 4,500 to 8,000 feet, June to July, type probably from Graham County (*Rothrock* 274). New Mexico, Arizona, and northern Mexico.

In the typical form the leaves are compactly imbricate, broadly oblong, one-third to two-fifths as wide as long, 10 to 15 cm. wide, 30 to 40 cm. long, with a stout end spine, flowers 50 to 60 mm. long. The var. *couesii* (Engelm.) Kearney and Peebles (*A. couesii* Engelm.), occurring in Yavapai and Gila Counties, sometimes with the typical form, is a somewhat smaller plant with flowers 25 to 50 mm. long and leaves less closely imbricate, oblong to lanceolate, one-fifth to one-third as wide as long. In the robust form *A. huachuensis*, known only from the general vicinity of the Huachuca Mountains, the leaves are up to 35 cm. wide and up to 65 cm. long, and the flowers up to 75 mm. long (pl. 13).

7. *Agave palmeri* Engelm., Acad. Sci. St. Louis Trans. 3: 319. 1875.

Graham, Cochise, Santa Cruz, and Pima Counties, in the mountains, 3,500 to 6,500 feet, July to August. New Mexico, southern Arizona, and Sonora.

The original description was based on several Arizona collections.

8. *Agave chrysantha* Peebles, Biol. Soc. Wash. Proc. 48: 139. 1935.

Gila, Pinal, and Pima Counties, in the mountains, 3,000 to 7,000 feet, common along the Apache Trail, June to August, type from the Pinal Mountains. Known only from Arizona.

9. *Agave murpheyi* Gibson, Boyce Thompson Inst. Contrib. 7: 83. 1935.

Paradise Valley (Maricopa County), Roosevelt and Tonto Basin (Gila County), Queen Creek near Superior, the type locality (Pinal County), March and April. Known only from Arizona.

19. IRIDACEAE. IRIS FAMILY

Perennial herbs; flowering stems from rootstocks or bulbs; leaves long and narrow, 2-ranked, equitant (folded together lengthwise and enfolding one another); flowers perfect, regular or nearly so, subtended by spathe-like bracts; stamens 3, inserted on the perianth; style 3-cleft; ovary inferior; fruit a 3-celled dehiscent, many-seeded capsule.

Key to the genera

1. Sepals recurved, longer than the erect petals; style branches petallike, opposite to and overarching the stamens; filaments separate; flowers about 8 cm. in diameter..... 1. IRIS.
1. Sepals and petals alike, all spreading; style branches not petallike; filaments more or less united; flowers not more than 6 cm. in diameter (2).
 2. Flowering stems from a tunicate bulb; style 3-branched, the branches 2-cleft or 2-parted..... 2. NEMASTYLIS.
 2. Flowering stems from a short rootstock, this often nearly obsolete; style entire or, if 3-branched, the branches entire..... 3. SISYRINCHIUM.

1. IRIS. FLAG, FLEUR-DE-LIS

Flowering stems from a thick, mostly horizontal, more or less branched rootstock; leaves long and rather narrow (not more than 1 cm. wide); flowers large and showy, violet; perianth segments united below into a tube, the 3 inner ones narrower; stigmas below the tips of the style branches.

Some of the exotic species have been brought to a high state of perfection as cultivated ornamentals. Orris-root powder, used extensively in toilet preparations, is obtained from certain European species. The leaves and rootstocks of the Arizona species are reputed to be poisonous to livestock.

1. *Iris missouriensis* Nutt., Acad. Nat. Sci. Phila. Jour. 7: 58. 1834.

Apache, Navajo, and Coconino Counties, south to the Chiricahua and Huachuca Mountains (Cochise County), 6,000 to 9,000 feet, in wet meadows, May to September. North Dakota to British Columbia, south to New Mexico, Arizona, and California.

2. NEMASTYLIS

Flowering stem from a tunicate bulb, often branched; leaves narrow, grasslike; flowers solitary or very few in a cluster, rather large; perianth violet, the segments all alike; filaments united below into a tube; capsule oblong or obovoid, dehiscent near the apex.

1. *Nemastylis pringlei* S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 85. 1889.

Huachuca Mountains (*Goodding* 279, *Pebbles* 14072), about 6,000 feet, in open grassy pine woods. Southern Arizona and northern Mexico.

The Arizona plant is referred doubtfully to *N. pringlei*, as it has a much shorter staminal column than as described by Watson.

3. SISYRINCHIUM

Flowering stems from a short rootstock, or apparently from a cluster of fibrous roots; leaves long, narrow, grasslike; flowers in few-flowered terminal umbels; perianth blue, violet, or yellow, the segments all alike or nearly so; capsule globose to oblong, 3-valved.

Key to the species

1. Stems branched above, leafy, stout, 30 cm. long or longer; leaves more than 5 mm. wide; perianth orange, the segments 15 mm. long or longer; filaments united about one-third of their length; anthers erect, about 6 mm. long; style 3-branched; capsules oblong, more than 10 mm. long.
 1. *S. ARIZONICUM*.
1. Stems unbranched, scapelite; leaves all basal or nearly so, less than 5 mm. wide; perianth segments not more than 15 mm. long; capsules broadly ellipsoid or subglobose, less than 10 mm. long (2).
 2. Perianth yellow or orange, with brown veins; filaments united only near the base; anthers versatile, 2 to 3 mm. long; style branched. 2. *S. LONGIPES*.
 2. Perianth blue or violet; filaments united into a tube; anthers erect, less than 2 mm. long; style not cleft.----- 3. *S. DEMISSUM*.

1. **Sisyrinchium arizonicum** Rothr., Bot. Gaz. 2: 125. 1877.

Oreolirion arizonicum Bicknell in Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 147. 1915.

White Mountains (Apache County), Mogollon Mesa (Coconino County), Chiricahua and Huachuca Mountains (Cochise County), 6,000 to 9,500 feet, in coniferous woods, August, type from Willow Spring, southern Apache County (*Rothrock* 238). New Mexico and Arizona, doubtless also in northern Mexico.

2. **Sisyrinchium longipes** (Bicknell) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 474. 1939.

Hydastylus longipes Bicknell, Torrey Bot. Club Bul. 27: 382. 1900.

San Francisco Peaks (Coconino County), White Mountains (Apache County), Chiricahua Mountains (Cochise County), Rincon Mountains (Pima County), 7,500 to 9,500 feet, in springy places and open pine woods, July to September, type from the San Francisco Peaks (*Knowlton* 34). Apparently known only from Arizona.

Varies greatly in size of the plant and in width and relative length of the leaves. Large plants from the Chiricahua Mountains (*Blumer* 1402) resemble *S. californicum* Ker.

3. **Sisyrinchium demissum** Greene, Pittonia 2: 69. 1890.

Apache to Coconino and Yavapai Counties, 5,000 to 8,000 feet, in wet meadows and springy places, June to July, type from Bill Williams Mountain, Coconino County (*Greene* in 1889). Western Kansas (?) to Arizona.

Blue-eyed-grass. The typical form has leaves 1 to 2 mm. wide and perianth not more than 10 mm. long; whereas, in var. *amethystinum* (Bicknell) Kearney and Peebles (*S. amethystinum* Bicknell), the leaves are commonly 3 to 4 mm. wide and the perianth up to 15 mm. long. In Arizona the variety appears to be the more common and more widely distributed form, ranging from the San Francisco Peaks and the White Mountains to the Huachuca Mountains (Cochise County), and the Rincon Mountains (Pima County). The type of *S. amethystinum* Bicknell was collected at the last-mentioned locality (*Nealley* 153).

S. macrocarpon Bicknell, known only by the type collection at Willow Spring, Apache County (*Palmer* 490a), is perhaps only an exceptionally large-fruited variant of *S. demissum*, with capsules 6 to 7 mm. long, as compared with the ordinary length of 4 to 5 mm.

20. ORCHIDACEAE. ORCHID FAMILY

Perennial herbs, some of them parasitic or saprophytic and without green coloring matter; flowering stems from bulbs, corms, or more or less thickened roots; perianth very irregular, the 3 outer segments sepallike and similar, the lowest of the 3 inner segments (lip) usually very unlike and larger than the other 2, sometimes saccate or spurred; stamen or stamens united with the style in a column; pollen grains coherent in 2 or more masses (pollinia), these attached at base to a viscid gland and united above by elastic threads; ovary inferior; capsule 3-valved; seeds minute, very numerous.

This large family, mainly tropical, includes some of the handsomest of all flowers. The species most extensively grown as ornamentals are mainly tropical and epiphytic. The Arizona species are all terrestrial (rooted in soil) and have relatively inconspicuous flowers, excepting the ladyslipper (*Cypripedium*) and *Calypso*. All orchids are interesting, however, because of the complicated structure of their flowers, which are specialized for pollination by various insects. It is remarkable that notwithstanding the enormous number of seeds produced, these plants are usually rare and seldom abundant. Aside from the value of some of the species in the florist trade, the family is of little importance economically, except that extract of vanilla is manufactured from the pods of certain climbing species of tropical America.

Key to the genera

1. Plants without green coloring matter, yellowish or purplish brown; inflorescence not spirally twisted; roots none; rootstock thick, corallike; leaves reduced to sheathing scales; flowers several or numerous, in a raceme (2).
2. Lip entire, erose, or with a pair of short lobes near the base, with a small callus or fold on each side of the midvein; perianth much less than 2 cm. long----- 7. CORALLORRHIZA.
2. Lip 3-lobed toward the apex, with several longitudinal winglike crests; perianth about 2 cm. long----- 10. HEXALECTRIS.
1. Plants with green, well-developed leaves or, if not so, then the inflorescence spirally twisted; roots present; rootstock, if any, not corallike (3).
3. Fertile anthers 2; lip an inflated sac 2 to 5 cm. long----- 1. CYPRIPEDIUM.
3. Fertile anther 1; lip not more than 2 cm. long (4).
4. Spur of the lip distinct, saccate to elongate-clavate---- 2. HABENARIA.
4. Spur of the lip none or obscure (5).
5. Lip not saccate or strongly concave (6).
6. Flowering stem not from a bulb; leaves 2; lip longer than the sepals, short-stalked, the blade broadest at the retuse or orbordate apex----- 5. LISTERA.
6. Flowering stem from a bulb; leaf solitary; lip shorter than the sepals, sessile, broadest near the base, entire or nearly so at apex.----- 8. MALAXIS.
5. Lip saccate or strongly concave, at least toward the base (7).
7. Leaf solitary, this and the scape arising from a corm; flower solitary, the lip conspicuously bearded, much larger than the other perianth segments----- 9. CALYPSO.
7. Leaves several; corm none; flowers several or numerous; lip beardless, not, or not much, larger than the other segments (8).
8. Plant acaulescent; foliage leaves in a basal rosette; flowers pubescent; lip strongly concave, erect----- 6. GOODYERA.
8. Plant caulescent, the stems leafy; flowers glabrous; lip concave only toward the base (9).
9. Flowers greenish or purplish, in a loose raceme; sepals and petals separate, spreading; column not beaked.----- 3. EPIPACTIS.
9. Flowers ochroleucous, in a spirally twisted, spikelike raceme; sepals and petals united or connivent, forming a galea over the column; column slender-beaked----- 4. SPIRANTHES.

1. CYPRIPEDIUM. LADYSLIPPER

Flowering stems from a cluster of somewhat thickened roots, leafy; herbage glandular-pubescent; leaves large, oval, sessile, strongly nerved; flower usually solitary; lip large, yellow, saccate, the other perianth segments long and narrow, greenish or brownish purple; stamens 3, the upper one sterile and somewhat petaloid, covering the summit of the style; stigma broad, slightly 3-lobed.

1. *Cypripedium parviflorum* Salisb., Linn. Soc. London Trans. 1: 77. 1791.

Cypripedium calceolus L. var. *pubescens* (Willd.) Correll, Harvard Univ. Bot. Mus. Leaflets 7: 14. 1938.

White Mountains, Apache County (*Zuck* in 1907, *Goodding* 1122), in moist soil, probably in shade, June to July. Newfoundland to British Columbia, south to Georgia, Arizona, and Washington.

It is the large-flowered form of this species, var. *pubescens* (Willd.) Knight (*C. pubescens* Willd.), that occurs in Arizona. Some persons who come into contact with the glandular hairs of this plant suffer severely from a form of dermatitis resembling "ivy" poisoning.

2. HABENARIA ²⁷

Roots clustered, tuberous-thickened; stems leafy; flowers small, greenish or yellowish, several or many in elongate, bracted, spikelike racemes; lip spreading or drooping, flat or somewhat saccate, with a tubular spur at base; sacs of the solitary anther divergent.

Plants of bogs and rich moist woods.

Key to the species

1. Bracts all (or all but the uppermost ones) much longer than the flowers, the lower bracts commonly 2 or more times as long; lip 2- or 3-toothed or lobed at apex; spur saclike, much shorter than the blade of the lip; lower leaves commonly obovate----- 1. *H. VIRIDIS*.
 1. Bracts (except sometimes the lowest ones) much less than twice as long as the flowers; lip entire, linear or lanceolate; spur equaling or longer than the blade of the lip; leaves never obovate (2).
 2. Spur much longer than the blade of the lip (commonly 2 or 3 times as long); stems commonly tall, stout, very leafy; spikes usually dense; lip linear or nearly so----- 2. *H. LIMOSA*.
 2. Spur less than twice as long as the blade of the lip (3).
 3. Spikes densely flowered; lip lanceolate, less than 5 mm. long.
 3. *H. HYPERBOREA*.
 4. *H. SPARSIFLORA*.
 3. Spikes loosely flowered; lip linear, 6 to 8 mm. long--
1. *Habenaria viridis* (L.) R. Br. in Ait. f., Hort. Kew. ed. 2, 5: 192. 1813.

Satyrium viride L., Sp. Pl. 944. 1753.

Pinaleno Mountains, Graham County (*Shreve* 5254), Santa Catalina Mountains, Pima County (*Shreve* 5416), 7,200 to 8,800 feet. New Brunswick and British Columbia, south to North Carolina, New Mexico, and Arizona; Europe.

The form found in Arizona is var. *bracteata* (Muhl.) Gray (*Habenaria bracteata* R. Br., *Cocloglossum bracteatum* Parl.).

2. *Habenaria limosa* (Lindl.) Hemsl., Biol. Cent. Amer. Bot. 3: 305. 1884.

Platanthera limosa Lindl., Ann. Nat. Hist. ser. 1, 4: 381. 1840.

Habenaria thurberi A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 389. 1868.

Limnorchis thurberi Rydb., Torrey Bot. Club Bul. 28: 624. 1901.

Limnorchis arizonica Rydb., *ibid.*, p. 629.

Mountains of Cochise and Pima Counties, 7,000 to 8,000 feet, rich moist woods and cool springy places, July to September, type of

²⁷ Reference: AMES, OAKES. THE GENUS HABENARIA IN NORTH AMERICA. Orchidaceae, Fasc. 4. 1910.

Habenaria thurberi from south of Babocomari, Cochise County (Thurber 925), type of *Limnorchis arizonica* from the Rincon Mountains, Pima County (Nealley 78). New Mexico and Arizona, south to Oaxaca.

3. *Habenaria hyperborea* (L.) R. Br. in Ait. f., Hort. Kew. ed. 2, 5: 193. 1813.

Orchis hyperborea L., Mant. 121. 1767.

Lukachukai and White Mountains, Apache and Greenlee Counties, 7,500 to 9,500 feet, in rich moist woods, July to August. Newfoundland to Alaska, south to New Jersey, Arizona, and Oregon.

4. *Habenaria sparsiflora* S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 276. 1877.

Limnorchis sparsiflora Rydb., Torrey Bot. Club Bul. 28: 631. 1901.

Apache, Navajo, and Coconino Counties, 7,000 feet and doubtless higher, June to October. Colorado and New Mexico to Washington, northern Arizona, and southern California.

3. EPIPACTIS. HELLEBORINE

Flowering stem tall, leafy, from a creeping rootstock; inflorescence a few-flowered bracted raceme; flowers greenish or purplish, the lip saccate only near the base, the larger terminal portion deltoid-ovate, inconspicuously crested.

1. *Epipactis gigantea* Dougl. ex Hook., Fl. Bor. Amer. 2: 202. 1839.

Serapias gigantea A. A. Eaton, Biol. Soc. Wash. Proc. 21: 67. 1908.

Amesia gigantea Nels. and Macbr., Bot. Gaz. 56: 472. 1913.

Navajo and Coconino Counties to Cochise and Pima Counties, 5,000 to 7,500 feet, rich woods, June to July. Montana to British Columbia, south to western Texas, Arizona, and California.

4. SPIRANTHES. LADIES-TRESSES

Plants leafy-stemmed from a cluster of tuberous-thickened roots; leaves with well-developed blades or reduced to sheathing scales; inflorescence a twisted spike with yellowish white flowers in 1 to 3 ranks; lip concave toward the base, the distal portion expanded, erose.

Key to the species

1. Leaves reduced to thin sheathing scales; scapes slender, glandular-pubescent above; spike slender, few-flowered, the flowers in 1 rank; lip dentate.

1. *S. PARASITICA.*

1. Leaves with well-developed, lanceolate or oblanceolate, green blades; scapes stout (2).

2. Inflorescence glabrous or nearly so; flowers crowded, commonly in 3 ranks, less than 1 cm. long; leaf blades seldom more than 1 cm. wide.

2. *S. ROMANZOFFIANA.*

2. Inflorescence villous; flowers not crowded, commonly in 1 rank, 1 cm. long or longer; leaf blades 2 to 3 cm. wide-----3. *S. MICHUACANA.*

1. **Spiranthes parasitica** A. Rich. and Gal., Ann. Sci. Nat. II Bot. ser. 3, 3: 32. 1845.

Marshall Gulch, Santa Catalina Mountains, Pima County (*Thornber* and *Lloyd* 4196), June. Southern Arizona and Mexico.

2. **Spiranthes romanzoffiana** Cham., Linnaea 3: 32. 1828.

Kaibab Plateau near the Grand Canyon National Park, Coconino County (*Kearney* and *Peebles* 13719), Baldy Peak, Apache County (*Peebles* and *Smith* 12496), Pinaleno Mountains, Graham County (*Shreve* 5374), 8,500 to 9,500 feet, in bogs, August and September. Newfoundland to Alaska, south to New York, New Mexico, Arizona, and California.

3. **Spiranthes michuacana** (La Llave and Lex.) Hemsl., Biol. Cent. Amer. Bot. 3: 301. 1884.

Neottia michuacana La Llave and Lex., Nov. Veg. Descr. 2: Orchid, Op. 3. 1825.

Rucker Valley or Huachuca Mountains, Cochise County (*Lemmon* 477), September. Southeastern Arizona and Mexico.

The floral bracts are remarkably large, attaining a length of 3 cm.

5. LISTERA. TWAYBLADE

Small plants with fibrous roots and a pair of nearly opposite, broadly ovate leaves; flowers inconspicuous, greenish yellow, in a short raceme; lip wedge-shaped, broadest at apex, slightly toothed or angled on each side at base.

1. **Listera convallarioides** (Swartz) Torr., Compend. 320. 1826.

Epipactis convallarioides Swartz, K. Vetensk. Acad. Handl. ser. 2, 21: 232. 1800.

Ophrys convallarioides W. F. Wight, Torrey Bot. Club Bul. 32: 380. 1905.

Santa Catalina Mountains, Pima County (*Peebles* and *Loomis* 2253a), about 8,000 feet, July. Newfoundland to Alaska, south to New England, Arizona, and California.

6. GOODYERA. RATTLESNAKE-PLANTAIN

Flowering stems scapose, from a cluster of thickened roots; foliage leaves in a basal rosette, somewhat fleshy, mottled or striped with white; inflorescence a somewhat 1-sided, bracted spike; flowers small, whitish; upper sepal united with the petals, forming a galea; column ending in a 2-forked beak.

1. **Goodyera decipiens** (Hook.) F. T. Hubbard in Olmsted, Coville, and Kelsey, Stand. Pl. Names, 328. 1923.

Spiranthes decipiens Hook., Fl. Bor. Amer. 2: 203. 1839.

Peramium decipiens Piper, Contrib. U. S. Nat. Herbarium 11: 208. 1906.

Kaibab Plateau and Bill Williams Mountain (Coconino County), White Mountains (Greenlee County), Pinaleno Mountains (Graham County), 8,000 to 9,500 feet, rich woods, July and August. Nova Scotia to Alaska south to New Hampshire, New Mexico, Arizona, and California.

7. CORALLORRHIZA. CORALROOT

Plants without chlorophyll, the leaves reduced to sheathing scales; rootstock thick, branching, corallike; flowers in racemes; lateral sepals united with the base of the column, often forming a short spur or projection, this adnate to the summit of the ovary.

Key to the species

1. Lip darker colored than the other perianth segments, oval or oblong-ovate, conspicuously striate-veined (as are the other segments), entire; spur none ----- 1. *C. STRIATA*.
1. Lip contrasting sharply in color with the other (brown) perianth segments, whitish and more or less spotted with crimson, broadly ovate, obovate, or suborbicular, erose-denticulate; spur or a saclike protuberance present (2).
 2. Lip conspicuously lobed or toothed on each side near the base; outer perianth segments obtuse or acutish ----- 2. *C. MACULATA*.
 2. Lip not lobed or toothed at base; outer perianth segments acuminate.
 3. *C. WISTERIANA*.

1. *Corallorrhiza striata* Lindl., Gen. et Sp. Orchid. 534. 1840.

Sierra Ancha, Gila County (*Harrison* 7864), Chiricahua Mountains, Cochise County (*Blumer* 2019), Santa Catalina Mountains, Pima County (*Peebles* and *Harrison* 2225), 7,500 to 9,000 feet, in deep shade of pine and spruce forests, July. Quebec to British Columbia, Michigan, Arizona, and California.

2. *Corallorrhiza maculata* Raf., Amer. Monthly Mag. 2: 119. 1817.

Corallorrhiza multiflora Nutt., Acad. Nat. Sci. Phila. Jour. 3: 138. 1823.

Lukachukai and White Mountains (Apache County), San Francisco Peaks (Coconino County), south to the Pinaleno Mountains (Graham County) and the Santa Catalina Mountains (Pima County), 6,000 to 10,000 feet, in coniferous forests, June and July. Nova Scotia to Alaska, south to Florida, New Mexico, Arizona, and California.

3. *Corallorrhiza wisteriana* Conrad, Acad. Nat. Sci. Phila. Jour. 6: 145. 1829.

San Francisco Peaks (Coconino County), Sierra Ancha and Pinal Mountains (Gila County), Santa Catalina Mountains (Pima County), 6,000 to 7,500 feet, May. Pennsylvania to Florida and Texas; Arizona.

8. MALAXIS. ADDERSMOUTH

Small plants with flowering stems from a corm, bearing a solitary rounded-ovate clasping leaf; flowers inconspicuous, in a terminal raceme or spike; sepals and petals separate, spreading; lip cordate or lobed at base.

Key to the species

1. Inflorescence a short, often corymbiform, loose raceme; leaves deeply cordate at base; pedicels equaling or longer than the flowers -- 1. *M. CORYMBOSA*.
1. Inflorescence elongate, not corymbiform; leaves not, or very slightly, cordate at base (2).
 2. Flowers 3 to 4 mm. long, sessile, greenish yellow, in a dense elongate spike 3 to 4 mm. wide; perianth segments oblong to ovate -- 2. *M. SOULEI*.
 2. Flowers commonly more than 4 mm. long, on pedicels half to equally as long as themselves; inflorescence loosely racemose; perianth segments linear or narrowly lanceolate (3).
 3. Flowers greenish, 10 to 12 mm. long ----- 3. *M. TENUIS*.
 3. Flowers brownish purple, 4 to 6 mm. long ----- 4. *M. EHRENERGII*.

1. **Malaxis corymbosa** (S. Wats.) Kuntze, Rev. Gen. Pl. 2: 673. 1891.

Microstylis corymbosa S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 195. 1883.

Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), about 6,000 feet, August, type from Tanners Canyon, Huachuca Mountains (*Lemmon* 2882). Southern Arizona to Guatemala.

2. **Malaxis soulei** L. O. Williams, Mo. Bot. Gard. Ann. 21: 343. 1934.

Microstylis montana Rothr. in Wheeler, U. S. Survey West 100th Mer. Rpt. 6: 264. 1878.

Malaxis montana Kuntze, Rev. Gen. Pl. 2: 673. 1891. Not Blume, 1826.

Buck Springs Ranger Station, Coconino County (*Collom* 700), Pinaleno Mountains (Graham County), fairly common in the mountains of Cochise and Pima Counties, 7,000 to 9,500 feet, in pine woods, July to September, type from Mount Graham (*Rothrock* 264). New Mexico and Arizona south to Oaxaca.

3. **Malaxis tenuis** (S. Wats.) Ames, Biol. Soc. Wash. Proc. 35: 85. 1922.

Microstylis tenuis S. Wats., Amer. Acad. Arts and Sci. Proc. 26: 152. 1891.

Santa Catalina Mountains, Pima County (*Peebles* et al. 2518), 7,000 feet. New Mexico, Arizona, and Mexico.

4. **Malaxis ehrenbergii** (Reichb. f.) Kuntze, Rev. Gen. Pl. 2: 673. 1891.

Microstylis ehrenbergii Reichb. f., *Linnaea* 22: 835. 1849.

Microstylis purpurea S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 195. 1883.

Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), about 7,500 feet, moist mossy places, August, type of *Microstylis purpurea* from the Huachuca Mountains (*Lemmon* 2881). New Mexico and Arizona to Guatemala.

9. CALYPSO

Stem from a corm, low, 1-leaved and 1-flowered; leaf broadly ovate or suborbicular; flower showy; lip boat-shaped, pendent, more than 1 cm. long, purple, striped and mottled with darker color, bearded with long, usually bright yellow hairs.

1. **Calypso bulbosa** (L.) Oakes, Cat. Vermont Pl. 28. 1842.

Cypripedium bulbosum L., Sp. Pl. 951. 1753.

Baldy Peak, Apache County (*Goodding* 1145), Hannigan Meadow, Greenlee County (*McNeill* in 1936), San Francisco Peaks, Coconino County (*Goldman* 2106), about 9,000 feet, in dense woods, June to July. Labrador to Alaska, south to New England, Michigan, Arizona, and California.

10. HEXALECTRIS

Plant without chlorophyll, the leaves reduced to sheathing scales; flowering stem from a thick corallike rootstock; flowers about 2 cm.

long, in a raceme; sepals and petals, except the lip, similar, spreading, brown-striate; lip obovate, not saccate, longitudinally several-crested, slightly 3-lobed.

1. *Hexalectris spicata* (Walt.) Barnhart, *Torrey* 4: 121. 1904.

Arethusa spicata Walt., *Fl. Carol.* 222. 1788.

Corallorrhiza arizonica S. Wats., *Amer. Acad. Arts and Sci. Proc.* 17: 379. 1882.

Santa Rita Mountains, Pima County (*Pringle* 353, the type of *C. arizonica*, *Thornber* in 1903), rich soil in woods among rocks, June and July. Virginia to Missouri, Florida, Texas, and Arizona.

Crested-coralroot. The plant resembles a large-flowered *Corallorrhiza*. The flowers, as observed in the southeastern United States, have a delicious odor of violets.

21. SAURURACEAE. LIZARDTAIL FAMILY

1. ANEMOPSIS. YERBA-MANSA

Plant herbaceous, perennial; leaves mostly basal, large, somewhat fleshy, cordate at base; inflorescence a dense cylindrical spike, subtended by large white petallike bracts; flowers perfect, very numerous, small, without a perianth.

1. *Anemopsis californica* (Nutt.) Hook. and Arn., *Bot. Beechey Voy.* 390. 1841.

Anemia californica Nutt., *Ann. Nat. Hist.* 1:136. 1838.

Yavapai County, Cochise to Yuma Counties, 2,000 to 5,500 feet, wet saline soil, May to August. Western Texas to Utah, Arizona, and California, southward into Mexico.

The Arizona form is var. *subglabra* Kelso. The inflorescence with its white bracts suggests the single flower of an *Anemone*. An infusion of the root was used by Californians of Spanish descent and by the Pima Indians as a remedy for various ailments.

22. SALICACEAE. WILLOW FAMILY

Trees or large shrubs, dioecious; leaves deciduous, alternate, simple; flowers of both sexes in catkins, appearing before or with the leaves; ovary 1-celled; stigmas 2 to 4; seeds minute, subtended by silky hairs.

Key to the genera

1. Winter buds covered by several scales; scales of the catkins lacinate or fimbriate; flowers borne on broad or cup-shaped disks; stigmas elongate, the lobes slender or dilated..... 1. POPULUS.
1. Winter buds covered by one scale; scales of the catkins entire or merely dentate; flowers without disks; stigmas short..... 2. SALIX.

1. POPULUS.²⁸ COTTONWOOD, POPLAR

Trees, with more or less resinous buds; leaves mostly long-petioled, the blades mostly deltoid or ovate, sometimes lanceolate; stipules minute, fungacious; catkins long and drooping; stamens numerous.

²⁸ Reference: SUDWORTH, GEORGE B. POPLARS, PRINCIPAL TREE WILLOWS, AND WALNUTS OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Tech. Bul. 420. 1934.

The familiar cottonwood (*P. fremontii*) is conspicuous along streams throughout the State, except in the higher mountains, and is planted everywhere as a shade tree. The trees grow rapidly and propagate readily from branch cuttings. The great quantities of pollen produced by the staminate trees and the copious quantities of downy seeds shed by the pistillate ones are distinct disadvantages to the use of the cottonwood in dooryards. Another drawback is the frequent mutilation that results from windstorms. The wood is light and tough and not durable, but has been used to some extent for fence posts. The Pima Indians use the twigs of this species for basket material and formerly ate the uncooked catkins. The inner bark was esteemed by the Indians as an antiscorbutic. Cattle browse on branches within their reach. Beavers cut the stems of poplars for dams and the bark is their principal food.

The aspen (*P. tremuloides*) occurs on the higher mountains, mingled with conifers or in pure stands of considerable extent, conspicuous because of the nearly white bark of the trunks and the brilliant yellow of the foliage in autumn (pl. 8). Stands of aspen usually quickly replace forest areas denuded by fire, in this way retarding soil erosion and conserving soil moisture. Aspen stands are usually transient, eventually being replaced by conifers. Aspen has limited value as a timber tree and as browse for livestock. The wood is used chiefly for paper-pulp and in making containers for butter, etc., as it imparts no flavor. An infusion of the inner bark was formerly used in treatment of intermittent fever, and is regarded by the Indians as an antiscorbutic.

Key to the species

1. Leaf blades considerably longer than wide, finely crenulate or serrulate (except sometimes on vigorous shoots), gradually or not very abruptly acuminate; petioles terete, shorter (commonly much shorter) than the blades (2).
2. Petioles usually less than one-third as long as the blades; blades lanceolate or ovate-lanceolate, more than twice (commonly 3 to 7 times) as long as wide, gradually acuminate at apex and often at base, the marginal teeth extending very nearly to the apex..... 1. *P. ANGUSTIFOLIA*.
2. Petioles commonly more than one-third (often one-half or more) as long as the blades; blades ovate or lance-ovate, commonly less than twice as long as wide, somewhat abruptly acuminate at apex, rounded or broadly short-cuneate at base, the marginal teeth not extending very nearly to the apex..... 2. *P. ACUMINATA*.
1. Leaf blades nearly as wide as, to considerably wider than long; petioles flattened laterally (3).
3. Stigma lobes slender; leaf blades broadly ovate to rhombic-suborbicular, crenulate or serrulate with numerous teeth, abruptly very short-acuminate or apiculate at apex, short-cuneate, truncate, or rounded at base, usually conspicuously paler beneath..... 3. *P. TREMULOIDES*.
3. Stigma lobes broad, more or less flattened, crenate; leaf blades broadly deltoid or subrhombic-deltoid, crenate or crenate-dentate (usually coarsely so), abruptly and commonly broadly acuminate at apex, truncate or very short-cuneate at base, not conspicuously paler beneath..... 4. *P. FREMONTII*.

1. *Populus angustifolia* James in Long, Exped.: 1. 497. 1823.

Apache, Coconino, and Yavapai Counties, south to Cochise and Pima Counties, 5,000 to 7,000 feet, along streams. South Dakota to Alberta, south to Nebraska, New Mexico, Arizona, and Chihuahua.

Narrowleaf cottonwood. A small tree, reaching a height of about 15 m. (50 feet) and a trunk diameter of 45 cm. (18 inches). The

crown is usually narrowly pyramidal, with slender, narrowly ascending branches.

2. *Populus acuminata* Rydb., Torrey Bot. Club Bul. 20: 50. 1893.

Apache, Navajo, Yavapai, and Greenlee Counties, 5,000 to 7,000 feet, along streams. Nebraska to Assiniboia, south to New Mexico and Arizona.

Lanceleaf cottonwood. This species reaches about the same size as *P. angustifolia*, from which it is distinguished chiefly by the broader, more spreading crown, stouter branches, and broader leaf blades. Some of the Arizona specimens seem to be nearly intermediate. A form with pubescent branchlets and bud scales (var. *rehderi* Sarg.) is of frequent occurrence throughout the range of the species in Arizona.

3. *Populus tremuloides* Michx., Fl. Bor. Amer. 2: 243. 1803.

Apache to Mohave Counties, south to the mountains of Cochise and Pima Counties, 6,500 to 9,000 feet. Labrador to Alaska, south to New Jersey, Missouri, Arizona, and northern Mexico.

Quaking aspen. The species is represented in Arizona by the golden aspen, var. *aurea* (Tidestrom) Daniels (*P. aurea* Tidestrom), characterized by the more intense autumnal coloration of the foliage (golden or orange). The trees reach a height of 24 m. (80 feet) and a diameter of 75 cm. (30 inches) but usually are much smaller. The slightest breeze causes movement of the leaves, hence the common name quaking aspen.

4. *Populus fremontii* S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 350. 1875.

Populus macdougalii Rose, Smithsn. Misc. Collect. 61¹²: 1. 1913.

Populus arizonica Sarg., Bot. Gaz. 67: 210. 1919.

Throughout the State, along streams, 6,000 feet or lower. Western Texas to Nevada, Arizona, California, and northern Mexico.

Fremont cottonwood. The trees are frequently 15 m. (50 feet), sometimes even 30 m. (100 feet) high, and the trunk diameter may reach 1.2 m. (4 feet). The main branches are large, the crown wide, flat topped, the older bark gray brown, thick, deeply furrowed. Several segregate species have been published, but there is such complete intergradation that it seems useless to maintain them. Exceptionally small-fruited specimens are referred to var. *arizonica* (Sarg.) Jepson. Specimens with persistently pubescent branchlets, petioles, and leaf veins are referable to var. *pubescens* Sarg. and, if thus characterized but having bluish-green foliage, to var. *macdougalii* (Rose) Jepson. The last-mentioned form is common near Yuma and in the delta of the Colorado River. Several specimens from eastern Arizona approach *P. wislizeni* (Wats.) Sarg. in their long pedicels, but they have the relatively broad capsules of *P. fremontii*.

2. SALIX.²⁹ WILLOW

Trees or shrubs; bud scales with an inner membrane, this adherent, or loose and then giving the appearance of 2 scales; leaves short-

²⁹ References: SUDWORTH, GEORGE B. POPLARS, PRINCIPAL TREE WILLOWS, AND WALNUTS OF THE ROCKY MOUNTAIN REGION. U. S. Dept., Agr. Tech. Bul. 420. 1934.
GOODING, LESLIE N. WILLOWS IN REGION VIII: NOTES ON THEIR CLASSIFICATION, DISTRIBUTION, AND PRESENT SIGNIFICANCE, WITH SUGGESTIONS FOR THEIR USE IN EROSION CONTROL. U. S. Dept. Agr. Soil Conserv. Serv. Regional Bul. 65. 1940. [Multigraphed.]

petioled or sessile, with mostly lanceolate blades; stipules large or small, persistent or fugacious; catkins not pendulous; stamens 2 to 10.

The genus is a difficult one and the Arizona species require further study. Most of the specimens in herbaria are incomplete, as leaves, staminate flowers, and fruit are needed for accurate determination of many of the species. The following treatment must be regarded as only provisional.

Willows grow mostly along streams and are valuable for their shade, especially on the stock ranges in the southern part of the State, where *S. gooddingii*, Arizona's largest willow, is widely distributed and common. The foliage is eaten by livestock and the bark by beavers. Small roots develop in abundance, and thus the willows are important agents in checking soil erosion along watercourses. In high mountains *S. scouleriana*, in particular, invades burned forest areas, holding the soil and acting as a nurse for the reproduction of conifers in much the same way as the aspen. The Pima and other Indians of Arizona used willow twigs for basket material. Timbers bound with willow withes have been found in cliff dwellings. The drug salicin, obtained from the bark of various species, has tonic, antiperiodic, and febrifugal properties.

Key to the species

1. Petioles none or very short (not more than 3 mm. long); leaf blades sericeous, at least beneath, linear-lanceolate or narrowly oblanceolate, seldom more than 7 mm. wide and usually much narrower, the margins entire or remotely denticulate; stamens 2 (2).
2. Leaf blades oblanceolate, sessile or very nearly so, at maturity not more than 3 cm. long; capsules silky-villous, then glabrate.----- 1. *S. TAXIFOLIA*.
2. Leaf blades linear-lanceolate, short-petioled, at maturity 5 cm. long or longer; capsules glabrous----- 2. *S. EXIGUA*.
1. Petioles more than 3 mm. long or, if shorter, the larger blades more than 7 mm. wide, or closely serrate or serrulate (3).
3. Margins of the leaf blades entire or nearly so, the lower surface more or less glaucous (4).
4. Upper surface of the mature leaves pubescent, not shiny; leaf blades usually less than 3 times as long as wide, elliptic, oblong, or oblong-lanceolate; pistillate catkins seldom more than twice as long as wide at maturity; capsules pubescent----- 3. *S. BEBBIANA*.
4. Upper surface of the mature leaves glabrous, often shiny (5).
5. Leaf blades obovate, rounded to acutish at apex; capsules silky-villous.----- 4. *S. SCOULERIANA*.
5. Leaf blades lanceolate or oblanceolate, acute to acuminate at apex; capsules glabrous (6).
6. Shrub up to 4 meters high; branchlets usually dark purple (plum-colored) and very glaucous----- 5. *S. IRRORATA*.
6. Shrubs or trees; branchlets yellowish to dark brown, not or but slightly glaucous (7).
7. Leaf blades prevailingly oblanceolate and acute or short-acuminate; stamens 2, the filaments glabrous----- 6. *S. LASIOLEPIS*.
7. Leaf blades prevailingly lanceolate or oblong-lanceolate and long-acuminate; stamens more than 2, the filaments hairy toward the base----- 7. *S. LAEVIGATA*.
3. Margins of the leaf blades closely serrate or serrulate (8).
8. Lower surface of the leaf blades green, slightly paler than the upper surface but not glaucous (9).
9. Petioles and leaf bases glandular----- 8. *S. CAUDATA*.
9. Petioles and leaf bases not glandular; branchlets yellowish; leaf blades lanceolate, often narrowly so, long-acuminate at apex, attenuate at base----- 9. *S. GOODDINGII*.

8. Lower surface of the leaf blades decidedly paler than the upper, usually glaucous (10).
10. Leaf blades all, or some of them, conspicuously and sharply long-acuminate at apex; stamens 3 or more; filaments hairy toward the base; usually trees (11).
 11. Petioles slender, those of the larger leaves usually 10 mm. long or longer; blades commonly not more than 3 times as long as wide, not shiny above----- 10. S. AMYGDALOIDES.
 11. Petioles stout, usually less than 10 mm. long; blades commonly at least 4 times as long as wide, often shiny above (12).
 12. Margins of the leaf blades and the petioles near the apex bearing conspicuous yellowish glands; branchlets and the upper surface of the leaf blades very shiny----- 11. S. LASIANDRA.
 12. Margins of the leaf blades and the petioles not or not conspicuously glandular; branchlets and the upper surface of the leaf blades not or only moderately shiny (13).
 13. Leaf blades commonly broadly lanceolate (less than 6 times as long as wide), usually only moderately acuminate, glaucous but ordinarily not silvery white beneath- 7. S. LAEVIGATA.
 13. Leaf blades commonly narrowly lanceolate (6 or more times as long as wide), very long- and sharp-acuminate, silvery white beneath----- 12. S. BONPLANDIANA.
10. Leaf blades acute or short-acuminate at apex (14).
 14. Bases of the leaf blades rounded or subcordate (seldom cuneate); stamens 2, the filaments glabrous (15).
 15. Bark of the twigs yellow or brown; leaf blades oblong-lanceolate to linear-lanceolate, yellowish green and usually not glossy above, moderately glaucous beneath----- 13. S. LUTEA.
 15. Bark of the twigs reddish brown to plum-colored; leaf blades elliptic (often broadly so), dark green and slightly glossy above, strongly glaucous beneath; stipules large, usually persistent----- 14. S. PSEUDOMONTICOLA.
14. Bases of the leaf blades cuneate or attenuate (sometimes rounded in *S. laevigata*), the blades often shiny above and very glaucous beneath (16).
 16. Branchlets commonly dark purple (plum-colored) and very glaucous; a shrub, up to 4 meters high----- 5. S. IRRORATA.
 16. Branchlets yellow to dark brown, not or but slightly glaucous; usually trees (17).
 17. Leaf blades prevailing oblong-lanceolate; stamens 2, the filaments glabrous----- 6. S. LASIOLEPIS.
 17. Leaf blades prevailing lanceolate or oblong-lanceolate; stamens more than 2, the filaments hairy toward the base. 7. S. LAEVIGATA.

1. *Salix taxifolia* H. B. K., Nov. Gen. et Sp. 2: 22. 1817.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, along streams and washes in the foothills. Western Texas to Arizona, south to Guatemala.

Yewleaf willow. A relatively slow-growing large shrub or tree, attaining a height of 12 m. (40 feet) and a trunk diameter of 45 cm. (18 inches), but in Arizona usually much smaller, affording excellent browse for livestock.

2. *Salix exigua* Nutt., North Amer. Sylva 1: 75. 1842.

Almost throughout the State, up to 7,000 feet, along streams. Saskatchewan to British Columbia, south to northern Mexico.

Coyote willow. Usually a shrub and not more than 4.5 m. (15 feet) high, often forming thickets. A very narrow-leaved form (var. *stenophylla* (Rydb.) Schneid.), and a less pubescent form with relatively broad leaves (var. *virens* Rowlee), are found here and there in Arizona. What may be an undescribed variety is reported from the Baboquivari Mountains. (See footnote 29, p. 216, Goodding, pp. 2, 5.)

3. *Salix bebbiana* Sarg., Gard. and Forest 8: 463. 1895.

San Francisco Peaks and Mormon Lake (Coconino County), White Mountains (Apache County), Lakeside (Navajo County), perhaps also summit of Mount Graham (Graham County), 8,500 to 11,000 feet, in coniferous forests, chiefly along streams. Canada to Alaska, south to Pennsylvania, New Mexico, and Arizona.

Bebb willow. Usually a shrub in Arizona, up to 4.5 m. (15 feet) high.

4. *Salix scouleriana* Barratt in Hook., Fl. Bor. Amer. 2: 145. 1839.

White Mountains (Apache County), San Francisco Peaks (Coconino County), Santa Catalina Mountains (Pima County), 8,000 to 10,000 feet. South Dakota to Alaska, south to New Mexico, Arizona, and California.

Scouler willow, sometimes known as fire willow. In Arizona probably always a shrub, but toward the Pacific coast attaining a height of 9 m. (30 feet). It frequently invades burned-over areas in forests.

5. *Salix irrorata* Anderss., Svenska Vetensk. Akad. Öfversigt af . . . Förhandl. 15: 117. 1858.

White Mountains (Apache County), Chiricahua Mountains (Cochise County), Rincon and Santa Catalina Mountains (Pima County), 6,000 to 7,500 feet (and probably higher), along streams. Western Texas to Colorado and Arizona.

A shrub, seldom more than about 4 m. (12 feet) high.

6. *Salix lasiolepis* Benth., Pl. Hartw. 335. 1857.

Apache to Coconino Counties, south to the mountains of Cochise and Pima Counties, 6,000 to 7,500 feet, along streams. Idaho and Washington to Arizona, California, and northern Mexico.

Arroyo willow. Usually a shrub but sometimes treelike and up to 9 m. (30 feet) high.

7. *Salix laevigata* Bebb, Amer. Nat. 8: 202. 1874.

Beaver Dam (Mohave County), Grand Canyon (Coconino County), Prescott (Yavapai County), Pinal Mountains (Gila County), Huachuca Mountains (Cochise County), 1,800 to 5,000 feet, along streams. Southwestern Utah to Arizona and California.

Red willow. Usually arborescent, reaching a height of 12 m. (40 feet) and a trunk diameter of 0.6 m. (2 feet).

8. *Salix caudata* (Nutt.) Heller, Muhlenbergia 2: 186. 1906.

Salix pentandra var. *caudata* Nutt., North Amer. Sylva 1: 61. 1842.

Reported by Goodding from Springerville, Apache County. South Dakota to British Columbia, south to New Mexico, Arizona, and California.

The form reported as occurring in eastern Arizona is var. *bryantiana* Ball and Bracelin, which has a range nearly coextensive with that of the species.

9. *Salix gooddingii* Ball, Bot. Gaz. 40: 376. 1905.

Salix nigra Marsh var. *vallicola* Dudley in Abrams, Fl. Los Angeles 100. 1904.

Throughout most of the State, along streams, 4,000 feet or lower. Western Texas to California and northern Mexico.

Dudley willow. Very similar to the black willow of the eastern United States (*S. nigra*). Along the lower courses of the Colorado and Gila Rivers it forms veritable forests, growing with cottonwood (*Populus fremontii*), attaining a height of 13.5 m. (45 feet) and a trunk diameter of 75 cm. (30 inches) or more. The typical pubescent form is less common than the glabrous or glabrate form.

10. *Salix amygdaloides* Anderss., Amer. Acad. Arts and Sci. Proc. 4: 53. 1858.

Tunitcha Mountains (Apache County), Rincon Mountains (Pima County), up to 7,000 feet, along streams, apparently rare in Arizona. Quebec to British Columbia, south to New York, Texas, Arizona, and Oregon.

Peachleaf willow. Usually treelike but seldom more than 9 m. (30 feet) high and 30 cm. (12 inches) in trunk diameter.

11. *Salix lasiandra* Benth., Pl. Hartw. 335. 1857.

White Mountains (Apache, Navajo, and Greenlee Counties), Tonto Basin (Gila County), 5,000 to 6,500 feet, along streams. Colorado to Yukon, south to New Mexico, Arizona, and California.

Pacific willow. A shrub or small tree, rarely reaching a height of 12 m. (40 feet).

12. *Salix bonplandiana* H. B. K., Nov. Gen. et Sp. 2: 20. 1817.

Yavapai, Greenlee, Gila, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet. New Mexico and Arizona to Guatemala.

A handsome tree, usually not more than 7.5 m. (25 feet), but sometimes 15 m. (50 feet) high. The more common form in Arizona is var. *toumeyii* (Britton) C. Schneid. (*S. toumeyii* Britton), the Toumey willow, with narrower, less deeply dentate leaves and shorter catkins.

13. *Salix lutea* Nutt., North Amer. Sylva 1: 63. 1842.

Apache County to Coconino and Yavapai Counties, 3,800 to 6,000 feet (and probably higher). Nebraska to Alberta, south to New Mexico, Arizona, and California.

Yellow willow. Usually shrubby. The var. *ligulifolia* Ball (*S. ligulifolia* Ball), with narrower leaves than in typical *S. lutea* and brown rather than yellow bark of the twigs, is much the more common form in Arizona. The twigs in this form are often very pubescent.

14. *Salix pseudomonticola* Ball, Contrib. U. S. Natl. Herbarium 22: 321. 1921.

White Mountains, Apache County (*Coville* 2009). Saskatchewan and Alberta to Colorado and Arizona.

A shrub, not more than 3 m. (10 feet) high. The specimen above cited, not seen by the writers, has been referred to var. *padophylla* (Rydb.) Ball.³⁰ The leaves resemble those of *S. cordata* Muhl. of eastern North America.

23. JUGLANDACEAE. WALNUT FAMILY

1. JUGLANS.³¹ WALNUT

A tree, or occasionally shrubby, with strong-scented, pinnately compound leaves; leaflets commonly 9 to 13, large, lanceolate or

³⁰ BALL, C. R. NEW VARIETIES AND COMBINATIONS IN SALIX. Wash. Acad. Sci. Jour. 28: 443-452. 1938. (p. 450).

³¹ Reference: SUDWORTH, GEORGE B. POPLARS, PRINCIPAL TREE WILLOWS, AND WALNUTS OF THE ROCKY MOUNTAIN REGION. U. S. Dept. Agr. Tech. Bul. 420. 1934.

ovate-lanceolate, acuminate, serrate; staminate flowers in long drooping catkins; pistillate flowers solitary, or very few in a cluster; fruit a large, usually nearly globular, hard-shelled nut enclosed in a finally dry husk; cotyledons 2-lobed.

The native walnut or nogal is a fine shade tree. The small, thick-shelled nuts are eaten by the Indians in New Mexico and probably in Arizona. Other species of walnut have been employed medicinally and as insecticides, and it is probable that the native species has similar properties. The wood is reported to be durable but is little used.

1. *Juglans rupestris* Engelm. in Sitgreaves, Zuñi and Colo. Rpt. 171. 1854.

Almost throughout the State, 3,500 to 6,800 feet, along streams, commonly with cottonwood (*Populus fremontii*) and buttonwood or sycamore (*Platanus wrightii*). New Mexico, Arizona, and northern Mexico.

A tree up to 15 m. (50 feet) high and 1.2 m. (4 feet) in trunk diameter but usually smaller, with mostly widely spreading branches. The Arizona walnut is var. *major* Torr. (*J. major* Heller), with larger, more coarsely serrate, and commonly more numerous leaflets than in typical *J. rupestris*, which does not extend so far west. The segregate species published by L. A. Dode, 3 of which are represented by collections in Arizona, are of doubtful validity. The most distinct is *J. elaeopyron* Dode (type from the Santa Rita Mountains, Pringle in 1881), with a more elongate nut than is usual in this species, but it may be merely an individual variation.

24. BETULACEAE. BIRCH FAMILY

Trees or large shrubs; leaves simple; flowers monoecious, appearing with or before the leaves, those of both sexes in catkins, the staminate catkins pendulous, the pistillate flowers subtended by conspicuous bracts; ovary 2-celled; fruit a 1-seeded nutlet.

Key to the genera

1. Nutlets wingless, each enclosed in a large, bladderlike, papery bract; staminate flower solitary in the axil of each scale..... 1. OSTRYA.
1. Nutlets winged, not enclosed in a bladderlike bract; staminate flowers more than one in the axil of each scale (2).
 2. Pistillate catkins solitary, their scales remaining thin, deciduous with or soon after the nutlets, not wedge-shaped, deeply 3-lobed, the midlobe elongate..... 2. BETULA.
 2. Pistillate catkins usually several in a racemelike cluster, their scales becoming thick and woody, long-persistent on the branch after the nutlets have fallen, wedge-shaped, shallowly 3- to 5-lobed..... 3. ALNUS.

1. OSTRYA. HOPHORNBEAM

Leaf blades ovate, sharply double-serrate; stamens several; style slender; stigmas 2, subulate; bracts much enlarged and bladderlike in fruit; nutlets sessile at the base of the bracts.

1. *Ostrya knowltoni* Coville, Gard. and Forest 7: 114. 1894.

Grand Canyon and Oak Creek (Coconino County), 5,000 to 7,000 feet, type from the Grand Canyon (*Toumey* 272). Southeastern Utah and northern Arizona.

Knowlton hophornbeam. Plant often treelike but not more than 3.6 m. (12 feet) high, the bark ashy gray. The fruiting "cones" resemble those of hops.

2. BETULA. BIRCH

Winter buds enveloped by several scales; bark smooth, copper-colored (in the Arizona species) with conspicuous lenticels; herbage resinous; flowers usually 2 or 3 in the axil of each bract, the staminate ones with a small perianth; styles 2; stigmas terminal; nutlets winged.

1. *Betula fontinalis* Sarg., Bot. Gaz. 31: 239. 1901.

Tunitcha and Lukachukai Mountains (Apache County), Betatakin (Navajo County), also reported from the Kaibab Plateau and the Grand Canyon (Coconino County), 7,000 to 8,000 feet, mostly along streams, often forming thickets. South Dakota to British Columbia, south to Nebraska, New Mexico, northern Arizona, and California.

Water birch. A small, finely branched tree, reaching a height of 9 m. (30 feet) and a stem diameter of 25 cm. (10 inches) but perhaps never so large in Arizona. The plant affords good browse for sheep and goats.

3. ALNUS. ALDER

Winter buds enveloped by a pair of stipular scales; bark becoming dark gray or brown, and scaly; flowers 2 or more in the axil of each bract, the staminate ones with a small perianth; nutlets with a narrow border.

Alders are browsed to some extent by livestock and tend to check erosion along watercourses in the mountains, where they often form thickets.

Key to the species

1. Leaf blades ovate or oblong-ovate, rounded, truncate, or subcordate at base, deeply and doubly serrate-dentate, often somewhat lobed; stamens 4.
 1. *A. TENUIFOLIA*.
1. Leaf blades elliptic or ovate-oblong (exceptionally ovate), acutish or short-cuneate at base, shallowly and doubly serrate-dentate, seldom lobed; stamens 1 to 3 (usually 2)----- 2. *A. OBLONGIFOLIA*.

1. *Alnus tenuifolia* Nutt., North Amer. Sylva 1: 32. 1842.

Tunitcha Mountains and White Mountains (Apache County), Pinaleno Mountains (Graham County), 7,000 to 9,000 feet, mostly along streams. Yukon to New Mexico, Arizona, and California.

Thinleaf alder. A large shrub or small tree up to 7.5 m. (25 feet) high, with reddish brown bark on the older trunks.

2. *Alnus oblongifolia* Torr., U. S. and Mex. Bound. Bot. 204. 1859.

Apache and Coconino Counties south to Graham and Pima Counties, 5,000 to 7,500 feet, mostly along streams in the mountains. New Mexico, Arizona, and northern Mexico.

New Mexican alder. A tree, up to 18 m. (60 feet) high and 1 m. (3 feet) in trunk diameter, with grayish-brown bark on the older trunks. More widely distributed and abundant in Arizona than *A. tenuifolia*.

25. FAGACEAE. BEECH FAMILY

1. QUERCUS. OAK

Contributed by C. H. MULLER

Trees or shrubs; leaves alternate, simple, petioled, the blades entire, toothed, or lobed, persistent or deciduous; stipules associated with the buds, ligulate, often caducous; flowers monoecious; staminate flowers in flaccid pendulous aments, the perianth about 5-lobed, the stamens 5 to 10, free; pistillate flowers solitary or clustered, subsessile or peduncled, enclosed in an involucre of numerous flat scales, the perianth 6-lobed, the ovary 3-carpellate, 1-celled, the ovules 6 (5 abortive), the styles 3, short; fruit a nut (acorn), 1-seeded, partly enveloped by an involucre (cup) of flat or basally thickened scales, maturing in 1 or 2 seasons.

The shrubby or scrub oaks, such as *Q. turbinella*, are the principal elements of the chaparral on exposed mountainsides in southern and central Arizona. In this region they are considered the chief reserve winter feed for cattle, and in addition are of inestimable value in retarding soil erosion. Some of the tree oaks of southern Arizona (*Q. arizonica*, *Q. emoryi*, etc.) are also important browse plants. At higher elevations, especially in northern Arizona, the deciduous white oaks, principally *Q. gambelii*, are abundant and provide ground cover as well as browse for livestock and deer. Although livestock may suffer poisoning when feeding exclusively on oak browse, the foliage is fairly nutritious if supplemented with other feed. The fattening effect of acorns, especially for swine, is well known. They are an important food of birds, squirrels, and other wild animals. The Indians gathered acorns for food, generally roasting them and often making a meal which they mixed with meat or fat. Although the Arizona oaks afford valuable shade on cattle ranges, they rarely attain sufficient size for logging. The wood is used locally for fuel, fence posts, and mine props. Oak bark is one of the principal sources of tanning material.

Key to the species

1. Shell of the fruit tomentose within; abortive ovules lateral or apical; cup scales thin and flat or, if thickened, then covered with a dense golden tomentum; stigmas short and broad or elongate, spatulate (2).
2. Cup scales basally thickened, covered with a dense golden tomentum, the cup large, heavy, loosely fitting the acorn; stigmas short and broad; abortive ovules lateral; leaves glaucous, dull, usually yellow and resinous-pubescent beneath, the blades obovate, the lobes mucronate to long-aristate, the margin markedly crisped, concave beneath: Subgenus *Protobalanus*, Intermediate oaks----- 11. *Q. PALMERI*.
2. Cup scales thin, flat, thinly scurfy-pubescent with gray or buff hairs, or glabrate, the cup medium-sized, closely fitting the acorn; stigmas elongate, spatulate; abortive ovules apical; leaves not glaucous or resinous, the blades lanceolate, usually not long-aristate, the margins flat or revolute, not crisped or concave: Subgenus *Erythrobalanus*, Black oaks (3).
3. Leaves flat, broadly lanceolate, usually distinctly cordate at base and subentire, or with a few short apical teeth, green on both sides, with a small tuft of stellate tomentum at base of the midrib beneath, otherwise glabrate----- 12. *Q. EMORYI*.
3. Leaves revolute, usually narrowly lanceolate or attenuate, cuneate or rarely rounded at base, entire or with several short teeth or small lobes above the middle, glaucous green and glabrate or nearly so above, densely white-tomentose beneath----- 13. *Q. HYPOLEUCOIDES*.

1. Shell of the fruit not tomentose within; abortive ovules basal; cup scales much thickened basally, narrowed at apex; stigmas short and broad; leaves, if toothed, not aristate; bark commonly gray and scaly or flaking: Subgenus *Lepidobalanus*, White oaks (4).
4. Leaves deciduous in autumn, deeply incised or crenate, the lobes round, not mucronate (5).
5. Leaves shallowly crenate-lobed, about 3 to 4.5 cm. long.
 9. Q. SUBOBTUSIFOLIA.
5. Leaves deeply incised with narrow lobes, 8 to 10 cm. (rarely only 3 to 5 cm.) long----- 10. Q. GAMBELII.
4. Leaves persistent until spring, entire, mucronate-serrate, or acutely shallow-lobed (6).
6. Veins slightly impressed above, markedly prominent beneath, the blades usually mucronate, or toothed toward the apex (7).
7. Leaves concave beneath, obovate to suborbicular, the base strongly cordate; fruit long-stalked----- 1. Q. DIVERSICOLOR.
7. Leaves flat, narrowly obovate to oblanceolate, the base usually cordate, occasionally rounded to subcuneate; fruit subsessile.
 3. Q. ARIZONICA.
6. Veins not impressed, usually somewhat prominent above, not markedly prominent beneath, the margins entire or toothed (8).
8. Leaves oblong, rounded at both ends or cordate at base, glabrous, very glaucous, the margins entire----- 2. Q. OBLONGIFOLIA.
8. Leaves not oblong or rounded at both ends or, if so, then not glabrous or glaucous, the margins entire or toothed (9).
9. Blades medium sized, 2 to 4 cm. wide, 3 to 6 cm. long, more or less undulate-cripsed, roughly short-pubescent or scabrous to the touch (10).
10. Leaves ovate, mucronately shallow-lobed, somewhat crisped, moderately rough-pubescent----- 7. Q. UNDULATA.
10. Leaves oblong, pungently lobed, strongly crisped with the lobes appearing twisted, harsh and scabrous like sandpaper.
 8. Q. PUNGENS.
9. Blades usually small, 0.5 to 2 cm. wide, 1 to 5 cm. long, entire, or if toothed, then flat, glabrate or soft-hairy (11).
11. Leaves narrowly elliptic to lanceolate, usually very small, acute, entire or rarely with a few short teeth, very sparsely pubescent beneath with soft white hairs, shiny above; bark roughly scaly or flaky on branches 5 years old----- 5. Q. TOUMEYI.
11. Leaves broadly elliptic, broadly lanceolate, or ovate (12).
12. Leaf blades entire or with a few mucronate teeth, relatively large, elliptic to broadly lanceolate or ovate, usually obtuse but sometimes acute and mucronate at apex, gray green or blue green, the upper surface shining and sparsely stellate-pubescent, the lower surface perceptibly roughened with stellate hairs.
 4. Q. GRISEA.
12. Leaf blades almost aristately many-toothed, small, broadly elliptic to ovate, glaucous, the upper surface dull, nearly glabrous, the lower surface with white or yellow resinous pubescence----- 6. Q. TURBINELLA.

1. *Quercus diversicolor* Trel., Natl. Acad. Sci. Mem. 20: 73. 1924.

Quercus reticulata of authors. Not Humb. and Bonpl.

Southern Coconino County to Cochise and Pima Counties, 4,000 to 6,500 feet, mostly in canyons, nowhere very abundant. Western Texas to central and southern Arizona and northern Mexico.

Netleaf oak. Not very closely related to any other species in the United States, its nearest relatives being the Mexican *Q. reticulata* Humb. et Bonpl., to which the Arizona material was formerly referred, and *Q. durangensis* Trel. It occurs as a low or tall tree or a shrub, from 2 to 12 m. (6.5 to 40 feet) high. The typically broadly obovate leaves, with several subaristate teeth about the round apex and strongly reticulate-veined beneath, make this species readily

distinguishable, even in sterile condition, from other southwestern oaks.

2. *Quercus oblongifolia* Torr. in Sitgreaves, Zuñi and Colo. Rpt. 173. 1853.

Mohave County and mountains of Cochise, Santa Cruz, and Pima Counties, up to about 6,000 feet, common in the foothills of desert mountain ranges. Arizona and northern Mexico.

Mexican blue oak. Commonly a small tree 5 to 8 m. (16 to 26 feet) high, with a broadly spreading crown, but it may mature as a shrub at higher altitudes.

3. *Quercus arizonica* Sarg., Gard. and Forest 8: 92. 1895.

Yavapai County to Graham, Cochise, Santa Cruz, and Pima Counties, up to about 6,000 (exceptionally 7,400) feet, common. New Mexico, Arizona, and northern Mexico.

Arizona oak. A well-marked species in Arizona, although it grades into *Q. grisea* Liebm. in New Mexico. It forms a tree up to 18 m. (60 feet) high, with a trunk 1 m. (3 feet) in diameter, or it may mature as a large shrub.

4. *Quercus grisea* Liebm., Overs. Danske Vidensk. Selsk. Forh. 1854: 171. 1854.

White Mountains (Apache County) and Oak Creek (Coconino County) to Cochise, Gila, and Maricopa Counties. Texas to Arizona and northern Mexico.

Gray oak. A small or large tree, reaching a height of 20 m. (65 feet) in moist, protected situations. It is one of the most difficult of Arizona oaks to distinguish, intergrading freely in this area with both *Q. arizonica* and *Q. turbinella*, although the much more abundant typical forms of the 3 species are clearly distinct. The species reaches the northwestern limit of its range in Arizona and is not an important element of the flora there, whereas in New Mexico and western Texas it is dominant in the "encinal" over large areas.

5. *Quercus toumeyii* Sarg., Gard. and Forest 8: 92. 1895.

San Francisco Peaks (Coconino County), near Prescott (Yavapai County), much more abundant in Cochise and Santa Cruz Counties, commonly 4,000 to 6,000 feet, type from the Mule Mountains, Cochise County (*Toumey* in 1899). Arizona and northern Mexico.

Toumey oak. A small tree usually less than 10 m. (33 feet) high, or a shrub 1 or 2 m. high. Its characteristically very small, entire, yellowish-green leaves, shiny above, mucronately acute, and densely disposed on the branches, make it easily distinguishable from all other species in its range.

6. *Quercus turbinella* Greene, Illus. West. Amer. Oaks 1: 37. 1889.

Quercus dumosa Nutt. var. *turbinella* Jepson, Silva Calif. 218. 1910.

Quercus subturbinella Trel., Natl. Acad. Sci. Mem. 20: 95. 1924.

Almost throughout the State, 8,000 feet or (commonly) lower. Colorado and New Mexico to California and northern Mexico.

Scrub oak. This species centers in Arizona, where it is the most abundant element of the chaparral, growing as a shrub or at most a

small tree up to 4 m. (13 feet) high. The species was described from California specimens. Trelease's treatment of the Arizona material as distinct apparently was based on supposed differences in geographical distribution, but the species has a nearly continuous range from California to New Mexico and, in the absence of morphological difference, *Q. subturbinella* must be reduced to synonymy. By reason of frequent misidentification, *Q. turbinella* in Arizona and New Mexico has been much confused with *Q. pungens* Liebm. to which it is not related and bears not even a superficial resemblance. The species is rather close to *Q. grisea* Liebm. and occasionally is confused with toothed-leaved forms of that species, but *Q. turbinella* is readily recognized by its glaucous leaves.

7. *Quercus undulata* Torr., Ann. Lyc. N. Y. 2: 248. 1828.

Quercus pauciloba Rydb., N. Y. Bot. Gard. Bul. 2: 215. 1901.

Navajo, Coconino, Mohave, and Cochise Counties, commonly 6,000 to 7,000 feet. Colorado, Utah, New Mexico, and Arizona.

Rocky Mountain shin oak. A low shrub, usually not more than 0.3 to 2 m. (1 to 6.5 feet) high, but attaining a height of 4 m. in moist, protected spots. It is a difficult species to understand and to characterize adequately, because of its close relationship to forms of the series *Gambelieae*, the multiplicity of its own leaf forms as well as those of the closely related *Q. pungens*, and the total lack of constant "key characters." Its hard, persistent scabrous leaves link it definitely with the more extreme *Q. pungens* from which it is distinguished by the usually flat, shallowly toothed or lobed leaves. Some of the Arizona specimens have been identified erroneously as *Q. fendleri* Liebm.

8. *Quercus pungens* Liebm., Overs. Danske Vidensk. Selsk. Forh. 1854: 171. 1854.

Swisshelm and Mule Mountains (Cochise County). Western Texas to southeastern Arizona.

A low shrub scarcely 2 m. (6.5 feet) high. The distinctive leaves, pungently lobed and markedly crisped and scabrous, clearly distinguish this species from all others save occasional forms of *Q. vaseyana* Buckl. of Texas. *Q. pungens* does not intergrade in Arizona with *Q. undulata*, its closest relative in this State.

9. *Quercus subobtusifolia* A. Camus, Soc. Bot. de Fr. Bul. 81: 816. 1934.

Quercus obtusifolia Rydb., N. Y. Bot. Gard. Bul. 2: 213. 1901.
Not Don.

Quercus undulata obtusifolia A. DC., Prodr. 16²: 23. 1864.
Quercus undulata Sarg., Silva 8: pl. 385, in part. 1895. Not Torr.

In the mountains, probably of southern Arizona (*Palmer* in 1869, *Rothrock* in 1874). Texas to Arizona.

A shrub 1 to 3 m. (3 to 10 feet) high, growing usually on rocky slopes at 7,000 to 8,000 feet. It is readily distinguished from *Q. undulata* by its deciduous leaves with rounded, not mucronate lobes. From *Q. gambelii* it may be separated by its obovate-cuneate leaves with shallowly crenate margins, as contrasted with the deeply lobed leaves of the other species.



Emory oak (*Quercus emoryi*) near the Patagonia Mountains, Santa Cruz County, altitude 4,000 feet.



10. *Quercus gambelii* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 179. 1848.

Q. gunnisonii Rydb., N. Y. Bot. Gard. Bul. 2: 206. 1901.
Q. novomexicana Rydb., *ibid.* p. 208.
Q. submollis Rydb., *ibid.* p. 202.
Q. utahensis Rydb., *ibid.* p. 202.

Throughout the State, except the extreme western and south-western parts, commonly 5,000 to 8,000 feet, often forming thickets. Colorado to Nevada, south to northern Mexico.

Rocky Mountain white oak, Gambel oak. In Arizona *Q. gambelii* ranges from a shrub 2 m. (6.5 feet) or less in height to a tree 15 m. (50 feet) high, in protected sites. The deeply lobed, deciduous leaves of this species make it readily recognizable among Arizona oaks. In a species so variable in size, lobing, and pubescence of the leaves, the fine distinctions of Rydberg are untenable.

11. *Quercus palmeri* Engelm., Acad. Sci. St. Louis Trans. 3: 393. 1877.

Quercus chrysolepis Liebm. var. *palmeri* Engelm in S. Wats., Bot. Calif. 2: 97. 1880.
Quercus wilcoxii Rydb., N. Y. Bot. Gard. Bul. 2: 227. 1901.

Hualpai Mountain (Mohave County) to the mountains of Greenlee, Cochise, and Pima Counties, 3,500 to 7,000 feet, often forming thickets. Arizona, California, and northwestern Mexico.

Palmer oak. A shrub or small tree, commonly 2 to 4 m. (6 to 13 feet) high. It cannot be confused with other species of oaks in Arizona, but its specific distinction from *Q. chrysolepis* Liebm. of California is open to question. The superficial resemblance of its pungently toothed, glaucous leaves, resinous beneath, to descriptions of *Q. turbinella* might be confusing until one becomes familiar with both species. The scales of the fruiting cups are dependable criteria.

12. *Quercus emoryi* Torr. in Emory, Mil. Recon. 151. 1848.

Quercus hastata Liebm., Overs. Danske Vidensk. Selsk. Forh. 1854: 171. 1854.

Yavapai to Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, dry foothills and moist canyons. Western Texas to Arizona and northern Mexico.

Emory oak, known locally as blackjack oak and bellota, is one of the most abundant oaks in the "encinal" areas of the Mexican border region. It forms a shrub, a small tree, or a large tree up to 15 m. (50 feet) high and 0.8 m. (2.5 feet) in trunk diameter (pl. 14).

13. *Quercus hypoleucoides* A. Camus, Mus. Hist. Nat. Bul., ser. 2, 4: 124. 1932.

Quercus hypoleuca Engelm, Acad. Sci. St. Louis Trans. 3: 384. 1876. Not Miquel.

Mountains of Greenlee, Graham, Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,000 feet, on slopes and in canyons. Western Texas to southern Arizona and northern Mexico.

Whiteleaf oak. This is a widely distributed and fairly common but nowhere very abundant shrub or small tree.

26. ULMACEAE. ELM FAMILY

1. CELTIS. HACKBERRY

Trees or shrubs; leaf blades unequal at base, very rough above; flowers perfect or unisexual, axillary, solitary or in small clusters; perianth 5- or 6-parted; style none, the stigmas elongate, spreading or recurved, plumose; ovary 1-celled; fruit a globular drupe with thin flesh and a hard-shelled stone, mostly yellow to dull red at maturity.

Hackberries are browsed by cattle when other forage is scarce, and the sweet but rather dry and insipid fruits are relished by birds and small desert mammals. The Papago and probably other Indians gather the fruits for food. The wood is sometimes used for fence posts.

Key to the species

1. Plant a spiny, intricately branched shrub; leaf blades not more than 2 cm. wide, elliptic to oblong-ovate, rounded to acutish at apex, entire or sparingly crenate-dentate, not reticulate-veined; herbage puberulent.
 1. *C. PALLIDA*.
1. Plants large shrubs or small trees, not spiny or intricately branched; leaf blades more than 2 cm. wide, ovate or lance-ovate, acute to sharply acuminate at apex, obliquely cuneate to obliquely cordate at base, serrate-dentate or entire, more or less prominently reticulate-veined beneath; twigs, petioles, and lower surface of the leaf blades (especially the veins) short-pilose (usually sparsely so) to nearly glabrous; bark warty.
 2. *C. RETICULATA*.

1. *Celtis pallida* Torr., U. S. and Mex. Bound. Bot. 203. 1859.

Greenlee, Pinal, Maricopa, Cochise, and Pima Counties, 1,500 to 3,500 feet, foothills and mesas, often forming dense thickets. Western Texas to Arizona and northern Mexico.

Granjeno. This is reportedly of value as a honey plant and for erosion control.

2. *Celtis reticulata* Torr., Ann. Lyc. N. Y. 2: 247. 1828.

Celtis occidentalis L. var. *reticulata* Sarg., Cat. Forest Trees Amer. 126. 1884.

Almost throughout the State, 2,500 to 6,000 feet, usually along streams. Oklahoma and Colorado to Arizona and northern Mexico.

Netleaf hackberry, paloblanco. The species is highly variable in the shape, thickness, and pubescence of the leaves and prominence of the veins, also in length of the pedicels, but there is so much intergradation that recognition, even of varieties, is difficult. *C. brevipes* Wats. is a form with pedicels somewhat shorter than to about equaling the petioles. At the other extreme are specimens from the Grand Canyon, referred by Sargent to *C. douglasii* Planch., with serrate, long-acuminate, more or less cordate leaf blades and pedicels up to 2 cm. long and 2 to 4 times as long as the petioles. *C. douglasii* is described as having brownish purple fruits, whereas in *C. reticulata* they are normally orange-colored at maturity.

27. MORACEAE. MULBERRY FAMILY

Small trees, shrubs, or nearly herbaceous plants with twining stems; flowers mostly dioecious, without petals, those of both sexes, or the pistillate ones only, in catkins.

Key to the genera

1. Plant a small tree; pistillate and staminate flowers both in catkins; perianths of the pistillate flowers becoming thick, succulent, and fused, the inflorescence as a whole becoming a juicy oblong aggregate fruit.... 1. MORUS.
1. Plant climbing, perennial, herbaceous or suffrutescent; staminate flowers in loose panicles, the pistillate flowers in short catkinlike spikes; bracts of the pistillate inflorescence foliaceous, imbricate, becoming much enlarged and membranous in fruit..... 2. HUMULUS.

1. MORUS. MULBERRY

A tree or large shrub; leaves alternate, crenate-serrate or palmately lobed (especially on young shoots); perianth 4-parted; stigmas 2, linear, spreading.

1. *Morus microphylla* Buckl., Acad. Nat. Sci. Phila. Proc. 1862: 8. 1863.

Greenlee County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,200 feet, usually along streams. Western Texas to Arizona and northern Mexico.

Texas mulberry. The stems seldom exceed 4.5 m. (15 feet) in height. The tart, palatable fruits are gathered by the Papago Indians and are greedily eaten by birds and other animals. It is reported that the Havasupai Indians in the Grand Canyon cultivate the native mulberry. There is great variation in the shape of the leaves, and, largely on this basis, several segregate species founded on Arizona types were described by E. L. Greene. These are: *M. confinis* (type *Pringle* in 1881, Santa Catalina Mountains); *M. crataegifolia* (type *Hough* in 1905, Blue River, Graham County); *M. radulina* (type *Fernow* in 1896, Beaver Creek, Yavapai County); and *M. grisea* (type *Palmer* in 1869, Hell Canyon, Yavapai County). The last is an exceptionally pubescent form.

2. HUMULUS. HOP

Plant twining, perennial, herbaceous or nearly so; leaves opposite, palmately 3- to 7-lobed; perianth 5-parted in the staminate flowers, entire in the pistillate flowers; stigmas 2, filiform.

1. *Humulus americanus* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 181. 1847.

Humulus lupulus L. var. *neomexicanus* A. Nels. and Cockerell, Biol. Soc. Wash. Proc. 16: 45. 1903.

Apache, Navajo, and Coconino Counties, south to Graham and Pima Counties, 5,500 to 9,500 feet, mountain woods. Rocky Mountain region, south to New Mexico and Arizona.

The pistillate inflorescences of the closely related European species (*H. lupulus*) are used in the brewing of malt beverages to impart the bitter flavor, and in medicine as a tonic and soporific. The southwestern form apparently was utilized by the Indians, the Apache name being stated to mean to "make bread with it." Rare cases of dermatitis from contact with the plant have been reported.

28. URTICACEAE. NETTLE FAMILY

Plants herbaceous; leaves simple, opposite or alternate, with or without stipules; inflorescences axillary; flowers perfect or unisexual;

perianth small, calyxlike; petals none; stamens commonly 4, opposite the perianth segments; ovary 1-celled; fruit an achene.

Key to the genera

1. Sepals of the pistillate flowers separate or nearly so, in pairs, the outer ones much smaller, the inner ones enveloping the achene; plants armed with stinging bristlelike hairs; leaves opposite..... 1. URTICA.
1. Sepals of the pistillate flowers united much of their length in a tubular or bell-shaped, 4-lobed calyx; plants without stinging hairs; leaves alternate..... 2. PARIETARIA.

1. URTICA. NETTLE

Stems tall; leaves opposite, with stipules; herbage more or less canescent or tomentose, usually also hispid with stinging hairs; inflorescences elongate, spikelike; stigma sessile or nearly so; achene compressed.

All of the species flower in Arizona in summer (July to September). Contact with nettles is very irritating to the skin, owing to the formic acid released by the stinging hairs.

Key to the species

1. Petioles of the lower leaves more than half as long as to longer than the blades, the latter broadly ovate (at least the lower ones), often nearly as wide as long, cordate to subcuneate at base, the marginal teeth broadly triangular ovate, obtuse or acutish, directed only slightly upward..... 1. U. GRACILENTA.
1. Petioles mostly much less than half as long as the blades, the latter commonly lanceolate and much longer than wide, rounded to cuneate (exceptionally cordate) at base, the marginal teeth triangular, very acute, directed strongly upward (2).
 2. Stipules linear or narrowly lanceolate, acuminate; herbage green, sparsely to copiously (but not densely) pubescent as well as hispid..... 2. U. GRACILIS.
 2. Stipules oblong or broadly lanceolate, obtuse or acutish; stem and the lower surface of the leaf blades usually densely grayish pubescent as well as hispid..... 3. U. HOLOSERICA.

1. *Urtica gracilentata* Greene, Torrey Bot. Club. Bul. 8: 122. 1881.

Sierra Ancha (Gila County), Chiricahua and Huachuca Mountains (Cochise County), Baboquivari Mountains (Pima County), 4,000 to 8,000 feet. New Mexico and Arizona.

The leaves are bright green on both surfaces and the shorter hairs are sometimes spreading and straight, sometimes subappressed and curly.

2. *Urtica gracilis* Ait., Hort. Kew. 3: 341. 1789.

Carrizo, Lukachukai, and White Mountains (Apache County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), up to 9,000 feet, in springy places and along streams. Almost throughout temperate North America.

3. *Urtica holosericea* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 183. 1847.

Kaibab Plateau and Grand Canyon (Coconino County), about 7,500 feet. Washington to California and Arizona.

This form apparently intergrades with *U. gracilis* and is perhaps best regarded as a variety (*U. gracilis* var. *holosericea* Jepson).

2. PARIETARIA. PELLITORY

Plants annual; leaves alternate, without stipules, the blades lanceolate to ovate; inflorescences small, glomerate, subtended by leafy bracts; style short, the stigma tufted; achene enclosed by the persistent calyx.

In Arizona these insignificant plants are in flower almost throughout the year.

Key to the species

1. Involucre 2 to 3 times as long as the flowers; stems simple or sparingly branched, erect or ascending; leaf blades commonly lanceolate or ovate-lanceolate.
 1. P. PENNSYLVANICA.
 1. Involucre commonly less than twice as long as the flowers; stems diffusely branched from the base; leaf blades commonly broadly ovate or suborbicular, sometimes oblong or lanceolate.----- 2. P. FLORIDANA.
1. **Parietaria pennsylvanica** Muhl. ex. Willd., Sp. Pl. 4: 955. 1806.

Grand Canyon (Coconino County), and Yavapai, Maricopa, Pinal, and Pima Counties, 1,300 to 4,000 (?) feet. Throughout most of temperate North America.

2. **Parietaria floridana** Nutt., Gen. Pl. 2: 208. 1818.

Parietaria debilis of American authors. Not Forst.

Throughout much of the State, 4,000 feet or lower. Southeastern United States to southern California.

Parietaria obtusa Rydb. apparently is only a form with obtuse bracts and sepals.

29. LORANTHACEAE. MISTLETOE FAMILY

Plants parasitic on trees and shrubs, with or without chlorophyll; stems jointed, brittle when dry; leaves opposite; flowers dioecious; perianth calyxlike, small, with 2 to 4 lobes or teeth; stamens inserted on the perianth, the anthers sessile; ovary inferior, 1-celled; fruit a 1-seeded berry.

The plants of both genera sap the vitality of the host tree and, when abundant, cause considerable damage in forests. Birds are very fond of the berries of *Phoradendron* and through their agency the viscid seeds are transferred from tree to tree. The Papago Indians dry the berries of *P. californicum* in the sun and store them as food supply. The Hopi are reported to use *P. juniperinum* medicinally. The berries of some species are reputedly poisonous and contain a principle similar in action to epinephrin. The European mistletoe (*Viscum album*) and some of the American species of *Phoradendron* are popular for Christmas decoration, because of their white or whitish pearl-like berries.

Key to the genera

1. Fruits sessile, globose or nearly so, whitish or reddish; flowers in axillary spikes; pistillate calyx normally 3-toothed; anthers 2-celled. 1. PHORADENDRON.
1. Fruits on short, often curved pedicels, longer than wide, greenish, bluish or purplish; flowers not in spikes; pistillate calyx normally 2-toothed; anthers 1-celled.----- 2. ARCEUTHOBIMUM.

1. PHORADENDRON.³² MISTLETOE

Plants with or without chlorophyll; leaves with well-developed blades or reduced to scales; style short, the stigma usually capitate.

Key to the species

1. Leaves reduced to triangular scales not more than 2 mm. long (2).
2. Stems not crowded, the branches relatively slender, terete, flexuous; leaf scales only slightly connate; spikes often tomentulose, the pistillate ones with 3 or more nodes; berries usually red----- 1. *P. CALIFORNICUM*.
2. Stems crowded, the branches stout, obscurely quadrangular, rather rigid; leaf scales strongly connate; pistillate spikes with only 1 node; berries whitish----- 2. *P. JUNIPERINUM*.
1. Leaves with well-developed blades seldom less than 1 cm. long (3).
3. Pistillate spikes with more than 2 (usually 6 or more) flowers at each node; leaf blades broadly elliptic, ovate, obovate, or nearly orbicular, commonly more than 10 mm. wide, distinctly petiolate; spikes more than 5 mm. long (4).
4. Fruits glabrous (the calyx sometimes puberulent), 4 to 5 mm. in greatest diameter when mature; herbage glabrous, short-pilose, or subtomentose; leaf blades commonly more than 3 cm. long.----- 6. *P. MACROPHYLLUM*.
4. Fruits puberulent at apex (the pubescence not confined to the calyx), about 3 mm. in greatest diameter when mature; herbage closely puberulent; leaf blades rarely more than 3 cm. long----- 7. *P. CORYAE*.
3. Pistillate spikes with 2 flowers at each node, commonly only 2-flowered; leaf blades linear-spatulate or oblanceolate, not more (usually much less) than 10 mm. wide, sessile or nearly so; spikes in flower not more than 5 mm. long (5).
5. Stems and leaves tomentulose; leaf blades linear-spatulate, 2 to 3 (seldom 4) mm. wide, sessile----- 3. *P. BOLLEANUM*.
5. Stems and leaves glabrous; leaf blades oblanceolate (6).
6. Leaves sessile, 10 to 15 mm. long, seldom more than 4 mm. wide; staminate spikes commonly about 12-flowered---- 4. *P. DENSUM*.
6. Leaves subpetiolate, 15 to 30 mm. long, 5 to 10 mm. wide; staminate spikes commonly about 8-flowered----- 5. *P. PAUCIFLORUM*.

1. *Phoradendron californicum* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 185. 1848.

Common in the semidesert southern and western parts of the State, 4,000 feet or lower. Southern Utah and Arizona to southern California and northern Mexico.

Parasitic chiefly on leguminous shrubs and trees (*Acacia*, *Prosopis*, *Cercidium*), but occasionally on Rhamnaceae. A common form in Arizona is var. *distans* Trelease, with spikes more elongate and whorls of fruit more widely spaced than in the typical form of the species.

2. *Phoradendron juniperinum* Engelm., Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 58. 1849.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 4,200 to 7,000 feet. Southwestern Colorado and southern Utah to western Texas, Arizona, and northern Mexico.

Parasitic on several species of juniper. The plant has yellowish or light brown stems and resembles a large *Arceuthobium*.

3. *Phoradendron bolleanum* (Seem.) Eichler in Mart., Fl. Bras. 5²: 134. 1868.

Coconino County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 7,000 feet. Western Texas to Arizona and northern Mexico.

³² Reference: TRELEASE, W. THE GENUS PHORADENDRON, A MONOGRAPHIC REVISION. Urbana, Ill., 1916.

Parasitic on junipers. The species is represented in Arizona by var. *capitellatum* (Torr.) Kearney and Peebles (*P. capitellatum* Torr.), distinguished from the typical form chiefly by the decidedly pubescent herbage.

4. *Phoradendron densum* Torr. ex Trel., Gen. Phoradendr. 27. 1916.

Flagstaff, Coconino County (*Hedgcock* 4915, part, cit. Trelease *ibid.*), Reno Pass, Mazatzal Mountains, Gila County (*Peebles* 11557), 3,500 to 7,000 feet. Oregon to Sonora.

Parasitic in Arizona on *Cupressus glabra*, elsewhere also on *Juniperus*.

5. *Phoradendron pauciflorum* Torr., U. S. Rpt. Expl. Miss. Pacific 4⁴: 134. 1857.

Sedona (Coconino County), Mazatzal Mountains and Natural Bridge (Gila County), Santa Catalina Mountains (Pima County), 4,200 to 7,700 feet. Arizona, California, and Baja California.

Parasitic on *Cupressus* in Coconino and Gila Counties, on *Abies* in the Santa Catalina Mountains.

6. *Phoradendron macrophyllum* (Engelm.) Cockerell, Amer. Nat. 34: 293. 1900.

Phoradendron flavescens (Pursh) Nutt. var. *macrophyllum* Engelm. in Wheeler, U. S. Survey West 100th Mer. Rpt. 6: 252. 1878.

Yavapai County to Cochise, Santa Cruz, Pima, and (probably) Yuma Counties, 5,500 feet or lower, very common. Western Texas to California and Sonora.

The most conspicuous and largest leaved of the Arizona mistletoes, growing in great masses, commonly on cottonwood (*Populus fremontii*) but also on sycamore, ash, hackberry, walnut, and willow. This species greatly resembles the common mistletoe of the eastern United States, *P. flavescens* Nutt. Trelease distinguishes two varieties based on collections in southern Arizona: var. *circularis* Trelease (type *Griffiths* and *Thorner* 191 from the Santa Rita Mountains) with nearly orbicular leaf blades, and var. *jonesii* Trelease (type *Jones* 4281 from Bowie) with oblanceolate or obovate leaf blades; but this range of variation is sometimes found on the same individual. *P. longispicum* Trelease appears to be merely a more pubescent form of *P. macrophyllum*. *P. coloradense* Trelease, described as having oblanceolate or obovate leaf blades and reported as growing on *Prosopis* in the lower Colorado River region, also seems scarcely separable from *P. macrophyllum*.

7. *Phoradendron coryae* Trel., Gen. Phoradendr. 43. 1916.

Southern Coconino County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 8,500 feet. Western Texas to Arizona and Sonora.

A very common species in Arizona, parasitic on several evergreen species of oak, rarely on barberry (*Berberis haematocarpa*).

2. ARCEUTHOBIMUM.³³ SMALL-MISTLETOE

Plants without chlorophyll, parasitic only on conifers; leaves reduced to connate scales; flowers solitary or several in the axils of the scales; perianth with a basal disk.

³³ Reference: GILL, L. S. ARCEUTHOBIMUM IN THE UNITED STATES. Conn. Acad. Arts and Sci. Trans. 32: 111-245. 1935.

A. vaginatum sometimes causes considerable damage in stands of young yellow pine.

Key to the species

1. Stems slender, about 1 mm. in diameter at base, seldom more than 2 cm. long, commonly scattered along the stem of the host plant, greenish----- 1. *A. DOUGLASII*.
 1. Stems relatively stout, 2 to 5 mm. in diameter at base, seldom less than 3 cm. long, commonly clustered (2).
 2. Plants yellowish, flowering normally in early summer; stems seldom less than 3 mm. in diameter at base----- 2. *A. VAGINATUM*.
 2. Plants olive green, brown, or sometimes yellowish, flowering in late summer; stems commonly about 2 mm. in diameter at base----- 3. *A. CAMPYLOPODUM*.
1. **Arceuthobium douglasii** Engelm. in Wheeler, U. S. Survey West 100th Mer. Rpt. 6: 253. 1878.

Razoumofskyia douglasii Kuntze, Rev. Gen. Pl. 2: 587. 1891.

Apache, Navajo, and Coconino Counties, south to Graham and Pima Counties, up to 8,500 feet (perhaps higher). Western Canada to New Mexico, Arizona, California, and Mexico.

The typical form, flowering normally April to June, is parasitic on *Pseudotsuga*. The variety *abietinum* Engelm. (*A. campylopodum* f. *abietinum* Gill), flowering normally in August and September, is parasitic on fir (*Abies* spp.). This variety is much less common in Arizona, apparently having been collected only at the Grand Canyon (Gill in 1934), and in the Pinaleno Mountains, Graham County (Stouffer and Gill in 1934).

2. **Arceuthobium vaginatum** (H. B. K.) Eichler in Mart., Fl. Bras. 5²: 105. 1868.

Viscum vaginatum H. B. K., Nov. Gen. et Sp. 3: 445. 1820.

Arceuthobium cryptopodum Engelm., Boston Jour. Nat. Hist. 6: 214. 1850.

Almost throughout the State, 5,500 to 8,000 feet. Colorado and Utah to western Texas, Arizona, and Mexico.

Parasitic on pines, the presumably typical form of *A. vaginatum* on *Pinus latifolia*, *P. arizonica*, and *P. leiophylla* in the south; whereas f. *cryptopodum* (Engelm.) Gill (*A. cryptopodum* Engelm.), infests the western yellow pine (*Pinus ponderosa*) in central and northern Arizona.

3. **Arceuthobium campylopodum** Engelm. in A. Gray, Boston Jour. Nat. Hist. 6: 214. 1850.

Razoumofskyia campylopoda Kuntze, Rev. Gen. Pl. 2: 587. 1891.

Throughout most of the State, in various forms, 4,500 feet or higher. New Mexico and Arizona to Oregon and California.

The typical form of the species has not been reported in Arizona. The f. *divaricatum* (Engelm.) Gill (*A. divaricatum* Engelm.) with the old stems often conspicuously divaricate, is common in the northern and central portions (Apache to Coconino and Yavapai Counties), parasitic on pinyon (*Pinus edulis*). The f. *microcarpum* (Engelm.) Gill (*A. douglasii* var.? *microcarpum* Engelm.) is frequent, ranging from the Kaibab Plateau (Coconino County) and the White Mountains (Apache County) to the Pinaleno Mountains (Graham County), parasitic on spruce (*Picea*). The type collection of this form is from

the White Mountains (*Gilbert* 112). The f. *blumeri* Gill (*A. blumeri* A. Nels.) occurs in the mountains of Graham, Cochise, and Pima Counties, parasitic on *Pinus strobiformis*. The type of *A. blumeri* was collected by Blumer in the Chiricahua Mountains. The f. *cyano-carpum* (A. Nels.) Gill (*Razoumofskya cyanocarpa* A. Nels.) has been collected in Arizona only on the San Francisco Peaks, 9,800 feet, on *Pinus aristata* (*Leiberg* 5884), and at Blue Summit, Greenlee County, on *Pinus flexilis* (*Gill* in 1934).

30. SANTALACEAE. SANDALWOOD FAMILY

1. COMANDRA. BASTARD-TOADFLAX

Plant probably a root parasite, small, herbaceous or nearly so; leaves alternate, narrow, entire; flowers perfect, small, pink, in terminal corymbose clusters; perianth persistent, urn-shaped, 4- or 5-cleft; stamens borne on a fleshy disk in the perianth tube; ovary inferior; fruit nutlike, indehiscent, 1-seeded.

1. *Comandra pallida* A. DC. in DC., Prodr. 14: 636. 1857.

Apache County to Mohave County, south to Cochise and Pima Counties, 4,000 to 8,000 feet, usually in pine woods, April to August. Minnesota to British Columbia, south to Texas, Arizona, and California.

31. ARISTOLOCHIACEAE. BIRTHWORT FAMILY

1. ARISTOLOCHIA

Plant herbaceous, perennial; stems from a thick root, trailing; leaves alternate, the blades triangular-lanceolate, often purplish; flowers perfect, axillary, solitary; perianth irregular, tubular below, dull greenish and brown purple; ovary inferior; fruit a dehiscent 6-valved capsule; seeds numerous, horizontal, flat.

1. *Aristolochia watsoni* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 117. 1913.

Aristolochia brevipes Benth. var. *acuminata* S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 148. 1883.

Greenlee County to Maricopa County, south to Cochise, Santa Cruz, and Pima Counties, 2,000 to 4,500 feet, April to September. type from southern Arizona or northern Sonora. Western Texas to southern Arizona.

Known locally as "indianroot," and reported to have been used medicinally, especially as a remedy for snake bite, by Indians and by the white settlers. The flowers, as in many tropical species, have a putrid odor and are so constructed as to capture insects.

32. RAFFLESIIACEAE. RAFFLESIA FAMILY

1. PILOSTYLES

Plant parasitic, with only the small brown flowers and a few subtending bracts visible outside the bark of the host; flowers unisexual (dioecious?), the perianth of 4 or 5 separate segments similar to the

subtending bracts, with a thick central column expanded at apex into a fleshy disk, the latter bearing under its margin in staminate flowers the anthers, in pistillate flowers the ring-shaped stigma; ovary inferior; fruit a many-seeded capsule.

1. *Pilostyles thurberi* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 326. 1855.

Known definitely only from the type locality, south side of the Gila River near its confluence with the Colorado (Yuma County), but reported to occur also in the Colorado Desert, Calif., flowering in April. The type was collected by George Thurber in 1850.

Parasitic on the stems of *Dalea emoryi*, a shrubby legume. All specimens of infested branches of the host, collected by Harrison, Loomis, and the writers, bear only pistillate flowers. It is noteworthy that the family to which this tiny plant belongs includes a plant having the largest of all known flowers, *Rafflesia arnoldii*, a native of Sumatra.

33. POLYGONACEAE. BUCKWHEAT FAMILY

Plants herbaceous or woody; stems usually jointed; leaves simple, often with stipules that are united into a sheath; flowers small, regular, commonly perfect; perianth not differentiated into a calyx and a corolla but usually corollalike; stamens 2 to 9; pistil 1, the ovary superior, 1-celled; style cleft or parted, the divisions 2 or 3; fruit an achene, usually triangular.

This family includes buckwheat (*Fagopyrum*) and rhubarb (*Rheum*), also several common weeds of the genera *Rumex* (dock) and *Polygonum* (knotweed).

Key to the genera

1. Flowers subtended by a campanulate, turbinate, or cylindric involucre (2).
 2. Teeth or lobes of the involucre not bristly or spiny at tip..... 4. ERIOGONUM.
 2. Teeth or lobes of the involucre ending in bristles or spines (3).
 3. Involucre subtending usually only 1 flower, its teeth tipped with hooked or straight spines or bristles; bracts not connate-perfoliate.
 2. CHORIZANTHE.
 3. Involucre subtending 2 or more flowers, its teeth tipped with straight spines or bristles; upper bracts connate-perfoliate, forming a cup-shaped disk..... 3. OXYTHECA.
1. Flowers not subtended by an involucre of the foregoing character (4).
 4. Leaves opposite, without stipules..... 1. PTEROSTEGIA.
 4. Leaves alternate or basal, with sheathlike stipules (5).
 5. Sepals 4 or 6, the outer ones spreading or reflexed, remaining small, the inner ones usually erect and enlarged in fruit (6).
 6. Leaf blades lanceolate to oblong-ovate; sepals 6, one or more of the inner ones often with a large dorsal tubercle; styles 3..... 5. RUMEX.
 6. Leaf blades reniform; sepals 4; styles 2..... 6. OXYRIA.
 5. Sepals 5 (exceptionally 4), all similar and erect in fruit (7).
 7. Achene enclosed by the fruiting calyx or, if exserted, then the leaf blades narrow and attenuate at base..... 7. POLYGONUM.
 7. Achene long-exserted; leaf blades broadly deltoid, hastate, or cordate.
 8. FAGOPYRUM.

1. PTEROSTEGIA

Plant herbaceous, annual; stems slender, weak, diffusely branched, often prostrate; leaves opposite, petioled, the blades cuneate-obovate or fan-shaped, usually deeply lobed; flowers solitary, subtended by a

single, folded, 2-lobed, dentate bract, this in fruit enlarged, scarios, reticulate-veined, bigibbous on the back.

1. *Pterostegia drymarioides* Fisch. and Meyer, Index Sem. Hort. Petrop. 2: 23. 1835.

Pinal, Maricopa, Pima, and Yuma Counties, 3,000 feet or lower, February to April. Oregon to Utah, Arizona, and Baja California.

2. CHORIZANTHE³⁴

Plants annual, herbaceous, dichotomously branched; foliage leaves in a basal rosette, soon disappearing, the stem leaves mostly bractlike, opposite or in 3's; flowers (usually solitary) in a tubular or funnellform involucre; stamens commonly 9.

Plants of the more desertic parts of the State.

Key to the species

1. Bracts divergently 3-lobed; involucre small, with 3 rather broad divaricate spurs at base; plant often reddish; stems glandular-puberulent, especially toward the base, slender, diffusely branched, not becoming rigid; foliage leaves all basal, oblanceolate or spatulate; teeth of the bracts and involucre straight..... 1. *C. THURBERI*.
1. Bracts entire; involucre not spurred (2).
2. Involucres 6-toothed, the tube 6-ribbed, the teeth strongly hooked at apex; stems very brittle, soon disarticulating; foliage leaves all basal, narrowly oblanceolate, strigose or villous, the stem leaves reduced to subulate bracts..... 2. *C. BREVICORNU*.
2. Involucres with fewer than 6 teeth, the tube either 3-ribbed (angled) or not ribbed; stems not very brittle; stem leaves, at least the lower ones, very like the basal leaves, the blades woolly beneath (3).
3. Tube of the involucre 3-angled, much shorter than the teeth, with prominent transverse ridges; leaf blades mostly broadly elliptic or suborbicular, shorter than the petioles; teeth of the involucre very unequal, leaflike, the spiny tips (and those of the bracts) straight..... 3. *C. RIGIDA*.
3. Tube of the involucre not angled, cylindric, nearly equaling to longer than the teeth, cross-corrugate, the teeth hooked (4).
4. Involucral teeth 5, unequal, one much larger than the others and often leaflike; blades of the basal leaves oblanceolate; tube of the involucre at maturity 4 to 6 mm. long, much longer than the teeth..... 4. *C. WATSONI*.
4. Involucral teeth 3, equal or nearly so; blades of the basal leaves ovate or suborbicular; tube of the involucre 2 to 3 mm. long, about as long as the teeth..... 5. *C. CORRUGATA*.

1. *Chorizanthe thurberi* (A. Gray) S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 269. 1877.

Centrostegia thurberi A. Gray ex Benth. in DC., Prodr. 14: 27. 1856.

Mohave, Yavapai, Graham, Gila, and Maricopa Counties, 4,000 feet or lower, in sandy soil, March to May. Arizona, Nevada, and California.

2. *Chorizanthe brevicornu* Torr., U. S. and Mex. Bound. Bot. 177. 1859.

Mohave, Graham, Maricopa, Pinal, Pima, and Yuma Counties, 2,700 feet or lower, March to May. Arizona, Nevada, and California.

³⁴Reference: GOODMAN, G. J. A REVISION OF THE NORTH AMERICAN SPECIES OF CHORIZANTHE. Mo. Bot. Gard. Ann. 21: 1-102. 1934.

3. *Chorizanthe rigida* (Torr.) Torr. and Gray, Amer. Acad. Arts and Sci. Proc. 8: 198. 1870.

Acanthogonum rigidum Torr., U. S. Rpt. Expl. Miss. Pacif. 4⁵: 133. 1857.

Pinal and Pima Counties to Mohave and Yuma Counties, 2,500 feet or lower, March to April. Arizona, California, and Baja California.

The blackened plants are persistent on the desert long after they have died.

4. *Chorizanthe watsoni* Torr. and Gray, Amer. Acad. Arts and Sci. Proc. 8: 199. 1870.

Apparently only once collected in Arizona, at Chloride, Mohave County (*Jones* in 1903). Washington to Arizona and California.

5. *Chorizanthe corrugata* (Torr.) Torr. and Gray, Amer. Acad. Arts and Sci. Proc. 8: 198. 1870.

Acanthogonum corrugatum Torr., U. S. Rpt. Expl. Miss. Pacif. 5²: 364. 1857.

Western Maricopa and Pima Counties to Mohave and Yuma Counties, 1,000 feet or lower. Arizona, California, and Baja California.

3. OXYTHECA

Plant annual, small, slender-stemmed, dichotomously branched; leaves with oblanceolate blades, the basal ones in a rosette, the stem leaves opposite.

1. *Oxythea perfoliata* Torr. and Gray, Amer. Acad. Arts and Sci. Proc. 8: 191. 1870.

Mohave County, at Fort Mohave (*Lemmon* in 1884) and north of Chloride (*Kearney* and *Peebles* 11201), 500 to 2,000 feet, April. Arizona, Nevada, and California.

4. ERIOGONUM³⁵

Plants annual or perennial, herbaceous or shrubby; leaves alternate or whorled, simple, entire, the larger ones often in a basal rosette and the stem leaves often bractlike; flowers several or many in a campanulate, turbinate, or cylindric, toothed or lobed involucre, the involucre arranged in cymose, racemose, or glomerate inflorescences, or sometimes solitary in the forks of the branches; perianth corollalike; stamens 9; fruit an achene, usually triangular.

This large genus is extraordinarily well represented in Arizona, in number both of species and of individuals. Often the roads are bordered for miles by plants of one species, notably skeletonweed (*E. deflexum*) in the low semidesert areas and *E. wrightii* in the foothills and mountains. The shrubby species, known collectively as buckwheatbrush, furnish browse for livestock, and flat-top buckwheatbrush or California-buckwheat (*E. fasciculatum*) is a valued honey plant.

³⁵ Reference: STOKES, SUSAN G. THE GENUS ERIOGONUM, A PRELIMINARY STUDY BASED ON GEOGRAPHIC DISTRIBUTION. San Francisco. 1936.

Key to the species

1. Plants annual or biennial, without a woody caudex (2).
2. Involucres all sessile and solitary in the forks of the stems and along the branches (3).
3. Plant without tomentose or lanate pubescence; involucres turbinate-campanulate; perianth lobes oblong or ovate (4).
4. Stems and leaves puberulent or short-pilose with subappressed hairs; involucres cleft to about the middle, glabrous or nearly so; perianth yellow, hispidulous and often glandular; stem leaves foliaceous but smaller than the basal ones, subtended by small triangular bracts----- 1. *E. DIVARICATUM*.
4. Stems and leaves silky pubescent; involucres cleft nearly to the base, sericeous; perianth pink, glabrous or nearly so; stem leaves all greatly reduced, bractlike----- 2. *E. PUBERULUM*.
3. Plant with tomentose or lanate pubescence, at least on the basal leaves; involucres narrowly turbinate or cylindric, short-toothed, strongly ribbed; outer lobes of the perianth wedge-shaped or fan-shaped, truncate or very obtuse, constricted near the base (5).
5. Stems not more than 30 cm. long and usually much shorter, diffusely many-branched; involucres not more than 1.5 mm. long, loosely and rather sparsely lanate-tomentose; herbage lanate-tomentose; cauline leaves greatly reduced, bractlike (6).
6. Plant intricately branched, the branches more or less incurved at maturity; perianth usually pale yellow----- 3. *E. NIDULARIUM*.
6. Plant more open, the branches spreading or ascending at a rather wide angle; perianth white or pink----- 4. *E. DENSUM*.
5. Stems seldom less than 30 cm. long, the branches few, ascending; involucres 2 to 3 mm. long, glabrous except on the margins; perianth white or pink (7).
7. Plant scapose, the scapes glabrous; cauline leaves reduced to bracts, the basal leaves with orbicular, subcordate blades; involucres not very numerous, 2.5 to 3 mm. long, cylindric-turbinate, their margins glabrous or very nearly so----- 5. *E. VIMINEUM*.
7. Plant not scapose, the stems leafy above the base, white-tomentose; lower cauline leaves large, with blades oblong-obovate or oblanceolate, cuneate or attenuate at base; involucres very numerous, about 2 mm. long, short-turbinate, their margins white-lanate----- 6. *E. POLYCLADON*.
2. Involucres all or some of them peduncled, except sometimes in *E. hookeri* (8).
8. Plants not scapose, the stems leafy (except rarely in *E. angulosum*), the lower stem leaves like the basal ones but smaller (9).
9. Stem leaves subtended by small triangular bracts; peduncles seldom more than 2 cm. long; involucre and perianth glandular-puberulent externally; plant more or less white-floecose; stems sharply angled; involucre hemispheric, many-flowered; perianth white or pink.
7. *E. ANGULOSUM*.
9. Stem leaves not subtended by bracts; peduncles often at least 3 cm. long; involucre and perianth not glandular (10).
10. Involucres parted or divided, glabrous; perianth yellow, hispidulous externally, with narrow, attenuate lobes; stems and leaves glabrous; leaf blades oblanceolate to linear; peduncles filiform.
8. *E. SALSUGINOSUM*.
10. Involucres deeply cleft but not parted or divided, pubescent; perianth usually white or pink, sometimes yellowish, glabrous externally, with broad outer lobes, the inner ones much narrower and longer; stems and leaves more or less pubescent (11).
11. Leaf blades villous, those of the lower stem leaves oblong-lanceolate to broadly ovate, flat; outer lobes of the perianth nearly orbicular, cordate, not saccate at base---- 9. *E. ABERTIANUM*.
11. Leaf blades conspicuously white-lanate beneath, all linear-lanceolate or linear-oblanceolate, more or less revolute; outer lobes of the perianth ovate, bisaccate at base.
10. *E. PHARNACEOIDES*.

8. Plants scapose or subscapose, the stem leaves all or nearly all reduced to small, usually scalelike bracts; all or most of the large foliaceous leaves usually confined to the basal rosette (12).
12. Perianth whitish hispidulous externally, yellow, sometimes fading pinkish; peduncles filiform; scapes usually much-branched (13).
13. Outer lobes of the perianth saccate-dilated below; blades of the basal leaves lanate-tomentose beneath; involucre 1 to 1.5 mm. high, glabrous externally or merely ciliolate.----- 11. *E. THOMASII*.
13. Outer lobes of the perianth not saccate-dilated; blades of the basal leaves mostly villous or loosely floccose, lanate-tomentose beneath only in *E. clutei* (14).
14. Glandular pubescence present on the scapes and often on the peduncles, although sometimes very sparse; peduncles often geniculate; involucre deeply cleft, often to below the middle, glabrous or glandular-puberulent; scapes not inflated; lower bracts often well developed, up to 10 mm. long.
12. *E. GLANDULOSUM*.
14. Glandular pubescence none; peduncles not geniculate; involucre not cleft to below the middle, glabrous outside (15).
15. First (and sometimes one or more higher) internodes of the scape usually strongly inflated toward the summit; basal leaves villous, often sparsely so; scapes usually 40 cm. or more long, sparingly branched, the branches ascending at a narrow angle; involucre usually 1 to 2 mm. long, usually with 4 or more flowers, cleft to about the middle; plant usually perennial.----- 13. *E. INFLATUM*.
15. None of the internodes strongly inflated (16).
16. Floccose pubescence none, the basal leaves villous, often sparsely so; scapes usually diffusely many-branched, the branches spreading or ascending at a wide angle; involucre 0.5 to 1 mm. long.----- 14. *E. TRICHOPES*.
16. Floccose pubescence present, at least on the basal leaves; scapes few-branched, the branches ascending; involucre 1 to 1.5 mm. long (17).
17. Scapes not inflated, not glaucous, these and the leaf blades loosely floccose; branches of the scape ascending at a narrow angle; leaf blades green above, usually obovate and narrowed at base, 2 to 6 cm. long; involucre 1- to 3-flowered; perianth less than 2 mm. long.
15. *E. ORDII*.
17. Scapes slightly inflated (the first internode), glaucous, glabrous; branches of the scape ascending at a wide angle; leaf blades grayish floccose above, densely white lanate beneath, reniform, 1 to 1.5 cm. long; involucre 4- or 5-flowered; perianth 2.5 to 3 mm. long.
16. *E. CLUTEI*.
12. Perianth not whitish hispidulous externally; basal leaves white-lanate, at least on the lower face (18).
18. Outer surface of the perianth puberulent, the segments yellow, often with a red central stripe and fading pinkish, the outer lobes not saccate-dilated; peduncles very slender, usually elongate; involucre broadly campanulate, often about 10-flowered (19).
19. Involucre and bracts glandular-puberulent externally; outer lobes of the perianth oblong-obovate or oblanceolate; blades of the basal leaves obovate to nearly orbicular, not cordate.
17. *E. PUSILLUM*.
19. Involucre glabrous externally or merely ciliolate; outer lobes of the perianth oblong-lanceolate; blades of the basal leaves round-cordate or reniform.----- 18. *E. RENIFORME*.
18. Outer surface of the perianth glabrous or very nearly so (20).
20. Peduncles often slender but not filiform, seldom more and usually less than 10 mm. long, sometimes none; scapes glaucous (21).
21. Involucre hemispheric, glabrous externally, mostly sessile or subsessile; perianth yellowish, fading pinkish, the outer lobes nearly orbicular, cordate; branches of the inflorescence somewhat flexuous or zigzag.----- 19. *E. HOOKERI*.

21. Involucres turbinate-campanulate, distinctly peduncled, the peduncles usually more than 1 mm. long; perianth white or pink (22).
22. Outer lobes of the perianth obovate, truncate, often emarginate at apex, narrowed at base; involucres glabrous externally; peduncles usually 5 mm. long or longer (23).
23. Peduncles more or less deflexed or decurved; involucres often many- (more than 10-) flowered; outer lobes of the perianth more or less panduriform; scapes usually erect or ascending----- 20. *E. CERNUUM*.
23. Peduncles spreading; involucres usually few- (about 5-) flowered; outer lobes of the perianth broadly flabelliform; scapes spreading----- 21. *E. ROTUNDIFOLIUM*.
22. Outer lobes of the perianth ovate to nearly orbicular, rounded at apex, more or less cordate at base (24).
24. Involucres, peduncles, and bracts normally glandular-pubescent; scapes with divaricate branches; some of the peduncles 5 mm. long or longer----- 22. *E. PARRYI*.
24. Involucres, peduncles, and bracts glabrous; scapes with ascending branches; peduncles seldom more than 3 mm. long (25).
25. Peduncles more or less deflexed; outer lobes of the perianth broadly ovate to suborbicular, scarcely longer than wide, cordate----- 23. *E. DEFLEXUM*.
25. Peduncles erect or ascending; outer lobes of the perianth oblong-ovate, distinctly longer than wide, subcordate.----- 24. *E. INSIGNE*.
20. Peduncles filiform, often more than 10 mm. long (26).
26. Glandular pubescence present on the involucres, peduncles, and bracts; involucres hemispheric, glandular-puberulent outside, 2 to 2.5 mm. long, usually more than 10-flowered; perianth white or pinkish, the outer lobes flabelliform and somewhat cucullate, greatly dilated from the narrow claw; scapes floccose below; peduncles often 20 mm. long.----- 25. *E. THURBERI*.
26. Glandular pubescence none or obscure; involucres turbinate, glabrous or nearly so outside, not more than 1.5 mm. long, few- (seldom more than 8-) flowered; outer lobes of the perianth not flabelliform or cucullate (27).
27. Scapes 10 to 20 cm. long, diffusely branched with spreading branches, glabrous or nearly so, as are also the bracts; leaf blades glabrate above; perianth yellowish, fading pinkish, the outer lobes oblong, not constricted.----- 26. *E. WETHERILLII*.
27. Scapes usually 30 cm. long or longer, fewer branched, with ascending branches, more or less villous or tomentose at the nodes, as are also the lower bracts (28).
28. Plant biennial (?); basal portion of the scapes leafy and with very short internodes; leaf blades sparsely lanate to densely whitish tomentose on both faces, their margins often pronouncedly crispate; perianth yellowish, sometimes fading pinkish, the outer lobes narrow, panduriform----- 27. *E. CAPILLARE*.
28. Plant annual; scapes not leafy above the basal rosette; leaf blades green and sericeous above, white-lanate beneath; perianth whitish or pink (sometimes yellowish?), the outer lobes oblong, not constricted.----- 28. *E. SUBRENIFORME*.
1. Plants perennial, the caudex, at least, thickened and woody (29).
29. Stems not, or not noticeably, woody above ground (30).
30. Achenes conspicuously winged with membranous wings; stems tall, stout, sparingly branched, leafy above the basal rosette; leaf blades oblanceolate, tapering into long petioles; involucres not strongly ribbed (31).

31. Perianth sericeous externally, yellow; inflorescence relatively short, compact, short-branched; stems and leaves hoary with dense, silky pubescence; involucre rather densely sericeous; achenes 4 to 5 mm. long, winged above the middle; plant sometimes subscapose, with reduced stem leaves----- 29. *E. HIERACIFOLIUM*.
31. Perianth glabrous externally; inflorescence elongate, open, long-branched; stems and leaves green, loosely villous or glabrate; achenes 6 to 8 mm. long, winged nearly to the base (32).
32. Achenes 6 to 7 mm. long, usually considerably more than half as wide; involucre rather sparsely sericeous; perianth yellow. 30. *E. ALATUM*.
32. Achenes 7 to 8 mm. long, about half as wide; involucre glabrous or sparsely sericeous; perianth purplish or yellowish. 31. *E. TRISTE*.
30. Achenes not conspicuously winged (33).
33. Peduncles filiform or nearly so, 5 to 20 mm. long; stems tall, sparingly branched; larger leaves usually orbicular or nearly so and more or less cordate; perianth yellow or fading pinkish; involucre glabrous externally (34).
34. Perianth whitish hispidulous externally, the lobes not panduriform; one or more internodes of the scapes usually strongly inflated; well-developed leaves basal only, rather sparsely villous or hirsute. 13. *E. INFLATUM*.
34. Perianth glabrous or very nearly so externally, the lobes panduriform; scapes not inflated; well-developed leaves at several of the crowded lower nodes of the stems, sparsely lanate to white-tomentose on both faces----- 27. *E. CAPILLARE*.
33. Peduncles not filiform; larger leaves usually considerably longer than wide, not cordate, except sometimes in *E. racemosum* and *E. jonesii* (35).
35. Perianth attenuate at base, stipitate; bracts subtending the divisions of the inflorescence large, verticillate, resembling the basal leaves but somewhat smaller; involucre turbinate, many-flowered, membranous, villous or sericeous externally, not strongly ribbed (36).
36. Perianth cream-colored or pinkish, densely silky-villous externally. 32. *E. JAMESII*.
36. Perianth bright yellow (37).
37. Stems usually only once-forked and bearing a single whorl of foliaceous bracts; inflorescence compact, often subcapitate; involucre few (38).
38. Involucre short-toothed or subtruncate; perianth densely silky-villous externally----- 33. *E. FLAVUM*.
38. Involucre deeply cleft, the lobes usually reflexed; perianth glabrous externally----- 34. *E. UMBELLATUM*.
37. Stems more than once-forked and bearing more than one whorl of foliaceous bracts; inflorescence more open, never subcapitate (39).
39. Involucre dentate with broad, erect or somewhat revolute teeth; perianth silky-villous externally. 35. *E. ARCUATUM*.
39. Involucre deeply cleft, usually to the middle or farther, the lobes more or less reflexed; perianth glabrous externally. 36. *E. COGNATUM*.
35. Perianth not attenuate-stipitate; bracts subtending the divisions of the inflorescence much smaller than the basal leaves and usually inconspicuous, but occasionally large and foliaceous in *E. racemosum* (40).
40. Plant pulvinate-cespitose, very pubescent; involucre few, villous or tomentose externally; scapes leafless except near the apex (41).
41. Scapes not more than 8 cm. long; perianth villous outside, white or pink (42).
42. Leaf blades villous-sericeous, elliptic or lanceolate, acute. 39. *E. VILLIFLORUM*.

42. Leaf blades lanate-fomentose, mostly obovate or oblanceolate, obtuse..... 40. *E. PULVINATUM*.
41. Scapes 10 to 30 cm. long (43).
43. Scapes usually not branched; involucre sessile in a capitate inflorescence; perianth glabrous outside, pale yellow or cream-colored, the outer lobes broadly obovate, truncate or emarginate, subcordate at base; leaf blades oval to nearly orbicular..... 37. *E. OVALIFOLIUM*.
43. Scapes sparingly dichotomous or trichotomous near the summit; perianth densely white-villous outside, yellow, the outer lobes ovate, obtuse; leaf blades lanceolate, narrowly elliptic, or oblanceolate; plant silky-villous.
38. *E. LACHNOGYNUM*.
40. Plant not pulvinate; involucre numerous, all or nearly all of them sessile; perianth glabrous outside (44).
44. Involucre glabrous or glabrate except on the margin, the teeth obtuse or truncate (45).
45. Plant not scapose, the stems leafy up to the inflorescence, the leaves mostly falling before anthesis; stems lanate, at least below the inflorescence; inflorescence compound-cymose, many-branched, the branches flexuous, the ultimate branches divergent or even decurved; involucre about 2 mm. long, more or less ciliate; perianth white.
41. *E. PLUMATELLA*.
45. Plant scapose, the large leaves all or nearly all basal, persistent; scapes glabrous except at the nodes; inflorescence dichotomous or trichotomously forked, the branches few, ascending; involucre 3 to 3.5 mm. long, glabrous or obscurely ciliate; perianth yellow...42. *E. THOMPSONAE*.
44. Involucre lanate on most of their surface; stems lanate-tomentose; perianth white or pink (46).
46. Plant not scapose, the stems leafy up to the inflorescence; leaf blades lanceolate, elliptic, or oblanceolate, acute at base, not more than 6 mm. wide, short-petioled; inflorescence simple or few-branched with the branches ascending at a narrow angle, racemiform or with the involucre glomerate toward the ends of the branches...43. *E. WRIGHTII*.
46. Plant scapose or subscapose, the well-developed leaves all or nearly all basal; leaf blades ovate or oblong-ovate, rounded, subcordate, or occasionally cuneate at base, 10 mm. wide or wider, long-petioled (47).
47. Inflorescence racemiform, elongate, simple or with very few virgate branches; involucre 4 to 5 mm. long, not much surpassing the large, strongly connate bracts.
44. *E. RACEMOSUM*.
47. Inflorescence compound-cymose, many-branched, the branches ascending at a wide angle, stout; involucre not more than 2 mm. long, much surpassing the small, nearly distinct bracts..... 45. *E. JONESII*.
29. Stems noticeably woody above ground; involucre mostly sessile or nearly so, or some of them often long-pedunculate in *E. simpsoni* (48).
48. Perianth silky-villous, white or pink; cymes or their ultimate divisions dense, subcapitate; leaf blades pilose or villous above, lanate beneath, narrow, strongly revolute; leaves often fascicled; plant shrubby; involucre silky-villous, many-flowered... 46. *E. FASCICULATUM*.
48. Perianth glabrous; inflorescence rarely subcapitate; leaf blades lanate or glabrate above (49).
49. Branches of the inflorescence rigid, divaricate, more or less spinescent, scabrous or puberulent; low, intricately branched shrubs; stems usually conspicuously white-lanate in the axils below the inflorescence, the latter seldom conspicuously cymose; involucre few-flowered, 1 to 2 mm. long, turbinate, glabrous or glabrate, sessile, the teeth very obtuse or truncate; leaves usually fugacious, the blades lanceolate or oblanceolate, the petioles short (50).
50. Branches of the inflorescence sharply quadrangular, deeply sulcate, obscurely puberulent, not papillate..... 47. *E. SULCATUM*.

50. Branches of the inflorescence terete, not sulcate, decidedly scabrous-papillate..... 48. *E. HOWELLII*.
49. Branches of the inflorescence not rigid or divaricate or spinescent, or if so, then more or less villous or lanate and the involucre also lanate (51).
51. Inflorescence not conspicuously cymose; involucre racemously disposed and often crowded on the ultimate divisions of the inflorescence, lanate; stems lanate; leaf blades linear-lanceolate, elliptic, or oblanceolate, not more than 6 mm. wide; perianth white or pink (52).
52. Involucre divergent (not appressed to the branchlets), the teeth obtuse or acutish, narrowly scarious-margined; stems woody only toward the base, much-branched, dichotomously or trichotomously so at the lower nodes, the ultimate divisions of the inflorescence short and usually conspicuously secund. 49. *E. LEPTOCLADON*.
52. Involucre appressed to the branchlets, the teeth acute, not noticeably scarious-margined; ultimate divisions of the inflorescence not conspicuously secund (53).
53. Plant shrubby, intricately many-branched; involucre 1 to 1.5 mm. long, scattered along the branches; perianth 1.5 mm. long, the outer lobes oblanceolate or narrowly obovate. 50. *E. PRINGLEI*.
53. Plant suffrutescent, few-branched; involucre 2 to 3 mm. long; perianth 2.5 to 3.5 mm. long, the outer lobes broadly obovate. 43. *E. WRIGHTII*.
51. Inflorescence conspicuously cymose (54).
54. Stems woody only near the base, lanate, at least below the inflorescence (55).
55. Plant subscapose, with well-developed leaves only near the base, these persistent; ultimate branches of the inflorescence not flexuous, ascending; involucre lanate, their teeth acute, not noticeably scarious-margined, often dark-colored. 45. *E. JONESII*.
55. Plant not at all scapose, with well-developed leaves nearly to the inflorescence, these fugacious; ultimate branches of the inflorescence flexuous, divergent or even decurved; involucre glabrous or glabrate except on the margin, their teeth obtuse, scarious-margined..... 41. *E. PLUMATELLA*.
54. Stems woody almost to the apex; leaf blades densely lanate beneath (56).
56. Leaf blades oblong-lanceolate to broadly ovate, seldom less than 6 mm. wide, cuneate to subcordate at base, irregularly undulate or crispate, not or only slightly revolute; petioles usually well developed, often half as long as the blade; involucre more or less lanate (57).
57. Branches of the inflorescence ascending, not rigid or spinescent; perianth white or pink..... 51. *E. CORYMBOSUM*.
57. Branches of the inflorescence divaricate, rigid, sometimes almost spinescent; perianth white, pink, or yellow; inflorescence sometimes slightly glutinous..... 52. *E. AUREUM*.
56. Leaf blades linear or lanceolate, seldom more than 4 mm. wide, acute at base, strongly revolute; petioles usually very short, rarely one-third as long as the blade; perianth white or pink (58).
58. Inflorescence glabrous or obscurely puberulent, relatively dense, broomlike, with the very numerous branches erect or ascending at a narrow angle; leaf blades 2 to 5 cm. long, very strongly revolute, the glabrous upper surface often completely hiding the white-lanate lower surface; involucre glabrous or obscurely ciliolate, cylindric-turbinate; perianth 3 to 4 mm. long, the outer lobes oblanceolate. 53. *E. LEPTOPHYLLUM*.

58. Inflorescence more or less lanate, relatively open, not broom-like, with the few branches ascending at a wide angle; leaf blades seldom more than 2 cm. long, less strongly revolute, the white-lanate lower surface nearly always evident, the upper surface rarely completely glabrous; involucre loosely lanate or glabrate, turbinate or turbinate-campanulate; perianth 2 to 2.5 mm. long, the outer lobes obovate to nearly orbicular (59).
59. Stems erect or ascending, few-branched from the base, the branches of the inflorescence 2.5 to 4 cm. long; leaf blades 10 to 20 (rarely 30) mm. long, sparsely floccose or glabrate and green above; perianth white or occasionally pale pink; involucre, especially those in the forks, often pedunculate----- 54. *E. SIMPSONI*.
59. Stems spreading or decumbent, many-branched from the base, the branches of the inflorescence not more than 2 cm. long; leaf blades 5 to 10 mm. long; perianth bright pink----- 55. *E. MEARNSII*.

1. *Eriogonum divaricatum* Hook., Jour. Bot. and Kew Gard. Misc. 5: 265. 1853.

Apache, Navajo, and Coconino Counties, 4,500 to 6,000 feet, June to September. Colorado, Utah, and Arizona.

2. *Eriogonum puberulum S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 295. 1879.

Not known definitely to occur in this State, but has been collected in Utah and Nevada very near the Arizona boundary.

3. *Eriogonum nidularium* Coville, Contrib. U. S. Natl. Herbarium 4: 186. 1893.

Eriogonum vimineum Dougl. subsp. *nidularium* Stokes, Gen. Eriog. 49. 1936.

Mohave County, 3,500 feet or lower, May. Idaho to Arizona and southern California.

4. *Eriogonum densum* Greene, Pittonia 3: 17. 1896.

Eriogonum vimineum Dougl. var. *densum* Stokes, Gen. Eriog. 49. 1936.

Coconino and Mohave Counties to Pima County, 3,000 to 6,300 feet, common, May to October. Utah and Nevada to New Mexico and Arizona.

Very common at roadsides in the foothills and mountains. Closely related to *E. nidularium* Coville.

5. *Eriogonum vimineum* Dougl. ex. Benth., Linn. Soc. London Trans. 17: 416. 1837.

Coconino and Mohave Counties to Gila and Maricopa Counties, 3,000 to 7,000 feet, May to October. Idaho and Washington to Arizona and California.

Broom eriogonum. Represented in Arizona by subsp. *juncinellum* (Gandoger) Stokes. The type of *E. juncinellum* Gandoger was collected at the Grand Canyon (*MacDougal* 182).

6. *Eriogonum polycladon* Benth. in DC., Prodr. 14: 16. 1856.

Eriogonum vimineum Dougl. subsp. *polycladon* Stokes, Gen. Eriog. 53. 1936.

Yavapai and Mohave Counties to Cochise, Santa Cruz, and Pima Counties, 2,400 to 5,500 feet, June to November. Western Texas to Arizona and northern Mexico.

Sorrel eriogonum. So common at roadsides and in washes, especially in southern Arizona, as to color the landscape in places with its tall gray stems and pink flowers.

7. *Eriogonum angulosum* Benth., Linn. Soc. London Trans. 17: 406. 1837.

Yavapai and Mohave Counties to Graham, Pinal, Maricopa, and Pima Counties, 4,500 feet or (usually) lower, April to June. Idaho and eastern Washington to Arizona and Baja California.

8. *Eriogonum salsuginosum* (Nutt.) Hook., Jour. Bot. and Kew Gard. Misc. 5: 264. 1853.

Stenogonum salsuginosum Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 170. 1848.

Apache and Navajo Counties, 5,000 to 6,000 feet, apparently rare, June to September. Wyoming to Utah, New Mexico, and north-eastern Arizona.

9. *Eriogonum abertianum* Torr. in Emory, Mil. Recon. 151. 1848.

Coconino and Yavapai Counties to Cochise, Santa Cruz, and Pima Counties, 1,500 to 7,000 feet, foothills and mountains, very common, March to September. Western Texas to Arizona and Chihuahua.

Several varieties have been distinguished recently by Fosberg.³⁶ Of these, the 3 following are credited to Arizona: var. *neomexicanum* Gandoger (*E. pinetorum* Greene), characterized by a paniculate inflorescence with inconspicuous, not leafy bracts, found in southern Greenlee, southern Yavapai, Cochise, and Pima Counties; var. *villosum* Fosberg with the inflorescence leafy, not paniculate, found in Gila, Cochise, Santa Cruz, and Pima Counties; and var. *gillespiei* Fosberg, similar to var. *villosum* in the type of inflorescence but with the upper leaves more reduced and bractlike, and the basal leaves shorter-petioled and attenuate (instead of truncate or cordate) at base, the type from Apache Gap, Pinal County, 2,500 feet (*Gillespie* 8797).

10. *Eriogonum pharnaceoides* Torr. in Sitgreaves, Zuffi and Colo. Rpt. 167. 1854.

Eriogonum arizonicum Gandoger, Soc. Roy. Bot. Belg. Bul. 42²: 186. 1905.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 4,500 to 7,000 feet, frequent in pine woods, July to October, type of *E. arizonicum* Gandoger from near Bill Williams Mountain, Coconino County (*MacDougal* 311). Utah, New Mexico, and Arizona.

³⁶ FOSBERG, F. RAYMOND. *ERIOGONUM ABERTIANUM* AND ITS VARIETIES. *Madroño* 4: 189-194. 1938.

11. *Eriogonum thomasii* Torr., U. S. Rpt. Expl. Miss. Pacif. 5: 364. 1857.

Mohave County to Graham, Gila, Pima, and Yuma Counties, 3,000 feet or lower, March to April. Southern Utah to southeastern California, Arizona, and Sonora.

A small annual, common in the more desertic parts of the State, in sandy soil.

12. *Eriogonum glandulosum* Nutt. ex Benth. in DC., Prodr. 14: 21. 1856.

Eriogonum flerum M. E. Jones, Zoe 2: 15. 1891.

Eriogonum trichopes Torr. subsp. *glandulosum* Stokes, Gen. Eriog. 25. 1936.

Moenkopi, Coconino County, 4,700 feet, the type locality of *E. flerum* (Jones in 1890), this being apparently the only collection of *E. glandulosum* in Arizona. Colorado, Utah, and Arizona.

13. *Eriogonum inflatum* Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 317. 1845.

Apache County to Mohave County, south to Graham, Pima, and Yuma Counties, 3,500 feet or lower (occasionally considerably higher), March to July. Utah and Arizona to southern California and Baja California.

Desert-trumpet, bladderstem, Indianpipe-weed. A familiar plant on the rocky foothills and lower slopes of desert mountains, remarkable for the inflated stem.

14. *Eriogonum trichopes* Torr. in Emory, Mil. Recon. 150. 1848.

Mohave County to Cochise, Pima, and Yuma Counties, 4,000 feet or lower, flowering almost throughout the year. Colorado and Utah to Arizona, California, and northwestern Mexico.

Often extremely abundant on the deserts and low hills, sometimes covering large areas in nearly pure stand, as in northern Maricopa County and northwest of Kingman, Mohave County. The hairlike, many-branched inflorescence and very small, few-flowered involucre are distinctive.

15. *Eriogonum ordii* S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 468. 1886.

This seems to be known in Arizona only by the type collection, on "sand dunes" near Fort Mohave, Mohave County (Lemmon in 1884). Utah to western Arizona and southern California.

16. *Eriogonum clutei* Rydb., Amer. Bot. 27: 61. 1921.

Known, apparently, only from the type collection at Cameron, Coconino County, "common in the driest places" (*Clute* 71a).

17. *Eriogonum pusillum* Torr. and Gray, Amer. Acad. Arts and Sci. Proc. 8: 184. 1870.

Eriogonum comosum M. E. Jones var. *playanum* M. E. Jones, Contrib. West. Bot. 11: 16. 1903.

Eriogonum reniforme Torr. and Gray subsp. *pusillum* Stokes, Gen. Eriog. 36. 1936.

Hackberry and Kingman (Mohave County), Wickenburg (Maricopa County), 2,000 to 3,000 feet, April to May. Southern Utah, Arizona, and southeastern California.

18. **Eriogonum reniforme** Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 317. 1845.

Eriogonum reniforme var. *comosum* M. E. Jones, Calif. Acad. Sci. Proc., ser. 2, 5: 719. 1895.

Eriogonum comosum M. E. Jones, Contrib. West. Bot. 11: 16. 1903.

Mohave, western Pima, and Yuma Counties, 1,000 feet or lower, March to June. Nevada to Arizona and Baja California.

19. **Eriogonum hookeri** S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 295. 1879.

Eriogonum deflexum Torr. subsp. *hookeri* Stokes, Gen. Eriog. 45. 1936.

Near Fredonia and Wupatki National Monument (Coconino County), Topock (Mohave County), 500 to 4,500 feet, August to September, apparently rare in Arizona. Utah, Nevada, and northern Arizona.

20. **Eriogonum cernuum** Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 162. 1848.

Apache County to western Coconino County, 3,000 to 8,000 feet, locally common, July to October. Saskatchewan and Alberta, south to Nebraska, northern Arizona, and California.

Nodding eriogonum.

21. **Eriogonum rotundifolium** Benth. in DC., Prodr. 14: 21. 1856.

Eriogonum cernuum Nutt., subsp. *rotundifolium* Stokes, Gen. Eriog. 41. 1936.

Near Duncan, Greenlee County (*Peebles* 12975), San Simon, Cochise County (*Kearney* and *Harrison* 9165), "central Arizona," probably near Clifton, Greenlee County (*Rusby* in 1883), 3,500 to 4,000 feet, on plains, rare in Arizona. Colorado to Texas, Arizona, and Chihuahua.

22. **Eriogonum parryi** A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 77. 1874.

Eriogonum deflexum Torr. subsp. *parryi* Stokes, Gen. Eriog. 45. 1936.

Southeast of Littlefield, Mohave County, 1,650 feet (*Goodman* and *Hitchcock* 1661), near Fredonia, Coconino County, on dry rocky hills, 4,750 feet (*Peebles* 13065). Southern Utah and northern Arizona.

The form collected near Fredonia is obscurely if at all glandular and seems to connect *E. parryi* with *E. deflexum*.

23. **Eriogonum deflexum** Torr. in Ives, Colo. River Rpt. 24. 1860.

Eriogonum turbinatum Small, Torrey Bot. Club Bul. 25: 52. 1898.

Coconino and Mohave Counties, south to Pima and Yuma Counties, 4,000 feet and lower, flowering most of the year, type of *E. turbinatum* from Tucson (*Pringle* in 1884). Utah to Arizona and Baja California.

Skeletonweed. Very abundant in the semidesert parts of the State, conspicuous at roadsides, often continuously for many miles. An

extremely drought-resistant plant, flourishing when nearly all other herbaceous plants of the desert have disappeared.

24. **Eriogonum insigne** S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 295. 1879.

Eriogonum deflexum Torr. subsp. *insigne* Stokes, Gen. Eriog. 45. 1936.

Colorado River (Loew in 1874). Southern Utah, Nevada, and Arizona.

Most of the Arizona specimens in herbaria labeled *E. insigne* seem indistinguishable from *E. deflexum*.

25. **Eriogonum thurberi** Torr., U. S. and Mex. Bound. Bot. 176. 1859.

Eriogonum panduratum S. Wats., Bot. Calif. 2: 480. 1880.

Eriogonum cernuum Nutt. subsp. *thurberi* Stokes, Gen. Eriog. 42. 1936.

Mohave County to Graham, Cochise, Santa Cruz, Pima, and Yuma Counties, 4,000 feet or (usually) lower, in sandy soil, March to June. Arizona, California, and Baja California.

One of the commonest of the small, annual, spring-flowering species in semidesert areas. *E. cernuum* subsp. *viscosum* Stokes (ibid.) appears to be merely a densely glandular form of *E. thurberi*. The type of *E. panduratum* was collected by Lemmon, probably in Arizona.

26. **Eriogonum wetherillii** Eastw., Calif. Acad. Sci. Proc. ser. 2, 6: 319. 1896.

Apache County to eastern Coconino County, 3,800 to 6,000 feet, May to July. Utah, New Mexico, and northeastern Arizona.

27. **Eriogonum capillare** Small, Torrey Bot. Club Bul. 25: 51. 1898.

Eriogonum arizonicum Stokes in M. E. Jones, Contrib. West. Bot. 11: 16. 1903.

Gila County near Roosevelt, Winkelman, and San Carlos, about 2,500 feet, apparently rare or very local. Known only from Arizona. The type of *E. capillare* was collected at San Carlos (Ebert in 1893).

28. **Eriogonum subreniforme** S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 260. 1877.

Apache, Navajo, and Coconino Counties, 5,000 to 6,000 feet, June to September. Southern Utah, New Mexico, and northern Arizona.

29. **Eriogonum hieracifolium** Benth. in DC., Prodr. 14: 6. 1853.

White Mountains (Apache and Navajo Counties), 5,000 to 7,200 feet, June to August. Western Texas to eastern Arizona.

At Fort Apache it grows among junipers and live oaks (*Quercus emoryi*), at higher altitudes probably among pines.

30. **Eriogonum alatum** Torr. in Sitgreaves, Zuñi and Colo. Rpt. 168. 1854.

Apache County to Cochise County, westward to Coconino, Yavapai, and Gila Counties, 5,300 to 8,000 feet, July to September. Nebraska to Texas, Utah, and Arizona.

Winged eriogonum. A common plant in open forests of yellow pine, with rather tall wandlike stems. The large root is reported by Mrs. Collom to be used medicinally by the Indians.

31. *Eriogonum triste* S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 347. 1875.

Eriogonum alatum Torr. subsp. *triste* Stokes, Gen. Eriog. 20. 1936.

Apache County to Coconino County, 7,000 to 8,000 feet, July to September. Colorado and Utah to New Mexico and Arizona.

Probably not specifically distinct from *E. alatum*.

32. *Eriogonum jamesii* Benth. in DC., Prodr. 14: 7. 1856.

Navajo and Gila Counties to Cochise and Pima Counties, 5,000 to 9,000 feet, among rocks in pine woods, July to October. Kansas to Colorado, south to Texas and Arizona.

Sometimes known as antelope-sage. Easily distinguished from other species of its group by the cream-colored (not bright yellow) perianth. Mrs. Collom reports that the roots are used medicinally by Indians.

33. *Eriogonum flavum* Nutt. ex Benth., Linn. Soc. London Trans. 17: 408. 1837.

Kaibab Plateau and north rim of the Grand Canyon, Coconino County, 8,000 to 8,500 feet (*Goodman and Hitchcock* 1643, *Kearney and Peebles* 13696), among yellow pines and in open meadows, August (probably other months). Manitoba and Alberta to Colorado and Arizona.

34. *Eriogonum umbellatum* Torr., Ann. Lyc. N. Y. 2: 241. 1828.

Navajo Creek, Kaibab Plateau, south rim of the Grand Canyon, Pagumpa Springs (Coconino and Mohave Counties), 5,000 to 9,000 feet, April to September. Wyoming to Washington, northern Arizona, and California.

Sulphur eriogonum or sulphurflower, names equally applicable to all of these closely related showy, yellow-flowered species.

35. *Eriogonum arcuatum* Greene, Pittonia 4: 319. 1901.

Eriogonum jamesii Benth. var. *flavescens* S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 255. 1877.

Eriogonum bakeri Greene, Pl. Baker. 3: 15. 1901.

Eriogonum jamesii var. *arcuatum* Stokes, Gen. Eriog. 118. 1936.

Hopi Indian Reservation (Navajo County), throughout Coconino County, Hualpai Mountain (Mohave County), 5,200 to 8,000 feet, in yellow pine forest, August and September. Colorado, Utah, New Mexico, and northern Arizona.

This species appears like a luxuriant development of *E. flavum* Nutt.

36. *Eriogonum cognatum* Greene, Pittonia 3: 201. 1897.

Eriogonum ferrissii A. Nels., Amer. Bot. 28: 21. 1922.

Eriogonum umbellatum Torr. subsp. *cognatum* Stokes, Gen. Eriog. 113. 1936.

Navajo, Coconino, Mohave, Gila, and (probably) Yavapai Counties, 5,000 to 7,500 feet, common in pine forests in Coconino County, July to September, type of *E. cognatum* from near the San Francisco Peaks

(Greene in 1889), type of *E. ferrissii* from Betatakin, Navajo County (Clute 10c). Definitely known only from Arizona.

Perhaps too near *E. stellatum* Benth. Both species appear like luxuriant developments of *E. umbellatum* Torr.

37. *Eriogonum ovalifolium* Nutt., Acad. Nat. Sci. Phila. Jour. 7: 50. 1834.

Carrizo Mountains (Apache County) to Pagumpa Springs (Mohave County), 5,000 to 7,000 feet, April to June, apparently rather rare in Arizona. Alberta to New Mexico, northern Arizona, and California.

38. *Eriogonum lachnogynum* Torr. ex Benth. in DC., Prodr. 14: 8. 1856.

Petrified Forest, Apache County (Ward in 1901, *A. S. Hitchcock* 8), rare in Arizona, June. Kansas to Texas, Colorado, and northeastern Arizona.

***39. *Eriogonum villiflorum* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 630. 1873.**

Apparently not yet collected in Arizona, but the type came from southern Utah not far from the Arizona line.

40. *Eriogonum pulvinatum* Small, Torrey Bot. Club Bul. 25: 44. 1898.

Eriogonum villiflorum A. Gray var. *candidum* M. E. Jones, *Zoe* 4: 282. 1893.

Eriogonum shockleyi S. Wats. subsp. *candidum* Stokes, *Gen. Eriog.* 96. 1936.

Twenty-five miles north of Ganado, Apache County, 5,900 feet (*Peebles* 13496), 15 miles north of Holbrook, Navajo County (Ward in 1901), June. Utah and northeastern Arizona.

Plant densely caespitose, forming hummocks about a foot in diameter, the perianth yellowish white. Perhaps only varietally distinct from *E. shockleyi*.

41. *Eriogonum plumatella* Dur. and Hilg., Rpt. Expl. Miss. Pacif. 5³: 14. 1855.

Eriogonum palmeri S. Wats., *Amer. Acad. Arts and Sci. Proc.* 12: 267. 1877.

Mohave County, near Kingman and southeastward to the Aquarius Mountains (*Eastwood* 18371, *Peebles* and *Kearney* 12581, 12604, 12605), about 3,500 feet, in dry thickets. Southern Utah and western Arizona to southern California.

The specimens cited represent both the typical form, with lanate inflorescence branches and the involucre copiously lanate-ciliate; and var. *jaegeri* (Munz and Johnston) Stokes, with inflorescence branches glabrous except at the nodes and the involucre sparsely ciliate.

***42. *Eriogonum thompsonae* S. Wats., *Amer. Nat.* 7: 302. 1873.**

Known only from the type collection at Kanab, Utah, very near the Arizona line (*Thompson* in 1873).

43. **Eriogonum wrightii** Torr. ex Benth. in DC., Prodr. 14: 15. 1856.

Eriogonum trachygonum Torr. subsp. *wrightii* Stokes, Gen. Eriog. 58. 1936.

Throughout the State except in the northeastern and southwestern corners, 3,000 to 7,200 feet, often very abundant, June to October. Colorado to Texas, Arizona, California, and northern Mexico.

The plant affords fair browse for cattle and is, according to Nichol, the most important deer-browse plant in the State. Mrs. Collom reports that the flowers yield a fine, almost colorless honey. A form with involucre glomerate toward the ends of the branches (these more scattered in the typical form) is encountered frequently in southern Arizona and has been collected on Hualpai Mountain (Mohave County). It is subsp. *glomerulum* Stokes.

44. **Eriogonum racemosum** Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 161. 1848.

Apache County to Hualpai Mountain (Mohave County), 5,000 to 9,000 feet, common in yellow pine forests, June to September. Colorado and Utah to western Texas and Arizona.

Redroot eriogonum.

45. **Eriogonum jonesii** S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 454. 1886.

Eriogonum lanosum Eastw., Calif. Acad. Sci. Proc. ser. 4, 20: 140. 1931.

Coconino County and near Peach Springs (Mohave County), 4,500 to 7,000 feet, August and September, type of *E. jonesii* from Cosnino (Coconino County), type of *E. lanosum* from near Canyon Diablo (Coconino County). Southern Utah and northern Arizona.

46. **Eriogonum fasciculatum** Benth., Linn. Soc. London Trans. 17: 411. 1837.

Coconino and Mohave Counties to Pima and Yuma Counties, 2,000 to 4,500 feet, on dry rocky slopes, March to June. Arizona to Nevada and California.

Flat-top buckwheatbrush, California-buckwheat, represented in Arizona by var. *polifolium* (Benth.) Torr. and Gray (*E. polifolium* Benth.), a xerophilous shrub up to about 1 m. (3 feet) high with involucre in dense headlike clusters and whitish or pinkish, slightly fragrant flowers.

47. **Eriogonum sulcatum** S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 296. 1879.

Eriogonum heermanni Dur. and Hilg. subsp. *sulcatum* Stokes, Gen. Eriog. 91. 1936.

Prospect Valley, Coconino County (Goldman 2291), Pagumpa Springs, Mohave County (Jones 5089p), 4,000 to 5,000 feet, September. Utah, Nevada, and Arizona.

48. **Eriogonum howellii** Stokes, Gen. Eriog. 91. 1936.

Lees Ferry and canyon of the Little Colorado River (Coconino County), to Kingman (Mohave County), 2,500 to 5,500 feet, in dry rocky places, August and September. Nevada, northern Arizona, and eastern California.

The type of var. *subracemosum* Stokes, to which all of the Arizona specimens probably belong, was collected 17 miles west of Cameron, Coconino County (*Kearney* and *Peebles* 12818). Specimens collected by M. E. Jones in 1903 and labeled "8 miles south of Vail" (Pima County) are very like *E. howellii*. The locality as stated is almost certainly erroneous.

49. *Eriogonum leptocladon* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2: 129. 1855.

Eriogonum ramosissimum Eastw., Calif. Acad. Sci. Proc. ser. 2, 6: 322. 1896.

Eriogonum pallidum Small, Torrey Bot. Club Bul. 25: 49. 1898.

Eriogonum effusum Nutt. subsp. *leptocladon* Stokes, Gen. Eriog. 81. 1936.

Navajo, Coconino, and Mohave Counties, 3,500 to 5,500 feet, in sandy soil, July to September, type of *E. pallidum* from in or near the Hopi Indian Reservation, Navajo County (*Hough* 30). Utah, New Mexico, and northern Arizona.

50. *Eriogonum pringlei* Coult. and Fish., Bot. Gaz. 17: 351. 1892.

Eriogonum trachygonum Torr. subsp. *pringlei* Stokes, Gen. Eriog. 59. 1936.

"Hills near Maricopa," Pinal County (*Pringle* in 1882, the type collection), Sierra Estrella (Maricopa County), Ajo Mountains (Pima County), and Tinajas Altas (Yuma County), on dry rocky slopes, flowering as late as October. Reported to occur also in southern California.

Closely related to *E. wrightii* Torr., but a larger, shrubbier plant with smaller flowers and involucre.

51. *Eriogonum corymbosum* Benth. in DC., Prodr. 14: 17. 1856.

Navajo County, at Kayenta (*Eastwood* and *Howell* 6547), and Monument Canyon (*Peebles* 11947), also Fredonia, Coconino County (*Eastwood* and *Howell* 6385), 5,000 to 6,000 feet. Colorado to Nevada, New Mexico, and northern Arizona.

The Arizona specimens are not quite typical, approaching *E. aureum* and perhaps better referred to that species.

52. *Eriogonum aureum* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 718. 1895.

Eriogonum corymbosum Benth. var. *divaricatum* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2: 129. 1855.

Eriogonum divergens Small, Torrey Bot. Club Bul. 33: 55. 1906.

Eriogonum microthecum Nutt. subsp. *aureum* Stokes, Gen. Eriog. 76. 1936.

Apache County to northern Mohave County, 5,000 to 8,000 feet, often very abundant, August to October. Colorado to Nevada, New Mexico, and northern Arizona.

The color of the perianth varies from bright yellow to nearly white, sometimes in the same colony. A more pubescent, slightly glutinous form is var. *glutinosum* M. E. Jones, the type of which was collected at Holbrook, Navajo County (*Rusby* in 1883).

53. *Eriogonum leptophyllum* (Torr.) Woot. and Standl., Contrib. U.S. Natl. Herbarium 16: 118. 1913.

Eriogonum effusum Nutt. var. *leptophyllum* Torr. in Sitgreaves, Rpt. Zuñi and Colo. 168. 1854.

Apache and Navajo Counties, 5,000 to 6,000 feet, August to October. Northwestern New Mexico and northeastern Arizona.

54. *Eriogonum simpsoni* Benth. in DC., Prodr. 14: 18. 1856.

Eriogonum macdougalii Gandoger, Soc. Roy. Bot. Belg. Bul. 42²: 191. 1906.

Eriogonum effusum Nutt. subsp. *simpsoni* Stokes, Gen. Eriog. 81. 1936.

Apache County to Mohave and Yavapai Counties, 3,500 to 7,500 feet, July to September. Colorado to Nevada, New Mexico, and Arizona.

One of the commonest species in the yellow pine forests of northern Arizona. Perhaps only a variety of *E. microthecum* Nutt., differing chiefly in its strongly revolute leaf blades. *E. macdougalii* (type *MacDougal* 176, Grand Canyon) is a form with exceptionally long peduncles.

55. *Eriogonum mearnsii* Parry ex Britton, N. Y. Acad. Sci. Trans. 8: 72. 1889.

Navajo, Coconino, and Yavapai Counties, 3,000 to 6,500 feet, August to October. Known only from Arizona.

The typical form, with leaf blades green and glabrous above, is known only from the type collection (Fort Verde, Yavapai County, *Mearns* 179). A much more common form is var. *pulchrum* (Eastw.) Kearney and Peebles (*E. pulchrum* Eastwood) with leaf blades floccose-pubescent and whitish above. The type of *E. pulchrum* was collected at Crater Mound, Coconino County (*Eastwood* 15746).

5. RUMEX.³⁷ DOCK, SORREL

Plants herbaceous, mostly perennial; leaves alternate, simple, the stipules united into a cylindrical, more or less fugacious sheath; flowers perfect or unisexual; perianth calyxlike, 6-parted, the 3 inner segments becoming enlarged and winglike in fruit; stamens 6; stigmas 3; fruit a triangular achene.

Most of the species are coarse plants and several are weeds introduced from the Old World. *R. triangulivalvis* and *R. violascens* are reported to be eaten freely by livestock. The majority flower in summer.

Key to the species

1. Flowers usually dioecious; leaf blades hastately lobed --- 1. *R. ACETOSELLA*.
1. Flowers usually monoecious; leaf blades never hastately lobed (2).
2. Stems erect, ascending, or procumbent, with axillary shoots (3).
3. Leaf blades ovate-lanceolate, broadest below the middle; inner sepals (valves) more than 4.5 mm. long in fruit (4).
4. Inner sepals one or all often bearing a pronounced grainlike callosity. 2. *R. ALTISSIMUS*.
4. Inner sepals without a callosity or one sepal bearing a very narrow elongate callosity (essentially a thickened midnerve). 3. *R. ELLIPTICUS*.

³⁷ Reference: RECHINGER, K. H., JR. THE NORTH AMERICAN SPECIES OF RUMEX. Field Mus. Nat. Hist., Bot. Ser. 17: 1-151. 1937.

3. Leaf blades usually narrower, lanceolate or linear-lanceolate (5).
 5. Inner sepals without callosities..... 4. *R. CALIFORNICUS*.
 5. Inner sepals all, or 1 of them, bearing a callosity, this much narrower than the sepal (6).
 6. Inner sepals about 4 mm. long; achenes about 2.5 mm. long. 5. *R. MEXICANUS*.
 6. Inner sepals about 3 mm. long; achenes about 2 mm. long. 6. *R. TRIANGULIVALVIS*.
2. Stems usually erect and without axillary shoots (7).
 7. Callosities wanting on the inner sepals but the midnerve sometimes thickened (8).
 8. Inner sepals in fruit 10 mm. long or longer, deeply cordate, usually reddish; stipular sheaths firm, persistent; leaf blades thickish. 7. *R. HYMENOSEPALUS*.
 8. Inner sepals in fruit 4 to 5 mm. long; sheaths delicate, fugacious; leaf blades thinnish, the basal ones very large (9).
 9. Lower leaves rounded or cuneate at base, the lateral veins divaricate, forming a right angle with the midvein... 8. *R. ORTHONEURUS*.
 9. Lower leaves more or less cordate at base, the lateral veins somewhat ascending, forming a smaller angle with the midvein. 9. *R. OCCIDENTALIS*.
7. Callosities present on at least 1 of the inner sepals (10).
 10. Inner sepals entire or, if denticulate, then the leaf margins usually distinctly crisped (11).
 11. Leaf blades small, flat, truncate or the lowest cordate at base; inner sepals 2.5 to 3 mm. long, scarcely broader than the thick callosity; inflorescence conspicuously leafy, much interrupted. 10. *R. CONGLOMERATUS*.
 11. Leaf blades large, crisped or undulate on the margin, commonly narrowed (seldom truncate) at base; inner sepals 4 to 6 mm. long, much broader than the callosity; inflorescence not leafy and interrupted, or so only toward the base..... 11. *R. CRISPUS*.
10. Inner sepals dentate or denticulate (12).
 12. Plant perennial; basal leaves not more than 2.5 times as long as wide, cordate at base; inner sepals usually sharply and conspicuously dentate..... 12. *R. OBTUSIFOLIUS*.
 12. Plants mostly annual; basal leaves 3 to 6 times as long as wide (13).
 13. Inner sepals 2.5 to 3 mm. long, short-dentate or denticulate; leaf blades oblanceolate or obovate, commonly about 3 times as long as wide..... 13. *R. VIOLASCENS*.
 13. Inner sepals not more than 2 mm. long, mostly long-dentate; leaf blades linear-lanceolate, usually more than 3 times as long as wide..... 14. *R. FUEGINUS*.

1. *Rumex acetosella* L., Sp. Pl. 338. 1753.

Navajo, Graham, Gila, and Pima Counties, 5,500 to 8,000 feet, occasional. Naturalized almost throughout temperate North America; native of Eurasia.

Sheep sorrel. An abundant and troublesome weed of fields and pastures in other parts of the United States. The herbage is very sour to the taste, containing much oxalic acid.

2. *Rumex altissimus* Wood, Class Book, ed. 2, 477. 1847.

Coconino, Graham, Gila, Cochise, and Pima Counties, 3,000 to 7,000 feet. Eastern and central United States to Arizona.

3. *Rumex ellipticus* Greene, Pittonia 4: 234. 1900.

Pinal Mountains, Gila County (*Peebles* et al. 4432), Tucson, Pima County (*Toumey* 343a), probably more widely distributed in the State. Texas to Arizona.

Scarcely more than a variety of *R. altissimus*.

4. *Rumex californicus* Rech. f., Repert. Spec. Novarum Regni Veg. 40: 297. 1936.

Prescott, Yavapai County (*Peebles* et al. 8861), Tucson, Pima County (*Toumey* 343c). Arizona and California.

Very similar to *R. triangulivalvis* except in the absence of callosities.

- *5. *Rumex mexicanus* Meisn. in DC., Prodr. 14: 45. 1856.

Not definitely known to occur in Arizona but Reehinger cites a specimen from Ship Rock, northwestern New Mexico. New Mexico and Mexico.

6. *Rumex triangulivalvis* (Danser) Rech. f., Repert. Spec. Novarum Regni Veg. 40: 297. 1936.

Rumex salicifolius Weinm. subsp. *triangulivalvis* Danser, Nederl. Kruidk. Arch. 1925: 415. 1926.

Coconino County, from the Kaibab Plateau to Long Valley, 7,000 to 8,500 feet, apparently also near Prescott (Yavapai County). Quebec to British Columbia, south to New Mexico, Arizona, and California.

Arizona specimens previously identified as *R. mexicanus* are referred here by Reehinger. It is doubtful that this form is more than a small-fruited variety of *R. mexicanus*.

7. *Rumex hymenosepalus* Torr., U. S. and Mex. Bound. Bot. 177. 1859.

Rumex arizonicus Britton, N. Y. Acad. Sci. Trans. 7: 73. 1889.

Navajo, Coconino, and Mohave Counties, south to Santa Cruz and Pima Counties, 6,000 feet or lower, common and conspicuous in sandy stream beds, fields, etc., March to April, type of *R. arizonicus* from Fort Verde, Yavapai County (*Mearns* 300). Wyoming to Utah, western Texas, Arizona, northern Mexico, and California.

Canaiigre, wild-rhubarb. The high tannin content has aroused interest in canaiigre but attempts to cultivate the plant have not been financially successful hitherto. The United States Department of Agriculture is now conducting experiments to this end. The petioles make a good substitute for rhubarb in pies. Indians and Mexicans use the leaves of this and other species of *Rumex* for greens and eat the petioles roasted or stewed with sugar. As with other greens that are sufficiently succulent, the Papago Indians roast rather than boil canaiigre leaves, probably because of the frequent scarcity of water. The Hopi and Papago Indians used the roots for treating colds and sore throat and a dye was formerly obtained from them by the Navajos.

8. *Rumex orthoneurus* Rech. f., Repert. Spec. Novarum Regni Veg. 40: 294. 1936.

A very distinct species, known only from the type collection in the Chiricahua Mountains, Cochise County, 7,800 feet (*Blumer* 1449).

9. *Rumex occidentalis* S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 253. 1877.

Rose Creek, Sierra Ancha, Gila County (*Harrison* and *Kearney* 5964), flowering June. Labrador to British Columbia, south to New Mexico, central Arizona, and California.

The collection cited is referred somewhat doubtfully to this species, the inflorescence being exceptionally open and long-branched. The

plants were nearly 2 meters high and the basal leaves up to 40 cm. long.

10. *Rumex conglomeratus* Murr., Prodr. Fl. Göttingen 52. 1770.

Occasional in Maricopa and Pinal Counties, along ditches and streams. Here and there in the United States; naturalized from Europe.

11. *Rumex crispus* L., Sp. Pl. 335. 1753.

Coconino County to the southern border of the State, up to 8,200 feet, along streams and ditches. Naturalized in most of temperate North America; native of Eurasia.

Curlyleaf dock. The plant is reputed to have medicinal value and is sometimes used as a potherb.

12. *Rumex obtusifolius* L., Sp. Pl. 335. 1753.

Chiricahua Mountains, 8,000 feet (*Blumer* 1576), Santa Catalina Mountains, 7,500 feet (*Peebles* et al. 2564). Extensively naturalized in North America; native of Europe.

13. *Rumex violascens* Rech. f., Repert. Spec. Novarum Regni Veg. 39: 171. 1936.

Rumex berlandieri of authors. Not of Meisn.

Catalpa, Gila County (*MacDougal* 751), Phoenix, Maricopa County (*Toumey* 343b), Tucson, Pima County (*Toumey* 342, 343a), Colorado River Valley (*Palmer* 638). Texas to California and Mexico.

14. *Rumex fueginus* Phil., Univ. Chile An. 91: 493. 1895.

Rumex persicarioides Pursh, Fl. Amer. Sept. 248. 1814. Not of L., 1753.

Springerville to Fort Apache, Apache or Navajo County (*Eggleston* 15755). Canada and most of the United States; South America.

6. OXYRIA. MOUNTAIN-SORREL

Plant resembling a small *Rumex* but differing in having reniform leaf blades, 4 sepals, 2 stigmas, and a lenticular achene.

1. *Oxyria digyna* (L.) Camptdera, *Rumex* 155. 1819.

Rumex digynus L., Sp. Pl. 337. 1753.

San Francisco Peaks (Coconino County), 10,000 to 12,000 feet, July and August. Greenland to Alaska, south in the mountains to New Hampshire and northern Arizona; Eurasia.

7. POLYGONUM.³⁸ KNOTWEED, SMARTWEED

Plants herbaceous, annual or perennial, a few species semiaquatic; stems jointed, often swollen at the nodes; leaves alternate, simple, entire, the stipules united in a sheath, this usually cylindric, often lacerate or fringed; flowers small, mostly perfect, in spikes or racemes, or scattered in the leaf axils; pedicels jointed; perianth cleft or parted, with 4 or 5 lobes; stamens 5 to 9; stigmas 2 or 3; achene lenticular or triangular.

³⁸ Reference: SMALL, J. K. A MONOGRAPH OF THE NORTH AMERICAN SPECIES OF THE GENUS POLYGONUM. Columbia Univ. Dept. Bot. Mem. 1: 1-183. 1895.

Many of the species are weeds, but are not troublesome in Arizona. The knotweeds (section *Avicularia*) tend to become abundant on overgrazed land. Some of the smartweeds (section *Persicaria*) have acrid juice which is irritating to the skin, eyes, and nostrils.

Key to the species

1. Stems twining; leaf blades (at least the lower ones) ovate, cordate-sagittate; flowers in loose axillary and terminal racemes or racemiform panicles; outer sepals winged or strongly keeled; flowers greenish white: Section *Bilderdykia*----- 1. *P. CONVULVULUS*.
1. Stems not twining; outer sepals not winged (2).
 2. Leaves with a hingelike joint at the point of attachment of blade and sheath, the blades oblong, elliptic, lanceolate, or linear; flowers in axillary clusters; bracts of the inflorescence with well-developed blades; flowers greenish, whitish, or tinged with pink: Section *Avicularia* (3).
 3. Flowers crowded toward the ends of the branches, the inflorescences appearing like terminal spikes; stems mostly erect (4).
 4. Stems slender, usually less than 15 cm. long; floral leaves little reduced; achenes granular-striate----- 2. *P. WATSONI*.
 4. Stems stout, 30 to 100 cm. long; floral leaves greatly reduced except near the base of the spike; achenes smooth, shiny.
 3. *P. ARGYROCOLEON*.
 3. Flowers scattered along the stems in small axillary clusters (5).
 5. Stems decumbent or prostrate; achenes dark brown, the surface dull and minutely roughened----- 4. *P. AVICULARE*.
 5. Stems usually erect or ascending (6).
 6. Pedicels mostly reflexed or deflexed; leaf sheaths 10 mm. long or longer; perianth 3 to 4 mm. long; achenes black, the surface (sometimes only the angles) shiny and smooth.
 5. *P. DOUGLASSII*.
 6. Pedicels erect or ascending (7).
 7. Stems usually slender; upper leaf blades reduced to subulate bracts; sheaths commonly less than 10 mm. long; perianth not more and usually less than 3 mm. long; achene black, very acutely angled, shiny and smooth----- 6. *P. SAWATCHENSE*.
 7. Stems stout; upper leaf blades often reduced but not subulate; achenes minutely roughened, not very shiny.
 7. *P. RAMOSISSIMUM*.
 2. Leaves without a distinct joint at the point of attachment of blade and sheath; flowers in terminal (sometimes also axillary) spikelike racemes or panicles; bracts of the inflorescence reduced to sheaths (8).
 8. Rootstock usually much thickened and bulblike; radical leaves well developed; inflorescence solitary; plants alpine or subalpine; flowers white or tinged with pink: Section *Bistorta* (9).
 9. Inflorescence narrowly cylindrical, 5 to 8 mm. wide, usually viviparous (bearing bulblets) below----- 8. *P. VIVIPARUM*.
 9. Inflorescence broadly cylindrical or somewhat ovoid, 10 to 20 mm. wide, not viviparous----- 9. *P. BISTORTOIDES*.
 8. Rootstock, if any, not bulblike; radical leaves none: Section *Persicaria* (10).
 10. Inflorescences often solitary, all terminal or nearly so; plants aquatic or semiaquatic; flowers bright pink (11).
 11. Leaf blades obtuse or acute, commonly widest near the middle; inflorescence seldom more than 3 cm. long, more than 10 mm. wide.
 10. *P. AMPHIBIUM*.
 11. Leaf blades acuminate, commonly widest near the base; inflorescence 3 to 10 cm. long, seldom more and often less than 10 mm. wide.
 11. *P. COCCINEUM*.
 10. Inflorescences usually several, axillary as well as terminal; plants not aquatic, but often growing in wet soil (12).
 12. Sheaths without marginal bristles (occasionally short-ciliate when young); flowers pink or pinkish (13).
 13. Inflorescences nodding or drooping, usually numerous, slender and elongate----- 12. *P. LAPATHIFOLIUM*.

13. Inflorescences erect or nearly so (14).
 14. Leaf blades glabrous, or strigose beneath; perianth usually bright pink----- 13. *P. PENNSYLVANICUM*.
 14. Leaf blades floccose-tomentose beneath; perianth pale pink.
 14. *P. INCANUM*.
12. Sheaths with marginal bristles, these sometimes almost wanting in *P. fusiforme* (15).
15. Inflorescences loose, more or less interrupted, narrowly cylindric; perianth greenish, glandular-punctate--- 15. *P. PUNCTATUM*.
15. Inflorescences dense, usually not interrupted; perianth pink, not or very obscurely glandular (16).
16. Internodes normally fusiform-inflated; inflorescences commonly more than 3 cm. long, narrowly cylindric, not more than 6 mm. wide----- 16. *P. FUSIFORME*.
16. Internodes not normally inflated; inflorescences commonly less than 3 cm. long, broadly cylindric or somewhat ovoid, usually more than 6 mm. wide----- 17. *P. PERSICARIA*.

1. *Polygonum convolvulus* L., Sp. Pl. 364. 1753.

Bilderdykia convolvulus Dum., Fl. Belg. 18. 1827.

Coconino, Yavapai, Gila, and Cochise Counties, 5,000 to 8,000 feet, roadsides, etc., July and August. Widely distributed in the United States; naturalized from Eurasia.

Cornbind. The only climbing plant of this family in Arizona.

2. *Polygonum watsoni* Small, Columbia Univ. Dept. Bot. Mem. 1: 138. 1895.

Kaibab Plateau, Coconino County, 9,000 feet (*Mead* 967), August. Saskatchewan to British Columbia, south to New Mexico, northern Arizona, and California.

3. *Polygonum argyrocoleon* Steud. ex Kunze, Linnaea 20: 17. 1847.

Mohave, Maricopa, Pinal, and Yuma Counties, 100 to 3,500 feet, roadsides, April to October. Arizona and California; naturalized from central Asia.

The plant resembles *P. ramosissimum* Michx., but the inflorescences are more spicate.

4. *Polygonum aviculare* L., Sp. Pl. 362. 1753.

Navajo and Coconino Counties to Maricopa, Pinal, and Cochise Counties, 1,000 to 8,000 feet, roadsides, April to October. Widely distributed in North America; naturalized from Eurasia.

The writers are unable to make any satisfactory distinction between *P. buriforme* Small and *P. aviculare*. Some of the Arizona specimens referred to the latter may belong to *P. neglectum* Besser, a very similar Old World species that has also become naturalized in the United States.

5. *Polygonum douglasii* Greene, Calif. Acad. Sci. Bul. 1: 125. 1885.

Apache, Coconino, and Graham Counties, 7,000 to 9,500 feet, June to September. Saskatchewan to British Columbia, south to New Mexico, Arizona, and California.

6. *Polygonum sawatchense* Small, Torrey Bot. Club Bul. 20: 213. 1893.

Apache County to Mohave County, south to Cochise and Pima Counties, 5,500 to 8,000 feet, common in dry pine woods, June to September. South Dakota to Washington, New Mexico, Arizona, and California.

7. *Polygonum ramosissimum* Michx., Fl. Bor. Amer. 1: 237. 1803.

Flagstaff, Coconino County (*Jones* 3991), White Mountains, Apache County (*Griffiths* 5378), August. Widely distributed in North America.

8. *Polygonum viviparum* L., Sp. Pl. 360. 1753.

Bistorta vivipara S. F. Gray, Nat. Arrang. Brit. Pl. 2: 268. 1821.

Inclusion of this species in the Arizona flora rests only upon the doubtful basis of a collection by E. Palmer in 1869, without locality except "Arizona." Greenland to Alaska, south to New Mexico (and Arizona?); Eurasia.

9. *Polygonum bistortoides* Pursh, Fl. Amer. Sept. 271. 1814.

Bistorta bistortoides Small, Torrey Bot. Club Bul. 33: 57. 1906.

Apache, Coconino, and Graham Counties, 8,500 to 9,500 feet, June to August. Montana to British Columbia, New Mexico, Arizona, and California.

A conspicuous plant in wet mountain meadows, with rather tall erect stems and dense spikes of white flowers. Most of the Arizona specimens belong to the glabrous-leaved var. *oblongifolium* (Meisn.) St. John.

10. *Polygonum amphibium* L., Sp. Pl. 361. 1753.

Persicaria amphibia S. F. Gray, Nat. Arrang. Brit. Plants 2: 268. 1821.

Lakeside, Navajo County (*Harrison* 5504), Tuba, Coconino County (*Purchase* 5086), 5,000 to 6,000 feet, in ponds. Quebec to Alaska, south to New Jersey, New Mexico, eastern Arizona, and California; Europe.

Some authorities regard the American plant as specifically distinct from *P. amphibium* of the Old World.

11. *Polygonum coccineum* Muhl. ex Willd., Enum. Pl. 428. 1809.

Polygonum muhlenbergii (Meisn.) S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 245. 1879.

Persicaria muhlenbergii Small in Rydb., Colo. Agr. Expt. Sta. Bul. 100: 111. 1906.

Apache, Navajo, and Coconino Counties, south to Santa Cruz and Pima Counties, 2,300 to 7,200 feet, in ponds, ditches, and marshes, July to September. Maine to Alaska, south to Virginia, Mexico, Arizona, and California.

Persicaria fistulosa, *P. ophiophila*, and *P. rothrockii* of Greene, all based upon Arizona types, seem to be merely forms of *P. coccineum*.

12. *Polygonum lapathifolium* L., Sp. Pl. 360. 1753.

Persicaria lapathifolia S. F. Gray, Nat. Arrang. Brit. Pl. 2: 270. 1821.

Navajo and Coconino Counties to Cochise and Pima Counties, 1,000 to 6,000 feet, along streams, April to October. Throughout most of North America; probably introduced from Europe.

Persicaria granulata Greene is probably a synonym. It was based upon a collection on the Verde River (*Smart* in 1867).

13. *Polygonum pennsylvanicum* L., Sp. Pl. 362. 1753.

Persicaria pennsylvanica Small, Fl. Southeast. U. S. 377. 1903.

In a marsh near Tuba, Coconino County, 5,000 feet (*Kearney* and *Peebles* 12877). Nova Scotia to Minnesota, south to Florida, Arizona, and Mexico.

The collection cited is referred tentatively to var. *laevigatum* Fernald.

14. *Polygonum incanum* F. W. Schmidt, Fl. Boem. 4: 90. 1795.

Near Hannigan, White Mountains, Greenlee County, about 8,700 feet, in wet soil, August (*J. Whitehead* 1557, *Kearney* and *Peebles* 12410, 12430). Introduced sparingly into the United States from Europe.

The specimens cited are referred doubtfully to this species.

15. *Polygonum punctatum* Ell., Bot. S. C. and Ga. 1: 455. 1817.

Persicaria punctata Small, Fl. Southeast. U. S. 379. 1903.

Navajo and Gila Counties to Cochise, Santa Cruz, and Pima Counties, 2,300 to 5,000(?) feet, along streams, July to October. Throughout most of the United States and south to Guatemala.

16. *Polygonum fusiforme* Greene, Erythra 1: 259. 1893.

Persicaria fusiformis Greene, Leaflets 1: 24. 1904.

Sabino Canyon, Pima County, about 3,000 feet (*Thornber* 232, *Harrison* and *Kearney* 7252), August to September. Arizona and southeastern California.

The specimens cited have somewhat less pointed achenes than the type, which came from the Colorado River Valley in California.

17. *Polygonum persicaria* L., Sp. Pl. 361. 1753.

Persicaria maculosa S. F. Gray, Nat. Arrang. Brit. Pl. 2: 269. 1821.

Grand Canyon, Flagstaff, and Williams (Coconino County), Prescott (Yavapai County), Huachuca Mountains (Cochise County), 5,000 to 7,000 feet, marshy places along streams, July to September. Extensively naturalized in North America, from Europe.

8. FAGOPYRUM. BUCKWHEAT

An annual glabrous herb; leaves alternate, petioled, with broad hastate blades; flowers in terminal or axillary racemes, these usually forming panicles; perianth greenish white, 5-parted; stamens 8; style 3-parted; achene triangular.

1. *Fagopyrum esculentum* Moench, Meth. Pl. 290. 1794.

Near Patagonia, Santa Cruz County, at roadside (*Peebles* et al. 5613). An escape from cultivation in many parts of the United States but scarcely naturalized.

34. CHENOPODIACEAE. GOOSEFOOT FAMILY

Plants herbaceous or shrubby; leaves simple, without stipules; flowers perfect or unisexual, not showy; perianth when present with 1 to 5 segments; stamens as many as or fewer than the perianth

segments, opposite them; styles 2 or 3; ovary 1-celled; fruit a 1-seeded utricle.

This large family includes the cultivated sugar beet, garden beet, and spinach. Many of the species are weeds, and some of them are valuable for browse and grazing. Species of *Atriplex* and other genera are characteristic plants of strongly saline and alkaline soils, often taking up so much sodium chloride from the soil solution as to give the herbage a distinctly salty taste.

Key to the genera

1. Embryo spirally coiled; leaf blades narrow, entire, either thick and fleshy or spine-tipped (2).
2. Flowers without bractlets, monoecious, the staminate ones in catkinlike spikes naked; perianth of the pistillate flowers confluent with the ovary. 13. *SARCOBATUS*.
2. Flowers with a pair of bractlets and a perianth, mostly perfect, never in catkinlike spikes; perianth free from the ovary (3).
3. Bractlets minute, scalelike, much shorter than the perianth; fruiting perianth scarcely enlarged, connivent, not winglike, remaining fleshy; plants mostly perennial, often suffrutescent; leaves soft and fleshy, subterete ----- 14. *SUAEDA*.
3. Bractlets narrow, elongate, equaling or longer than the perianth; fruiting perianth greatly enlarged, spreading, winglike, dry, scarious; plant annual, becoming hard and prickly, the intricately branched stem breaking off at the surface of the ground and becoming a tumble weed; leaves strongly spine-tipped ----- 15. *SALSOLA*.
1. Embryo not spirally coiled, circular to horseshoe-shaped, or conduplicate (4).
4. Leaves reduced to small scales; stems appearing jointed; flowers in dense, continuous, cylindrical, fleshy spikes, perfect ----- 12. *ALLENROLFEA*.
4. Leaves with well-developed blades; stems not appearing jointed; flowers not in dense, continuous, fleshy spikes (5).
5. Perianth segments strongly imbricate, nearly distinct; individual flowers relatively conspicuous; leaves opposite ----- 1. *NITROPHILA*.
5. Perianth segments, if present, not or only slightly imbricate; individual flowers inconspicuous; leaves all or most of them alternate (6).
6. Fruit at maturity naked; flowers perfect, in long slender spikes, without bractlets, borne in the axils of conspicuous, scarious-margined bracts but not enclosed by them ----- 11. *CORISPERMUM*.
6. Fruit at maturity enclosed by the perianth or by the enlarged bractlets (7).
7. Pubescence of the herbage pilose, villous, or lanate, the hairs simple and slender; flowers mostly perfect (8).
8. Perianth in fruit not winged, bearing a dorsal tubercle or spine on each segment; plant annual; stem tall, much-branched; leaf blades linear, entire ----- 9. *ECHINOPSIS*.
8. Perianth in fruit with conspicuous, scarious, horizontal wings (9).
9. Plant annual; stems not tufted, much-branched; leaf blades thin and flat, oblong, coarsely sinuate-dentate; wing of the perianth annular, continuous or nearly so -- 3. *CYCLOLOMA*.
9. Plant perennial; stems numerous, tufted, simple or sparingly branched above; leaf blades thick, subterete, narrow, entire; wing of the perianth in 5 wedge-shaped segments. 10. *KOCHIA*.
7. Pubescence of the herbage wholly or partly of stellate, glandular, or inflated hairs (the last collapsing and scurflike when dry), seldom none; perianth, if any, not spiny or horizontally winged (10).
10. Flowers mostly perfect, without bractlets, with a perianth; plants herbaceous (11).
11. Perianth segments and stamens 3 to 5; upper leaves of the inflorescence usually much reduced ----- 2. *CHENOPODIUM*.
11. Perianth segment and stamen one; upper leaves of the inflorescence little reduced ----- 4. *MONOLEPIS*.

10. Flowers unisexual, monoecious or dioecious (or some of them perfect in *Eurotia*), the pistillate flowers with bractlets and usually without a perianth; bractlets becoming enlarged and enclosing the fruit; plants mostly woody, at least at base (12).
12. Pubescence entirely or chiefly of simple inflated hairs, these collapsing and scurflike when dry (13).
13. Bractlets separate, at least near the apex; seeds all vertical, or both vertical and horizontal on the same plant----- 5. *ATRIplex*.
13. Bractlets united up to the depressed apex; seeds all horizontal----- 6. *ZUCKIA*.
12. Pubescence of branched, scarcely inflated hairs; bractlets united to the middle or higher; seeds vertical (14).
14. Fruiting bractlets very thin and flat, glabrous or scurfy-pubescent, winged, more or less retuse at apex; herbage puberulent or glabrate----- 7. *GRAYIA*.
14. Fruiting bractlets forming a 2-beaked tube, densely long-villous, not winged; herbage conspicuously and densely stellate-pubescent----- 8. *EUROTIA*.

1. NITROPHILA

A glabrous perennial herb; stems numerous, tufted, not more than 30 cm. long; leaves opposite, fleshy, narrow, semiterete; flowers perfect, axillary, conspicuous for the family, pink or white; perianth segments and the stamens usually 5; style larger than the ovary, persistent.

1. *Nitrophila occidentalis* (Nutt.) S. Wats. in King, Geol. Expl. 40th Par. 5: 297. 1871.

Halimocnemis occidentalis Nutt. ex Moq. in DC., Prodr. 13²: 279. 1849.

Gila Crossing, Pinal County, 1,200 feet (*Plumb* 75, *Peebles* 13232), in moist saline soil, April to May. Oregon to Arizona and California.

2. CHENOPODIUM.³⁹ GOOSEFOOT, PIGWEED

Plants herbaceous, annual or perennial, often mealy, sometimes glandular-pubescent; leaves alternate, with entire to pinnatifid blades; flowers green, perfect, in glomerules, these axillary or forming spikes or panicles; perianth herbaceous or fleshy, with 2 to 5 lobes or segments; stamens 2 to 5.

Plants mostly weedlike. Several of the species occurring in Arizona are said to be eaten freely by sheep and cattle. The Indians use the leaves for greens and the seeds of certain species for making mush and cakes, sometimes mixing them with corn meal. *C. ambrosioides* yields oil of chenopodium, distilled from the leaves and stems, which is a powerful anthelmintic.

Key to the species

1. Perianth at maturity bright red, fleshy; flowers in dense glomerules, these in elongate spikes----- 1. *C. CAPITATUM*.
1. Perianth not bright red at maturity (2).
2. Foliage and inflorescence glandular-pubescent or resinous-granular, not farinose; plants strong scented; leaf blades (some or all of them) coarsely toothed or pinnatifid (3).
3. Flowers densely glomerate, the glomerules in elongate, leafy, axillary spikes; odor fetid----- 2. *C. AMBROSIOIDES*.

³⁹ Reference: ALLEN, P. BEITRAG ZUR SYSTEMATIK DER CHENOPODIUM-ARTEN AMERIKAS. Repert. Spec. Novarum Regni Veg. 26: 31-64, 119-160. 1929.

3. Flowers solitary or loosely clustered, in dichotomous cymes; odor pronounced but not fetid (4).
4. Plant glabrous or sparsely puberulent, subspinescent at maturity; calyx resinous-granular, the lobes corniculate-appendaged ----- 3. *C. INCISUM*.
4. Plant copiously glandular-hirtellous; calyx not or scarcely granular, the lobes not appendaged ----- 4. *C. BOTRYS*.
2. Foliage and inflorescence not glandular (5).
5. Plant not farinose, glabrous throughout or very nearly so, green, often tinged with red; leaf blades thin, coarsely toothed or pinnatifid, deltoid or rhombic-ovate, cuneate at base; seeds mostly vertical ----- 5. *C. RUBRUM*.
5. Plant more or less farinose, at least on the lower surface of the leaves, or on the calyx (6).
6. Seeds mostly vertical, their surface minutely roughened; inflorescence often sparsely pilose (some of the hairs more or less elongate); leaf blades green above, densely white-farinose beneath, sinuate-dentate ----- 6. *C. GLAUCUM*.
6. Seeds all or mostly horizontal; inflorescence with scaly (farinose) pubescence only, none of the hairs elongate (7).
7. Plant bright green, the lower leaf surface and inflorescence sparsely farinose; flowers mostly in axillary panicles not or not greatly surpassing the leaf blades; leaf blades (at least the lower ones) broadly deltoid or rhombic-ovate, coarsely and often sharply dentate; pericarp closely adherent to the sharp-edged seed. ----- 7. *C. MURALE*.
7. Plant not bright green, or the flowers mostly in elongate, terminal and axillary panicles, or the pericarp not closely adherent and the seeds shiny (8).
8. Leaf blades linear, lanceolate, or narrowly oblong, usually at least 3 times as long as wide, entire or slightly hastate; petioles seldom more and usually less than one-third as long as the blade; seeds not more than 1 mm. in diameter (9).
9. Pericarp free from the smooth, shiny, black seed. ----- 8. *C. LEPTOPHYLLUM*.
9. Pericarp closely adherent to the seed (10).
10. Leaf blades prevailingly linear or linear-lanceolate; calyx open at full maturity, its lobes not strongly carinate. ----- 9. *C. INAMOENUM*.
10. Leaf blades prevailingly oblong or oblong-lanceolate; calyx partly closed at maturity, its lobes strongly carinate. ----- 10. *C. HANS*.
8. Leaf blades broadly oblong, lance-ovate, or broader, usually less than 3 times as long as wide; petioles seldom less and usually more than one-third as long as the blade (11).
11. Leaf blades often more than 3 cm. long, considerably longer than wide, mostly deltoid or rhombic-ovate, the margins sinuate or dentate; plant usually green, seldom densely farinose (12).
12. Seeds smooth and very shiny ----- 11. *C. ALBUM*.
12. Seeds minutely alveolate, not very shiny. ----- 12. *C. BERLANDIERI*.
11. Leaf blades usually less than 3 cm. long, not, or but slightly, longer than wide, deltoid, mostly subhastately toothed or lobed near the base, the margins otherwise entire (13).
13. Plants spreading, whitish, copiously farinose; branches stout, divergent; leaf blades thick: species of very similar appearance (14).
14. Pericarp closely adherent to the seed; plant very ill-scented. ----- 13. *C. WATSONI*.
14. Pericarp free; seeds smooth and shining ----- 14. *C. INCANUM*.
13. Plants erect, more or less virgate; branches ascending, usually slender; leaf blades thin (15).
15. Pericarp free from the smooth, shiny, black seed; plant usually sparsely farinose and green ----- 15. *C. FREMONTII*.
15. Pericarp closely adherent to the seed; plant usually rather copiously farinose and whitish --- 16. *C. ARIZONICUM*.

1. **Chenopodium capitatum** (L.) Asch., Fl. Brand. 572. 1864.

Blitum capitatum L., Sp. Pl. 4. 1753.

Kaibab Plateau, Flagstaff, San Francisco Peaks, and Grand Canyon (Coconino County), White Mountains (Apache County), 7,000 to 9,500 feet, in rich moist soil, June to August. Quebec to Alaska, south to New Jersey, New Mexico, Arizona, and Oregon; Europe.

Strawberry-blite.

2. **Chenopodium ambrosioides** L., Sp. Pl. 219. 1753.

Pinal, Maricopa, Cochise, and Yuma Counties, occasional at roadsides. Throughout most of the United States, introduced from tropical America.

Spanish-tea, Mexican-tea. Plant fetid.

3. **Chenopodium incisum** Poir. in Lam., Encycl. Sup. 1: 392. 1810.

Chenopodium cornutum (Torr.) Benth. and Hook. ex S. Wats., Bot. Calif. 2: 482. 1880.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 5,000 to 9,000 feet, usually in pine woods, August to September. Western Texas and Colorado to Arizona, south to Costa Rica.

Represented in Arizona by var. *neomexicanum* Aellen, the type of which was collected in the Santa Catalina Mountains (*Harrison* 3026). Plant with a strong but not unpleasant odor, turning bright red in fall.

4. **Chenopodium botrys** L., Sp. Pl. 219. 1753.

Yavapai and Maricopa Counties, 1,000 to 5,500 feet, at roadsides. Extensively naturalized in North America, from Europe.

Jerusalem-oak, feather-geranium.

*5. **Chenopodium rubrum** L., Sp. Pl. 218. 1753.

Not known to occur in Arizona but has been collected in northwestern New Mexico. Widely distributed in the United States, probably an introduction from Eurasia.

6. **Chenopodium glaucum** L., Sp. Pl. 220. 1753.

Apache and Navajo Counties, 5,000 to 6,000 feet, in saline soil, July to August. Probably naturalized from Europe.

The Arizona form is var. *salinum* (Standl.) Aellen (*C. salinum* Standl.).

7. **Chenopodium murale** L., Sp. Pl. 219. 1753.

Coconino to Cochise and Pima Counties, 1,000 to 8,000 feet, flowering throughout the year. Widely distributed in North America, naturalized from Europe.

Nettleleaf goosefoot. A common weed in waste places in southern Arizona.

8. **Chenopodium leptophyllum** Nutt. ex S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 94. 1874.

Apache, Navajo, and Coconino Counties, south to Cochise, Gila, and Pinal Counties, 1,300 to 8,000 feet, May to September. Manitoba and Alberta, south to northern Mexico and California.

The typical form of the species, with linear entire 1-nerved leaves, and var. *leptophylloides* (Murr) Thellung und Aellen (*C. pratericola* Rydb.) with oblong or oblong-lanceolate leaves, the lower ones 3-nerved and subhastately toothed, are both common in Arizona. They are usually tall and only moderately farinose. The var. *desiccatum* (A. Nels.) Aellen (*C. desiccatum* A. Nels.), is known in Arizona only by a collection in Apache County (*Griffiths* 5832). It is a lower, more diffusely branched, copiously farinose plant.

9. *Chenopodium inamoenum* Standl., North Amer. Fl. 21: 15. 1916.

Painted Desert, Apache County (*Eastwood* and *Howell* 6902), Nagle Ranch, Coconino County, 7,300 feet (*Jones* 6050 f). Wyoming to Oregon, south to Chihuahua and Arizona.

10. *Chenopodium hians* Standl., North Amer. Fl. 21: 16. 1916.

Wupatki National Monument, Coconino County, altitude 5,700 feet (*Whiting* 5288.)

11. *Chenopodium album* L., Sp. Pl. 219. 1753.

Sacaton (Pinal County), possibly also in Walnut Canyon (Coconino County) and at Prescott (Yavapai County), a weed in cultivated and waste land. Naturalized almost throughout North America, from Europe.

Lambsquarters.

12. *Chenopodium berlandieri* Moq., *Chenop. Monog.* 23. 1840.

Apache County to Coconino County, near Elgin (Santa Cruz County), probably elsewhere in the State, up to 7,000 feet. Western Kansas to Arizona and California, southward to South America.

Represented in Arizona by var. *zschackei* (Murr) Aellen, with leaf blades entire or shallowly dentate, and by var. *pseudopetiolare* Aellen (*C. petiolare* of authors, not H.B.K.), with leaf blades subhastately 3-lobed. This species (especially var. *zschackei*) closely resembles *C. album*, being scarcely distinguishable except by the seed character.

13. *Chenopodium watsoni* A. Nels., *Bot. Gaz.* 34: 362. 1902.

Navajo County to eastern Mohave County, south to Greenlee and Santa Cruz Counties, 1,300 to 7,000 feet, June to August. Montana to New Mexico and Arizona.

14. *Chenopodium incanum* (S. Wats.) Heller, *Plant World* 1: 23. 1897.

Chenopodium fremontii var. *incanum* S. Wats., *Amer. Acad. Arts. and Sci. Proc.* 9: 94. 1874.

Apache County to Mohave County, south to Pima County, 1,300 to 5,200 feet, June to September. Nebraska to Utah, south to Chihuahua and Arizona. Apparently intergrades in Arizona with *C. fremontii*.

15. *Chenopodium fremontii* S. Wats. in King, *Geol. Expl.* 40th Par. 5: 287. 1871.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 9,000 feet, July to September. North Dakota to British Columbia, south to Texas, Arizona, and Mexico.

A common plant in chaparral and pine forests, furnishing feed for cattle in autumn.

16. *Chenopodium arizonicum* Standl., North Amer. Fl. 21: 19. 1916.

Pinal and Pima Counties, 4,000 to 7,800 feet. Known only from Arizona, where the type was collected in foothills of the Santa Rita Mountains (*Griffiths* 5982).

3. CYCLOLOMA

Annual herbs with diffusely branched stems; leaves coarsely sinuate-dentate; inflorescence a panicle of interrupted spikes; flowers sessile; perianth 5-lobed, in fruit developing a thin, horizontal, irregularly denticulate wing; stamens 5; utricle depressed; seed horizontal.

Plant becoming a "tumbleweed." The Indians made mush and cakes from the ground-up seeds.

1. *Cycloloma atriplicifolium* (Spreng.) Coult., Torrey Bot. Club Mem. 5: 143. 1894.

Salsola atriplicifolia Spreng., Nachtr. Bot. Gart. Halle 1: 35. 1801.

Navajo and Coconino Counties, also near Tempe (Maricopa County), 1,100 to 6,000 feet. Indiana to Manitoba, south to Texas and Arizona.

4. MONOLEPIS. PATATA, PATOTA

Annual, slightly succulent, nearly glabrous herb; stems low, diffuse or prostrate; flowers in small axillary clusters; perianth reduced to a single persistent segment; stamen 1; utricle compressed laterally.

The plant affords good spring pasturage for cattle and is used as greens by the Indians, who also make pinole from the seeds.

1. *Monolepis nuttalliana* (Schult.) Greene, Fl. Francisc. 168. 1891.

Blitum nuttallianum Schult., Mant. 1: 65. 1822.

Apache County to Pima and Yuma Counties, commonly 3,000 feet or lower, abundant in southern Arizona, January to April. Manitoba and Alberta, south to Texas, Sonora, and California.

5. ATRIPLEX.⁴⁰ SALTBUSH, ORACHE

Plants annual or perennial, herbaceous or shrubby, mostly mealy; leaves commonly alternate, entire to sinuate-dentate; flowers monoecious or dioecious, in glomerules, these axillary or (the staminate ones especially) forming terminal spikes or panicles; perianth of the staminate flowers 3- to 5-parted; pistillate flowers without a perianth, subtended by 2 connivent bracts (bractlets), these in fruit enlarged, usually more or less connate, often dentate or tuberculate.

Most of the species are very salt tolerant, and flower in summer and early autumn. The shrubby species are good browse, especially in winter. Some of the herbaceous species, also, are grazed by livestock. The salty taste of the plants probably increases their palatability. The fruits are very nutritious. The Indians used to depend on the saltbushes as a source of meal, which was made from the parched seeds and, like the pinole made from mesquite pods, sometimes was drunk

⁴⁰ Reference: HALL, H. M., and CLEMENTS, F. E. THE PHYLOGENETIC METHOD IN TAXONOMY. THE GENUS ATRIPLEX. Carnegie Inst. Wash. Pub. 326: 235-346. 1923. The species are arranged here in the sequence used by Hall and Clements.

mixed with water. The leaves and young shoots were used for greens, the Hopi Indians usually boiling them with meat. This tribe is reported to have used the ashes of *A. canescens* as a substitute for baking powder. The pollen of many species is a cause of hay fever.

Key to the species

1. Fruiting bracts fleshy-thickened and bright red at maturity, deltoid-cuneate, coarsely few-toothed; plant perennial; stems prostrate or nearly so, sometimes woody below, much-branched; leaf blades whitish scurfy beneath, glabrate above, oblong or obovate-oblong, shallowly dentate or entire.
 3. *A. SEMIBACCATA.*
1. Fruiting bracts not becoming fleshy-thickened and bright red (2).
 2. Stems herbaceous; plants mostly annual, commonly monoecious, the staminate and pistillate flowers in the same or in separate clusters (3).
 3. Leaf blades triangular-hastate, commonly becoming glabrate and green on both faces, the lowest leaves often opposite; fruiting bracts acute or acutish, rounded deltoid, often hastate, united only at base.
 1. *A. PATULA.*
 3. Leaf blades not distinctly hastate, sometimes subhastate, usually remaining scurfy and whitish, grayish, or yellowish, at least on the lower surface (4).
 4. Fruiting bracts (often those in the same axil) commonly distinctly dimorphic, some of them wedge-shaped, about 3 mm. long, broadly truncate and emarginate or denticulate at apex and with smooth faces, others rounded-triangular or suborbicular, larger, with dentate margins and prominently crested faces; leaf blades more or less cordate at base, broadly triangular to suborbicular, the margins entire.----- 4. *A. SACCARIA.*
 4. Fruiting bracts not noticeably dimorphic; leaf blades not cordate at base (5).
 5. Bracts of the fruits orbicular, their margins herbaceous and evenly dentate all around----- 7. *A. ELEGANS.*
 5. Bracts of the fruits not orbicular (sometimes semiorbicular in *A. argentea*), their margins not herbaceous and evenly dentate all around (6).
 6. Leaf blades strongly 3-nerved from the base with long, ascending, lateral nerves, entire, whitish farinose beneath; fruiting bracts conspicuously differentiated into a 2- to several-crested basal portion and a smooth, truncate and apiculate, or acute, apical portion; plant sometimes with arachnoid as well as scurfy pubescence----- 6. *A. POWELLII.*
 6. Leaf blades not strongly 3-nerved from the base, or if so, the lateral nerves short or spreading or the margins of the blades dentate; fruiting bracts not conspicuously differentiated basally and apically (7).
 7. Staminate flowers in conspicuous naked or nearly naked terminal panicles; leaf blades seldom less than 3 times as long as wide; fruiting bracts 2 to 3 mm. long (8).
 8. Leaf blades obtuse to acute at apex, commonly widest above the middle, densely white-farinose beneath when mature; fruiting bracts strongly ribbed but usually not tuberculate on the faces, broadly deltoid or somewhat wedge-shaped, coarsely dentate----- 8. *A. WRIGHTII.*
 8. Leaf blades sharply acute or acuminate at apex, widest at or below the middle, sparsely farinose or glabrate beneath when mature; fruiting bracts usually tuberculate on the faces----- 9. *A. SERENANA.*
 7. Staminate flowers not in conspicuous naked panicles; leaf blades less than 3 times as long as wide; fruiting bracts more than 3 mm. long at maturity (9).
 9. Leaf blades oblong-lanceolate to ovate, conspicuously and sometimes acutely dentate, sometimes green and glabrate on both faces when mature; fruiting bracts rhombic or deltoid, cuneate at base, acutish to short-acuminate at apex, dentate, strongly 3-nerved, usually short-crested on the faces.
 2. *A. ROSEA.*

9. Leaf blades rounded-triangular or triangular-subhastate, entire or inconspicuously repand-dentate; fruiting bracts obovate-cuneate or semiorbicular, more or less truncate at apex, lacinate, not strongly 3-nerved, usually conspicuously long-crested on the faces..... 5. *A. ARGENTEA*.
2. Stems woody, at least near the base; plants mostly dioecious (10).
10. Fruits conspicuously 4-winged, the wings much broader than the body of the fruit and extending to its base; plants shrubby; glomerules of flowers mostly aggregated in leafy or nearly naked panicles of spikes terminating the branches; leaf blades with entire margins, linear, oblong-lanceolate, or spatulate (11).
11. Leaf blades commonly less than 3 mm. wide; fruiting bracts 4 to 8 mm. long, with free tips commonly much surpassing the wings, the latter coarsely dentate to lacinate; herbage whitish.
18. *A. LINEARIS*.
11. Leaf blades commonly more than 3 mm. wide; fruiting bracts 6 to 20 mm. long; herbage grayish or yellowish green (12).
12. Blades usually broadest above the middle and less than 1 cm. wide; free tips of the fruiting bracts commonly not surpassing the wings; shrub 0.4 to 1.5 m. high..... 19. *A. CANESCENS*.
12. Blades usually broadest at the middle and 1 cm. wide or wider; free tips of the fruiting bracts commonly surpassing the wings; undershrub less than 0.4 m. high..... 20. *A. GARRETTII*.
10. Fruits not 4-winged (13).
13. Bracts of the fruits with entire to denticulate margins, rounded-deltoid, orbicular, or reniform, the faces smooth (14).
14. Leaf blades deeply and rather sharply dentate or lacinate; plant not spinescent; foliage silvery white; fruiting bracts separate, thin, strongly compressed, entire..... 15. *A. HYMENELYTRA*.
14. Leaf blades sometimes subhastate, the margins often entire; plants commonly spinescent, the ends of the branches becoming indurate and sharp pointed (15).
15. Glomerules of flowers in slender, dense or interrupted, elongate, often drooping spikes commonly aggregated in large open terminal panicles, these leafy or nearly naked toward apex; fruiting bracts not more than 6 mm. long, sometimes united up to the middle, usually crenulate; leaf blades oblong to deltoid-ovate, often subhastate; plants commonly tall, 1 to 3 m. high.
16. *A. LENTIFORMIS*.
15. Glomerules of flowers small and dense, axillary or in short leafy spikes, the pistillate flowers sometimes solitary; fruiting bracts 5 to 15 mm. long, united only at base, entire or denticulate; leaf blades oval, ovate, obovate, or suborbicular, never subhastate-deltoid; plant usually rounded and compact, less than 1 m. high..... 17. *A. CONFERTIFOLIA*.
13. Bracts of the fruits normally with dentate to lacinate margins, the faces often tuberculate or crested (16).
16. Leaf blades with sinuate or sinuate-dentate (seldom entire) margins; fruiting bracts pedicellate, 6 to 14 mm. long, with lacinate margins and the faces bearing long hornlike processes; plant suffrutescens; foliage usually silvery white.... 10. *A. ACANTHOCARPA*.
16. Leaf blades with entire margins; fruiting bracts not more than 6 mm. long (17).
17. Plant an intricately and rigidly branched shrub; stems 0.5 to 2 m. high; leaf blades mostly less than 1 cm. long; fruiting bracts normally deeply dentate on nearly the whole margin, including the truncate apex..... 14. *A. POLYCARPA*.
17. Plants suffrutescens; stems not more than 0.5 m. high; leaf blades seldom less than 1 cm. long (18).
18. Apical portion of the fruiting bracts broadly deltoid, with margins entire or denticulate..... 13. *A. CORRUGATA*.
18. Apical portion of the fruiting bracts truncate and dentate, or entire and beaklike, the faces bearing a few short blunt appendages or nearly smooth (19).
19. Bracts united only at the truncate or subcordate base; herbage silvery..... 11. *A. OBOVATA*.
19. Bracts united above the broadly cuneate base; herbage yellowish..... 12. *A. JONESII*.

1. *Atriplex patula* L., Sp. Pl. 1053. 1753.

Winslow, Navajo County (*Griffiths* 5034), Moenkopi, Coconino County (*Clute* 63), 4,500 to 5,000 feet, reported to be common in Moenkopi Wash.

Represented in Arizona by var. *hastata* (L.) Gray, which is widely distributed in Canada and the United States.

2. *Atriplex rosea* L., Sp. Pl. ed. 2, 1493. 1763.

Apache County to Coconino County, south to Maricopa County, 1,000 to 7,000 feet. Extensively naturalized in the western United States, from Europe.

Redscale, red orache. A common weed in waste places in parts of northern Arizona.

3. *Atriplex semibaccata* R. Br., Prodr. Fl. Nov. Holl. 406. 1810.

Near Safford (Graham County), Salt River Valley (Maricopa County), 1,000 to 3,000 feet. New Mexico, Arizona, and California; naturalized from Australia.

Australian saltbush. Introduced into the United States about 45 years ago, now a common weed in southern Arizona. The low plants help bind the soil along irrigation ditches, crowd out undesirable weeds, and furnish forage for domestic animals, particularly sheep.

4. *Atriplex saccaria* S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 112. 1874.

Apache County to Coconino County, 4,500 to 6,000 feet. Wyoming and Utah to New Mexico and Arizona.

Plants apparently sometimes dioecious.

5. *Atriplex argentea* Nutt., Gen. Pl. 1: 198. 1818.

Apache, Navajo, and (probably) Coconino Counties, about 5,000 feet. North Dakota to New Mexico, northern Arizona, and California.

This plant is a tumbleweed. The species is represented in Arizona by *A. caput-medusae* Eastw., a form in which the faces of the fruiting bracts are covered with long, often twisted, hornlike processes, but it is stated (see footnote 40, p. 267, Hall and Clements, p. 285) that this form intergrades completely with typical *A. argentea*.

6. *Atriplex powellii* S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 114. 1874.

Apache County to eastern Coconino County, 5,000 to 6,000 feet. South Dakota and Montana to New Mexico and Arizona.

Griffiths reported that this species covers extensive areas of denuded land in the Little Colorado River region. The plants apparently are sometimes dioecious.

7. *Atriplex elegans* (Moq.) D. Dietr., Syn. Pl. 5: 537. 1852.

Obione elegans Moq. in DC., Prodr. 13²: 113. 1849.

Greenlee, Maricopa, Pinal, Cochise, Santa Cruz, Pima, and Yuma Counties, 3,600 feet or lower. Western Texas to southern California and northern Mexico.

A plant of weedlike habit, very common at roadsides and in waste land in southern Arizona, and freely grazed by cattle. The Pima Indians boiled it with other food, sometimes with the flower buds of

Opuntia. Three forms, all intergrading, and similar in geographical distribution, occur in Arizona. In var. *fasciculata* (S. Wats.) M. E. Jones (*A. fasciculata* S. Wats.) the margins of the fruits commonly are dissected only half way to the base, with relatively broad teeth, the stems are decumbent or nearly prostrate, and the leaf blades are obovate or broadly spatulate, commonly more than 6 mm. wide. In typical *A. elegans* the margins of the fruits are dissected nearly or quite to the base with slender teeth, the stems tend to be erect, and the leaf blades are usually narrower. The var. *thorneri* M. E. Jones differs from typical *A. elegans* only in having the faces of the bracts prominently crested.

8. *Atriplex wrightii* S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 113. 1874.

Coconino County to Cochise and Pima Counties, 1,000 to 7,000 feet. Southern New Mexico, Arizona, and Sonora.

Common, especially in southern Arizona, in similar habitats as are occupied by *A. elegans*. It is usually a larger plant than the latter. This is one of the species held by the Indians in particular esteem as a potherb.

9. *Atriplex serenana A. Nels. in Abrams, Fl. Los Angeles 128. 1904.

Obione bracteosa Dur. and Hilg., U. S. Rpt. Expl. Miss. Pacif. 5³: 13. 1858.

Atriplex bracteosa (Dur. and Hilg.) S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 115. 1874. Not Trautv. 1870.

Not known to occur in Arizona but has been collected at Needles, Calif., on the Colorado River.

10. *Atriplex acanthocarpa* (Torr.) S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 117. 1874.

Obione acanthocarpa Torr., U. S. and Mex. Bound. Bot. 183. 1859.

Gila River Valley near Safford (Graham County), about 3,300 feet, in saline soil. Western Texas to southern Arizona and northern Mexico.

The Arizona specimens referred doubtfully to this species have the fruiting bracts less united and thinner and less spongy in texture than in typical *A. acanthocarpa*. Apparently they represent a transition to *A. obovata*, with which they were growing.

11. *Atriplex obovata* Moq., Chenop. Monog. 61. 1840.

Atriplex greggii S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 118. 1874.

Near Safford (Graham County), 2,600 to 3,300 feet. Western Texas to southern Arizona and northern Mexico.

12. *Atriplex jonesii* Standl., North Amer. Fl. 21: 65. 1916.

Atriplex sabulosa M. E. Jones, Contrib. West. Bot. 11: 21. 1903. Not of Rouy, 1890.

Apache County to eastern Coconino County, 3,500 to 5,000 feet, in dry saline soil. Northwestern New Mexico and northeastern Arizona.

This species has been united with *A. obovata* (see footnote 40, p. 267),

Hall and Clements), but it has a different geographical distribution and the writers believe it to be specifically distinct. The plants are readily browsed by cattle, sheep, and goats.

*13. **Atriplex corrugata** S. Wats., Bot. Gaz. 16: 345. 1891.

Not known definitely to occur in Arizona but has been collected in northwestern New Mexico, near the Arizona State line.

14. **Atriplex polycarpa** (Torr.) S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 117. 1874.

Obione polycarpa Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 130. 1857.

Maricopa, Pinal, Pima, Mohave, and Yuma Counties, 2,500 feet or lower, very abundant on sandy-gravelly plains and mesas. Arizona to Nevada, southern California, and northwestern Mexico.

Cattle-spinach, desert saltbush, allscale, commonly known in Arizona by the confusing names "sage" and "sagebrush." In the deserts of southwestern Arizona it covers vast areas of moderately saline or nonsaline soil, in pure stands or associated with creosotebush (*Larrea*), the bushes often symmetrically rounded and evenly spaced. It is by far the most important native forage plant of that region, which, however, is too arid to support many cattle.

15. **Atriplex hymenelytra** (Torr.) S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 119. 1874.

Obione hymenelytra Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 129. 1857.

Near Mead Lake, Mohave County (*Clover* 4291), and in Yuma County, below 1,000 feet, in dry sandy or stony soil. Arizona, Nevada, and southeastern California.

Desertholly. The silvery, evergreen leaves are gathered for Christmas decorations and winter bouquets, and are sometimes dyed or gilded.

16. **Atriplex lentiformis** (Torr.) S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 118. 1874.

Obione lentiformis Torr. in Sitgreaves, Zuñi and Colo. Rpt. 169. 1853.

Coconino and Mohave Counties, south to Pima and Yuma Counties, 4,200 feet or (usually) lower, in moist or dry saline soil. Southern Utah and Nevada to Sonora and California.

Quailbrush, lenscale, sometimes known in Arizona as white-thistle. This is the largest and showiest saltbush in Arizona, reaching a height of 10 feet where the watertable is high. It is especially abundant in the low western and southwestern parts of the State. Cattle browse the plants and the forage is palatable. In addition to the common typical form, with obtusely angled branches, there occurs an apparently rare form with acutely angled branches and relatively narrow leaves, subsp. *griffithsii* (Standl.) Hall and Clements (*A. griffithsii* Standl.). The type of *A. griffithsii* was collected at Willcox, Cochise County (*Griffiths* 1895).

17. *Atriplex confertifolia* (Torr. and Frém.) S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 119. 1874.

Obione confertifolia Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 318. 1845.

Apache, Navajo and Coconino Counties, 4,200 to 5,700 feet, dry plains and mesas, usually forming small hummocks. North Dakota to Oregon, south to Chihuahua, northern Arizona, and California.

Shadscale, sheepfat, spiny saltbush. In the northern part of the State shadscale often occurs over large areas in pure stands, crowding out nearly all other plants. It has the ability to resist overgrazing. *A. collina* Woot. and Standl., the type of which was collected in the Carrizo Mountains, Apache County (Standley 7481), differs from typical *A. confertifolia* in having dentate fruiting bracts, but there seems to be complete intergradation.

18. *Atriplex linearis* S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 72. 1889.

Atriplex canescens subsp. *linearis* Hall and Clements, Carnegie Inst. Wash. Pub. 326: 344. 1923.

Pinal, Maricopa, Pima, and Yuma Counties, 2,300 feet or lower, in dry saline soil. Arizona, southeastern California, Sonora, and Baja California.

19. *Atriplex canescens* (Pursh) Nutt., Gen. Pl. 1: 197. 1818.

Calligonum canescens Pursh, Fl. Amer. Sept. 370. 1814.

Throughout the State, 6,500 feet or lower, commonly in sandy, sometimes in saline, soil. South Dakota to Oregon, south to northern Mexico.

Fourwing saltbush, cenizo, chamiso, chamiza, often erroneously called "shadscale" and "sagebrush." This plant is adapted to very diverse soil and climatic conditions and is found in association with creosotebush, sagebrush, pinyon, and sometimes yellow pine. It is highly prized as a browse plant, and the fruits are so relished by livestock that reproduction is often greatly hindered. The plant is deep-rooted and should be useful for erosion control.

20. *Atriplex garrettii* Rydb., Torrey Bot. Club Bul. 39: 312. 1912.

Atriplex canescens subsp. *garrettii* Hall and Clements, Carnegie Inst. Wash. Pub. 326: 344. 1923.

Lees Ferry and vicinity (Coconino County), about 3,500 feet. Western Colorado, eastern Utah, and northern Arizona.

The plant is not unlike *A. jonesii* in general appearance.

Atriplex nuttallii S. Wats., both subsp. *typica* Hall and Clements and subsp. *cuneata* (A. Nels.) Hall and Clements, have been reported from Arizona, but the writers have no satisfactory evidence that either form occurs in the State. The species bears considerable resemblance to *A. jonesii* Standl.

6. ZUCKIA

A low erect shrub, pubescent with inflated whitish hairs; leaves alternate, petioled, entire; flowers dioecious, the pistillate ones without perianth, bibracteolate, sessile, solitary or in small clusters, forming

short, interrupted, naked panicles of spikes; fruiting bractlets accrescent, united except for a small apical orifice, 6-keeled, 2 of the keels broader and winglike; stigmas 2, filiform, exserted; seed horizontal.

1. *Zuckia arizonica* Standl., Wash. Acad. Sci. Jour. 5: 58. 1915.

Adamana, Apache County (*Griffiths* 5085), Chalcedony Park (Petrified Forest?), Navajo County (*Zuck* 39, the type collection), near Tuba, Coconino County (*Goodding* 1503, *Eastwood* and *Howell* 6503), about 5,000 feet. Known only from northeastern Arizona.

7. GRAYIA. HOP-SAGE

Low, branched shrubs with stiff divergent branches; leaves with oblanceolate, slightly fleshy blades; flowers unisexual, in glomerules, these forming terminal or axillary spikes or panicles; fruits closely subtended by a pair of conspicuous thin, flat-winged, connivent bractlets, these united to the middle or higher; seeds vertical.

The spiny hop-sage (*G. spinosa*) is an excellent browse plant relished by all livestock, but not sufficiently abundant in Arizona to be of much importance.

Key to the species

1. Fruiting bractlets at maturity glabrous, not carinate, more than 6 mm. wide; plant often spiny----- 1. *G. SPINOSA*.
 1. Fruiting bractlets at maturity scurfy-pubescent, carinate, not more than 6 mm. wide; plant not spiny----- 2. *G. BRANDEGEI*.

1. *Grayia spinosa* (Hook.) Moq. in DC., Prodr. 13²: 119. 1849.

Chenopodium spinosum Hook., Fl. Bor. Amer. 2:127. 1838.

Keam Canyon (Navajo County), near Kingman, Chloride, and Oatman (Mohave County), 3,000 to 6,000 feet, flowering in spring. Wyoming to Washington, south to Arizona and California.

2. *Grayia brandegei* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 101. 1876.

Petrified Forest (Apache County), about 5,000 feet, in clay soil (*Hall* 11167). Colorado, Utah, and northeastern Arizona.

Hall's specimen has the bracts broader and more retuse than in typical *G. brandegei*.

8. EUROTIA. WINTERFAT

Plants shrubby or suffrutescent, stellate-tomentose; leaves alternate, entire, linear; flowers unisexual or perfect, in axillary clusters and terminal spikelike inflorescences; perianth 4-parted; stamens 4; fruiting bractlets united into a villous, 2-beaked tube.

One of the most valuable native forage plants, especially as winter feed for sheep. As implied by the vernacular name, livestock fatten well on *Eurotia*. The plant is also known (erroneously) as "white sage." Mrs. Collom reports that the Indians used the plant medicinally, applying the powdered root to burns and treating fever with a decoction of the leaves. The plant avoids very saline soil. It is of value for controlling soil erosion.

1. **Eurotia lanata** (Pursh) Moq., Chenop. Monog. 81. 1840.

Diotis lanata Pursh, Fl. Amer. Sept. 602. 1814.

Apache County to Mohave County, south to Cochise and Pima Counties, 2,000 to 7,000 feet, on dry plains and mesas, usually among grasses, May to October. Saskatchewan to Washington, south to Texas, Arizona, and California.

The var. *subspinosa* (Rydb.) Kearney and Peebles (*E. subspinosa* Rydb.) occurs throughout the range of the species in Arizona and is apparently the only form present in the southern counties. As compared with typical *E. lanata*, it has, normally, more woody stems, more spreading branches, and hairs with few or no elongate rays, but there is intergradation in all characters.

9. ECHINOPSISILON

An annual herb; stems tall, much-branched; herbage loosely villous; leaf blades linear, entire; flowers perfect, without bractlets, in open leafy-bracted panicles of short spikes; perianth lobes each bearing a dorsal tubercle or spine.

1. **Echinopsilon hyssopifolius** (Pall.) Moq. in DC., Prodr. 13²: 135. 1849.

Suaeda hyssopifolia Pall., Illus. Pl. 44. 1803.

Bassia hyssopifolia Kuntze, Rev. Gen. Pl. 1: 547. 1891.

Kayenta, Navajo County (*Eastwood* and *Howell* 6541), Lake Mead, Mohave County (*Clover* 4209), Arlington, Maricopa County (*McLellan* and *Stitt* 1009), flowering in summer. A weed, here and there in the western United States; introduced from Asia.

10. KOCHIA

Small perennial herbs; stems numerous from a woody base, mostly unbranched; leaves entire, narrow, subterete, somewhat fleshy; flowers mostly perfect, axillary, solitary or in small clusters; fruiting perianth with 5 wedge-shaped, scarious, horizontal wings.

Summer-cypress (*K. scoparia*) is a European species, often seen in old-fashioned gardens.

1. **Kochia americana** S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 93. 1874.

Apache and Navajo Counties, 5,000 to 6,000 feet, on dry open plains, often in saline soil, June to August. Wyoming to California, northwestern New Mexico, and northeastern Arizona.

This plant, sometimes known as green-molly and redsage, was reported by Griffiths as sufficiently abundant in the valley of the Little Colorado River to furnish winter feed for sheep. Both the glabrate typical form and var. *vestita* S. Wats. (*K. vestita* Rydb.), which has densely and permanently sericeous-villous herbage, occur in Arizona.

11. CORISPERMUM. BUGSEED

Plants annual, herbaceous, with branching stems; herbage glabrous or sparsely pubescent; leaves alternate, entire, narrow, 1-nerved; flowers perfect, in narrow, loose, terminal spikes, each flower sub-

tended by a leaflike, scarious-margined bract broader than the foliage leaves; perianth usually of only 1 segment, this deciduous; stamens 1 to 3; styles 2, persistent; utricle narrowly winged; seed vertical.

1. *Corispermum nitidum* Kit. in Schult., Oesterr. Fl. ed. 2, 1: 7. 1814.

Apache County to Coconino and Yavapai Counties, 5,000 to 6,000 feet, usually in sandy soil, July to September. A widely distributed weed in the United States; naturalized from Europe.

The plant is a "tumbleweed."

12. ALLENROLFEA. IODINEBUSH

Plant fleshy, much-branched, woody toward the base; stems constricted at intervals, appearing jointed; leaves reduced to triangular scales; flowers perfect, in 3's in the axils of spirally arranged bracts, forming dense cylindric spikes.

1. *Allenrolfea occidentalis* (S. Wats.) Kuntze, Rev. Gen. Pl. 2: 546. 1891.

Halostachys occidentalis S. Wats. in King, Geol. Expl. 40th Par. 5: 293. 1871.

Almost throughout the State, 5,000 feet or lower, July to November. Oregon to western Texas, Sonora, and Baja California.

A reliable indicator of strongly saline soil, to which the plant is mainly confined. Unpalatable to livestock and eaten only when other feed is lacking. The abundant pollen is stated to cause hay fever in some persons. Other common names of this plant are pickleweed and chico.

13. SARCOBATUS. GREASEWOOD

Plant shrubby, up to 2.4 m. (8 feet) high, with spreading rigid branches; leaves fleshy, entire, narrow; flowers unisexual (monoecious), the staminate ones in catkinlike spikes, without a perianth, each subtended by a peltate stipitate bract, the pistillate flowers enclosed in a perianth, this with a turbinate tube and a spreading winglike limb much enlarged in fruit.

1. *Sarcobatus vermiculatus* (Hook.) Torr. in Emory, Mil. Recon. 149. 1848.

Batis? vermiculatus Hook., Fl. Bor. Amer. 2: 128. 1838.

Apache, Navajo, and Coconino Counties, south to Pinal and Maricopa Counties, 1,000 to 6,000 feet, in saline, usually moist soil, June to September, most abundant in northeastern Arizona, where it often covers large areas in pure stands or mixed with *Suaeda*. North Dakota to Alberta, south to New Mexico, Arizona, and California.

A valuable browse plant, the young shoots and leaves being eaten by cattle and sheep in winter and spring, but bloating, and perhaps poisoning by the oxalates in the sap, may result from eating this forage too freely. The plant often indicates the presence in the soil of alkali carbonates, "black alkali." Various articles, such as planting sticks, are made from the wood by the Hopi Indians and it is used as fuel in their "kivas."

14. SUAEDA. SEEPWEED, QUELITE-SALADO

Plants mostly perennial, herbaceous or suffrutescent; leaves alternate, fleshy, terete or subterete; flowers perfect or some of them unisexual, axillary, solitary or in small clusters; perianth 5-lobed or 5-parted, fleshy, enclosing the utricle; stamens 5.

These plants are indicators of moderate to excessive soil salinity. They are browsed to some extent when other feed is scarce. The young plants are used for greens by the Pimas and other Indians, and are sometimes eaten with cactus fruits. Pinole was made from the seeds. The dried leaves were applied to sores by the Hopi.

The taxonomy of the genus is perplexing.

Key to the species

1. Calyx lobes (at least some of them) corniculate-appendaged or winged, unequal; plant annual, glabrous or very nearly so; stems erect and little-branched, or low and spreading; leaves of the inflorescence broadly lanceolate or ovate-lanceolate..... 1. *S. DEPRESSA*.
1. Calyx lobes not appendaged or winged, often carinate or cucullate, equal; plants perennial, suffrutescent, green or glaucous; leaves all linear or lance-linear, subterete or somewhat flattened (2).
2. Young stems and leaves copiously soft-pubescent; branches stout, commonly short and ascending at a narrow angle..... 2. *S. SUFFRUTESCENS*.
2. Young stems and leaves commonly glabrous, sometimes puberulent; branches slender, often flexuous, commonly elongate and spreading or ascending at a wide angle..... 3. *S. TORREYANA*.

- *1. **Suaeda depressa** (Pursh) S. Wats. in King, Geol. Expl. 40th Par. 5: 294. 1871.

Salsola depressa Pursh, Fl. Amer. Sept. 197. 1814.

Dondia depressa Britton in Britt. and Brown, Illus. Fl. 1: 585. 1896.

Not known definitely to occur in Arizona, but both the typical form and var. *erecta* S. Wats. (*Dondia erecta* A. Nels.) have been collected in northwestern New Mexico. Minnesota to Saskatchewan, south to western Texas, New Mexico, and California.

2. **Suaeda suffrutescens** S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 88. 1874.

Dondia suffrutescens Heller, Cat. North Amer. Pl. 3. 1898.

Navajo County and eastern Coconino County, 3,200 to 5,000 feet, March to July. Western Texas to Arizona and Chihuahua.

Dondia ramosissima Standl., the type of which was collected at Lees Ferry, Coconino County (Nelson 62), is perhaps not specifically distinct from *S. suffrutescens*.

3. **Suaeda torreyana** S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 88. 1874.

Suaeda moquini A. Nels. in Coult., New Man. Rocky Mount. 170. 1909.

Dondia torreyana Standl., North Amer. Fl. 21: 90. 1916.

Apache, Navajo, and Coconino Counties, south to Cochise, Pima, and Yuma Counties, 5,000 feet or lower, very common, July to September. Alberta to Oregon, south to northern Mexico.

This form is closely allied to the Old World *S. fruticosa* (L.) Druce, to which many of the Arizona specimens have been referred. The plants sometimes reach a height of 2.4 m. but are usually smaller.

15. SALSOLA

An annual much-branched herb, becoming hard and prickly; leaves awl-shaped, spine-tipped; flowers perfect, each subtended by 2 bractlets, sessile, axillary; perianth 5-parted, in fruit with horizontal scarious dorsal wings; stamens commonly 5; styles 2; seed horizontal.

1. *Salsola pestifer* A. Nels. in Coult., New Man. Rocky Mount. 169. 1909.

Extensively naturalized in the western United States; introduced from Eurasia. It is perhaps better regarded as a variety of *S. kali* L. (var. *tenuifolia* Tausch).

Russian-thistle. Abundant along roads in some of the irrigated districts of southern Arizona and on overgrazed ranges in the northern part of the State. In early spring the young plants are readily eaten by livestock, and the dead plants are eaten in winter after softening by rains. In case of need good ensilage can be made from the mature plants, which otherwise are unpalatable. Hay sometimes is made of the young plants. The plant is a typical "tumbleweed," breaking off at the surface of the ground when mature and piling up along fences. One of the Hopi Indian names signifies "white man's plant."

35. AMARANTHACEAE. AMARANTH FAMILY

Stems herbaceous or slightly woody below; leaves simple, entire, without stipules; flowers small, unisexual or some of them perfect, commonly in dense heads or spikes; perianth scarious, hyaline, or papery; ovary 1-celled; fruit a utricle, circumscissile or bursting irregularly.

Key to the genera

1. Leaves alternate; anthers 4-celled, appearing 2-celled after dehiscence; plants annual, without lanate pubescence (2).
2. Pistillate flowers with a perianth, not concealed by the bracts, these narrow, not cordate----- 1. AMARANTHUS.
2. Pistillate flowers without a perianth, more or less concealed by broad, cordate, spine-tipped, scarious-margined bracts--- 2. ACANTHOCHITON.
1. Leaves opposite; anthers 2-celled, often appearing 1-celled after dehiscence (3).
3. Stamens adnate to the perianth, perigynous----- 3. BRAYULINEA.
3. Stamens free from the perianth, hypogynous (4).
4. Perianth segments united into a tube, this in fruit hardened and longitudinally crested, winged, or bearing longitudinal rows of spines----- 5. FROELICHIA.
4. Perianth segments separate or united only near the base, not forming an appendaged tube in fruit (5).
5. Flowers in few-flowered, rather loose axillary glomerules, these subtended by leaves with the bases becoming more or less hardened and united, forming a turbinate involucre; plants with lanate pubescence----- 4. TIDESTROMIA.
5. Flowers in dense heads or spikes, these naked or, if subtended by leaves, their bases not becoming hardened and united; pubescence not lanate; bracts of the inflorescence thin, scarious, white, yellowish, or pink (6).
6. Stigma capitate----- 6. ACHYRANTHES.
6. Stigma with 2 or 3 subulate or filiform lobes (7).
7. Flowers perfect, in globose or ovoid heads, these terminal or both terminal and axillary, solitary or in dense subcapitate clusters----- 7. GOMPHRENA.
7. Flowers dioecious, in a loose panicle of numerous slender spikes----- 8. IRESINE.

1. AMARANTHUS. AMARANTH

Plants herbaceous, annual; leaves alternate, petioled, the blades pinnate-veined; flowers mostly unisexual, small, commonly subtended by a bract and 2 bractlets; perianth segments 2 to 5, separate; stamens 2 to 5; utricle 2- or 3-beaked by the persistent styles.

These plants are commonly known as pigweed. Their seeds, produced in great abundance, are an important food supply for birds such as the common dove, whitewing, and quail. Indians of several tribes gathered the young leaves for greens and the seeds for meal. In southern Arizona carelessweed (*A. palmeri*), abundant in river bottoms, is sometimes cut for hay, and is relished by stock, in both the green and dry state. Most of the species are weeds of cultivated land and roadsides, flowering in summer.

Key to the species

1. Sepals of the pistillate flowers broadly spatulate, with a flabelliform or obovate blade considerably wider than the claw, at apex obtuse, truncate, or emarginate, often apiculate, exceptionally acutish (2).
2. Utricle not circumscissile, narrow, nearly equaling the calyx; plants monoecious, the staminate flowers often very few; leaf blades lanceolate or narrowly oblong, not more than 3 cm. long----- 1. *A. OBCORDATUS*.
2. Utricle circumscissile, subglobose, considerably shorter than the calyx (3).
3. Plants dioecious; petioles slender, equaling or longer than the broad, rhombic-ovate blades; flowers mostly in elongate, naked, compound spikes, these single or forming terminal panicles; bracts rigidly spinose-tipped; sepals often denticulate----- 2. *A. PALMERI*.
3. Plants monoecious, the staminate flowers sometimes very few; inflorescences leafy, at least below (4).
4. Axillary flower clusters much shorter than the petioles; leaf blades linear-lanceolate to ovate-lanceolate; bracts shorter than the flowers; sepals of the pistillate flowers usually with fimbriate margins----- 3. *A. FIMBRIATUS*.
4. Axillary flower clusters mostly equaling or longer than the petioles; leaf blades linear to elliptic; bracts equaling or longer than the flowers; sepals of the pistillate flowers with entire or denticulate margins----- 4. *A. PRINGLEI*.
1. Sepals of the pistillate flowers linear, lanceolate, oblong, elliptic, or occasionally narrowly spatulate, with the blade little wider than the claw; plants monoecious, the staminate flowers sometimes very few (5).
5. Utricle not circumscissile; leaf blades ovate, up to 8 cm. long; flowers in a rather small panicle of slender spikes; sepals 3---- 5. *A. GRACILIS*.
5. Utricle circumscissile (6).
6. Flowers all in small, glomerate or racemiform, leafy-bracted, axillary clusters (7).
7. Sepals 4 or 5; seeds 1.5 mm. in diameter; stems commonly prostrate; plant glabrous or nearly so----- 6. *A. BLITOIDES*.
7. Sepals 3 or fewer; seeds 1 mm. or less in diameter; stems commonly erect or ascending (8).
8. Plant densely viscid-pubescent; leaf blades crispate.
 7. *A. PUBESCENS*.
 8. Plant glabrous or puberulent, not viscid; leaf blades flat or nearly so.
 8. *A. GRAECIZANS*.
6. Flowers mostly in terminal and axillary, compound spikes, these often clustered in a terminal, leafy or nearly naked panicle; leaf blades mostly rhombic-ovate; species of similar appearance, difficult to distinguish (9).
9. Sepals of the pistillate flowers, or some of them, acute or acuminate at apex (10).
10. Seeds usually whitish and dull; terminal spike more or less drooping. sepals equaling or shorter than the fruit--- 9. *A. CAUDATUS*.

10. Seeds black or very dark brown, shining; terminal spike erect or nearly so (11).
11. Spikes usually slender; bracts commonly less than 5 mm. long; seeds orbicular; sepals equaling or shorter than the fruit.
11. Spikes usually stout; bracts commonly more than 5 mm. long; seeds obovoid or broadly oval; sepals usually longer than the fruit.
9. Sepals of the pistillate flowers mostly obtuse or truncate at apex (12).
12. Plant glabrous or very nearly so; stems slender, usually less than 50 cm. long; flowers in slender, more or less interrupted, leafy spikes.
12. Plant villous, at least in the inflorescence; stems stout, usually more than 50 cm. long; flowers in ample, usually dense, panicles of spikes (13).
13. Capsule ovoid, considerably surpassing the calyx.
13. Capsule subglobose, not surpassing and usually considerably shorter than the calyx.
10. *A. HYBRIDUS*.
11. *A. POWELLII*.
12. *A. WRIGHTII*.
13. *A. CRUENTUS*.
14. *A. RETROFLEXUS*.

1. *Amaranthus obcordatus* (A. Gray) Standl., North Amer. Fl. 21: 107. 1917.

Amblygyne urceolata var. *obcordata* A. Gray, Amer. Acad. Arts and Sci. Proc. 5: 168. 1861.

Cochise and Pima Counties, 2,200 to 3,700 feet, apparently not common. Western Texas to Arizona and northern Mexico.

2. *Amaranthus palmeri* S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 274. 1877.

Graham County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 5,000 feet or lower. Kansas to Texas, Arizona, California, and central Mexico.

Carelessweed, redroot, quelite, blede. A tall, coarse, weedy plant, abundant in river bottoms and irrigated land.

3. *Amaranthus fimbriatus* (Torr.) Benth. in S. Wats., Bot. Calif. 2: 42. 1880.

Sarratia berlandieri var. *fimbriata* Torr., U. S. and Mex. Bound. Bot. 179. 1859.

Gila County to Mohave County, south to Cochise, Pima, and (probably) Yuma Counties, below 4,000 feet, commonly in sandy washes. Southern Utah and Nevada to Arizona and northwestern Mexico.

The typical form with fimbriate margins of the sepals, is much the more common in Arizona, but var. *denticulatus* Uline and Bray (*A. venulosus* S. Wats.), with sepals entire or denticulate, has been collected at Tucson, Pima County (*Toumey, Thornber*), and at Casa Grande, Pinal County (*Jones*).

4. *Amaranthus pringlei* S. Wats., Amer. Acad. Arts and Sci. Proc. 22: 476. 1887.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet. Western Texas to Nevada, Arizona, and northern Mexico.

5. *Amaranthus gracilis* Desf., Tabl. Bot. 43. 1804.

Sacaton (Pinal County), a casual introduction from the Tropics, probably not established in Arizona.

6. **Amaranthus blitoides** S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 273. 1877.

Navajo, Coconino, and Mohave Counties, south to Cochise, Santa Cruz, and Pima Counties, 1,000 to 8,000 feet, a common roadside weed. Wyoming to Washington, south to Chihuahua and Arizona.

7. **Amaranthus pubescens** (Uline and Bray) Rydb., Torrey Bot. Club Bul. 39: 313. 1912.

Amaranthus graecizans var. *pubescens* Uline and Bray, Bot. Gaz. 19: 317. 1894.

Apache County to Coconino County, 5,500 to 7,000 feet, type from Flagstaff, Coconino County (*Jones* 3978). Southern Colorado to Nevada, New Mexico, and northern Arizona.

8. **Amaranthus graecizans** L., Sp. Pl. 990. 1753.

Nagle Ranch (Coconino County), and Gila, Pinal, Cochise, and Pima Counties, 1,300 to 8,000 feet. Widely distributed in North America.

A typical "tumbleweed," common at roadsides and in fields.

9. **Amaranthus caudatus** L., Sp. Pl. 990. 1753.

"Pueblo," Apache or Navajo County (*Stevenson* 7), collected also by the Powell Expedition, without definite locality. Occasional in the United States; introduced from tropical America.

Love-lies-bleeding, often grown in old-fashioned gardens.

10. **Amaranthus hybridus** L., Sp. Pl. 990. 1753.

Jacobs Lake (Coconino County), near Prescott (Yavapai County), Salt River Valley (Maricopa County), where a common weed in cultivated land, near Sacaton (Pinal County), 1,000 to 8,100 feet. Widely distributed in North America.

11. **Amaranthus powellii** S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 347. 1875.

Apache, Navajo, and Coconino Counties, south to Cochise and Yavapai Counties, 3,000 (?) to 8,000 feet. Wyoming to Oregon, Chihuahua, and Arizona.

12. **Amaranthus wrightii** S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 275. 1877.

San Francisco Peaks and Wupatki National Monument, Coconino County (*Knowlton* 205, *D. J. Jones* 65), reported also from Fort Verde, Yavapai County (*Mearns* 277). Southern Colorado, New Mexico, and Arizona.

13. **Amaranthus cruentus** L., Syst. Nat. ed. 10, 1269. 1759.

An immature specimen, possibly of this species, was collected in the Hopi Reservation and Little Colorado River region (*Hough* 44), and what may be *A. cruentus* was collected in the Pinaleno Mountains, Graham County, 8,000 feet (*Shreve* 5367). Occasional in the United States; introduced from tropical America.

The Hopi are reported to use the seeds for coloring corn bread pink, for use in certain ceremonies.

14. **Amaranthus retroflexus** L., Sp. Pl. 991. 1753.

Apache County to Coconino and Yavapai Counties, 5,000 to 7,000 feet. Southern Canada to northern Mexico.

2. ACANTHOCHITON

Plant annual, glabrous; stems striped green and white, erect, branched; flowers commonly dioecious, the staminate ones in glomerules forming spikes, with a perianth of 5 sepals and bractless, the pistillate flowers without a perianth, subtended by cordate bracts, these becoming spiny.

1. *Acanthochiton wrightii* Torr. in Sitgreaves, Zuñi and Colo. Rpt. 170. 1853.

Holbrook, Navajo County (*Zuck* in 1897), Hopi Indian Reservation and Little Colorado River region (*Hough* 60). Western Texas to Arizona and Chihuahua.

While young the plants are relished by livestock. They are also eaten by the Indians of northern Arizona, both as greens and when dried and stored.

3. BRAYULINEA

Plant perennial; stems numerous, much branched, prostrate from a thick root, forming mats; leaves opposite, ovate, very unequal in size in the pair, lanate-pubescent beneath, as is the inflorescence; flowers perfect, in dense axillary glomerules; perianth 5-lobed; utricle indehiscent.

1. *Brayulinea densa* (Humb. and Bonpl.) Small, Fl. Southeast. U. S. 394. 1903.

Illecebrum densum Humb. and Bonpl. in Roem. and Schult., Syst. Veg. 5: 517. 1819.

Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, May to October. Western Texas to Arizona and southward to South America.

4. TIDESTROMIA

Plants annual or perennial, lanate-pubescent; stems erect to prostrate, branched, herbaceous, or woody toward the base; leaves mostly opposite; flowers perfect, in small axillary clusters, the perianth yellow; stamens 5, the filaments united, intervening staminodia sometimes present; utricle compressed.

Key to the species

1. Plant annual; stems procumbent or prostrate, radiating from the root; blades of the larger leaves broadly obovate to spatulate, the veins not prominent beneath; perianth commonly 2 to 3 mm. long; staminodia minute or wanting.----- 1. *T. LANUGINOSA*.
1. Plant perennial; stems erect, ascending, or decumbent, often woody below; blades of the larger leaves suborbicular, ovate, elliptic, or oblong, the veins prominent beneath; perianth less than 2 mm. long; staminodia triangular, nearly half as long as the filaments of the fertile stamens.----- 2. *T. OBLONGIFOLIA*.

1. *Tidestromia lanuginosa* (Nutt.) Standl., Wash. Acad. Sci. Jour. 6: 70. 1916.

Achyranthes lanuginosa Nutt., Amer. Phil. Soc. Trans., ser. 2, 5: 166. 1820.

Apache, Navajo, and Coconino Counties, south to Cochise, Pima, and Yuma Counties, 5,500 feet or lower, June to October. Western Kansas to Utah, south to northern Mexico.

The whitish mats of this plant are conspicuous soon after summer rains on the deserts in southern Arizona, and are well adapted for checking the blowing of sandy soils.

2. **Tidestromia oblongifolia** (S. Wats.) Standl., Wash. Acad. Sci. Jour. 6: 70. 1916.

Cladotrix oblongifolia S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 376. 1882.

Mohave and Yuma Counties, 5,000 feet or lower, in sandy soil, June to October. Arizona, Nevada, and southeastern California.

Plant often shrubby, up to about 0.6 m. high.

5. FROELICHIA. SNAKECOTTON

Plants herbaceous, annual or perennial, lanate-tomentose; stems erect, sparingly branched; flowers perfect, subtended by glabrous, dark-colored bracts, in somewhat elongate glomerules, these forming terminal panicles or interrupted spikes; stamens 5, the filaments united; utricle indehiscent.

The plants are relished by livestock.

Key to the species

1. Plant annual; stems slender, simple or branched at base, leafy only near the base, commonly not more than 30 cm. long; leaf blades thin, lanceolate, 1 cm. wide or narrower..... 1. *F. GRACILIS*.
1. Plant perennial, with a thick woody root; stems stout, often sparingly branched above the base, commonly leafy well above the base, often much more than 30 cm. long; leaf blades thick, commonly oblanceolate and 1 to 2 cm. wide..... 2. *F. ARIZONICA*.

1. **Froelichia gracilis** Moq. in DC., Prodr. 13²: 420. 1849.

Navajo and Yavapai Counties south to Cochise County, 4,500 to 5,500 feet, summer. Iowa to Colorado, south to Chihuahua and Arizona.

2. **Froelichia arizonica** Thornber ex Standl., North Amer. Fl. 21: 128. 1917.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, on dry grassy plains and slopes, late summer. Western Texas, southern Arizona, and northern Mexico.

Closely related to and perhaps not specifically distinct from *F. floridana* (Nutt.) Moq.

6. ACHYRANTHES

Plant herbaceous, perennial, with a thick, woody, vertical root; stems prostrate or procumbent, forming mats; leaves opposite, with oval or obovate blades, those of the pair very unequal; flowers perfect, in short axillary spikes, with conspicuous white bracts; sepals 5, pubescent with stiff-jointed hairs, these minutely barbed at apex.

1. **Achyranthes repens** L., Sp. Pl. 205. 1753.

Alternanthera repens (L.) Kuntze, Rev. Gen. Pl. 2: 540. 1891.

Tombstone, Cochise County (*Peebles* et al. 3374), Huachuca Mountains, Cochise County (*Jones* in 1903), Patagonia, Santa Cruz County (*Peebles* et al. 4652), 4,000 to 5,500 feet, summer. South Carolina to Arizona, south to tropical America.

A roadside weed, resembling *Brayulinea densa* but with larger leaves and flower spikes.

7. GOMPHRENA. GLOBE-AMARANTH

Plants herbaceous; stems leafy or scapose; flowers perfect, in globose or ovoid heads, conspicuously subtended by white, pink, or yellowish scarious bracts and bractlets; perianth 5-lobed or 5-parted.

The plants, which grow on dry plains and slopes, usually with grasses, are eaten freely by cattle and probably other livestock.

Key to the species

1. Bractlets crested along the keel with a lacinate-dentate crest, thin but firm, yellowish white or pink; stems leafy; leaf blades elliptic, ovate, or obovate; spikes usually solitary, commonly subtended by 2 or more leaves.
 1. *G. NITIDA*.
1. Bractlets not crested (2).
 2. Plant annual or perennial, not caespitose; stems leafy, 15 to 60 cm. long; leaf blades commonly narrow, elliptic, lanceolate, or oblanceolate; spikes subtended by 2 or more leaves, usually clustered; bractlets thin but firm (scarious), strongly carinate, entire, cream-colored, pale orange, or pink.
 2. *G. SONORAE*.
 2. Plant perennial with a deep woody root, caespitose; stems scapelike, leafy only near the base, not more than 15 cm. long; leaf blades oblanceolate, obovate, or nearly orbicular; spikes not subtended by leaves, usually solitary; bractlets very thin and soft (hyaline), not strongly carinate, often denticulate at apex, white----- 3. *G. CAESPITOSA*.

1. ***Gomphrena nitida*** Rothr. in Wheeler, U. S. Survey West 100th Mer. Rpt. 6: 233. 1878.

Cochise and Santa Cruz Counties, 4,000 to 6,000 feet, August to September, type from the Chiricahua Mountains. Western Texas to southeastern Arizona and northern Mexico.

2. ***Gomphrena sonora*** Torr., U. S. and Mex. Bound. Bot. 181. 1859.

Gila County to Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, August to September. Arizona and northern Mexico.

3. ***Gomphrena caespitosa*** Torr., U. S. and Mex. Bound. Bot. 181. 1859.

Coconino County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, April to August. New Mexico, Arizona, and northern Mexico.

Sometimes known as ballclover. *G. viridis* Woot. and Standl. appears to be merely a greener, less pubescent form.

8. IRESINE. BLOODLEAF

Plant perennial, herbaceous; stem tall, erect, leafy; leaves opposite, petioled, with thin, broad blades; flowers small, white, in loose terminal panicles of spikes; calyx 5-parted; utricle indehiscent.

1. ***Iresine heterophylla*** Standl., Contrib. U. S. Natl. Herbarium 18: 95. 1916.

Pinal, Cochise, Santa Cruz, and Pima Counties, 3,500 to 4,500 feet, usually among trees and bushes, late summer. Western Texas and southern Arizona to central Mexico.

36. NYCTAGINACEAE. FOUR-O'CLOCK FAMILY

Plants annual or perennial, herbaceous or suffrutescent; flowers perfect, subtended by separate bracts or these united in a calyxlike involucre; perianth usually corollalike, with a campanulate, funnelform,

or salverform limb, the lower part of the tube persistent, becoming hardened and closely investing the fruit; ovary 1-celled, appearing inferior, but technically superior; fruit usually ribbed, grooved, or winged.

Key to the genera

1. Stigma narrowly linear, this and the stamens included in the perianth tube; cotyledon one, by abortion (2).
2. Limb of the perianth 5-lobed; wings of the fruit thickish, opaque, interrupted above and below the body of the fruit..... 10. *ABRONIA*.
2. Limb of the perianth 4- or 5-lobed; wings of the fruit thin, nearly transparent, conspicuously reticulate-veined, continuous around the body of the fruit..... 11. *TRIPTEROCALYX*.
1. Stigma globose or hemispheric; cotyledons 2 (3).
3. Wings of the fruit 3 to 5, conspicuous, scarious (4).
4. Free portion of the perianth tubular-funnelform; stamens 5 or 6, attached to the lower part of the perianth tube..... 1. *SELINOCARPUS*.
4. Free portion of the perianth broadly campanulate; stamens 2 or 3, free from the perianth..... 2. *AMMOCODON*.
3. Wings of the fruit none or coriaceous, sometimes (in genus *Boerhaavia*), the angles narrowly winglike, subscarious (5).
5. Fruit strongly compressed, oval or obovate in outline, the (usually dentate) margins commonly strongly inflexed over the dorsal (outer) face.
 6. *ALLIONIA*.
5. Fruit not compressed, terete or angled, without inflexed, dentate margins (6).
6. Floral bracts more or less united into a calyxlike involucre; stamens and pistil more or less exserted (7).
7. Fruits not strongly 5-angled (sometimes noticeably 5-ribbed), usually not constricted at base; involucre in fruit scarcely enlarged, remaining leaflike in texture..... 4. *MIRABILIS*.
7. Fruits strongly 5-angled longitudinally, constricted at base; involucre in fruit greatly enlarged, thin, conspicuously veined.
 5. *OXYBAPHUS*.
6. Floral bracts separate, remaining small (8).
8. Flowers solitary, axillary; bracts persistent.... 3. *ACLEISANTHES*.
8. Flowers in umbels, cymes, or racemes; bracts usually soon deciduous (9).
9. Fruits with not more than 5 angles or ribs; free portion of the perianth campanulate to nearly rotate, with scarcely any tube.
 7. *BOERHAAVIA*.
9. Fruits 10-ribbed; free portion of the perianth funnelform, with a distinct tube (10).
10. Fruits narrowly clavate, wingless, conspicuously beset with wartlike, stipitate glands..... 8. *COMMICARPUS*.
10. Fruits biturbinate, with a rigid, horizontal, median annular wing, glandless..... 9. *ANULOCAULIS*.

1. *SELINOCARPUS*

Plant perennial; stems low, diffusely branched; leaves opposite, thickish, with ovate blades; flowers few, axillary and solitary, or in short-stalked terminal leafy clusters; free portion of the perianth 3 cm. long, or longer; stamens 5 or 6; fruit conspicuously winged.

*1. *Selinocarpus diffusus* A. Gray, Amer. Jour. Sci. ser. 2, 15: 262. 1853.

Not known definitely to occur in Arizona but has been collected near St. George, Utah. Western Texas to southern Nevada.

2. *AMMOCODON*

Plant perennial, with the habit of *Selinocarpus*; leaves opposite, with broadly ovate blades; flowers several or numerous, in simple or

compound cymes, these usually long-stalked; free portion of the perianth about 5 mm. long; stamens 2 or 3; fruit conspicuously winged.

1. *Ammocodon chenopodioides* (A. Gray) Standl., Wash. Acad. Sci. Jour. 6: 631. 1916.

Selinocarpus chenopodioides A. Gray, Amer. Jour. Sci., ser. 2, 15: 262. 1853.

Duncan, Greenlee County (*Davidson* in 1900), Chiricahua Mountains, Cochise County (*Lemmon* in 1881), Tucson, Pima County (*Thornber* 259), 2,400 to 4,000 feet, late summer. Western Texas to southern Arizona and Chihuahua.

3. ACLEISANTHES

Plant perennial; stems low and spreading from a woody root; flowers axillary, solitary, the subtending bracts small, separate, persistent; perianth salverform, the free portion 8 cm. long or longer, the tube very slender; stamens 2 to 5, often exerted; fruit angled or ribbed.

1. *Acleisanthes longiflora* A. Gray, Amer. Jour. Sci. ser. 2, 15: 261. 1853.

Salt River Mountains, Maricopa County (*Bailey* in 1913), Table Top Mountain, Pinal County (*Harrison* and *Kearney* 7299), Plomosa Mountains, Yuma County (*Peebles* and *Fulton* 8515), 2,000 to 3,000 feet, among rocks, April to August. Texas to California and northern Mexico.

Plant night blooming, the flowers fragrant. It is known in California as yerba-de-la-rabia, and sometimes (erroneously) as "angel-trumpet."

4. MIRABILIS. FOUR-O'CLOCK

Plants herbaceous, perennial; leaves opposite, petioled, with broad blades; flowers solitary or several in the calyxlike involucre; perianth salverform or funnellform; stamens 3 to 5; fruit smooth or tuberculate, sometimes 5-ribbed.

Key to the species

1. Involucre subtending more than 1 flower; perianth purplish red (2).
2. Perianth not more than 1 cm. long; involucre subtrotate, 3-flowered; perianth campanulate-funnelform; stamens 3, the filaments separate; herbage copiously viscid-villous to glabrate----- 1. *M. OXYBAPHOIDES*.
2. Perianth 4 to 6 cm. long; involucre campanulate, usually more than 3-flowered; perianth tubular-funnelform; stamens 5, the filaments connate at base; herbage puberulent, commonly not viscid-- 2. *M. MULTIFLORA*.
1. Involucre subtending a single flower (3).
3. Perianth about 1 cm. long, less than 3 times as long as the involucre, salverform-campanulate, white or pinkish; fruit smooth, longitudinally striate but not angled or ribbed----- 3. *M. BIGELOVII*.
3. Perianth at least 3 cm. long, 3 or more times as long as the involucre, funnellform or elongate-salverform; fruit rugose-tuberculate, obtusely angled or ribbed (4).
4. Stamens not conspicuously exerted; perianth bright red or purplish red, not more than 6 cm. long----- 4. *M. JALAPA*.
4. Stamens conspicuously exerted; perianth white or tinged with purple, 7 to 17 cm. long----- 5. *M. LONGIFLORA*.

1. *Mirabilis oxybaphoides* A. Gray in Torr., U. S. and Mex. Bound. Bot. 173. 1859.

Quamoclidion oxybaphoides A. Gray, Amer. Jour. Sci. ser. 2, 15: 320. 1853.

Allioniella oxybaphoides Rydb., Torrey Bot. Club Bul. 29: 687. 1902.

Navajo and Coconino Counties, about 6,000 feet, August to September, apparently rare in Arizona. Colorado and Utah to western Texas and northern Arizona.

2. *Mirabilis multiflora* (Torr.) A. Gray in Torr., U. S. and Mex. Bound. Bot. 173. 1859.

Orybaphus multiflorus Torr., Ann. Lyc. N. Y. 2: 237. 1828.

Quamoclidion multiflorum Torr. in A. Gray, Amer. Jour. Sci., ser. 2, 15: 321. 1853.

Almost throughout the State, 2,500 to 6,500 feet, on hillsides and mesas, often among rocks and shrubs, April to September. Colorado and Utah to northern Mexico.

A handsome plant with large magenta-purple flowers and dark-green foliage. According to Mrs. Collom, the powdered root is used as a remedy for stomach ache. It is reported that the Hopi Indians eat the root to induce visions.

3. *Mirabilis bigelovii* A. Gray, Amer. Acad. Arts and Sci. Proc. 21: 413. 1886.

Hesperonia bigelovii Standl., North Amer. Fl. 21: 235. 1918.

Hesperonia glutinosa subsp. *gracilis* Standl., Contrib. U. S. Natl. Herbarium 12: 365. 1909.

Mohave, Yavapai, Pinal, Maricopa, Pima, and Yuma Counties, 3,000 feet or lower, rocky slopes, March to May, type of *H. glutinosa gracilis* from Sabino Canyon, Pima County (*Toumey* 471c). Southern Utah to Arizona and southeastern California.

A straggling, weak-stemmed plant with pale-pink flowers and viscid, pilose or villous herbage. A glabrate form with retrorsely scabrous-puberulent stems is var. *retrorsa* (Heller) Munz (*Hesperonia retrorsa* Standl.). This occurs in the San Tan and Sacaton Mountains, Pinal County, and probably elsewhere in the State.

4. *Mirabilis jalapa* L., Sp. Pl. 177. 1753.

Cave Creek, Chiricahua Mountains (*Harrison* and *Kearney* 6132), probably an escape from cultivation. Native of tropical America, the well-known four-o'clock of old-fashioned gardens.

5. *Mirabilis longiflora* L., Svenska Vetensk. Akad. Handl. 1755: 176. 1755.

Apache and Yavapai Counties to Cochise, Santa Cruz, and Pima Counties, 2,500 to 7,000 feet, rich soil among trees and shrubs, August to September. Western Texas to Arizona and far southward in Mexico.

Plant remarkable for the very long and slender perianth tube of the white or pinkish flowers. Two forms occur in Arizona, the typical form, with short-villous and very viscid stems and sessile or subsessile

upper leaves, being less common than var. *wrightiana* (A. Gray) Kearney and Peebles (*M. wrightiana* A. Gray), which has puberulent, scarcely viscid stems and all the leaves usually distinctly petioled.

5. OXYBAPHUS

Plants perennial, herbaceous; stems tall and erect, or low and decumbent; leaves opposite, usually thickish; involucre calyxlike, gamophyllous, becoming enlarged and papery in fruit; flowers 1 to 5 in each involucre; perianth campanulate or short-funnelform, slightly oblique; fruits more or less obovoid, 5-angled.

Key to the species

1. Leaf blades not more than 4 times as long as wide, short-cuneate, truncate, or cordate at base; petioles mostly elongate, well differentiated from the blade; stems pilose or villous above, or throughout, with soft, weak hairs, often also glandular; fruit short-pilose (2).
2. Stems low, decumbent or nearly prostrate, much-branched, viscid, and pilose or villous, to the base; leaf blades deltoid-ovate to nearly orbicular, not or scarcely longer than wide; perianth pale pink or purplish, pubescent.
 1. *O. PUMILUS*.
 2. Stems normally tall and erect, commonly not branched below the inflorescence, glabrous below or puberulent in lines (seldom on the whole surface); leaf blades elongate-deltoid (sometimes deltoid-ovate or ovate-lanceolate), commonly 1.5 to 4 times as long as wide; perianth purplish red, rarely pale pink, often nearly glabrous----- 2. *O. COMATUS*.
1. Leaf blades 5 or more times as long as wide, narrowly linear to broadly lanceolate, acutish to long-attenuate at base; petioles short or almost none; stems normally tall, erect, and not branched below the inflorescence (3).
3. Perianth bright red, funnelform, 3 to 4 times as long as the copiously strigose or short-pilose involucre; stems glaucous, glabrous or inconspicuously strigose, only the peduncles bearing spreading hairs-- 3. *O. COCCINEUS*.
3. Perianth pink or purple, usually pale-colored, campanulate, about twice as long as the involucre (4).
4. Stems, involucre, perianth, and fruit glabrous or sparsely strigose; leaf blades more than 10 times as long as wide, attenuate at both ends, thick----- 4. *O. GLABER*.
4. Stems usually glandular, and pilose or villous, above; involucre pilose or villous, often glandular; perianth more or less pubescent; fruit copiously strigose or pilose----- 5. *O. LINEARIS*.

1. **Oxybaphus pumilus** Standl., Field Museum Nat. Hist. Bot. Ser. 8: 11. 1930.

Allionia pumila Standl., Contrib. U. S. Natl. Herbarium 12: 345. 1909.

Coconino, Mohave, Gila, and Yavapai Counties, 3,000 to 7,500 feet, July to September, type from Kingman, Mohave County (*Lemmon* in 1884). New Mexico, Arizona, Nevada, and southeastern California.

A collection in the Santa Catalina Mountains, Pima County, south of the main area of *O. pumilus* in Arizona (*Toumey* 484) is referred doubtfully to this species. It has an exceptionally deeply cleft involucre, with narrowly triangular teeth.

2. **Oxybaphus comatus** (Small) Weatherby, Amer. Acad. Arts and Sci. Proc. 49: 492. 1913.

Allionia comata Small, Fl. Southeast. U. S. 407. 1903.

Coconino County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 9,000 feet, August to October. Western Texas to Arizona, and far south in Mexico.

3. **Oxybaphus coccineus** Torr., U. S. and Mex. Bound. Bot. 169. 1859.

Allionia coccinea Standl., Contrib. U. S. Natl. Herbarium 12: 339. 1909.

Southern Apache and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,500 feet, open pine woods and grassy slopes, May to August. New Mexico, Arizona, and Sonora.

The showiest of the Arizona species, with brilliant carmine-red flowers.

4. **Oxybaphus glaber** S. Wats., Amer. Nat. 7: 301. 1873.

Allionia glabra Kuntze, Rev. Gen. Pl. 2: 533. 1891.

Hopi Indian Reservation, Navajo County (*Zuck* in 1897, *Hough* 53), August. Kansas to Utah, south to Chihuahua and northeastern Arizona.

The Indians are reported to have treated wounds with an infusion of the leaves.

5. **Oxybaphus linearis** (Pursh) Robinson, Rhodora 10: 31. 1908.

Allionia linearis Pursh, Fl. Amer. Sept. 728. 1814.

Apache County to Mohave County, south to Cochise and Pima Counties, 4,500 to 8,000 feet, often in pine woods. South Dakota and Montana to northern Mexico.

Occurs in two forms, about equally common throughout the area of distribution in Arizona. These are (1) the typical form with linear to narrowly lanceolate, sessile or subsessile leaves; (2) var. *decipiens* (Standl.) Kearney and Peebles (*Allionia decipiens* Standl.), with broader, sometimes ovate-lanceolate, short-petioled leaves.

6. ALLIONIA

Plants herbaceous, annual or perennial, usually glandular-pubescent; stems prostrate; leaves opposite, petioled; involucre solitary on axillary peduncles, 3-flowered; perianth campanulate-rotate; fruit flattened, the dorsal (seemingly the inner) face bearing 2 rows of stipitate glands.

Key to the species

1. Fruit with a broad entire or subentire wing on the ventral side, the outer margin as in *A. incarnata*; perianth 6 mm. long----- 1. *A. CRISTATA*.
1. Fruit not winged on the ventral side; perianth more than 6 mm. long (2).
2. Plant perennial; outer margin of the fruit strongly incurved so as to cover nearly the entire dorsal surface, usually with about 3 broadly triangular nonglandular teeth on each side, seldom entire----- 2. *A. INCARNATA*.
2. Plant annual; margin of the fruit spreading or moderately incurved, with several relatively slender gland-tipped teeth on each side----- 3. *A. GLABRA*.

1. **Allionia cristata** Standl., Field Museum Nat. Hist. Bot. Ser. 8: 10. 1930.

Wedelia cristata Standl., Contrib. U. S. Natl. Herbarium 12: 331. 1909.

Wedeliella cristata Cockerell, Torreya 9: 167. 1909.

Known only from the type collection at Holbrook, Navajo County (*Zuck* in 1896).

2. *Allionia incarnata* L., Syst. Nat. ed. 10, 2: 890. 1759.

Wedeliella incarnata Cockerell, *Torreyia* 9: 167. 1909.

Throughout most of the State, 6,000 feet or (usually) lower, April to October. Colorado and Utah to southern Mexico; also South America.

Trailing-four-o'clock. A conspicuous plant on open plains, mesas, and slopes, with long trailing stems and showy, rose-purple (occasionally white) flowers.

3. *Allionia glabra* (Choisy) Standl., Field Museum Nat. Hist. Bot. Ser. 8: 10. 1930.

Allionia incarnata L. var. *glabra* Choisy in DC., *Prodr.* 13²: 435. 1849.

Wedeliella glabra Cockerell, *Torreyia* 9: 167. 1909.

Apache, Navajo, Yavapai, and Cochise Counties, 4,000 to 6,000 feet, July to October. Western Texas to Arizona, south to Oaxaca.

7. BOERHAAVIA

Plants herbaceous, annual or perennial; stems usually branched, often with a viscid band around each internode; flowers very small, mostly in terminal racemes or cymes, the perianth limb campanulate to nearly rotate; fruits obpyramidal or clavate, the ribs sometimes winged, the furrows between the ribs rugose.

The plants grow usually where exposed to full sunlight, but sometimes in open chaparral, flowering in late summer and autumn.

Key to the species

1. Fruit pubescent, the hairs more or less spreading; plants perennial, with a woody caudex; perianth carmine or dark red (2).
2. Flowers solitary on long slender pedicels; plant glabrous or obscurely puberulent, not glandular..... 1. *B. GRACILLIMA*.
2. Flowers in glomerules, sessile or on short pedicels; plant usually densely glandular-puberulent in the inflorescence, often more or less hirsute below..... 2. *B. CARIBAEA*.
1. Fruit glabrous or with strigose hairs in the furrows; plants annual; perianth not carmine or dark red (3).
3. Flowers in elongate racemes, these forming a cymose or paniculate inflorescence (4).
4. Bracts persistent, more than half as long as the fruit; plant viscid-villous; fruit 4- (rarely 5-) angled..... 3. *B. WRIGHTII*.
4. Bracts deciduous, much less than half as long as the fruit; fruit 5-angled (5).
5. Flowers crowded; bracts broadly ovate or obovate, usually much surpassing the ovary at anthesis; stems conspicuously viscid-villous below the inflorescence..... 4. *B. SPICATA*.
5. Flowers not crowded; bracts lanceolate or ovate-lanceolate, not or scarcely surpassing the ovary; stems not conspicuously villous; species of very similar appearance (6).
6. Fruit with narrow ridges and open furrows, these conspicuously transverse-rugose..... 5. *B. TORREYANA*.
6. Fruit with broad ridges and narrow or nearly closed furrows, these scarcely, or not conspicuously, transverse-rugose..... 6. *B. COULTERI*.
3. Flowers not in racemes, the inflorescence cymose or cymose-paniculate (7).
7. Inflorescence glandular-villous; bracts large, equaling or surpassing the fruit, persistent; flowers short-pedicelcd or nearly sessile, in dense glomerules, these borne on long, slender peduncles; fruit with narrow ridges and very broad furrows..... 7. *B. PURPURASCENS*.

7. Inflorescence glabrous or puberulent, the internodes often ringed with a viscid band; bracts very small, much shorter than the fruit (8).
 8. Fruit not winged; cymules not dense, umbelliform or racemiform, the flowers borne on pedicels often more than 2 mm. long.
 8. Fruit conspicuously winged; cymules dense, the flowers borne on pedicels not more than 2 mm. long (9).
 9. Wings of the fruit 4 (rarely 3); fruit abruptly contracted into a short, winged stipe, the body coarsely transverse-rugose; stems short, decumbent or procumbent----- 9. *B. PTEROCARPA*.
 9. Wings 5; fruit not stipitate, the body smooth or nearly so; stems tall, erect or ascending----- 10. *B. MEGAPTERA*.

1. *Boerhaavia gracillima* Heimerl, Bot. Jahrb. 11: 86. 1889.

Huachuca Mountains, Cochise County (*Jones* in 1903), also foothills of the Coyote, Baboquivari, and Quijotoa Mountains (western Pima County), 2,600 to 4,300 feet, April to September. Western Texas to Arizona and Mexico.

The specimens from Pima County have longer, narrower, and thinner leaf blades than those from the Huachuca Mountains.

2. *Boerhaavia caribaea* Jacq., Observ. Bot. 4: 5. 1771.

Yavapai County to Cochise, Santa Cruz, and Pima Counties, 5,500 feet or lower, common at roadsides and in fields, May to September. Widely distributed in tropical and subtropical America.

With its long trailing stems and viscid herbage, this is sometimes an annoying weed in gardens. According to I. L. Wiggins (personal communication) the oldest valid name for this species is *B. coccinea* Mill.

3. *Boerhaavia wrightii* A. Gray, Amer. Jour. Sci. ser. 2, 15: 322. 1853.

Coconino and Mohave Counties to Cochise, Pima, and Yuma Counties, 4,000 feet or lower, July to September. Western Texas to Nevada, Arizona, and northwestern Mexico.

A collection near the base of the Gila Mountains, Yuma County (*Harrison* and *Kearney* 6257), approaches *B. triquetra* S. Wats. of Baja California in its turbinate, truncate, narrowly wing-angled fruits and in having only 2 stamens, but is nearer *B. wrightii* in other characters. This and other specimens from Yuma County may represent an undescribed species.

4. *Boerhaavia spicata* Choisy in DC., Prodr. 13²: 456. 1849.

Pinal and Pima Counties, 1,500 to 2,500 feet. Arizona and northern Mexico.

5. *Boerhaavia torreyana* (S. Wats.) Standl., Contrib. U. S. Natl. Herbarium 12: 385. 1909.

Boerhaavia spicata var. *torreyana* S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 70. 1889.

Navajo, Coconino, Yavapai, and Maricopa Counties, 1,100 to 5,000 feet. Western Texas and Coahuila to southern California.

6. *Boerhaavia coulteri* (Hook. f.) S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 70. 1889.

Senkenbergia coulteri Hook. f. in Benth. et Hook., Gen. Pl. 3: 6. 1880.

Coconino and Mohave counties to Cochise, Pima, and Yuma Counties, 500 to 5,000 feet. Arizona, southern California, Sonora, and Baja California.

One of the commonest and most widely distributed species of *Boerhaavia* in Arizona.

7. *Boerhaavia purpurascens* A. Gray, Amer. Jour. Sci. ser. 2, 15: 321. 1853.

Gila, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, often in chaparral and on limestone. Western Texas to Arizona and Sonora.

8. *Boerhaavia erecta* L., Sp. Pl. 3. 1753.

Gila and Yavapai Counties to Cochise, Santa Cruz, Pima and Yuma Counties, 1,000 to 5,500 feet. Widely distributed in tropical and subtropical America.

The species occurs in Arizona in two nearly equally common forms—(1) the tall, presumably typical form with a relatively loose and racemiform inflorescence; (2) var. *intermedia* (M. E. Jones) *Kearney* and *Peebles* (*B. intermedia* M. E. Jones), with shorter stems, a more compact and umbelliform inflorescence, and smaller fruits. Many specimens show intermediate combinations of these characters.

9. *Boerhaavia pterocarpa* S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 376. 1882.

Cochise and Pima Counties, 2,300 to 4,500 feet, at roadsides, type from Apache Pass, Cochise County. Arizona and Sonora.

10. *Boerhaavia megaptera* Standl., Contrib. U. S. Natl. Herbarium 12: 379. 1909.

Pima County, Tucson to Sells and Topawa, 2,300 to 2,800 feet, type from the Tucson Mountains (*Thorner* 162). Known only from southern Arizona.

8. COMMICARPUS

Plant suffrutescent; stems leafy, long and weak, usually supported on other plants; flowers in umbels; perianth less than 5 mm. long, yellowish white; fruits narrowly clavate, bearing stipitate glands.

1. *Commicarpus scandens* (L.) Standl., Contrib. U. S. Natl. Herbarium 12: 373. 1909.

Boerhaavia scandens L., Sp. Pl. 3. 1753.

Pinal, Cochise, and Pima Counties, 2,000 to 4,500 feet, June to September. Western Texas, Arizona, and southward, widely distributed in tropical America.

9. ANULOCAULIS

Plant herbaceous, perennial, with a tuberous-thickened root, subscapose; stems with a viscid band; leaves mostly basal, with leathery, broadly ovate to suborbicular, more or less cordate blades;

perianth funnellform, white, 2 to 3 cm. long; filaments purple; fruits biturbinate, glandless.

1. *Anulocaulis leisolenus* (Torr.) Standl., Contrib. U. S. Natl. Herbarium 12: 375. 1909.

Boerhaavia leisolena Torr., U. S. and Mex. Bound. Bot. 172. 1859.

"Arizona," without definite locality (*Wheeler Expedition* in 1872), near Fort Verde, Yavapai County (*Mearns* 198, *Peebles* 14411), about 3,300 feet, on calcareous soils. Western Texas to southern Nevada and central Arizona.

10. ABRONIA. SANDVERBENA

Plants herbaceous, annual or perennial, often viscid-pubescent; stems mostly decumbent or prostrate, leafy or scapose; leaves opposite, petioled, with lanceolate, elliptic, or ovate blades; flowers numerous, in heads subtended by conspicuous separate thin bracts; perianth funnellform-salverform, the tube slender and elongate, the limb small; fruits deeply lobed or winged.

The sandverbenas are attractive plants, with bright pink to white, more or less fragrant flowers. They are conspicuous in spring in sandy open places, often in dry beds of streams.

Key to the species

1. Perianth purplish red; plants annual; bracts linear-lanceolate to ovate-lanceolate, attenuate-acuminate, herbaceous or not conspicuously scarious, greenish; leaf blades prevailingly ovate (2).
2. Stems copiously to densely viscid-villous; fruits mostly broadly winged, the central cavity not extending to the edge of the wings, the latter often surpassing the beak of the fruit and rounded or acutish at apex.
 1. *A. VILLOSA*.
 2. *A. ANGUSTIFOLIA*.
1. Perianth with a white or pinkish limb and a greenish tube; plants perennial, the root often thickened and woody; bracts elliptic to suborbicular or obovate, obtuse to short-acuminate, conspicuously scarious, whitish; fruits commonly with winglike lobes (3).
3. Plant acaulescent or nearly so, cespitose, sparsely villous and often hirtellous, commonly glabrate in age; petioles much longer than the elliptic-lanceolate to elliptic-ovate blades; peduncles scapelike, slender, 7 to 15 cm. long.
 3. *A. NANA*.
3. Plants with leafy stems; petioles mostly shorter to not much longer than the blades (4).
4. Stems viscid-villous, at least above, usually copiously so; bracts oval, commonly narrowly so, acute or acuminate at apex; fruits thick-walled, olive or brownish, mostly biturbinate (the lobes narrowed at apex), up to 10 mm. long, considerably longer than wide.
 4. *A. FRAGRANS*.
4. Stems viscid-puberulent or glabrate, sometimes also sparsely villous; bracts broadly oval, suborbicular, or obovate, rounded and often apiculate at apex; fruits thin-walled, straw-colored, mostly simply turbinate (the lobes truncate at apex), seldom more than 6 mm. long, little if any longer than wide.
 5. *A. ELLIPTICA*.

1. *Abronia villosa* S. Wats., Amer. Nat. 7: 302. 1873.

Mohave, Maricopa, Pima, and Yuma Counties, 1,500 feet or lower, March to April. Arizona, southern California, and Sonora.

2. *Abronia angustifolia* Greene, *Pittonia* 3: 344. 1898.

Graham, Maricopa, Pinal, and Cochise Counties, 1,000 to 4,000 feet, March to July (occasionally September). Western Texas and Chihuahua to Arizona.

The form occurring in this State is var. *arizonica* (Standl.) Kearney and Peebles (*A. arizonica* Standl.), which is usually more pubescent and broader leaved than typical *A. angustifolia*. Specimens without fruit are difficult to distinguish from *A. villosa*. The type of *A. arizonica* was obtained in Arizona (Vasey in 1882, without definite locality).

3. *Abronia nana* S. Wats., *Amer. Acad. Arts and Sci. Proc.* 14: 294. 1870.

Coconino and Mohave Counties, especially in the Grand Canyon region, 3,000 to 5,000 feet, April to May. Southern Utah and Nevada and northern Arizona.

Specimens having a bright pink perianth limb have been collected at the Grand Canyon (*Collom* in 1940).

4. *Abronia fragrans* Nutt. ex Hook., *Jour. Bot. and Kew Gard. Misc.* 5: 261. 1853.

North of Ganado, Apache County (*Peebles* 13497), east of Tuba, Coconino County (*Harrison* and *King* 8715), 5,000 to 6,000 feet. South Dakota to Idaho, south to Chihuahua and northern Arizona.

5. *Abronia elliptica* A. Nels., *Torrey Bot. Club. Bul.* 26: 7. 1899.

Apache County to Mohave County, 1,800 to 7,000 feet, common in northeastern Arizona, April to June. Wyoming to northern New Mexico and Arizona.

Perhaps only varietally distinct from *A. fragrans* Nutt., with which it seems to intergrade in Arizona.

11. TRIPTEROCALYX

Plants similar to *Abronia* but often with a 4-lobed perianth limb and with the body of the fruit harder, spindle-shaped, completely surrounded by the 2 to 4 broad, thin, nearly transparent, conspicuously reticulate-veined wings.

The fruits with their large fish-scalelike wings are conspicuous.

Key to the species

1. Perianth less than 2 cm. long, sparsely pubescent or glabrate, the limb greenish or pink ----- 1. *T. MICRANTHUS*.
1. Perianth more than 2 cm. long, copiously pubescent, the limb pink outside, white within ----- 2. *T. WOOTONII*.

1. *Tripterocalyx micranthus* (Torr.) Hook., *Jour. Bot. and Kew Gard. Misc.* 5: 261. 1853.

Abronia micrantha Torr. and Frém. in Frém., *Exped. Rocky Mount. Rpt.* 92. 1843.

Mohave County, at Pierce Ferry, 1,700 feet (*Jones* 5077av), and Pipe Springs, 4,700 feet (*Peebles* 13068), April to June. North Dakota and Montana to Kansas, Nevada, and Arizona.

The Arizona form is *T. pedunculatus* (M. E. Jones) Standl. (*Abronia micrantha* var. *pedunculata* M. E. Jones), which seems, at most, to be only varietally distinct from *T. micranthus*.

2. *Tripterocalyx wootonii* Standl., Contrib. U. S. Natl. Herbarium 12: 329. 1909.

Apache County to Coconino County, 4,400 to 6,200 feet, May to September. Northern New Mexico and Arizona.

37. PHYTOLACCACEAE. POKEBERRY FAMILY

Plants perennial, herbaceous or nearly so; stems leafy; leaves alternate, petioled, with entire blades; flowers mostly perfect, small, in axillary and terminal racemes; perianth of 4 or 5 distinct or nearly distinct segments, whitish; fruit berrylike, juicy, of 1 or several carpels.

Key to the genera

1. Sepals and stamens commonly 4; fruit 1-seeded..... 1. RIVINA.
1. Sepals normally 5; stamens 9 to 12; fruit several-seeded... 2. PHYTOLACCA.

1. RIVINA. ROUGE-PLANT, PIGEONBERRY

Plant herbaceous or barely suffrutescent; stems erect, up to 1 meter high; leaf blades ovate, acute or acuminate; perianth white or pinkish; style and stigma 1; fruit red or yellow at maturity.

1. *Rivina humilis* L., Sp. Pl. 121. 1753.

Rivina portulacoides Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 167. 1837.

Greenlee County to Maricopa County, south to Cochise, Santa Cruz, and Pima Counties, 1,600 to 4,500 feet, ravines and canyons, mostly in shade, June to August. Florida to Arizona, southward into tropical America.

In Mexico a red dye is obtained from the fruits, and the leaves are reported to be used medicinally. The plant is worth cultivating as an ornamental.

2. PHYTOLACCA. POKEBERRY

Stems tall, usually branched, very juicy; leaves large, the blades ovate-lanceolate, acute or acuminate at both ends; racemes terminal but appearing opposite the leaves as growth of the stem continues; styles and stigmas several, the styles recurved; fruit depressed-globose, dark purple (nearly black) at maturity, with 1 seed in each cell.

1. *Phytolacca americana* L., Sp. Pl. 441. 1753.

Chiricahua Mountains, Cochise County (*Fowler* in 1933), near Patagonia, Santa Cruz County (*Peebles* et al. 5614), 4,000 to 4,500 feet, August, perhaps introduced from farther east. Maine and Ontario to Florida, Texas, and Arizona.

Also known as pokeweed, and scoke. The roots and berries contain a bitter substance, probably saponin, and are poisonous, but the succulent young shoots are esteemed as a potherb and are harmless when thoroughly cooked. The root has been used medicinally.

38. AIZOACEAE. AIZOON FAMILY

Plants annual, often succulent, with low or prostrate, usually branched stems; leaves opposite or nearly so, or in whorls, entire; flowers perfect, axillary, solitary or in small clusters, inconspicuous;

sepals 5, separate or united below; petals none; ovary superior, 1- to 5-celled.

Key to the genera

1. Capsule dehiscent by valves; calyx of 5 distinct sepals, these not appendaged..... 1. MOLLUGO.
1. Capsule circumscissile; calyx 5-lobed, the lobes usually with a thick dorsal ridge ending in a free hornlike tip, the margins thin and petallike (2).
 2. Styles 3 to 5; ovary 3- to 5-celled; seeds many..... 2. SESUVIUM.
 2. Styles 1 or 2; ovary 1- or 2-celled; seeds few..... 3. TRIANTHEMA.

1. MOLLUGO. CARPETWEED

Plants not fleshy; stems prostrate or erect; leaves narrow, mostly in whorls of 3 to 6; sepals white within; stamens 3 to 5; capsules longitudinally dehiscent, 3- to 5-celled.

Key to the species

1. Stems commonly prostrate, radiating from the root, not filiform, green; stem leaves mostly oblanceolate and more than 1 mm. wide; seeds reniform, red brown, very shiny, with several parallel ribs along the back and sides..... 1. M. VERTICILLATA.
1. Stems erect or ascending, filiform, straw-colored; stem leaves linear or linear-lanceolate, commonly about 1 mm. wide; seeds irregularly obovoid, dark brown, scarcely shiny, finely reticulate..... 2. M. CERVIANA.

1. **Mollugo verticillata** L., Sp. Pl. 89. 1753.

Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,000 feet, commonly in sandy soil, September to October. Widely distributed in North America; Eastern Hemisphere.

Sometimes called Indian-chickweed.

2. **Mollugo cerviana** (L.) Seringe in DC., Prodr. 1: 392. 1824.

Pharnaceum cervianum L., Sp. Pl. 272. 1753.

Coconino County to Cochise and Pima Counties, 1,300 to 7,000 feet, sandy soil, August to October. Texas to California and south to tropical America; Eastern Hemisphere.

2. SESUVIUM. SEA-PURSLANE

Plant fleshy; leaves opposite, the blades narrow, usually oblanceolate; stipules none; petioles more or less connate at base; perianth 5-lobed, the lobes purplish within, the tube turbinate; stamens numerous, inserted on the perianth tube.

1. **Sesuvium verrucosum** Raf., New Fl. 4: 16. 1838.

Sesuvium sessile Robinson in A. Gray, Syn. Fl. 1¹: 259. 1897.
Not of Pers.

Maricopa and Yuma Counties, 1,000 feet or lower, saline soil, March to November. Arkansas to California, south to tropical America.

3. TRIANTHEMA

Plant somewhat fleshy; leaves with stipules, opposite, those of the pair very unequal in size, the blades obovate, cuneate at base; perianth purplish within, the lobes concave, with a hornlike dorsal appendage; stamens 6 to 10; capsule crested.

1. *Trianthema portulacastrum* L., Sp. Pl. 223. 1753.

Greenlee, Maricopa, Pinal, Cochise, and Pima Counties, 1,000 to 4,000 feet, July to October. Widely distributed in tropical and subtropical America; Eastern Hemisphere.

A common weed in irrigated land in southern Arizona, but easily controlled by cultivation. Locally known as "pigweed," a name applied to several unrelated plants.

39. PORTULACACEAE. PORTULACA FAMILY

Plants mostly herbaceous and small, annual or perennial, often succulent; leaves entire; flowers perfect, regular but slightly asymmetric; sepals commonly 2; petals mostly 4 or 5; stamens few or numerous; style cleft or divided; ovary superior or partly inferior, 1-celled; fruit a circumscissile or longitudinally dehiscent capsule.

Key to the genera

1. Capsule circumscissile (2).
2. Calyx of 2 separate sepals, free from the ovary; capsule circumscissile near the base and splitting upward longitudinally; plants subcaulescent, the leaves mostly basal..... 3. LEWISIA.
2. Calyx 2-lobed, the tube adherent to the ovary; capsule circumscissile near the middle, the calyx lobes coming away with the top of the capsule; plants caulescent, with leafy stems..... 7. PORTULACA.
1. Capsule valvate, splitting downward from the top (3).
3. Stigmas and valves of the capsule 2; inflorescence more or less scorpioid in flower; plants annual..... 4. CALYPTRIDIMUM.
3. Stigmas and valves of the capsule 3; inflorescence not scorpioid (4).
4. Sepals deciduous; plants perennial..... 1. TALINUM.
4. Sepals persistent (5).
5. Stem leaves alternate; petals 5 to 7; stamens 5 to 12, usually more numerous than the petals; plants annual..... 2. CALANDRINIA.
5. Stem leaves opposite; petals and stamens 5 (6).
6. Plants perennial, with a large globose corm; stem leaves 1 pair, not connate..... 5. CLAYTONIA.
6. Plants annual, or perennial with runners ending in bulblets; stem leaves several pairs or, if 1 pair, then connate-perfoliate.
6. MONTIA.

1. TALINUM

Plants perennial, glabrous; stems leafy or scapose; leaves alternate, the blades broad and flat, to narrow and nearly terete; inflorescence paniculate or cymose; stamens 5 to numerous; style 3-cleft; ovary superior.

Key to the species

1. Blades of the lower leaves 1 to 5 cm. wide, flat; inflorescence a many-flowered elongate open panicle, its leaves mostly reduced to small bracts; petals commonly pink, not more than 6 mm. long; flowering stems 25 cm. long or longer, from a thick tuberous root..... 1. T. PANICULATUM.
1. Blades of all of the leaves less than 5 mm. wide; inflorescence a few-flowered cyme, or the flowers solitary in the leaf axils (2).
2. Flowers in terminal cymes; petals pink (3).
3. Stamens 10 or more; stems and scapes spreading, less than 10 cm. long.
 2. T. VALIDULUM.
3. Stamens 4 to 8; stems and scapes erect or ascending, commonly at least 10 cm. long (4).
4. Sepals obtuse to short-acuminate, not or obscurely cuspidate.
 3. T. PARVIFLORUM.
4. Sepals bearing a stout, erect, apical-dorsal, hornlike cusp.
 4. T. GOODINGH.

2. Flowers solitary, or in very few-flowered axillary cymes (5).
 5. Stems not more than 10 cm. long; leaves crowded, very thick, less than 15 mm. long, commonly spatulate; pedicels not reflexed in fruit; petals lavender or rose pink; plant with the aspect of *Scdum*.
 5. T. BREVIFOLIUM.
 5. Stems commonly more than 10 cm. long; leaves not crowded or very thick, 10 to 60 mm. long, linear or narrowly lanceolate; pedicels reflexed in fruit; petals yellow or orange (6).
 6. Petals yellow; capsules globose or nearly so; stems woody below, with exfoliating bark..... 6. T. ANGUSTISSIMUM.
 6. Petals orange or copper-colored; capsules ovoid; stems herbaceous or barely suffrutescent..... 7. T. AURANTIACUM.

1. **Talinum paniculatum** (Jacq.) Gaertn., Fruct. et Sem. 2: 219. 1791.

Portulaca paniculata Jacq., Enum. Pl. Carib. 22. 1762.

Greenlee County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, rich soil among rocks in partial shade, August to September. Florida to Arizona, south to tropical America.

Easily distinguished from the other Arizona species of this genus by its relatively tall leafy stems, broad flat leaf blades, and large open panicle of small flowers.

2. **Talinum validulum** Greene, Leaflets 2: 270. 1912.

Coconino County, in the Tusayan (now the Kaibab) National Forest (*Hill* in 1912, the type collection), and at Rattlesnake Tanks, 5,900 feet (*Leiberg* 5966). Known only from Arizona.

3. **Talinum parviflorum** Nutt. ex Torr and Gray, Fl. North Amer. 1: 197. 1838.

Showlow, Apache County (*Pebbles* and *Smith* 13974), near Prescott, Yavapai County (*Pebbles* et al. 2695), 5,000 to 6,200 feet, yellow pine forests. Minnesota and North Dakota to Arkansas, New Mexico, and Arizona.

4. **Talinum goodingii** P. Wilson, North Amer. Fl. 21: 287. 1932.

Boyles, San Francisco River, Greenlee County (*Gooding* 1282, the type collection), Nogales, Santa Cruz County, about 4,000 feet (*Stalmach* 282, *Pebbles* et al. 4639), on open rocky slopes, August. Known only from Arizona.

The specimens from Nogales have shorter and stouter cusps of the sepals than in the type collection. Traces of such appendages are occasionally seen in specimens of *T. parviflorum* from farther east, and the two species are not distinguishable by the shape of the capsule, as indicated in the key in North American Flora.

5. **Talinum brevifolium** Torr. in Sitgreaves, Zuni and Colorado Rpt. 156. 1853.

Navajo and Coconino Counties, 5,000 to 6,000 feet, May to August, type from along the Little Colorado River. Southern Utah, New Mexico, and northeastern Arizona.

6. **Talinum angustissimum** (A. Gray) Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 120. 1913.

Talinum aurantiacum var. *angustissimum* A. Gray, Pl. Wright. 1: 14. 1852.

Hereford, Cochise County (*Harrison* 8270), near Sells, Pima County (*Pebbles* et al. 2796, 8034), August to September. Western Texas to southern Arizona.

7. *Talinum aurantiacum* Engelm., Boston Jour. Nat. Hist. 6: 153. 1850.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, plains and rocky slopes, often among grasses, July to September. Western Texas to southern Arizona and northern Mexico.

Arizona's largest-flowered and showiest species. Indians in Arizona cooked and ate the roots.

2. CALANDRINIA. ROCKPURSLANE

Small somewhat fleshy annual herbs; leaves alternate; inflorescence umbellike or racemiform; sepals 2, persistent; petals 3 to 7; style 3-cleft; capsule longitudinally dehiscent.

Key to the species

1. Leaf blades oblong-spatulate, very obtuse; flowers in rather compact, umbel-like, lateral and terminal clusters; sepals glabrous; petals white, shorter than the sepals; capsules obtuse..... 1. *C. AMBIGUA*.
1. Leaf blades narrowly to rather broadly lanceolate or oblanceolate, often sub-rhombic, acutish or obtuse; flowers in loose, leafy terminal racemes; sepals usually more or less pubescent with thick, white hairs; petals rose red (exceptionally white), mostly longer than the sepals; capsules acuminate. 2. *C. CILIATA*.

1. *Calandrinia ambigua* (S. Wats.) Howell, Erythea 1: 34. 1893.

Claytonia ambigua S. Wats., Amer. Acad. Arts and Sci. Proc 17: 365. 1882.

Near Dome, Yuma County (*Harrison and Peebles* 5056), in sandy soil, March. Deserts of southwestern Arizona and southeastern California.

2. *Calandrinia ciliata* (Ruiz and Pavon) DC., Prodr. 3: 359. 1828.

Talinum ciliatum Ruiz and Pavon, Fl. Peruv. Prodr. 65. 1794.

Calandrinia arizonica Rydb., North Amer. Fl. 21: 292. 1932.

Gila, Pinal, Maricopa, and Pima Counties, 1,500 to 4,000 feet, February to April. British Columbia to Baja California and Arizona; South America.

Redmaids, one of the common early spring wild flowers of the southern deserts. The form occurring in Arizona is var. *menziesii* (Hook.) Macbride (*Talinum menziesii* Hook., *Calandrinia caulescens* var. *menziesii* A. Gray).

3. LEWISIA

Plants small, perennial, somewhat fleshy, scapose, with thick roots; leaves mostly basal, narrow; flowers solitary, rather showy; sepals 2, separate; petals pink or white.

The Arizona species belong to the subgenus *Orebroma* and differ considerably from the type of the genus (*L. rediviva* Pursh), bitterroot, the State flower of Montana. The roots of this species (and possibly of those occurring in Arizona) were eaten by the Indians.

Key to the species

1. Bracts closely investing the flower, ovate-lanceolate, narrower than the broadly ovate entire sepals, simulating an outer pair of sepals; petals whitish, 12 to 20 mm. long..... 1. *L. BRACHYCALYX*.
1. Bracts remote from the flower; sepals suborbicular, glandular-dentate at the rounded or truncate apex; petals pink or white, 8 to 10 mm. long. 2. *L. PYGMAEA*.

1. *Lewisia brachycalyx* Engelm. in A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 400. 1868.

Oreobroma brachycalyx Howell, Erythea 1: 31. 1893.

Coconino, Gila, and Yavapai Counties, 5,000 to 7,000 feet, among oaks, junipers, and yellow pines, April to May. Southern Utah, Arizona, and southern California.

2. *Lewisia pygmaea* (A. Gray) Robinson in A. Gray, Syn. Fl. 1¹: 268. 1897.

Talinum pygmaeum A. Gray, Amer. Jour. Sci. ser. 2, 33: 407. 1862.

Oreobroma pygmaeum Howell, Erythea 1: 33. 1893.

Tsugie, Navajo County (*Wetherill* 105, 276), Kaibab Plateau and north rim of Grand Canyon, Coconino County, 8,000 to 9,000 feet (*Mead* 259, Forest Service 62611), June. Montana to Washington, Arizona, and California.

4. CALYPTRIDIDIUM

Small, glabrous, somewhat succulent annual herbs; stem leaves alternate; flowers small, ephemeral, in scorpioid racemes; petals 2 to 4, pink or white; stamens 1 to 3.

Key to the species

1. Inflorescence rather loose, the flowers not closely imbricate, or so only at ends of the branches; sepals 1.5 to 2.5 mm. long, one-fourth to one-third as long as the capsule; petals 2 or 3; stamen 1; capsules somewhat falcate.
1. *C. MONANDRUM*.
1. Inflorescence dense, the flowers closely imbricate; sepals 3 to 4 mm. long, fully half as long as the capsule; petals 4; stamens 1 to 3; capsules straight or nearly so.----- 2. *C. PARRYI*.

1. *Calyptridium monandrum* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 198. 1838.

Mohave County to Pinal, Santa Cruz, Pima, and (doubtless) Yuma Counties, 4,000 feet or lower, common on desert plains and slopes, March to April. Arizona, California, and Baja California.

2. *Calyptridium parryi* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 285. 1887.

Canoa to Arivaca, and Rosemont, Pima County (*Griffiths* 3556, 4125), Nogales, Santa Cruz County (*Pebbles* and *Fulton* 11454), 3,500 to 4,000 feet, March to April. Southern Arizona and southern California.

The seeds are described as dull and minutely roughened in *C. parryi*, whereas in the specimens from Nogales they are smooth and shining. The species apparently varies in this character.

5. CLAYTONIA. SPRINGBEAUTY

Plant a small glabrous perennial with a large corm; stem leaves one pair, opposite; flowers few, in loose racemes, rather conspicuous; sepals 2, persistent; petals 5, pale pink; style 3-cleft; capsule 3-valved.

1. *Claytonia rosea* Rydb., Torrey Bot. Club Bul. 31: 404. 1904.

Near Oak Creek Canyon (Coconino County), Sierra Ancha and Mazatzal Mountains (Gila County), 5,500 to 7,000 feet, moist rich

soil, preferring shade on northern exposures, April to May. Wyoming and Utah to New Mexico and Arizona.

The Arizona specimens have longer leaves than those from the Rocky Mountains (5 to 10 cm. long) and perhaps constitute a distinct variety. *C. rosea* is perhaps not specifically distinct from *C. lanceolata* Pursh.

6. MONTIA

Small glabrous plants of diverse habit, annual or perennial; stem leaves opposite, in 1 or more pairs; flowers small and inconspicuous, in loose, simple or compound racemes; sepals 2; petals and stamens 5.

Key to the species

1. Plant perennial, with runners ending in a bulblet; stems commonly decumbent and rooting at the lower nodes; leaves none of them long-petioled, the stem leaves several pairs, obovate to oblong-spatulate, narrowed at base; racemes axillary (often appearing terminal); petals 6 to 8 mm. long.

1. *M. CHAMISSOI.*

1. Plant annual, with fibrous roots; stems erect or ascending; basal leaves very long-petioled, the stem leaves 1 pair, broader than long, connate-perfoliate, forming a nearly orbicular or somewhat angled disk subtending the inflorescence; racemes terminal; petals 3 to 5 mm. long.

2. *M. PERFOLIATA.*

1. *Montia chamissoi* (Ledeb.) Durand and Jackson, Index Kew. Sup. 1: 282. 1903.

Claytonia chamissoi Ledeb. in Spreng., Syst. Veg. 1: 790. 1825.

Crucocallis chamissonis Rydb., Torrey Bot. Club Bul. 33: 139. 1906.

Apache County to Coconino and Yavapai Counties, 6,200 to 8,500 feet, wet ground in forests, June to August. Alaska to Iowa, New Mexico, Arizona, and California.

2. *Montia perfoliata* (Donn) Howell, Erythea 1: 38. 1893.

Claytonia perfoliata Donn, Hort. Cantabr. 25. 1796.

Limnia perfoliata Haw., Syn. Pl. Succ. 11. 1812.

Mohave, Coconino, Gila, Maricopa, and Pinal Counties, 3,000 to 6,000 feet, along brooks and around springs, February to May. South Dakota to British Columbia, south to Arizona and California.

Miners-lettuce, Indian-lettuce, easily recognized by the saucer-shaped disk formed by the stem leaves, has been used as a salad plant and potherb by both white people and Indians. A form with narrower basal leaves, var. *parviflora* (Dougl.) Jepson (*Claytonia parviflora* Dougl.), often grows with the typical form and is equally common in Arizona. A depauperate form occasionally found in the State is var. *depressa* (A. Gray) Jepson (*Limnia humifusa* Rydb.). Several Arizona specimens have been identified as *Limnia utahensis* Rydb.

7. PORTULACA

Small, more or less succulent plants, annual or perennial, with diffuse or ascending, leafy stems; sepals 2, united below; petals mostly 5, inserted on the calyx; stamens often numerous, inserted on the calyx; ovary partly inferior; capsule opening by an apical lid.

All of the species prefer dry soil and full sunlight, growing on plains and mesas. Some of the Arizona species were used by the Indians as potherbs. The popular garden annual (*P. grandiflora* Hook.) is a native of southern South America.

Key to the species

1. Capsule rim conspicuously extended in a circular membranous wing; plant annual, glabrous; leaf blades flat, lanceolate or spatulate; petals reddish with a yellow base----- 1. *P. LANCEOLATA*.
1. Capsule rim not winged (2).
2. Petals pink or purplish, 3 to 4 mm. long; plant annual, copiously and conspicuously pubescent in the leaf axils with long kinky hairs; stems spreading or procumbent, commonly less than 10 cm. long; leaves subterete----- 2. *P. PARVULA*.
2. Petals yellow or copper-colored (3).
3. Plant perennial, with tuberous-thickened roots, pubescent in the leaf axils (usually conspicuously so) with long kinky hairs; stems commonly erect or ascending and more than 10 cm. long, sometimes slightly woody at base; leaves linear, subterete; petals more than 5 mm. long, reddish or copper-colored----- 3. *P. SUFFRUTESCENS*.
3. Plants annual, glabrous or with a few inconspicuous short hairs in the axils; stems commonly decumbent or prostrate; leaves obovate-cuneate or spatulate, thick but flat; petals less than 5 mm. long, yellow (4).
4. Seeds (at low magnification) conspicuously and sharply granulate (almost echinate), very nearly to fully 1 mm. in greatest diameter.----- 4. *P. RETUSA*.
4. Seeds minutely and not sharply granulate, usually distinctly less than 1 mm. in diameter----- 5. *P. OLERACEA*.

1. *Portulaca lanceolata* Engelm., Boston Jour. Nat. Hist. 6: 154. 1850.

Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, August to September. Western Texas to Arizona and Baja California.

2. *Portulaca parvula* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 274. 1887.

Navajo, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,300 to 7,000 feet, September. Missouri to Colorado, Arizona, California, and central Mexico.

3. *Portulaca suffrutescens* Engelm., Bot. Gaz. 6: 236. 1881.

Yavapai County to Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, July to September. Arkansas and Texas to Arizona and northern Mexico.

Arizona's showiest species, the flowers sometimes 3 cm. wide.

4. *Portulaca retusa* Engelm., Boston Jour. Nat. Hist. 6: 154. 1850.

Navajo, Coconino, Gila, Pinal, Cochise, and Santa Cruz Counties, 1,300 to 5,500 feet, sometimes in saline soil, August to September. Arkansas and Texas to Utah and Arizona.

Difficult to distinguish from *P. oleracea* except by the seed characters.

5. *Portulaca oleracea* L., Sp. Pl. 445. 1753.

Apache, Navajo, and Santa Cruz Counties, 4,000 to 8,600 feet, late summer. Widely distributed in both the Eastern and the Western Hemisphere.

Common purslane, pusley. A common garden weed in the eastern United States but rare in Arizona.

40. CARYOPHYLLACEAE. PINK FAMILY

Plants herbaceous, annual or perennial; leaves opposite, entire; flowers perfect, regular, mostly with both a calyx and a corolla but

sometimes apetalous; styles and stigmas 2 to 5; ovary superior; fruit a many-seeded capsule, dehiscent by valves at least at apex, or a 1-seeded achene or utricle.

This family includes those favorites of gardeners and florists, the pinks and carnations, but in many of the genera the plants are insignificant, with small, inconspicuous flowers.

Key to the genera

1. Fruit a 1-seeded achene or utricle, enclosed in the calyx tube; stipules scarious; sepals more or less united; petals minute or none (2).
2. Plant perennial, pulvinate-cespitose; stipules large and conspicuous, not or not much shorter than the leaf blades; flowers in terminal cymose clusters..... 9. PARONYCHIA.
2. Plants annual; stipules relatively small, much shorter than the blades; flowers in axillary clusters (3).
3. Sepals with conspicuous thin white blades and green claws, these united below into an elongate, turbinate tube..... 8. ACHYRONYCHIA.
3. Sepals greenish, without differentiation of claw and blade, united only toward the base..... 10. HERNIARIA.
1. Fruit a several-seeded capsule, valvate, at least at apex; petals usually present (4).
4. Sepals united for most of their length, forming a more or less inflated gamosepalous calyx, this 5-toothed at apex; petals with long claws, usually with appendages forming a crown in the throat of the corolla (5).
5. Calyx terete or 5-angled, inconspicuously veined; petals with or without a crown; herbage glabrous or obscurely puberulent... 13. SAPONARIA.
5. Calyx with 10 or more conspicuous longitudinal nerves or ribs; petals with crownlike appendages, these sometimes reduced to small scales (6).
6. Styles normally 3; ovary and capsule stipitate or at least narrowed at base; blade of the petal broader than the claw..... 11. SILENE.
6. Styles 4 or 5; ovary and capsule sessile or very nearly so, broad at base; blade of the petal not or very little wider than the apical part of the claw..... 12. LYCHNIS.
4. Sepals separate to the base or nearly so; petals not clawed or appendaged (7).
7. Style one, 3-cleft or 3-toothed; capsule 3-valved (8).
8. Petals usually present although sometimes very small; sepals not recurved or rigid..... 6. DRYMARIA.
8. Petals minute or none; sepals recurved, becoming rigid and almost spinose..... 7. LOEFLINGIA.
7. Styles 3 to 5, usually separate to the base (9).
9. Stipules present, scarious, conspicuous; petals pink, entire, sometimes rudimentary..... 5. SPERGULARIA.
9. Stipules none; petals white, occasionally purple tinged, rarely wanting (10).
10. Styles alternate with the sepals and of the same number, usually 5. 3. SAGINA.
10. Styles opposite the sepals or, if fewer in number, then opposite the outer sepals (11).
11. Capsule elongate, cylindric, often curved, dehiscent at apex with twice as many teeth as there are styles; styles usually 5. 2. CERASTIUM.
11. Capsule short, ovoid or oblong, straight, splitting into as many valves as there are styles, the valves often 2-cleft; styles usually 3 (12).
12. Petals bifid, often deeply so, rarely none..... 1. STELLARIA.
12. Petals entire or slightly emarginate..... 4. ARENARIA.

1. STELLARIA. CHICKWEED

Plants small, herbaceous, annual or perennial, usually with tufted stems; flowers solitary in the axils or in few-flowered terminal cymes,

inconspicuous; sepals and petals commonly 5; styles usually 3, sometimes partly united; fruit a dehiscent capsule.

Other names for these plants are starwort and stitchweed.

Key to the species

1. Plant glandular-pubescent, at least in the inflorescence, perennial; petals 6 to 8 mm. long, about twice as long as the sepals, retuse or bifid (cleft not more than half way to the base); flowering stems from creeping, often tuberous-thickened rootstocks, sharply 4-angled; leaves lanceolate, attenuate-acuminate, 3 cm. long or longer, closely sessile.
 1. *S. JAMESIANA*.
1. Plants not glandular, or the pedicels obscurely so in *S. media*; petals not more than 5 mm. long, not or scarcely surpassing the sepals, 2-parted (2).
 2. Leaves distinctly petioled, at least the basal ones; plants annual (3).
 3. Stems procumbent, pubescent in lines; leaves mostly long-petioled, the blades ovate; petioles ciliate; flowers axillary, solitary on long, soon deflexed, puberulent pedicels; sepals pubescent, not shiny, broadly lanceolate, not setose-tipped, not conspicuously scarious-margined.
 2. *S. MEDIA*.
 3. Stems erect or ascending, glabrous or sparsely pubescent below, not in lines; leaves (except the lowest) sessile, lanceolate; flowers in terminal scarious-bracted cymes; sepals glabrous, shiny, narrowly lanceolate, setose-acuminate, conspicuously scarious-margined.
 3. *S. NITENS*.
 2. Leaves all sessile or subsessile; pedicels elongate, filiform (4).
 4. Petals none or rudimentary; plant annual; leaf blades thin, lanceolate to elliptic-oblong; flowers numerous in terminal, subumbellate inflorescences; pedicels spreading or deflexed.----- 4. *S. UMBELLATA*.
 4. Petals equaling or surpassing the sepals; plant perennial, from creeping rootstocks; leaf blades linear or linear-lanceolate, acuminate, 1 to 3 cm. long; flowers solitary or in very few-flowered cymes (5).
 5. Leaves ascending, somewhat shiny, broadest near the base; pedicels erect or ascending, straight or nearly so.----- 5. *S. LONGIPES*.
 5. Leaves spreading, not shiny, broadest near the middle; pedicels becoming wide-spreading or deflexed and usually curved.
 6. *S. LONGIFOLIA*.

1. *Stellaria jamesiana* Torr., Ann. Lyc. N. Y. 2: 169. 1827.

Alsine jamesiana Heller, Cat. North Amer. Pl. ed. 2, 4. 1900.

Navajo and Coconino Counties, 7,000 to 8,500 feet, June and July. Wyoming to Idaho, Texas, northern Arizona, and California.

Represented in Arizona by a relatively narrow-leaved form (*Alsine curtisii* Rydb.).

2. *Stellaria media* (L.) Cyrillo, Pl. Char. Comm. 36. 1784.

Alsine media L., Sp. Pl., 272. 1753.

Tempe, Maricopa County (*McLellan* and *Stitt* 690). A common weed of lawns and gardens in many parts of the United States; naturalized from Europe.

3. *Stellaria nitens* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 185. 1838.

Alsine nitens Greene, Bot. San Francisco Bay 33. 1894.

Gila, Pinal, Maricopa, and Pima Counties, 1,500 to 3,000 feet, February and March. Montana to British Columbia, south to Arizona and California.

4. *Stellaria umbellata* Turcz., Soc. Imp. Nat. Moscou Bul. 15: 173. 1842.

Alsine baicalensis Coville, Contrib. U. S. Natl. Herbarium 4: 70. 1893.

San Francisco Peaks (Coconino County), 11,000 to 12,000 feet, July and August. Montana to Oregon, south to New Mexico, northern Arizona, and California; Siberia.

5. *Stellaria longipes* Goldie, Edinb. Phil. Jour. 6: 327. 1822.

Alsine longipes Coville, Contrib. U. S. Natl. Herbarium 4: 70. 1893.

White Mountains, Apache County (*Zuck* in 1897), Chiricahua Mountains, Cochise County, 9,200 feet (*Blumer* 1602), June and July. Greenland to Alaska, south to New Mexico, Arizona, and California; northern Asia.

6. *Stellaria longifolia* Muhl. ex Willd., Enum. Pl. 479. 1809.

Alsine longifolia Britton, Torrey Bot. Club Mem. 5: 150. 1894.

Buck Springs Ranger Station, Coconino County, 7,500 feet (*Colom* 783), July. Canada to Maryland and Arizona.

2. CERASTIUM

Plants herbaceous, annual or perennial, mostly pubescent; flowers in terminal cymes; sepals and petals commonly 5, the petals 2-lobed or 2-cleft, rarely wanting; capsules dehiscent only near the apex.

The name powderhorn, suggested by the shape of the capsule, is sometimes given these plants. They are also known as mouse-ear chickweed.

Key to the species

1. Plants perennial, commonly loosely caespitose; capsules not or but slightly more than twice as long as the calyx (2).
 2. Petals not surpassing and often shorter than the sepals; leaf blades oblong-ovate to oblong-lanceolate, obtuse----- 1. *C. VULGATUM*.
 2. Petals surpassing the sepals (3).
 3. Stems decumbent or prostrate; lower leaves with oblong or oblanceolate, obtuse or acutish blades; petals commonly less than twice as long as the sepals----- 2. *C. BEERINGIANUM*.
 3. Stems erect, or ascending; lower leaves commonly with linear or linear-lanceolate, acute blades; petals fully twice as long as the sepals.
 3. *C. ARVENSE*.
1. Plants mostly annual; petals less than twice as long as the sepals (4).
 4. Leaf blades oblanceolate or obovate; capsules straight, less than twice as long as the calyx, their teeth at maturity strongly revolute from the tip.
 4. *C. TEXANUM*.
 4. Leaf blades mostly lanceolate to ovate-oblong, the lowest ones sometimes oblanceolate; capsules usually curved, 2 to 3 times as long as the calyx, their teeth at maturity not revolute from the tip, but often with revolute margins (5).
 5. Pedicels in fruit seldom more than twice as long as the calyx, straight, or slightly and gradually curved; leaf blades oblong or oblong-ovate.
 5. *C. BRACHYPODUM*.
 5. Pedicels in fruit mostly 3 or more times as long as the calyx, usually strongly curved or hooked near the apex; leaf blades linear-lanceolate or oblong-lanceolate----- 6. *C. NUTANS*.

1. *Cerastium vulgatum* L., Sp. Pl. ed. 2, 627. 1762.

Greer, Apache County (*Fulton* 8214), Lakeside, Navajo County (*Harrison* 5492), 6,200 to 8,200 feet, June to September. Widely distributed in the United States; naturalized from Europe.

2. *Cerastium beeringianum* Schlecht. and Cham., *Linnaea* 1: 62. 1826.

San Francisco Peaks (Coconino County), 11,000 to 12,000 feet, July and August. Quebec to Alaska, south to New Mexico and northern Arizona.

3. *Cerastium arvense* L., Sp. Pl. 438. 1753.

Apache County to Coconino County, 7,000 to 9,000 feet, June and July. Labrador to Alaska, south to Georgia, New Mexico, northern Arizona, and California; Europe.

Flowers showy for the genus, with pure-white petals. The form of this polymorphic species occurring in Arizona is probably *C. scopulorum* Greene.

4. *Cerastium texanum* Britton, Torrey Bot. Club Bul. 15: 97. 1888.

Graham, Gila, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,500 to 6,000 feet, moist, partly shaded places, March and April, also August and September. Central Texas and southern Arizona.

5. *Cerastium brachypodum* (Engelm.) Robinson in Britton, Torrey Bot. Club Mem. 5: 150. 1894.

Cerastium nutans var. *brachypodum* Engelm. in A. Gray, Man. ed. 5, 94. 1867.

Apache, Navajo, Coconino, Greenlee, and Cochise Counties, 7,000 to 9,500 feet, May to July. South Dakota to Alberta, south to Virginia, Missouri, Arizona, Oregon, and northern Mexico.

Specimens collected in the Huachuca Mountains (*Goodding* 1296) are apparently perennial.

6. *Cerastium nutans* Raf., Prec. Somiolog. 36. 1814.

Cerastium longipedunculatum Muhl., Cat. 46. 1813. (Nom. nud. ?)

Apache and Gila Counties to Cochise and Pima Counties, 7,500 to 9,500 feet, July to October. Nova Scotia to British Columbia, south to North Carolina, Arizona, and nearly throughout Mexico.

Both the typical form, viscid-villous with spreading hairs, and var. *obtectum* Kearney and Peebles (*C. sericeum* S. Wats. not Pourr.) occur in Arizona. The latter has the stems and leaves, at least near the base of the plant, sericeous with long nonglandular hairs. Many Arizona specimens are intermediate in character of the pubescence. The type of *C. sericeum* was obtained in the Huachuca Mountains.

3. SAGINA. PEARLWORT

Plants herbaceous, annual or perennial, small and inconspicuous; stems slender, diffuse, matted; leaves narrowly linear; petals 4 or 5 and entire, or wanting; capsule finally dehiscent to the base.

The identification of the Arizona specimens is uncertain.

Key to the species

1. Plant perennial, glabrous; sepals 5; petals usually present.
 1. *S. SAGINOIDES.*
 1. Plant annual, often glandular-pubescent; sepals 4; petals usually none.
 2. *S. APETALA.*
1. **Sagina saginoides (L.) Britton, Torrey Bot. Club Mem. 5: 151. 1894.**

Spergula saginoides L., Sp. Pl. 441. 1753.

San Francisco Peaks, Coconino County, 11,500 feet (*Knowlton* 134), Pinal Mountains, Gila County, about 5,000 feet (*Kearney* and *Harrison* 1542). Greenland to Alaska, south to New Mexico, Arizona, and California; Eurasia.

The Arizona specimens probably belong to var. *hesperia* Fernald.

2. **Sagina apetala** Ard., Animad. Alt. 22. 1764.

Miami to Superior, Gila County (*Nelson* 1907). Eastern United States, Arizona, and southern California, introduced from Europe.

4. ARENARIA. SANDWORT

Plants mostly perennial; stems slender, often tufted; flowers mostly in cymes, these open or congested; sepals 5, commonly ribbed or keeled; petals 5, entire or nearly so; stamens normally 10; styles 3; capsule longitudinally dehiscent.

Where sufficiently abundant, these plants are said to furnish excellent forage but do not withstand heavy grazing.

Key to the species

1. Valves of the capsule not cleft; plants usually glandular-pubescent (2).
 2. Plant annual; stems diffusely branched from near the base, usually more than 5 cm. long; leaf blades linear-subulate to nearly filiform, not rigid or pungent.----- 1. *A. DOUGLASSII.*
 2. Plants perennial, more or less caespitose; stems numerous, seldom more than 5 cm. long; leaf blades less than 1 cm. long, linear-subulate, often slightly pungent; alpine or subalpine (3).
 3. Sepals acute or acuminate, surpassing the petals----- 2. *A. VERNA.*
 3. Sepals obtuse, not surpassing and usually shorter than the petals.
 3. *A. SAJANENSIS.*
 1. Valves of the capsule cleft; plants perennial (4).
 4. Leaf blades lanceolate or broader, not or scarcely rigid or pungent; glandular pubescence none (5).
 5. Pedicels divergent after anthesis, often 4 times as long as the fruit; plant green, sparsely puberulent or glabrate; stems lax, diffusely branched, 20 to 40 cm. long; sepals at anthesis mostly 3 to 3.5 mm. long.
 4. *A. CONFUSA.*
 5. Pedicels erect or ascending, seldom more than 3 times as long as the fruit; plants grayish and densely puberulent, to green and glabrate.
 5. *A. SAXOSA.*
 4. Leaf blades linear-subulate or acicular, more or less rigid and pungent; plants grasslike, more or less caespitose, with a subligneous caudex (6).
 6. Sepals obtuse or obtusish, apiculate, broadly ovate and broadly scarious-margined, as are the bracts; petals much surpassing the sepals; leaf blades more or less incurved; inflorescence glandular.
 6. *A. CAPILLARIS.*
 6. Sepals acute or acuminate, linear-lanceolate to ovate-lanceolate (7).
 7. Petals and capsules shorter than to slightly surpassing the sepals (8).

8. Plant bluish green; stems usually 20 cm. long or longer, strict; leaf blades erect or nearly so, some of them usually at least 30 mm. long, not very rigid or very sharply pungent; sepals normally lanceolate or linear-lanceolate; petals white; inflorescence glandular----- 7. *A. FENDLERI*.
8. Plant light green or yellowish; stems usually not more than 15 cm. long; leaf blades more or less spreading, commonly not more than 20 mm. long, very rigid and sharply pungent; sepals normally oblong-lanceolate or ovate-lanceolate; petals often yellowish.----- 8. *A. EASTWOODIAE*.
7. Petals usually conspicuously surpassing the sepals; plants loosely caespitose (9).----- 9. *A. ACULEATA*.
9. Stems glandular-puberulent, at least in the inflorescence; basal leaves densely crowded; capsule conspicuously surpassing the calyx----- 9. *A. ACULEATA*.
9. Stems glabrous throughout; basal leaves not densely crowded; capsule rarely much surpassing the calyx (10).----- 10. *A. MACRADENIA*.
10. Flowers numerous, long-pedicelled, in large, very open cymes; stems suffrutescent, conspicuously swollen at the nodes.----- 10. *A. MACRADENIA*.
10. Flowers few, sessile or subsessile, in small, compact cymes; stems not or barely suffrutescent, not conspicuously swollen at the nodes----- 11. *A. CONGESTA*.

1. *Arenaria douglasii* Fenzl ex Torr. and Gray, Fl. North Amer. 1: 674. 1840.

Gila and Maricopa Counties, chiefly in the vicinity of the Mazatzal Mountains, 2,300 to 3,500 feet, sandy soil, March to June. Arizona and California.

2. *Arenaria verna* L., Mant. 72. 1767.

Arenaria propinqua Richards., Bot. App. Franklin Jour. ed. 2, 17. 1823.

San Francisco Peaks (Coconino County), 11,000 to 12,400 feet, July and August. Hudson Bay to Mackenzie, south to Arizona and California; Eurasia.

In addition to the ordinary glandular-puberulent form (var. *pubescens* (Cham. et Schlecht.) Fernald, *A. propinqua* Richards.), a glabrous form with purplish sepals (*A. verna* var. *pubescens* f. *epilis* Fernald) was collected by E. L. Little, Jr., among lava boulders at 12,000 feet.

3. *Arenaria sajanensis* Willd. in Schlecht., Mag. Gesell. Naturf. Freund. Berlin 7: 200. 1813.

San Francisco Peaks, 11,500 to 12,000 feet (*Knowlton* 128, *Little* 4654), August. Alberta and British Columbia to New Mexico and northern Arizona; Siberia.

4. *Arenaria confusa* Rydb., Torrey Bot. Club Bul. 28: 275. 1901.

Navajo, Coconino, and Yavapai Counties to Cochise and Pima Counties, 6,000 to 8,500 feet, pine forests, July to September. Colorado, Utah, New Mexico, and Arizona.

The commonest species at moderate elevations in central and southern Arizona.

5. *Arenaria saxosa* A. Gray, Pl. Wright. 2: 18. 1853.

Arenaria polycaulos Rydb., Torrey Bot. Club Bul. 31: 406. 1904.

White Mountains (Apache County), San Francisco Peaks (Coconino County), Pinaleno Mountains (Graham County), Santa

Catalina Mountains (Pima County), 8,000 to 12,000 feet, commonly in coniferous forests, May to September. New Mexico, Arizona, and northern Mexico.

The distribution in Arizona, as given above, is that of the typical form, a compact plant with low matted stems seldom more than 10 cm. long and small, oblong-lanceolate leaves. Two other forms that occur in Arizona, both of them less compact plants with taller stems and longer narrower leaves, are: (1) Var. *cinerascens* Robinson, ranging from the Lukachukai Mountains (Apache County) and the Kaibab Plateau (Coconino County), to the mountains of Cochise and Pima Counties, 7,000 to 9,000 feet; (2) var. *mearnsii* (Woot. and Standl.) Kearney and Peebles (*A. mearnsii* Woot. and Standl.), in the mountains of Graham, Cochise, Santa Cruz, and Pima Counties, 4,000 to 9,000 feet. The stiffer stems, more erect leaves and fine grayish pubescence distinguish var. *cinerascens* from var. *mearnsii*, but there is intergradation among all forms of this species.

6. *Arenaria capillaris* Poir. in Lam., Encycl. 6: 380. 1804.

Coconino and Yavapai Counties, also Superstition Mountains (Pinal County), 5,000 to 8,000 feet, May and June. Alberta and British Columbia to Arizona and California; Asia.

The American plant is *A. formosa* Fisch., considered by Rydberg to be specifically distinct from the Asiatic *A. capillaris*.

7. *Arenaria fendleri* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 13. 1849.

Apache County to Mohave County, 4,000 to 12,000 feet, April to September. Wyoming to New Mexico and Arizona.

A common plant of the yellow pine forests, becoming very depauperate near the summit of the San Francisco Peaks.

In a recently published paper (Maguire, Bassett. Great Basin plants. III. Caryophyllaceae. Madroño 6: 22-27. 1941), a form of *A. fendleri* with relatively short leaves and long petals, subsp. *brevifolia* Maguire, is recorded as occurring in the Kaibab National Forest; and *A. aberrans* M. E. Jones, related to *A. capillaris* but having very large, urn-shaped capsules, is reported from Grand Canyon National Park, and from Mount Dellenbaugh, northern Mohave County, where the type is stated to have been collected.

8. *Arenaria eastwoodiae* Rydb., Torrey Bot. Club Bul. 31: 406. 1904.

Apache County to Coconino County, 5,000 to 7,000 feet, sandy soil on plains and mesas, tending to make small hummocks, June to September. Colorado, Utah, New Mexico, and northern Arizona.

The typical glabrous form is less common in Arizona than the glandular-puberulent var. *adenophora* Kearney and Peebles. The Hopi Indians are reported to use the plant as an emetic.

9. *Arenaria aculeata* S. Wats. in King, Geol. Expl. 40th Par. 5: 40. 1871.

Navajo County to Mohave and Yavapai Counties, 4,000 to 9,000 feet, May to September. Idaho and Oregon to New Mexico, Arizona, and California.

10. *Arenaria macradenia* S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 367. 1882.

San Francisco Peaks (*Lemmon* in 1884), Beaver Dam Creek, Mohave County (*Goodding* 771). Utah and Arizona to California.

These Arizona specimens are referred somewhat doubtfully to *A. macradenia*.

11. *Arenaria congesta* Nutt. ex. Torr. and Gray, Fl. North Amer. 1: 178. 1838.

"Arizona," without definite locality (*Palmer* in 1869). This specimen belongs to var. *subcongesta* S. Wats. (*A. subcongesta* Rydb.). The species ranges from Montana to Washington, south to Colorado, Arizona (?), and California.

5. SPERGULARIA.⁴¹ SANDSPURRY

Plant annual, somewhat fleshy, usually glandular-pubescent, with spreading or prostrate, branched stems; leaves narrow, nearly terete, often fasciated; sepals 5; petals usually 5, sometimes wanting; styles 3; capsule longitudinally dehiscent to the base.

1. *Spergularia marina* (L.) Griseb., Spicil. Fl. Rumel. et Bith. 1: 213. 1843.

Arenaria rubra L. var. *marina* L., Sp. Pl. 423. 1753.
Spergularia salina Presl., Fl. Cech. 95. 1819.

Southern Yavapai, Gila, Maricopa, Pinal, and Pima Counties, 1,000 to 3,000 feet, moist, strongly saline soil, March to June. Throughout most of the Northern Hemisphere.

The Arizona specimens are of the smooth-seeded form, *S. leioperma* (Kindb.) Fern. and Wieg.

6. DRYMARIA

Plants annual, with slender, usually tufted stems; stipules present but sometimes fugacious; sepals 5; petals 2- to 5-cleft or -parted; stamens usually 5; capsule longitudinally dehiscent.

Key to the species

1. Stem leaves nearly as wide as to wider than long, elliptic to suborbicular, at least 4 mm. wide (2).
2. Plant bright green, glandular-puberulent; leaf blades thin, subreniform, wider than long, abruptly short-acuminate or apiculate; flowers in long-peduncled, dense or rather loose clusters; sepals lanceolate, setose-acuminate..... 1. *D. FENDLERI*.
2. Plant glaucous, glabrous; leaf blades thickish, ovate or broadly elliptic, as long as or longer than wide, obtuse; flowers in sessile or subsessile axillary clusters; sepals ovate, obtuse or apiculate..... 2. *D. PACHYPHYLLA*.
1. Stem leaves much longer than wide, linear, narrowly lanceolate, or oblanceolate, not more than 2 mm. wide; flowers in open, mostly terminal cymes (3).
3. Cauline leaves fasciated, appearing verticillate; mature capsules 3 to 5 mm. long..... 3. *D. SPERGULOIDES*.
3. Cauline leaves opposite; mature capsules not more than 2.5 mm. long (4).
4. Herbaceous portion of the sepals (not the scarious margin) acute; plant glabrous; petals shorter than or barely equaling the sepals.
 4. *D. TENELLA*.
4. Herbaceous portion of the sepals obtuse (5).
5. Plant usually puberulent; stems 6 to 15 cm. long, erect, branching above; petals usually considerably surpassing the sepals... 5. *D. EFFUSA*.
5. Plant glabrous or very nearly so; stems not more than 5 cm. long, diffuse, branching from the base; petals not surpassing the sepals.
 6. *D. DEPRESSA*.

⁴¹ Reference: ROSSBACH, RUTH P. SPERGULARIA IN NORTH AND SOUTH AMERICA. *Rhodora* 42: 105-143, 158-193, 203-213. 1940.

1. **Drymaria fendleri** S. Wats., Amer. Acad. Arts and Sci. Proc. 17:328. 1882.

Coconino and Cochise Counties, 5,000 to 6,000 feet, thickets, etc., September. New Mexico, Arizona, and Mexico.

2. **Drymaria pachyphylla** Woot. and Standl., Contrib. U. S. Natl. Herbarium 16:121. 1913.

Chiricahua Mountains, Cochise County (*Jones* in 1931). Western Texas to southeastern Arizona and northern Mexico.

The plant is very poisonous to cattle and sheep, as has been demonstrated by feeding experiments, but fortunately animals avoid it when other feed is obtainable. The species is related to *D. holosteoides* Benth. of Baja California, but differs in several important characters.

3. **Drymaria sperguloides** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4:11. 1849.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, open places, August and September. Western Texas to Arizona.

4. **Drymaria tenella** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4:12. 1849.

Coconino County to Cochise and Pima Counties, dry pine woods, August and September. New Mexico, Arizona, and Mexico.

5. **Drymaria effusa** A. Gray, Pl. Wright 2:19. 1853.

Cochise, Santa Cruz, and Pima Counties, 6,000 to 7,500 feet, dry pine woods and among rocks, August and September. Southeastern Arizona and northern Mexico.

Glabrous individuals are occasional in Arizona.

6. **Drymaria depressa** Greene, Leaflets 1:153. 1905.

Hannigan Meadow, White Mountains, Greenlee County, 9,500 feet (*Kearney* and *Peebles* 12374). New Mexico and eastern Arizona.

Perhaps not specifically distinct from *D. effusa*.

7. LOEFLINGIA

Plants annual, small; stems branched from the base, stiff; leaves subulate, rigid; flowers axillary, inconspicuous; petals 3 to 5, sometimes wanting; capsule longitudinally 3-valved.

1. **Loeflingia squarrosa** Nutt. ex. Torr. and Gray, Fl. North Amer. 1:174. 1838.

Pinal and Pima Counties, 1,300 to 3,000 feet, March and April. Southern Arizona and California.

8. ACHYRONYCHIA

Plant annual, glabrous or nearly so; stems branched, prostrate; flowers in axillary clusters; perianth segments in one series, the blades white, petallike, the claws united; stamens 10 to 15, few of them fertile; style 2-cleft; fruit 1-seeded, indehiscent.

1. **Achyronychia cooperi** A. Gray, Amer. Acad. Arts and Sci. Proc. 7:331. 1868.

Mohave and Yuma Counties, 2,000 feet or lower, March and April. Western Arizona, southern California, and Baja California.

An attractive little plant, forming mats on the desert sand, with bright green foliage and snow-white flowers.

9. PARONYCHIA. NAILWORT

Plant perennial, with an almost woody caudex, pulvinate-cespitose; herbage scabrous-puberulent; flowering stems short; leaves crowded, the blades linear, thickish, cuspidate, the stipules conspicuous, white, sharply acuminate; calyx lobes hooded toward the apex, cuspidate; petals none.

1. **Paronychia depressa** Nutt. ex Torr. and Gray, Fl. North Amer. 1:171. 1838 (as synonym).

Paronychia jamesii Torr. and Gray var. *depressa* Torr. and Gray, *ibid.*

Crater Mound, Coconino County, about 5,500 feet (*Eastwood* and *Howell* 6918). Nebraska to Texas and northern Arizona.

In the collection cited the styles are completely united.

10. HERNIARIA. BURSTWORT

Plant annual, small and inconspicuous, hispidulous; stems erect or ascending, branching from the base; flowers minute, greenish, in dense axillary clusters; perianth-segments in one series; fruit 1-seeded, indehiscent.

1. **Herniaria cinerea** DC. and Lam., Fl. Franç. Sup. 375. 1815.

Sentinel, Maricopa County (*Orcutt* 117), near Casa Grande, Pinal County (*Harrison* 7518), March. Southern Arizona and California; introduced from southern Europe.

11. SILENE. CATCHFLY, CAMPION

Plants herbaceous, annual or perennial; herbage often viscid; flowers in racemes, cymes, cymose panicles, or solitary; calyx gamophyllous, campanulate or cylindric, more or less inflated, longitudinally nerved; petals 5, often deeply notched, with scalelike or fringed appendages; stamens 10; capsule dehiscent by apical teeth.

Key to the species

1. Stems very short, densely caespitose in cushionlike mats; herbage glabrous or puberulent, not glandular; leaves crowded, narrowly linear; flowers about 1 cm. long; petals normally purplish pink----- 1. *S. ACAULIS*.
1. Stems elongate, leafy, not or very loosely caespitose; leaves not crowded (2).
2. Plants annual; petals entire to shallowly cleft (3).
3. Herbage puberulent, hirtellous, or glabrate; upper internodes with a sharply defined viscid area; leaves acute, mostly linear to oblong-lanceolate, the lowest oblanceolate; inflorescence cymose-paniculate; capsules oblong-ovoid----- 2. *S. ANTIRRHINA*.
3. Herbage villous; internodes not viscid; leaves very obtuse, apiculate, all broadly spatulate; inflorescence racemose; capsules broadly ovoid. 3. *S. ANGLICA*.

2. Plants perennial; petals commonly deeply cleft (4).
4. Petals cardinal red, greatly surpassing the calyx, laciniate with several divisions, rarely merely bifid; leaves oblong-lanceolate, oblanceolate, or obovate.----- 4. *S. LACINIATA*.
4. Petals white, pink, or purplish, moderately or only slightly surpassing the calyx, bifid (5).
5. Inflorescence subracemose or narrowly thyrsoid, elongate (6).
6. Leaves lanceolate or oblanceolate, acute or short-acuminate; calyx at anthesis turbinate-campanulate; petals cream-colored or pale pink; capsules ovoid.----- 5. *S. HALLII*.
6. Leaves linear, narrowly lanceolate, or the lowest oblanceolate, long-acuminate; calyx at anthesis cylindrical; petals dull purplish pink; capsules ovoid-oblong.----- 6. *S. PRINGLEI*.
5. Inflorescence loose and open, cymose or cymose-paniculate, or the flowers solitary in the upper leaf axils (7).
7. Stems copiously glandular-pilose above, commonly more than 30 cm. long; inflorescence elongate, cymose-paniculate; calyx at anthesis cylindrical; flowers about 12 mm. long; leaf blades narrowly to broadly lanceolate or the lowest oblanceolate, attenuate-acuminate at apex, abruptly contracted at base, sessile.
7. *S. THURBERI*.
7. Stems puberulent and only slightly glandular, commonly less than 30 cm. long; inflorescence short and spreading, cymose, some of the flowers often solitary; calyx at anthesis obconic; flowers not more than 10 mm. long (8).
8. Cauline leaves seldom less than 8 mm. wide, ovate, oblong-lanceolate, or broadly oblanceolate, attenuate at base, sometimes short-petioled; flowers mostly subtended by large foliage leaves; calyx at anthesis campanulate-obconic.
8. *S. MENZIESII*.
8. Cauline leaves not more than 4 mm. wide, linear-lanceolate or narrowly oblanceolate, scarcely narrowed at base, sessile; flowers in very open terminal cymes, these with the leaves greatly reduced and bractlike; calyx at anthesis cylindrical-obconic.----- 9. *S. RECTIRAMEA*.

1. *Silene acaulis* L., Sp. Pl. ed. 2. 603. 1762.

San Francisco Peaks (Coconino County), 11,500 to 12,000 feet, July to September. Circumpolar and alpine, in both the Eastern and the Western Hemisphere.

Moss campion. An attractive little plant, forming mosslike cushions studded with bright pink flowers, among rocks above timberline.

2. *Silene antirrhina* L., Sp. Pl. 419. 1753.

Coconino and Mohave Counties, south to Cochise, Pima, and (doubtless) Yuma Counties, 6,000 feet or lower, March to May. Throughout temperate North America. Sleepy catchfly.

3. *Silene anglica* L., Sp. Pl. 416. 1753.

Canyon Lake, Maricopa County (*Peebles* 3904), Tucson, Pima County (*Thornber*), April. Naturalized in the Eastern United States and in Arizona and California, from Europe.

4. *Silene laciniata* Cav., Icon. Pl. 6: 44. 1801.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 6,000 to 9,000 feet, mostly in pine forests, July to October. Western Texas to California and Mexico.

Mexican campion. Arizona's showiest species of *Silene*, with large flowers of a brilliant cardinal red. Most of the Arizona specimens are of the relatively broadleaved var. *greggii* (Gray) Wats., but a collection by Rothrock, without definite locality, resembles the narrowleaved form that prevails in California.

5. *Silene hallii* S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 446. 1886.

Apache, Navajo, and Coconino Counties, 6,500 to 9,500 feet, pine forests, August and September. Colorado, New Mexico, and northern Arizona.

Some of the Arizona specimens have a narrower calyx and are less pubescent than most of those from Colorado, intergrading, apparently, with *S. pringlei*.

6. *Silene pringlei* S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 269. 1888.

Kaibab Plateau (Coconino County), Pinaleno Mountains (Graham County), mountains of Pima County, 7,500 to 9,500 feet, August and September. New Mexico, Arizona, and northern Mexico.

7. *Silene thurberi* S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 343. 1875.

Cochise County, Swisshelm Mountains (*Lemmon*), Chiricahua Mountains (*Eggleston* 11003, *Kearney* and *Harrison* 6196), 5,000 to 6,000 feet. Southeastern Arizona and northern Mexico.

8. *Silene menziesii* Hook., Fl. Bor. Amer. 1: 90. 1830.

Betatakin, Navajo County, about 7,000 feet, on a "sandy flat" (*Wetherill* in 1935), Greenland Lake, Kaibab Plateau, about 9,000 feet (*Collom* in 1939). Canada to Missouri, northern New Mexico and Arizona, and California.

9. *Silene rectiramea* Robinson, Bot. Gaz. 28: 134. 1899.

South rim of the Grand Canyon (Coconino County), 7,000 feet, June, known only from the type collection (*MacDougal* 181).

The nightflowering catchfly, *Silene noctiflora* L., a European species, was collected at Flagstaff, Coconino County (*Whiting* 814), but there is no evidence that it has become established in Arizona. It is annual, viscid-pubescent, and has rather large, deeply cleft white petals.

12. LYCHNIS. CAMPION

Plant perennial, densely puberulent; stems erect, usually branched only in the inflorescence; leaf blades narrow, oblanceolate to linear; flowers few, in a cymose panicle; calyx gamophyllous, longitudinally nerved; petals scarcely surpassing the calyx, with very narrow white or purplish pink blades, these entire or nearly so; styles commonly 5.

1. *Lychnis drummondii* (Hook.) S. Wats. in King, Geol. Expl. 40th Par. 5: 37. 1871.

Silene drummondii Hook., Fl. Bor. Amer. 1: 89. 1830.

Kaibab Plateau, Grand Canyon, San Francisco Peaks (Coconino County) 7,000 to 11,500 feet, July. Manitoba to British Columbia, south to New Mexico and northern Arizona.

Plant similar in appearance to *Silene hallii* but with stricter, more slender stems and narrower leaves.

13. SAPONARIA. SOAPWORT

Plants herbaceous, annual or perennial, glabrous or nearly so; leaves sessile or nearly so, lanceolate to ovate; flowers in terminal compound

cymes or corymbs, showy; calyx not conspicuously ribbed; petals pink or red, with or without appendages; stamens 10; styles 2.

Key to the species

1. Plant annual; flowers in a broad open flat-topped corymbiform panicle; calyx ovoid, strongly 5-angled; petals rose red, not appendaged. 1. *S. VACCARIA*.
1. Plant perennial; flowers in compact cymes, these forming a more or less elongate panicle; calyx cylindric (rarely ovoid), not angled; petals normally pale pink, appendaged with long subulate teeth at the junction of the blade and claw----- 2. *S. OFFICINALIS*.

1. **Saponaria vaccaria** L., Sp. Pl. 409. 1753.

Vaccaria vulgaris Host, Fl. Austr. 1: 518. 1827.

Tucson, Pima County (*Toumey* 461), April and May. A field weed here and there in the United States; naturalized from Europe. Scarcely established in Arizona.

Cow soapwort. The seeds contain saponin and may be somewhat poisonous.

2. **Saponaria officinalis** L., Sp. Pl. 408. 1753.

Prescott (Yavapai County), well established in waste land, mid-summer. Widely distributed in the United States; naturalized from Europe.

Bouncing-bet. The leaves and roots contain saponin and form a lather in water. The plant has been used medicinally, as a tonic, etc.

41. CERATOPHYLLACEAE. HORNWORT FAMILY

1. CERATOPHYLLUM. HORNWORT

Plant aquatic, submersed; stems slender, much-branched; leaves whorled, dissected into filiform segments; flowers unisexual, minute, axillary, sessile, subtended by a many-cleft involucre simulating a perianth; stamens numerous; pistil with a 1-celled ovary and an elongate filiform style.

1. **Ceratophyllum demersum** L., Sp. Pl. 992. 1753.

San Bernardino, Cochise County (*Mearns* 2538), Gila Crossing, Pinal County (*Wooton* in 1914). Throughout most of North America; Europe.

42. RANUNCULACEAE. CROWFOOT FAMILY

Plants mostly perennial, herbaceous or suffrutescent; leaves alternate or opposite, simple or compound; flowers mostly perfect, regular or irregular; perianth in one series or of both a calyx and a corolla; stamens often numerous; pistils usually several; ovary 1-celled; ovules 1 to many; fruit either follicular (dehiscent on 1 suture) or indehiscent achenes or berries.

This large and diverse family contains some of the showiest of Arizona wild flowers, notably the columbines, larkspurs, and monkshoods.

Key to the genera

1. Carpels with 2 or more ovules; fruit follicular or (in *Actaea*) berrylike (2).
2. Flowers irregular, large and showy, commonly blue or bluish (3).
3. Upper sepal extended into a conspicuous cylindric spur.
5. DELPHINIUM.

- 3. Upper sepal expanded into a helmet-shaped hood..... 6. ACONITUM.
- 2. Flowers regular (4).
- 4. Petals with a relatively small erect limb, produced below into a long tapering hollow spur, this clavate-thickened at the end. 4. AQUILEGIA.
- 4. Petals not spurred, very small or none (5).
- 5. Flowers solitary or in very few-flowered cymes; sepals 4 to 10, showy, flat, somewhat persistent; plant subcaulescent; leaves simple, with broad cordate blades..... 1. CALTHA.
- 5. Flowers numerous or many, in simple or few-branched racemes; sepals 3 to 5, not showy, somewhat cucullate, deciduous at anthesis; plants caulescent; leaves large, decomposed (6).
- 6. Fruit berrylike, commonly red when ripe; raceme short.. 2. ACTAEA.
- 6. Fruit of 1 to 3 dry, thin-walled follicles; raceme elongate. 3. CIMICIFUGA.
- 1. Carpels with a solitary ovule, in fruit achenes (7).
- 7. Petals present (except sometimes in *Myosurus*); leaves commonly alternate, or all basal; flowers perfect (8).
- 8. Sepals spurred at base, the spur usually elongate, scarious; petals very small or none; receptacle becoming greatly elongate; head of fruit slender-cylindric; plants scapose..... 9. MYOSURUS.
- 8. Sepals not spurred; petals always present, showy; receptacle not becoming greatly elongate; head of fruit conic, ovoid, or hemispheric; stems commonly leafy..... 11. RANUNCULUS.
- 7. Petals none (9).
- 9. Sepals large and showy, petallike, somewhat persistent (10).
- 10. Sepals 5 or more; head of achenes ovoid to cylindric, woolly, the achenes without long tails..... 7. ANEMONE.
- 10. Sepals commonly 4; head of achenes globose, the achenes with long plumose tails..... 8. CLEMATIS.
- 9. Sepals small, less conspicuous than the stamens, caducous (11).
- 11. Leaves simple, palmately lobed or parted; outer filaments flat, somewhat petaloid; anthers oval or ovate, about 1 mm. long. 10. TRAUTVETTERIA.
- 11. Leaves decomposed; filaments all filiform; anthers narrowly linear, much more than 1 mm. long..... 12. THALICTRUM.

1. CALTHA. MARSHMARGOLD

Plant perennial, herbaceous, glabrous; leaves simple, mostly basal, with broad cordate blades; flowers regular, rather showy, the perianth segments all alike, petallike, purplish outside, white within; stamens numerous; pistils several, becoming several-seeded follicles in fruit.

1. *Caltha leptosepala* DC., Regni Veg. Syst. 1: 310. 1818.

Apache, Coconino, and Graham Counties, 9,000 to 9,500 feet, wet meadows, June to September. Montana to Alaska, south to New Mexico, Arizona, and Washington.

Known as "elkslip" in New Mexico.

2. ACTAEA. BANEERRY

Plant herbaceous, perennial; leaves few, very large, the lower long-stalked, ternately compound, with large serrate-dentate leaflets; flowers in short, simple, terminal racemes, with 3 to 5 fugacious, petallike sepals, and 4 to 10 small petals, these less conspicuous than the numerous stamens; pistil 1; fruit a several-seeded berry.

The root and berries of the European species, *A. spicata* (probably also those of *A. arguta*) are poisonous, and deaths of children eating the berries have been reported.

1. *Actaea arguta* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 35. 1838.

White Mountains (Apache County), San Francisco Peaks (Cocconino County), southward to the mountains of Cochise and Pima Counties, 8,000 to 9,800 feet, May to July. South Dakota to Alaska, south to New Mexico, Arizona, and California.

The Arizona form seems to be *A. viridiflora* Greene, of which the type was collected on the San Francisco Peaks (*Greene* in 1889). It may be at least varietally distinct.

3. CIMICIFUGA. BUGBANE

Racemes long, sometimes branched; sepals 2 to 5; petals 1 to 8; pistils usually more than 1, becoming, in fruit, dry, several-seeded follicles; plants otherwise resembling *Actaea*.

The name snakeroot is sometimes given these plants. The underground parts, at least in *C. racemosa* of eastern North America, contain a drug, cimicifugin, which has been used in treatment of uterine disorders and of rheumatism. The eastern species were also reputed beneficial in cases of snake bite. The botanical name of the genus, of which "bugbane" is a translation, suggests that the plant was used as an insecticide.

1. *Cimicifuga arizonica* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 352. 1885.

Known only from Bill Williams Mountain, Coconino County (*Lemon* 3275, the type collection, *Rusby* in 1883, *Kearney* and *Peebles* 14040), about 7,000 feet, rich soil in a wooded ravine, July and August.

The long white spikelike racemes, borne on tall stems above the large leaves, make this a conspicuous plant when in flower.

4. AQUILEGIA.⁴² COLUMBINE

Plants perennial, herbaceous; leaves ternately decompose; flowers regular, solitary or few on long peduncles, large and showy; sepals 5, petallike, soon deciduous; petals with a small blade and a long spur; pistils 5, becoming in fruit many-seeded follicles with long slender beaks.

Key to the species

1. Sepals and spurs red, the spurs not more than 2.5 cm. long, mostly incurved near the apex, abruptly contracted toward the apex; flowers nodding (2).
2. Stems copiously glandular-pilose above; basal leaves biternate; leaflets glaucous on both faces, sparsely sericeous beneath; sepals about 10 mm. long.----- 1. *A. DESERTORUM*.
2. Stems sparsely to copiously glandular above; basal leaves typically triternate but often biternate; leaflets bright green above, glaucous and glabrous to copiously sericeous beneath; sepals 15 to 20 mm. long.----- 2. *A. TRITERNATA*.
1. Sepals and spurs not red (rarely faintly tinged with pink), the spurs straight or nearly so, tapering gradually from base to apex; flowers erect or nearly so (3).
3. Leaves copiously pubescent and somewhat viscid; spurs less than 3 cm. long, very slender; flowers cream-colored or pale yellow.----- 3. *A. MICRANTHA*.
3. Leaves glabrous or pubescent beneath; spurs 3.5 to 7 cm. long (4).
4. Sepals and spurs yellow; sepals acuminate ----- 4. *A. CHRYSANTHA*.
4. Sepals and spurs blue or white; sepals obtuse or acute.----- 5. *A. COERULEA*.

⁴² Reference: PAYSON, E. B. THE NORTH AMERICAN SPECIES OF AQUILEGIA. Contrib. U. S. Natl. Herbarium 20: 133-157. 1918.

1. **Aquilegia desertorum** (M. E. Jones) Cockerell, *Muhlenbergia* 1: 27. 1901.

Aquilegia formosa Fisch. var. *desertorum* M. E. Jones, *Contrib. West. Bot.* 8: 2. 1898.

Northern Navajo County and Coconino County, 7,000 to 7,500 feet, July, type from Flagstaff (*Jones* in 1884). Known only from northern Arizona.

2. **Aquilegia triternata** Payson, *Contrib. U. S. Natl. Herbarium* 20: 147. 1918.

Apache and Coconino Counties, south to Cochise and Pima Counties, 6,000 to 10,000 feet, chiefly in coniferous forests, June to October. Colorado, New Mexico, and Arizona.

3. **Aquilegia micrantha** Eastw., *Calif. Acad. Sci. Proc. ser. 2*, 4: 559. 1895.

Aquilegia ecalcarata Eastw. var. *micrantha* Payson, *Contrib. U. S. Natl. Herbarium* 20: 154. 1918.

Betatakin Canyon (Navajo County), Grand Canyon (Coconino County), 6,500 to 7,000 feet, rocky slopes, June. Colorado, Utah, and northern Arizona.

The flowers are reported by Payson to be fragrant.

4. **Aquilegia chrysantha** A. Gray, *Amer. Acad. Arts and Sci. Proc.* 8: 621. 1873.

Apache County to Mohave County, south to Cochise and Pima Counties, 3,500 to 11,000 feet, rich moist soil, chiefly in the yellow pine belt but descending lower along streams, April to September. Southern Colorado to western Texas, Arizona, and northern Mexico.

With its large, very long-spurred, canary-yellow flowers, this is one of the handsomest plants of the State. It is by far the most abundant and widely distributed of the Arizona columbines and is exceptional in its wide altitudinal range.

5. **Aquilegia coerulea** James in Long, *Exped.* 2: 15. 1823.

Tunitcha Mountains, Apache County (*Goldman* 2920), San Francisco Peaks, Coconino County, 11,000 feet (*Deaver* 919). Montana and Idaho to New Mexico and northern Arizona.

The very beautiful typical form of the species, with blue sepals and spurs and white petal blades, is the State flower of Colorado. A white-flowered form, var. *pinetorum* (Tidestrom) Payson (*A. pinetorum* Tidestrom), is known for Arizona only by the type collection in Warm Spring Canyon, Kaibab Plateau (*Tidestrom* 2328).

5. DELPHINIUM. LARKSPUR

Contributed by JOSEPH EWAN

Perennial herbs; leaf blades palmately divided; inflorescence racemose; sepals 5, irregular, the upper one produced into a spur; petals in 2 unequal and unlike pairs, the upper ones firm with an oblique blade, the lower ones wholly membranous, more or less ligulate and notched; follicles many-seeded; seeds with wings or angles, or enveloped in a papery pellicle.

The seeds, usually unnoticed when ripe, are the most reliable evidence for positive identification and define the subgeneric groups. Larkspurs in general react readily to variations in soil, shade, and moisture, and numerous natural hybrids are known. The low arenicolous species are spring- or early summer-flowering and occur in large or small colonies. The tall hydrophilous species are summer- and autumn-flowering and occur as close stands in mountain meadows or partially shaded ravines. The plants contain delphinine and other toxic alkaloids. The extent and exact nature of larkspur poisoning is as yet little known; but the tall meadow species are often deadly to cattle, apparently less so to sheep and horses.

Key to the species

1. Plants low, less than 70 cm. high, in sandy or heavy soils of plains, deserts, and foothills; stems usually not uniformly leafy throughout, the leaves clustered at or near the base (2).
2. Sepals whitish or pale lavender-blue, the spur slender, 15 to 20 mm. long; lower petals white, conspicuously white-pilose, deeply notched at apex into cuneate-acuminate lobes, the sinus 4 to 6 mm. deep; stems puberulent with fine curling white hairs..... 1. *D. WOOTONI*.
2. Sepals azure blue to intense royal blue, the spur 10 to 12 (or 15) mm. long; lower petals bluish to dark purple, shallowly to deeply notched into ovate lobes, the sinus not more than 4 mm. deep; stems glabrous, often glaucous, rarely glandular-hairy, but not closely and evenly puberulent (3).
3. Sinuses of the lower petals 3 to 4 mm. deep; leaves chiefly strictly basal, the primary segments obovate or even subspatulate; flowers mostly clear dark or royal blue..... 2. *D. SCAPOSUM*.
3. Sinuses of the lower petals less than 2.5 mm. deep; leaves not strictly basal, the primary segments linear to broadly cuneate-oblongate; flowers blue purple to pale or azure blue (4).
4. Stems narrowing at ground level, easily disarticulating from the tuberous roots; flowers dark blue, the upper petals bicolored, prominently venulose; plant of pine forests..... 3. *D. PINETORUM*.
4. Stems not narrowing at ground level, persistent upon the woody-fibrous roots; flowers variously light blue, the upper petals pallid or, if somewhat bicolored, then not conspicuously venulose; plants of canyons and deserts..... 4. *D. AMABILE*.
1. Plants tall, usually 1 m. or more high, in heavy often wet soils of ravines, meadows, and valley floors; stems usually leafy throughout; flowers dark blue or purple (5).
5. Racemes dense, numerous flowered; leaves nearly circular in outline, 4 to 7 cm. wide, the primary segments cuneate-obovate with short barely acute teeth, velvety with gray puberulence beneath..... 5. *D. GERANIIFOLIUM*.
5. Racemes more or less loose or elongating early; leaves pentagonal in outline, 10 to 18 (or 20) cm. wide, glabrous or thinly hairy (6).
6. Sepals lance-acuminate; rachis of the raceme lustrous-hairy with glandular spreading hairs; follicles subglabrous, dark-venulose. 6. *D. BARBEYI*.
6. Sepals ovate; rachis nonglandular; follicles ashy-puberulent, not venulose (7).
7. Primary segments of the leaves cuneate-rhomboid or cuneate-obovate, the intersegmental spaces prominent, the ultimate divisions pinnatifid with long sublinear few-toothed pinnae, the teeth acute; stems puberulent with a close even hairiness.... 7. *D. ANDESICOLA*.
7. Primary segments of the leaves cuneate-obovate, the intersegmental spaces scant, the ultimate divisions lacerate-pinnatifid with short oblong pinnae, the teeth subobtusely or abruptly acute; stems subglabrous below..... 8. *D. SIERRAE-BLANCAE*.

1. *Delphinium wootoni* Rydb., Torrey Bot. Club Bul. 26: 587. 1899.

Pinaleno, Chiricahua, Huachuca, Tumacacori, and Rincon mountains and adjacent valleys (Graham, Cochise, Santa Cruz, and Pima

Counties), 6,000 feet or lower, open flats, valley floors, and gentle foothill slopes, May. Southern New Mexico and southern Arizona.

The Arizona plants have pale blue or lavender flowers rather than the whitish or cream-colored flowers of the type. This larkspur, a relative of *D. camporum* Greene which ranges to the northeast of this area, is notable for its deeply notched and white-pilose petals and long, often geniculate, spurs.

2. *Delphinium scaposum* Greene, Bot. Gaz. 6: 156. 1881.

Coconino, Mohave, Yavapai, Gila, Maricopa, Pinal, and Pima Counties, 5,000 feet (rarely 7,000 feet) or lower, locally frequent on open deserts and gravelly mesas, March to May. Southwestern Colorado to southern Nevada, New Mexico, and Arizona.

The typically scapose habit and deep royal-blue flowers (except in northern Arizona plants) are distinctive. Plants of the Colorado River and Plateau drainages have lighter blue flowers, more diffuse racemes, and follicles 18 to 20 mm. long, as compared with 10 to 13 mm. long in the type. This larkspur is used by the Hopi Indians, who call it "teoro'si." It is reported that they grind the flowers with corn to make a blue meal, "blue pollen," for the flute altar, and also use the plant as an emetic in one of their rituals. At least in portions of its range this species is known to be poisonous to cattle.

3. *Delphinium pinetorum* Tidestrom, Biol. Soc. Wash. Proc. 26: 121. 1913.

Defiance Plateau (Apache County), Navajo Mountain, Kaibab Plateau, and Mogollon Mesa (Coconino County), 6,000 to 8,600 feet, yellow pine forests, type from the Kaibab Plateau (*Tidestrom* 2375). Southern Utah to central Arizona.

4. *Delphinium amabile* Tidestrom, Contrib. U. S. Natl. Herbarium 25: 207. 1925.

Delphinium coelestinum Rydb., Torrey Bot. Club Bul. 39: 320. 1912. Not Franchet.

Coconino, Mohave, Maricopa, and Pima Counties, 3,500 feet or lower, rocky knolls and desert mesas, March to April. Southwestern Utah and Arizona to southern California.

This is the most xerophytic of North American larkspurs. The reduction in vegetative parts enables the plants to withstand withering heat or prolonged droughts. The species has developed many local races. The range in Arizona, as given above, is that of the typical form. The subspecies *apachense* (Eastw.) Ewan (*D. apachense* Eastw.) occurs in Gila, Maricopa, Pinal, and Pima Counties, 5,000 feet or lower, February to April, commoner than the typical form. It has sinuses of the lower petals 2 to 2.5 mm. deep, the lobes distally spreading, leaves rather conspicuous at flowering time, flowers clear sky blue, in loose racemes; whereas, in typical *D. amabile*, the sinuses of the lower petals are 1.5 to 2 mm. deep, the lobes not noticeably spreading, leaves withering, not noticeable at flowering time, flowers mostly deep blue, in moderately dense racemes. The size and form of the leaves vary greatly in the subspecies, in response to varying ecologic factors.

5. **Delphinium geraniifolium** Rydb., Torrey Bot. Club Bul. 26: 583. 1899.

Apache, Navajo, and Coconino Counties, 7,000 to 8,200 feet, mountain parks, summer and autumn, type from "Charles" (Clark?) Valley (*Rusby* in 1883). Known only from northern Arizona.

The plant is of a strict, often simple, habit with flowers densely massed in a turretlike spike. Occasional cream-colored variants may be noted among the usual indigo-blue-flowered plants. The leaves recall *Geranium* or *Paeonia* in their distinctive contour and lobation.

6. **Delphinium barbeyi** Huth, Herbarium Boissier Bul. 1: 335. 1893.

Delphinium exaltatum var. *barbeyi* Huth, Delph. North Amer. 11. 1892.

Baldy Peak, White Mountains, Apache County (*Goodding* 605), apparently scarce, in subalpine parks. Wyoming, Colorado, Utah, and eastern Arizona.

The lower flowers in the short raceme are subtended by broad leaflike few-parted bracts, the stems usually hollow and succulent.

7. **Delphinium andesicola** Ewan, Wash. Acad. Sci. Jour. 29: 476. 1939.

Chiricahua, Huachuca, and Santa Rita mountains (Cochise and Pima Counties), 5,000 to 8,500 feet, in swales on open yellow pine slopes, summer and autumn, type from Barfoot Park, Chiricahua Mountains (*Blumer* 136). Known only from southeastern Arizona.

Most closely related to *D. tenuisectum* Greene of the Sierra Madre Occidental of Mexico, this larkspur has puberulent dull- or dark-blue hooded sepals, and flowers in an elongate but not dense raceme.

8. **Delphinium sierrae-blancae** Wooton, Torrey Bot. Club. Bul. 37: 38. 1910.

Mountains about the headwaters of Salt River and along the upper Gila River (Apache, Greenlee, and Graham Counties), 6,500 to 9,500 feet, wet creek bottoms, late summer or autumn. New Mexico and eastern Arizona.

The Arizona form is subsp. *amplum* Ewan (*ibid.*), with dark green, more ample and broader leaves than in the typical form of the species. The plants average taller and more leafy in the subspecies, but the flowers and follicles correspond closely with those of the species.

6. ACONITUM. MONKSHOOD

Plants herbaceous, perennial; stems tall, leafy; leaves palmately lobed; flowers in simple or branched racemes, perfect, very irregular; sepals 5, the upper one much the largest, helmet-shaped; petals small, varying in number; stamens numerous; pistils 3 to 5, these in fruit several-seeded, short-beaked follicles.

Showy plants with a general resemblance to larkspur but different in the structure of the large, normally dark-blue or violet flowers. All parts of the plants contain aconitin and other alkaloids. The European monkshood, *A. napellus* L., is the source of the powerful heart stimulant, aconite. *A. columbianum* is reputed to be poisonous to livestock. It is stated that the plants are most toxic in the preflowering stage.

Key to the species

1. Inflorescence often paniculate (somewhat branched below), the peduncles and branches commonly spreading or ascending at a wide angle; herbage villous and somewhat viscid, or glabrous; hood sepal rarely less than 2 cm. high.
1. A. COLUMBIANUM.
1. Inflorescence racemiform, the peduncles 1-flowered, erect or ascending at a narrow angle; blades of the upper leaves copiously short-pilose, at least on the upper surface, deeply, narrowly, and acutely dissected; hood sepal not more than 1.5 cm. high-----2. A. INFECTUM.
1. **Aconitum columbianum** Nutt. ex. Torr and Gray, Fl. North Amer. 1: 34. 1838.

Aconitum arizonicum Greene, Repert. Spec. Novarum Regni Veg. 7: 5. 1909.

Apache, Coconino, and Pima Counties (doubtless elsewhere), 5,000 to 9,000 feet, rich moist soil along mountain brooks, June to September, type of *A. arizonicum* from the Santa Rita Mountains (Pringle in 1881). British Columbia to Montana, south to New Mexico, Arizona, and California.

A collection in Oak Creek Canyon, Coconino County, (*Babcock* and *Goddard* 615), with herbage glabrous except for a few hairs on the upper surface of the leaf veins, is referred to var. *glaberrimum* (Rydb.) Kearney and Peebles (*A. glaberrimum* Rydb.), the type of which (*Palmer* in 1877) may have been collected in Arizona.

2. **Aconitum infectum** Greene, Repert. Spec. Novarum Regni Veg. 7: 5. 1909.

Known only from the San Francisco Peaks (Coconino County), 9,500 to 11,000 feet, July and August, type collected by MacDougal (No. 396).

Very similar to *A. bakeri* Greene, differing principally in its smaller flowers. Similar forms occur elsewhere in the range of *A. columbianum* of which *A. infectum* seems scarcely more than a good variety.

7. ANEMONE

Plants herbaceous, perennial, with erect, scapelike stems; leaves basal and in an involucrelike pair or whorl subtending the inflorescence, the blades pedately parted or divided; flowers solitary on long peduncles, regular, showy; perianth segments 5 to 10, all alike, petaloid; stamens and pistils numerous; achenes compressed, in a dense ovoid or cylindrical head.

These attractive plants are sometimes known as windflower. Some of the Old World species, notably *A. japonica* Sieb. and Zucc., are popular garden flowers.

Key to the species

1. Sepals 8 to 10, linear or narrowly elliptic, pink or purplish; stems from a short tuberlike, sometimes forked, root, up to 40 cm. long; herbage sparsely soft-pubescent or nearly glabrous; leaves ternate or biternate, the ultimate divisions usually cleft or coarsely toothed; fruiting head cylindrical or ovoid-cylindrical-----1. A. TUBEROSA.

1. Sepals 5 to 8, elliptic to ovate; stems from an elongate, more or less woody caudex; herbage copiously pubescent (2).
2. Stems commonly not more than 30 cm. long; pubescence soft, spreading, the hairs long and very fine; leaves pedately several-parted, the divisions all narrow, lanceolate or oblanceolate, entire or few-cleft, the uppermost leaves sessile or very short-petioled; sepals purplish outside, yellowish or purplish within; head of carpels globose or short-ovoid, not more than 15 mm. long; styles usually deciduous.....2. *A. GLOBOSA*.
2. Stems commonly more than 30 cm. long; pubescence subappressed; leaves pedately 3-parted, the main divisions broadly cuneate-obovate, several-cleft and several-toothed, the uppermost leaves with petioles nearly to quite as long as the blades; sepals whitish; head of carpels cylindrical, 20 mm. long or longer; styles (at least the bases) persistent.....3. *A. CYLINDRICA*.

1. *Anemone tuberosa* Rydb., Torrey Bot. Club Bul. 29: 151. 1902.

Coconino and Mohave Counties to Santa Cruz and Pima Counties, 2,500 to 4,500 feet, among rocks on mesas and foothills, February to April. Texas to Utah, Arizona, and California.

A pretty spring wild flower. Perhaps not specifically distinct from *A. sphenophylla* Poepp., of southern South America.

2. *Anemone globosa* Nutt. ex Pritz., Linnaea 15: 673. 1841.

San Francisco Peaks (Coconino County), 10,500 to 12,000 feet, July. Western Canada to New Mexico, northern Arizona, and California.

3. *Anemone cylindrica* A. Gray, Ann. Lyc. N. Y. 3: 221. 1836.

Apache and Coconino Counties, 6,500 to 7,500 feet, rich soil along streams, July. New Brunswick to British Columbia, south to New Jersey, New Mexico, and Arizona.

8. CLEMATIS

Plants perennial; stems woody below, weak, usually climbing by means of tendrillike petioles; leaves opposite, the pairs scattered along the stem, pinnate or bipinnate; flowers perfect or unisexual, regular; perianth in one series, the segments thin and petallike or thick and leathery, the petals none or rudimentary; stamens and pistils numerous; fruit of achenes, these in globose heads, with long, persistent, plumose styles.

Several species are grown extensively as ornamentals and some of the exotic species are among the handsomest of cultivated climbing plants. The species of the section *Viorna* are known, collectively, as leatherflower.

Key to the species

1. Flowers in panicles of cymes, numerous, dioecious or polygamo-dioecious; sepals cream-colored or ochroleucous, spreading (2).
2. Leaflets divergently cleft or parted, not more than 5 cm. long; tails of the mature carpels commonly more than 5 (up to 10) cm. long; herbage grayish-pubescent, usually copiously so.....1. *C. DRUMMONDII*.
2. Leaflets with ascending lobes and teeth, 3 to 7 cm. long; tails of the carpels not more (usually less) than 5 cm. long; herbage loosely pubescent to nearly glabrous, green.....2. *C. LIGUSTICIFOLIA*.
1. Flowers solitary, very few, perfect (3).
3. Sepals thin, spreading, violet or purple, glabrous or inconspicuously pubescent; stamens spreading; leaves ternate or biternate; leaflets few-toothed or cleft: Section *Atragene*.....3. *C. PSEUDOALPINA*.

3. Sepals thick, erect or connivent, dull or purplish brown, conspicuously white-lanate, at least on the margins; stamens erect: Section *Viorna* (4).
4. Leaf segments narrowly lanceolate to nearly filiform, less (commonly much less) than 10 mm. wide; leaves bipinnate or occasionally ternate; stems mostly erect, unbranched, and 1-flowered; herbage villous to glabrate (5).
5. Petioles ascending; leaflets lanceolate; sepals 3 cm. long or longer----- 4. *C. HIRSUTISSIMA.*
5. Petioles spreading; leaflets linear-lanceolate to nearly filiform; sepals 2 to 2.5 cm. long----- 5. *C. ARIZONICA.*
4. Leaf segments oblong-lanceolate to nearly orbicular, commonly more than 10 mm. wide; leaves simply pinnate or occasionally bipinnate, the divisions few-toothed or cleft; stems mostly climbing or reclining, branched, and bearing more than one flower; herbage sparsely pubescent or glabrate; sepals 2.5 to 4 cm. long (6).
6. Leaves slightly paler but not glaucous beneath; leaflets oblong or oblong-ovate, with acutish lobes and teeth----- 6. *C. BIGELOVII.*
6. Leaves glaucous beneath; leaflets broadly ovate or suborbicular, with obtuse or rounded lobes and teeth----- 7. *C. PALMERI.*

1. *Clematis drummondii* Torr. and Gray, Fl. North Amer. 1: 9. 1838.

Gila, Maricopa, Pinal, Cochise, and Pima Counties, 4,000 feet or lower, among shrubs usually in comparatively open ground, March to September. Texas to Arizona and northern Mexico.

2. *Clematis ligusticifolia* Nutt. ex. Torr. and Gray, Fl. North Amer. 1: 9. 1838.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 4,000 to 7,000 feet, commonly along streams, May to September. Western Canada and North Dakota to New Mexico, Arizona, and California.

Apparently intergrades or hybridizes, in Arizona, with *C. drummondii*, and is extremely variable in the shape, size, and dentation of the leaflets. *C. neomexicana* Woot. and Standl., a form with broad, rounded teeth and lobes, occurs in the Pinal Mountains (*Toumey* 44) and Chiricahua Mountains (*Blumer* 1510). An extremely small-leaved variant of this form, with leaflets not more than 2.5 cm. long and equally wide, was collected in the White Mountains (*Zuck* in 1896). An extraordinary form, collected at Rock Point, Apache County (*Peebles* 13518), has elongate, nearly entire leaflets 5 to 10 mm. wide.

Occasionally grown as an ornamental, this plant was formerly used by the Indians as a remedy for sore throat and colds, and it is stated that the crushed roots were placed in the nostrils of tired horses to revive them.

3. *Clematis pseudoalpina* (Kuntze) A. Nels. in Coult., New Man. Rocky Mount. 198. 1909.

Clematis pseudoatragene var. *pseudoalpina* Kuntze, Verhandl. Bot. Ver. Brandenb. 26: 160. 1884.

Atragene pseudoalpina Rydb., Torrey Bot. Club Bul. 29: 157. 1902.

Apache, Coconino, and northern Greenlee Counties, 7,000 to 8,000 feet, rich soil of forests, apparently rare in Arizona. South Dakota and Montana to New Mexico and Arizona.

4. *Clematis hirsutissima* Pursh, Fl. Amer. Sept. 385. 1814.*Clematis douglasii* Hook., Fl. Bor. Amer. 1: 1. 1829.*Viorna hirsutissima* Heller, Muhlenbergia 1: 40. 1904.

Coconino County, Kaibab Plateau (*Jones* 6056y), north rim of the Grand Canyon (*Tidestrom* 2369, *McHenry* 2068, *Collom* in 1939), about 8,000 feet. Montana to Washington, south to northern Arizona.

5. *Clematis arizonica* Heller, Torrey Bot. Club Bul. 26: 547. 1899.*Viorna arizonica* Heller, Muhlenbergia 1: 40. 1904.

Coconino County, Grand Canyon and vicinity of Flagstaff, 7,000 to 8,000 feet, April to July, type from Walnut Canyon (*MacDougal* 343). New Mexico and northern Arizona.

Perhaps not specifically distinct from *C. hirsutissima*.

6. *Clematis bigelovii* Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 61. 1856.*Viorna bigelovii* Heller, Muhlenbergia 6: 96. 1910.

Fort Apache, Navajo County (*Mrs. R. W. Hoyt*), also in the Tunitcha Mountains, New Mexico, very near the Arizona State line. New Mexico and eastern Arizona.

7. *Clematis palmeri* Rose, Contrib. U. S. Natl. Herbarium 1: 118. 1891.*Viorna palmeri* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 123. 1913.

Known in Arizona only from the type collection at Fort Apache, Navajo County, 5,000 feet (*Palmer* 600), and from a collection at Black River, White Mountains (*Goodding* 4417). Occurs also in southwestern New Mexico.

9. MYOSURUS. MOUSETAIL

Plants annual, dwarf; leaves all basal, the blades narrowly linear or oblanceolate, entire; flowers solitary on slender scapes, inconspicuous; sepals commonly 5, deciduous; petals rudimentary or none; stamens 5 to numerous; pistils many; achenes in a dense, slender, cylindric spike.

Key to the species

1. Achenes when mature roundish, with a dorsal cup or border nearly surrounding the base of the beak, the cup often larger than the body of the achene (2).
 2. Border of the achene deep, cup-shaped, suborbicular, erose or nearly entire, corky-thickened, the beak stout, triangular, strongly flattened laterally; plant up to 15 cm. high ----- 1. *M. CUPULATUS*.
 2. Border of the achene shallow, relatively thin, the beak elongate, subulate; plant not more than 3 cm. high ----- 2. *M. EGGLESTONII*.
1. Achenes when mature more or less quadrangular, without cup or border, keeled dorsally from base to apex, the beak subulate, not strongly flattened laterally (3).
 3. Back of the achene scarcely wider on each side than the very prominent keel, the latter prolonged into a beak at least half as long as the body of the achene ----- 3. *M. ARISTATUS*.
 3. Back of the achene distinctly wider on each side than the relatively low keel, the latter prolonged into a beak much less than half as long as the body of the achene, or the beak sometimes obsolete ----- 4. *M. MINIMUS*.

1. *Myosurus cupulatus* S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 362. 1882.

Mohave County to Cochise and Pima Counties, 2,500 to 5,000 feet, moist soil, usually along streams, February to March, type from between the San Francisco and Gila Rivers, Greenlee County (*Greene* in 1880). New Mexico to California and Sonora.

2. *Myosurus egglestonii* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 123. 1913.

Coconino County, Grand Canyon, 2,000 feet (*MacDougal* 236a), and Leroux Spring, near Flagstaff, 7,200 feet (*Leiberg* 5568), northern Gila County (*Peebles* 13297). Arizona and New Mexico.

3. *Myosurus aristatus* Benth., London Jour. Bot. 6: 458. 1847.

Young to Payson, Gila County, 5,600 feet (*Peebles* 13297), Santa Rita Mountains, Pima County (*Shear* 4217), in wet soil, May to June. Nebraska to British Columbia, south to New Mexico, Arizona, and California; South America.

4. *Myosurus minimus* L., Sp. Pl. 284. 1753.

Bellemont, Coconino County (*Toumey* 325), Prescott, Yavapai County (*Peebles* and *Harrison* 4175), Sacaton, Pinal County (*Peebles* 1267), flowering in spring. Canada to Florida, Arizona, and California; Europe and Africa.

10. TRAUTVETTERIA

Plant perennial, herbaceous; stems tall, branched; leaves alternate, large, deeply palmately lobed, the lobes incised and serrate; flowers in corymbose panicles, perfect, white; perianth in one series (petals none), of 3 to 5 segments, these concave, caducous; stamens and pistils numerous; achenes in heads, sharply angular, not ribbed or the ribs not extending to the apex of the achene.

1. *Trautvetteria grandis* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 37. 1838.

Head of Black River, White Mountains, Apache County, near springs (*Goodding* 1206), July. Idaho to British Columbia, south to New Mexico, eastern Arizona, and California.

11. RANUNCULUS.⁴³ BUTTERCUP, CROWFOOT

Contributed by LYMAN BENSON

Plants herbaceous; radical leaves with blades entire, 3-lobed, 3-parted, 3-divided, or pinnately compound, the cauline leaves alternate or rarely opposite; flowers from terminal buds; sepals 5 or rarely 3, seldom persistent in fruit; petals 5, or rarely 6 to 26, yellow, seldom white or red, each bearing a scale-covered nectariferous pit at base of the blade; pistils 5 to many, the single ovule attached at base of the ovary.

⁴³ References: (1) BENSON, LYMAN. PACIFIC STATES RANUNCULI I AND II. Amer. Jour. Bot. 23: 26-33, 169-176. 1936. THE NORTH AMERICAN SUBDIVISIONS OF RANUNCULUS. Amer. Jour. Bot. 27: 799-807. 1940. NORTH AMERICAN RANUNCULI. Torrey Bot. Club Bul. 68: 157-172. 1941.

(2) DREW, W. B. NORTH AMERICAN REPRESENTATIVES OF RANUNCULUS § BATRACHIMUM. Rhodora 38: 1-47. 1936.

Key to the species

1. Achenes roughly transverse-ridged; petals not glossy, white, the claws sometimes yellow; plants aquatic or rarely palustrine, with finely dissected submerged leaves: Subgenus *Batrachium*----- 1. *R. AQUATILIS*.
1. Achenes not transverse-ridged; petals usually glossy; plants terrestrial or palustrine, rarely aquatic, if so then with simple entire leaves (2).
2. Sepals persistent in fruit; fruits utricular; petals red; leaves compound, dissected into lingulate leaflets: Subgenus *Crymodes*----- 2. *R. JUNIPERINUS*.
2. Sepals not persistent when the fruit is mature; fruits not utricular; petals yellow (3).
3. Wall of the fruit striate, the nerves 3 or more on each face, often branched; ovary wall very thin and usually fragile; plant perennial, palustrine, stoloniferous, with simple crenate leaves and elongate fruiting heads each bearing 50 to 300 achenes: Subgenus *Cyrtorhyncha*.
3. *R. CYMBALARIA*.
3. Wall of the fruit not striate or nerved, thick and firm: Subgenus *Euranunculus* (4).
4. Styles lacking, the achenes practically beakless; plant annual, of brackish marshes; juice very acrid; stem markedly fistulose; fruiting head elongate, bearing 40 to 300 achenes: Section *Hecatonia*.
4. *R. SCELERATUS*.
4. Styles present, the achenes beaked (5).
5. Leaves all entire or dentate, serrulate, or undulate; dorsoventral dimension of the achene not more than twice or thrice the lateral dimension: Section *Flammula* (6).
6. Radical leaves lanceolate, oblanceolate, or linear, never ovate, the cauline leaves similar to the radical.----- 5. *R. FLAMMULA*.
6. Radical leaves ovate or cordate-ovate, the cauline leaves similar, or lanceolate or oblanceolate.----- 6. *R. HYDROCHAROIDES*.
5. Leaves all lobed, parted, or divided, except only the basal leaves of *R. glaberrimus* (7).
7. Nectary scale not forming a pocket, free laterally for at least two-thirds of its length; achene discoid, the dorsoventral dimension 3 to 15 times the lateral dimension; sepals rarely with lavender or purple pigment: Section *Chrysanthe* (8).
8. Petals 8 to 18; achene beaks 3 to 5 mm. long, straight or at least not regularly curved; plants perennial with stout stems up to 0.9 m. long; leaves simple or compound, 3.5 to 15 cm. long, 4 to 10 cm. wide.----- 7. *R. MACRANTHUS*.
8. Petals 5; achene beaks 1 to 2 mm. long, curving above (9).
9. Sepals equaling or a little shorter than the petals, the latter 3 to 7 mm. long; head of achenes ovoid, 7 to 9 mm. long; plant perennial; stems rooting at the nodes in Arizona specimens.----- 8. *R. MACOUNII*.
9. Sepals about twice as long as the petals, the latter 2 to 3 mm. long; plant annual; stems never rooting adventitiously, erect.----- 9. *R. PENNSYLVANICUS*.
7. Nectary scale forming a pocket, attached to the petal laterally for all or most of its length; achene not discoid, plump, the dorsoventral dimension only 1 to 2.5 times the lateral dimension; sepals always tinged dorsally with lavender or purple: Section *Epirotes* (10).
10. Fruiting receptacle and head of achenes globose or spherical; achenes each with a broad, thin stipelike base; basal leaves entire or nearly so, the cauline leaves parted.
10. *R. GLABERRIMUS*.
10. Fruiting receptacle and head of achenes cylindrical or ovoid; achenes stipitate or winged at base; none of the leaves entire (11).
11. Nectary scale not ciliate, glabrous, as is the whole petal (12).
12. Achenes obovate.----- 11. *R. INAMOENUS*.
12. Achenes almost oblong.----- 12. *R. ESCHSCHOLTZII*.
11. Nectary scale ciliate (except rarely in *R. arizonicus*), the adjacent petal surface sometimes bearing similar hairs (13).

13. Stems not scapose, branching near the base; nectary scale obdeltoid; achene beak recurved; blades of the radical leaves cordate, 1 to 6 cm. long, 1 to 5 cm. wide, not markedly longer than wide and not very deeply cordate at base----- 13. *R. CARDIOPHYLLUS*.
13. Stems scapose, rarely branching near the base; nectary scale rectangular or nearly so; achene beak straight (14).
14. Scapes each 4- or more- (usually 8- to 12-) flowered; leaf bases remarkably fibrous after withering; margins of the nectary scale free along their distal third; petals 2 to 3 times as long as wide, not emarginate; fruiting receptacle cylindrical, slender.
14. *R. ARIZONICUS*.
14. Scapes 1- to 3- or 4-flowered; leaf bases not very fibrous; margins of the nectary scale adnate to the petal almost their entire length; petals nearly as wide as long, sometimes emarginate; fruiting receptacle ovoid or ovoid-cylindric, stout; blades of the radical leaves cordate or long-ovate, rarely subsagittate, 1.5 to 4.5 cm. long, 1 to 4 cm. wide, longer than wide and often deeply cordate at base: var. *subsagittatus*.
13. *R. CARDIOPHYLLUS*

1. *Ranunculus aquatilis* L., Sp. Pl. 556. 1753.

Apache County to Coconino, eastern Yavapai, and northern Gila Counties, 5,000 to 7,000 feet, ponds and streams in the yellow pine and sagebrush belts. Almost throughout North America; Eastern Hemisphere.

An aquatic perennial flowering in late spring and summer. The form occurring in Arizona is var. *capillaceus* DC. (*R. trichophyllum* Chaix, *R. subrigidus* Drew).

Ranunculus circinatus Sibth. (*R. longirostris* Godr.) was collected by Sutton Hayes (No. 7) on the El Paso and Fort Yuma Wagon Road Expedition, perhaps in Arizona. It is characterized by a persistent achene beak about 1 mm. long (this deciduous in *R. aquatilis* and its varieties), by the origin of the leaf divisions within the dilated leaf base instead of from a petiole beyond it, and by the leaves not collapsing when withdrawn from water. However, it is to be noted that these leaf characters vary in forms of *R. aquatilis* var. *capillaceus*.

2. *Ranunculus juniperinus* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 616. 1895.

Ranunculus andersonii A. Gray, var. *tenellus* S. Wats. in King, Geol. Expl. 40th Par. 5: 7. 1871.

Beckwithia juniperina Heller, Muhlenbergia 1: 144. 1906.

Virgin Mountains, Mohave County (*Goodding* 2135), 5,000 to 6,000 feet, rocky slopes in the juniper-pinyon belt, May. Utah to eastern Nevada and northwestern Arizona.

3. *Ranunculus cymbalaria* Pursh, Fl. Amer. Sept. 392. 1814.

Northern, central, and eastern Arizona, commonly 5,000 to 7,000 feet but sometimes lower, along streams and about springs in the yellow pine, sagebrush, juniper-pinyon, and oak belts. Alberta to Vancouver Island and south to Kansas, Arizona, California, and central Mexico.

A stoloniferous perennial with erect flowering stems, flowering in the late spring and summer. It is called desert crowfoot. The Arizona plant is var. *saximontanus* Fernald.

4. *Ranunculus sceleratus* L., Sp. Pl. 551. 1753.

Sacaton (Pinal County), about 1,200 feet, in wet places, May to August. Canada and Alaska, south to Florida, New Mexico, and Arizona; Eurasia.

The species is represented in Arizona by the western var. *multifidus* Nutt. (*R. eremogenes* Greene). The acrid juice of *R. sceleratus* is said to have been used by beggars to induce sores. It is also reported that livestock eating this plant may develop severe intestinal inflammation. The active principle (anemonal) is reputed to be a cardiac poison. The species is too rare in Arizona to make these undesirable properties important.

5. *Ranunculus flammula* L., Sp. Pl. 548. 1753.

Jacobs Lake, Kaibab Plateau, 8,340 feet (*Kearney* and *Peebles* 13705, 13706), May to August. Canada and Alaska, south to New Jersey, New Mexico, northern Arizona, and California; Eurasia.

A creeping perennial. The western form that occurs in Arizona is *R. filiformis* Michx. var. *ovalis* Bigel.

6. *Ranunculus hydrocharoides* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 306. 1855.

San Francisco Peaks (Coconino County) to the Chiricahua Mountains (Cochise County), 6,800 to 9,500 feet, marshes, streams, and springs in the yellow pine belt, June to September. Southwestern New Mexico, Arizona, eastern California, and Mexico.

An aquatic or palustrine perennial, represented in Arizona by both the typical form, with entire radical leaves and ovate or cordate-ovate stem leaves, and by var. *stolonifer* (Hemsl.) L. Benson (*R. stolonifer* Hemsl.), with dentate radical leaves and lanceolate or oblanceolate stem leaves. The variety has been collected in the White Mountains (Apache and Greenlee Counties) and on the San Francisco Peaks (Coconino County).

7. *Ranunculus macranthus* Scheele, Linnaea 2: 585. 1848.

Eastern Arizona from the White Mountains (Apache County) to the Huachuca Mountains (Cochise County), 6,000 to 7,500 feet, in yellow pine forests, June to July. Western and southern Texas, eastern Arizona, and Mexico.

The showiest buttercup in Arizona, worthy of cultivation as an ornamental.

8. *Ranunculus macounii* Britton, N. Y. Acad. Sci. Trans. 12: 3. 1892.

San Francisco Peaks (Coconino County) to the White Mountains (Apache County), 6,000 to 8,000 feet, usually in yellow pine forests, summer. Labrador to Alaska, south to Minnesota, New Mexico, and Arizona.

Subpalustrine perennial, creeping in mud and, in the form occurring in Arizona, rooting adventitiously.

9. *Ranunculus pennsylvanicus* L. f., Sup. 272. 1781.

Vicinity of Flagstaff (Coconino County), East Fork of White River (Apache or Navajo County), 6,000 to 8,000 feet, woods or bottom lands, summer. Newfoundland to Alaska, south to New Jersey, Missouri, New Mexico, and Arizona; China.

10. *Ranunculus glaberrimus* Hook., Fl. Bor. Amer. 1: 12. 1829.

North rim of the Grand Canyon (*McHenry* 2076), 8,000 feet, dry ground, April to June. Western South Dakota to British Columbia, south to New Mexico, northern Arizona, and northeastern California.

An absolutely glabrous perennial with a remarkable fascicle of large roots. The first flower of spring in most of its range. The species is represented in Arizona by var. *ellipticus* Greene (*R. ellipticus* Greene).

11. *Ranunculus inamoenus* Greene, Pittonia 3: 91. 1896.

Ranunculus affinis R. Br. var. *micropetalus* Greene, Pittonia 2: 110. 1890.

San Francisco Peaks and vicinity (Coconino County), 8,000 to 9,000 feet, coniferous forests, flowering mostly in June and July. Rocky Mountains from Alberta to New Mexico and northern Arizona.

The type of var. *micropetalus*, a form with small flowers and fruits, was collected on the San Francisco Peaks (*Greene*, in 1889). There occurs also on the San Francisco Peaks, near timber line at about 12,000 feet, var. *subaffinis* (Gray) L. Benson (*R. arizonicus* var. *subaffinis* Gray, *R. subaffinis* Rydb.), the type of which was collected on Mount Agassiz (*Lemmon* 4152). This variety is characterized by having achenes about 2 mm. long and 1.5 to 1.7 mm. thick dorsoventrally, the beak not curved, hooked at tip, usually 1.5 to 2 mm. long, the petals 6 to 9 mm. long and 2.5 to 7 mm. wide, and the stipular leaf bases 2.5 to 3 cm. long; whereas, in typical *R. inamoenus* the achenes are about 1.5 mm. long and 1.3 mm. thick dorsoventrally, the beak 0.8 to 0.9 mm. long, recurved, the petals 2.5 to 5 (sometimes 8) mm. long and 2 to 4 mm. wide, and the stipular leaf bases 1.5 to 2.5 cm. long.

12. *Ranunculus eschscholtzii* Schlecht., Animad. Ranunc. 2: 16. 1820.

San Francisco Peaks near timber line, 11,000 feet (*Kearney* and *Peebles* 12155), July and August. Alaska to Colorado, northern Arizona, and southern Oregon.

A variety of *R. eschscholtzii*, not yet recombined as such (*R. eximius* Greene), has been collected on the San Francisco Peaks (*Whiting* and *Saunders*). It is distinguished by cleft, rather than parted, basal leaves, with the lobes sharply acute.

13. *Ranunculus cardiophyllus* Hook., Fl. Bor. Amer. 1: 14. 1829.

Coconino County, on the Kaibab Plateau and the San Francisco Peaks, 7,000 to 9,500 feet, yellow pine forests, flowering mostly in July. Rocky Mountains from Alberta to northern New Mexico and Arizona.

In addition to typical *R. cardiophyllus*, the var. *subsagittatus* (Gray) L. Benson (*R. arizonicus* var. *subsagittatus* Gray, *R. subsagittatus* Greene) is common in northern Arizona, ranging from the north rim of the Grand Canyon and the San Francisco Peaks to the White Mountains (Apache and Greenlee Counties), type collected by Lemmon in De La Vergne Park (now Fort Valley), near Flagstaff. The variety is less hairy than the typical form and is otherwise distinguished by the characters given in the key. Forms intermediate between this variety and typical *R. cardiophyllus* are as numerous as the extreme forms in Arizona.

14. *Ranunculus arizonicus* Lemmon ex A. Gray, Amer. Acad. Arts and Sci. Proc. 21: 370. 1886.

Ranunculus nudatus Greene, Leaflets 1: 211. 1906.

Greenlee County to the Chiricahua, Huachuca, and Patagonia Mountains (Cochise and Santa Cruz Counties), 5,000 to 7,000 feet, dry situations, summer, type from Rucker Valley, Cochise County (Lemmon 585). Southwestern New Mexico and southeastern Arizona.

Species remarkable in this genus for its habitat in dry situations.

After this publication went to press, it was discovered that an apetalous small form of *Ranunculus pedatifidus* J. E. Smith had been collected on the San Francisco Peaks at 12,000 feet (Little 4632). This form has lobed instead of divided leaves.

Furthermore, an undescribed species of *Ranunculus* related to *R. alismaefolius* Geyer, has been found in Coconino County, near the Grand Canyon (Collom in 1940), between Mormon Lake and Sedona (M. Wetherill), and at Jacobs Lake (Maguire 13550), occurring also in the La Sal Mountains, southeastern Utah. It is distinguished from *R. glaberrimus* var. *ellipticus* by the ovoid, short-pubescent receptacle, the entire cauline leaves, and the large achenes which are about 3.5 mm. long and measure 2.2 mm. dorsoventrally and 1.5 mm. laterally. It is distinguished from *R. alismaefolius* Geyer and its varieties by the smaller number of roots occurring in solitary plants, that is, 6 to 10 instead of 15 to 30, the pubescent receptacle, the flat, winged stalk of the achene, and the pubescent fruits. Hairy achenes occur in *R. alismaefolius* only in the variety *lemmoni*. The unnamed species is intermediate between the sections *Epiroteles* and *Flammula* and it forms a strong connecting link between them.

Also *R. bongardi* Greene var. *tenellus* (Nutt.) Greene has been discovered recently on the north rim of the Grand Canyon (Collom in 1940). It is distinguished from other Arizona species of the section *Chrysanthus* as follows: Petals 5, not more than 4 mm. long; achene beaks not more than 2 mm. long, strongly recurved; receptacle glabrous, in fruit not more than 2.5 times the length in anthesis; head of achenes hemispherical or globose.

12. THALICTRUM. MEADOWRUE.

Plants herbaceous, perennial; leaves alternate large, twice or thrice ternate with numerous cleft or shallowly lobed leaflets, the basal leaves long-stalked; flowers mostly unisexual, small, greenish or yellowish, in terminal panicles; perianth of 4 or 5 caducous segments, these all alike; petals none; stamens numerous; pistils few, becoming asymmetric achenes in fruit, these with prominent longitudinal ribs extending from base to apex.

Key to the species

1. Stem leaves sessile or very nearly so, the leaflets longer than wide, rather thick and rigid, distinctly pubescent beneath; achenes moderately asymmetric; stems tall..... 1. *T. DASYCARPUM*.
1. Stem leaves petioled (except sometimes the uppermost), the leaflets usually wider than long, thin, not rigid, minutely puberulent or glabrate beneath; achenes very asymmetric, gibbous on the ventral side... 2. *T. FENDLERI*.

1. *Thalictrum dasycarpum* Fisch. and Lall. in Fisch. and Meyer, Index Sem. Hort. Petrop. 8: 72. 1841.

White Mountains, Apache County (Whitehead 1511), Showlow, Navajo County, 5,900 feet (Hough), July. Western Canada to New Mexico and eastern Arizona.

2. *Thalictrum fendleri* Engelm., Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 5. 1849.

Thalictrum wrightii A. Gray, Pl. Wright. 2: 7. 1853.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,500 feet, mostly in pine forests, common, April to August. Wyoming to New Mexico, Arizona, and northern Mexico.

T. wrightii (*T. fendleri* var. *wrightii* (Gray) Trel.) has, typically, smaller leaflets and relatively broader achenes than *T. fendleri*, but the intergradation is so complete that the form is scarcely worth maintaining, even as a variety.

43. BERBERIDACEAE. BARBERRY FAMILY

1. BERBERIS. BARBERRY, HOLLYGRAPE

Shrubs or undershrubs; wood and inner bark yellow; leaves compound, pinnate or palmately trifoliolate, the leaflets thick, evergreen, spiny-toothed, more or less conspicuously reticulate-veined; inflorescence racemose or subcorymbose; flowers perfect, regular, yellow; sepals, petals, and stamens 6, the sepals and petals each in 2 series; anthers opening by 2 apical valves; fruit a few-seeded berry.

These handsome plants are secondary hosts of the black stem rust of cereals, which restricts their otherwise considerable value for planting as ornamentals. Some (perhaps all) of the species contain berberine, which has limited use as a drug, and the Indians are said to use the root as a tonic. The plants are reputed to be sometimes poisonous to livestock. The juicy berries of *B. repens* and *B. haematocarpa* are excellent for making jelly and are eaten by birds and various mammals. A brilliant yellow dye is obtainable from the roots. All of the Arizona species belong to the hollygrapes, subgenus *Mahonia* or *Odostemon*.

Key to the species

1. Leaves palmately trifoliolate; leaflets with 1 or 2 pairs of large teeth, not glaucous, rhombic- or triangular-wedge-shaped, the terminal one up to 3.5 cm. wide and not more than 5 (mostly 3 or 4) cm. long; berries at maturity about 5 mm. in diameter, blue black, usually with a pronounced bloom..... 1. *B. HARRISONIANA*.
1. Leaves pinnate, the larger ones usually with 5 or more leaflets (2).
2. Inflorescence elongate, racemose, many-flowered, usually dense at anthesis; berries ovoid or ellipsoid, blue black and very glaucous when ripe; leaves not or only moderately glaucous, the leaflets broadly oblong-ovate to nearly orbicular (3).
3. Stems above ground very short or almost none, seldom more than 10 cm. long; leaflets with numerous, commonly 10 or more, small and slender teeth, seldom strongly reticulate..... 2. *B. REPENS*.
3. Stems above ground usually 20 cm. long or longer; leaflets with fewer than 10 coarse teeth, commonly strongly reticulate..... 3. *B. WILCOXII*.
2. Inflorescence usually short and subcorymbose, relatively few-flowered, loose; berries globose or nearly so, not or only slightly glaucous (4).
4. Berries at maturity dark blue, becoming dry and more or less inflated; leaflets usually distinctly reticulate, moderately glaucous, ovate or broadly oblong, the terminal one short-acuminate, seldom more than 2.5 cm. long or more than twice as long as wide... 4. *B. FREMONTII*.
4. Berries at maturity red, remaining juicy; leaflets not or obscurely reticulate, very glaucous, mostly lanceolate or oblong-lanceolate, the terminal one long-acuminate, commonly 3 or more (up to 11) cm. long and 2 to 5 times as long as wide..... 5. *B. HAEMATOCARPA*.

1. **Berberis harrisoniana** Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 477. 1939.

Known only from the Kofa Mountains, Yuma County, about 2,500 feet, in rocky side canyons of Palm Canyon, and from Pitahaya Canyon, Ajo Mountains, Pima County (*Nichol* in 1939), February to March, type from the Kofa Mountains (*Peebles* and *Loomis* 6768).

2. **Berberis repens** Lindl., Bot. Reg. 14: pl. 1176. 1828.

Odostemon repens Cockerell, Univ. Mo. Stud. Sci. 2²:125. 1911.

Apache, Navajo, Coconino, Gila, and Yavapai Counties, 5,000 to 8,500 feet, chiefly in coniferous forests, April to May. Wyoming to British Columbia, New Mexico, Arizona, and California.

Oregon-grape. The creeping rootstocks of this low shrub make it an excellent ground cover, protective against erosion.

3. **Berberis wilcoxii** Kearney, N. Y. Acad. Sci. Trans. 14:29. 1894.

Odostemon wilcoxii Heller, Muhlenbergia 7:139. 1912.

Near Jerome Junction, Yavapai County, and in the mountains of Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 5,500 to 8,000 feet, April, type from the Huachuca Mountains (*Wilcox* in 1894). New Mexico, Arizona, and Sonora.

A straggling shrub, frequently 2 m. high, the flowers fragrant. The plant is closely related to *B. dictyota* Jepson, of California, and is, perhaps, not specifically distinct.

4. **Berberis fremontii** Torr., U. S. and Mex. Bound. Bot. 30. 1859.

Odostemon fremontii Rydb., Torrey Bot. Club Bul. 33:141. 1906.

Apache County to eastern Mohave and northern Yavapai Counties, 4,000 to 7,000 feet, often with pinyon and juniper, May to July. Colorado and Utah to New Mexico and northern Arizona.

In the valley of the Little Colorado River it is a roundish shrub 6 to 8 feet high, but is reported as occasionally reaching tree size in the Grand Canyon National Park. Various articles are made from the wood by the Hopi Indians.

5. **Berberis haematocarpa** Wooton, Torrey Bot. Club Bul. 25: 304. 1898.

Southern Apache County to Hualpai Mountain (Mohave County), south to Cochise, Santa Cruz, and Yuma Counties, 4,500 feet or lower, common, usually with scrub oak and other chaparral plants, February to April. New Mexico and Arizona.

Algerita. Mrs. Collom reports that the flowers are fragrant and that a delicious red jelly can be made from the fruits. The ranges of this species and its near relative, *B. fremontii*, scarcely overlap in Arizona.

44. MENISPERMACEAE. MOONSEED FAMILY

1. COCCULUS. SNAILSEED

Plant woody, climbing; leaves alternate, with entire, thickish, semievergreen, lanceolate to ovate blades; flowers dioecious, regular, small, in axillary panicles; sepals, petals, and stamens 6; anthers

completely or incompletely 4-celled; pistils 3 to 6 in fertile flowers; fruit a dark-purple drupe, with a flattened stone.

1. *Cocculus diversifolius* DC., Regni Veg. Syst. 1:523. 1818.

Pima County, westward to the Baboquivari Mountains, 3,500 to 5,000 feet, in thickets, May to August. Southern Texas, southern Arizona, and far south in Mexico.

45. PAPAVERACEAE. POPPY FAMILY

Plants herbaceous, of diverse character; leaves simple or decom-
pound; flowers perfect, regular or irregular, solitary or in small
clusters; sepals 2 or 3, caducous; petals 4 to 6, separate or the inner
ones cohering at apex; stamens 6 to numerous; fruits various.

The outstanding plants of this family are the true poppies (genus
Papaver), comprising several species of great value as ornamentals,
one of them (*P. somniferum* L.) being the source of the drug opium.
This species was observed in 1932 growing wild at a roadside near
Picacho, Pinal County, but did not become established. *Esch-
scholtzia californica* Cham., the State flower of California, is a
deservedly popular annual in flower gardens and is usually known as
California-poppy.

Key to the genera

1. Flowers very irregular, one or both of the outer petals spurred at base, the smaller inner petals united at apex and enclosing the anthers and stigma; stamens 6; leaves decom-
pound: Subfamily FUMARIOIDEAE. 5. CORYDALIS.
1. Flowers regular, the petals all alike, separate; stamens numerous: Subfamily PAPAVEROIDEAE (2).
 2. Herbage, sepals, and capsules prickly; leaf blades large, sinuate-dentate or sinuate-pinnatifid; sepals with hornlike appendages; stems leafy. 3. ARGEMONE.
 2. Herbage, sepals, and capsules not prickly (or the leaves somewhat so in *Arctomecon*); leaf blades not sinuate or pinnatifid; sepals not appendaged; plants scapose or subscapose (3).
 3. Fruit of several follicles, these becoming torulose or moniliform. 1. PLATYSTEMON.
 3. Fruit of a single capsule (4).
 4. Leaves compound, ternately dissected; sepals united into a conic acuminate cap, this pushed off as the flower expands. 2. ESCHSCHOLTZIA.
 4. Leaves simple; sepals not united into a cap----- 4. ARCTOMECON.

1. PLATYSTEMON. CREAMCUPS

Plant annual; herbage pilose or subhirsute; leaf blades linear or narrowly lanceolate, entire; flowers solitary, long-stalked; sepals 3; petals 6, in 2 series, cream-colored; pistils 6 or more, connivent or coherent in a circle, separating in fruit; stigmas subulate-filiform.

The peculiar fruits have been compared to tiny ears of corn with the husks removed.

1. *Platystemon californicus* Benth., Hort. Soc. London. Trans. ser. 2, 1: 405. 1835.

Yavapai, Mohave, Gila, Maricopa, and Pima Counties, 1,500 to 4,300 feet, moist ground along streams, March to May. Southern Utah, Arizona, and California.

Several segregate species have been described by E. L. Greene (*Pittonia* 5: 176, 190. 1903) of which the following are based on Arizona types: *P. arizonicus* (type *Pringle* in 1882, Santa Catalina

Mountains), *P. confinis* (type *Toumey* 47b, Bradshaw Mountains), and *P. mohavensis* Greene (type *Jones* in 1884, Hackberry). The writers have not found satisfactory characters for distinguishing these forms, even as varieties.

2. ESCHSCHOLTZIA. CALIFORNIA-POPPY

Plants annual; leaves ternately dissected, smooth, glaucous; flowers solitary on long peduncles, or in small loose clusters at the ends of the branches; petals orange or yellow; receptacle concave around the base of the pistil, often with a spreading outer rim and an erect scarious inner rim; fruit a slender 1-celled, 2-valved, several-seeded, longitudinally ribbed capsule.

The juice of *E. californica* Cham. is reported to be mildly narcotic and to have been used by the Indians of California in alleviating toothache.

Key to the species,

1. Outer rim of the hypanthium distinct, 0.5 to nearly 2 mm. wide, nearly as wide as to wider than the scarious inner rim, after anthesis more or less cartilaginous and flaring or revolute; stems leafy and branching above the base or the plant nearly acaulescent; petals 15 to 30 mm. long; mature seeds dark-colored, rugose-reticulate-----1. *E. MEXICANA*.
1. Outer rim of the hypanthium indistinct or nearly obsolete, less than 0.5 mm. wide, usually narrower than the inner rim, after anthesis not flaring (2).
 2. Plant acaulescent or nearly so, very glaucous; leaf segments numerous and crowded, very narrow, often almost filiform; petals 10 to 25 mm. long; stamens usually more than 15; mature seeds at least partly covered with a thick, gray, deeply pitted, outer coat.
 2. *E. GLYPTOSPERMA*.
 2. Plants branching and leafy well above the base, slightly to rather pronouncedly glaucous; leaf segments relatively few and not crowded; petals less than 10 mm. long; stamens usually fewer than 15; mature seeds dark-colored, with grayish reticulations, not deeply pitted.
 3. *E. MINUTIFLORA*.

1. *Eschscholtzia mexicana* Greene, Calif. Acad. Sci. Bul. 1: 69. 1885.

Throughout the State, except the northeastern portion, 4,000 feet or lower, on plains and mesas, February to May. Western Texas to southern Utah, Arizona, and Sonora.

In favorable springs the landscape is colored over extensive areas by the showy orange-colored (rarely white or pink) flowers. It is reported that in southern Arizona the plants are grazed by cattle in winter and early spring, when other feed is scarce. This species is closely related to *E. californica* and apparently intergrades with it. E. L. Greene (*Pittonia* 5: 260-262. 1905) published as species, based on Arizona types, *E. aliena*, *E. arizonica*, *E. jonesii*, and *E. paupercula*. The writers have been unable to find satisfactory characters by which to separate these forms from *E. mexicana*.

2. *Eschscholtzia glyptosperma* Greene, Calif. Acad. Sci. Bul. 1: 70. 1885.

Mohave and Yuma Counties, 2,000 feet or lower, in sandy soil of deserts, March to May. Southwestern Utah and western Arizona to California.

3. *Eschscholtzia minutiflora* S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 122. 1876.

Eschscholtzia micrantha Greene, Pittonia 5: 277. 1905.

Eschscholtzia ludens Greene, Pittonia 5: 272. 1905.

Mohave County to Pinal, Maricopa, and Yuma Counties, 3,000 feet or lower, commonly in sandy soil, March to May. Southern Utah to southeastern California and western Arizona.

3. ARGEMONE. PRICKLEPOPPY

Perennial, herbaceous, glaucous, rather coarse, prickly plants, with yellow sap; stems erect, leafy; flowers large; petals 4 to 6, white or pale yellow, contrasting with the numerous orange-colored stamens; stigma large, with radiating lobes; capsule dehiscent apically by valves.

The name chicalote also is applied to these plants. The white-flowered species are handsome and, except for the prickles, resemble the Matilija-poppy (*Romneya*) of California. The plants grow in dry soil in fields and at roadsides and are decidedly drought resistant. They are unpalatable to livestock. An abundance of these plants on cattle range is an indication of excessive overgrazing. The acrid yellow juice of *A. mexicana* has been used to treat cutaneous diseases.

Key to the species

1. Petals pale yellow to orange; herbage sparsely spiny, without fine bristles; horns of the sepals without lateral spines----- 1. *A. MEXICANA*.
 1. Petals white, occasionally tinged with pink (2).
 2. Horns of the sepals long and slender, dilated only at base, without lateral spines or with a very few slender ones near the base; valves of the capsule not becoming indurate-thickened, rather sparsely spiny; herbage with few or no short fine bristles----- 2. *A. INTERMEDIA*.
 2. Horns of the sepals short and stout, dilated well above the base, usually with several lateral spines and bristles, these sometimes extending nearly to the apex of the horn; valves of the capsule becoming indurate-thickened, usually copiously to densely spiny; herbage usually with numerous short fine bristles----- 3. *A. PLATY CERAS*.
1. *Argemone mexicana* L., Sp. Pl. 508. 1753.

Occasional near Tucson, Pima County, April and May, probably introduced from tropical America.

2. *Argemone intermedia* Sweet, Hort. Brit., ed. 2, 585. 1830.

Yavapai, Pinal, Santa Cruz, and Pima Counties, 1,300 to 5,000 feet, flowering most of the year. South Dakota and Wyoming to Arizona and northern Mexico.

3. *Argemone platyceras* Link and Otto, Icon. Pl. Rar. 1: 85. 1828.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 1,400 to 8,000 feet, flowering almost throughout the year. Nebraska and Wyoming to Arizona and Mexico.

Specimens with numerous short and fine bristles approach var. *hispida* (Gray) Prain (*A. hispida* Gray).

4. ARCTOMECON. DESERTPOPPY

Plants herbaceous, biennial or perennial, with a stout taproot; leaves mostly basal, hirsute or hispid with long hairs, the blades wedge-shaped, commonly dentate or 3-lobed at apex; flowers on long

peduncles, large; petals 4 or 6, white or pale yellow; capsule oblong, ovoid, or obovoid, 3- to 6-valved, dehiscent apically.

1. *Arctomecon humilis* Coville, Biol. Soc. Wash. Proc. 7: 67. 1892.

North of Wolf Hole, Mohave County, 2,700 feet, May (*Peebles* and *Parker* 14749). Southwestern Utah and northwestern Arizona.

A handsome plant, the flowers numerous, the petals 4, pure white, the herbage sparsely hispid-hirsute. *A. californica* Torr. and Frém., a larger, much hairier plant, with usually 6 yellow petals, has been collected near Pierce Ferry, northern Mohave County (*Hester* in 1941).

5. CORYDALIS

Plant herbaceous, biennial or short-lived perennial; herbage glabrous, glaucous; leaves dissected into numerous small segments; flowers very irregular, in spikelike racemes; sepals 2; corolla yellow; capsules elongate, cylindric, usually curved, 2-valved, more or less torulose; seeds numerous, black, shining.

The plants contain several alkaloids and are said to be poisonous to sheep, less so to cattle, if eaten freely.

1. *Corydalis aurea* Willd., Enum. Pl. 740. 1809.

Capnoides aureum Kuntze, Rev. Gen. Pl. 1: 14. 1891.

Throughout the State except the extreme western portion, 2,500 to 8,000 feet, February to June (sometimes also in late summer). Nova Scotia to Alaska, south to Pennsylvania, Arizona, northern Mexico, and California.

Many of the Arizona specimens may be regarded as belonging to var. *occidentalis* Engelm. (*Corydalis montana* Engelm.) which is described, in comparison with typical *C. aurea*, as having the spur longer relative to the rest of the corolla, the pods less torulose and ascending-incurved rather than spreading or pendulous, the stems more erect, and the racemes denser, with more numerous flowers; but there is no close correlation among these characters and plants intermediate in respect to one or all of them are numerous.

Corydalis wetherillii Eastw., based on a collection near Bright Angel Creek, Grand Canyon (*A. Wetherill* in 1897), is described as having more finely dissected foliage, and pinkish outer petals.

C. jonesii Fedde, *C. jonesii* var. *stenophylla* Fedde, and *C. pseudomicrantha* var. *griffithsii* Fedde are based on types collected in Arizona, but none of them seem to be satisfactorily distinguishable from *C. aurea* and its var. *occidentalis*. A specimen collected on the San Francisco Peaks (*Purpus* 7058) was identified by Fedde as *C. gooddingii* Fedde. Specimens from Pima County with exceptionally large bracts and with pinnae at base of the petioles (*Griffiths* 3553, *Eggleston* 19825, *Toumey* in 1896) are *C. campestris* (Britton) Fedde (*C. curvisiliquaeformis* Fedde, *Capnoides euchlamydeum* Woot. and Standl.), but it is doubtful that this form is more than varietyally distinct from *C. aurea*.

46. CRUCIFERAE. MUSTARD FAMILY

Plants herbaceous or (in *Lepidium*) sometimes suffrutescent, annual or perennial; leaves alternate, commonly simple and entire to pinnatifid (pinnate or bipinnate in *Descurainia*); flowers perfect, regular; sepals and petals 4, the petals rarely wanting; stamens usually 6 and usually tetradynamous (1 pair shorter); fruit a capsule (silique or silicle), commonly 2-celled, with a thin longitudinal partition and dehiscent, or 1-celled and indehiscent in a few genera.

This large family, chiefly of temperate regions, includes such well-known garden vegetables and culinary herbs as cabbage, cauliflower, turnip, radish, cress, and mustard. Many of the species found in Arizona are weeds of Old World origin. Few of them have any considerable value as forage, but it happens that species of *Lepidium*, *Lesquerella*, *Descurainia*, etc., although avoided while the plants are green, are relished, especially by horses, when the pods are ripe. It has been reported that hay containing mature plants of *Sisymbrium*, *Brassica*, *Camelina*, *Conringia*, etc., may cause disorders in livestock, because of the oil of mustard in the seeds. Plants of certain genera (*Stanleya*, *Descurainia*, etc.) are used as potherbs by the Indians.

There is much difference of opinion concerning the limits of genera in the Cruciferae, and it is probable that some of the generic segregates made by Rydberg, Schulz, and others and accepted in this publication should be reduced to subgeneric rank.

Key to the genera

1. Capsules 1-celled, 1-seeded, indehiscent, thin and flat, orbicular or nearly so; pedicels strongly decurved in fruit (2).
 2. Pubescence, if any, of simple hairs; pods with conspicuous, commonly perforate wing-margins, not bearing hooked hairs. 29. THYSANOCARPUS.
 2. Pubescence partly of branched hairs; pods wingless, bearing hooked hairs. 30. ATHYSANUS.
1. Capsules 2-celled, normally containing 2 or more seeds (3).
 3. Pods strongly compressed contrary to the very narrow partition, not more than twice as long as wide (4).
 4. Capsules didymous (twinlike), wider than long, indehiscent or tardily dehiscent; plants copiously or densely stellate-pubescent (5).
 5. Plant not lepidote; pods flat; seed solitary in each cell. 22. DITHYREA.
 5. Plant silvery-lepidote; pods inflated; seeds commonly more than one in each cell. 23. PHYSARIA.
 4. Capsules not didymous, at most obcordate, regularly dehiscent, but tardily so in *Lyrocarpa* (6).
 6. Seed solitary in each cell; pubescence, if any, of simple hairs. 10. LEPIDIUM.
 6. Seeds 2 or more in each cell (7).
 7. Plants glabrous; leaves entire or merely dentate, those of the stem auriculate-clasping. 11. THLASPI.
 7. Plants mostly pubescent with stellate hairs (8).
 8. Petals brown purple, 15 to 20 mm. long; pods more or less irregular in shape, often lobed at apex; plant perennial. 21. LYROCARPA.
 8. Petals white or whitish, small; plants annual (9).
 9. Plant glabrous or stellate-puberulent; stems very slender; leaves mostly petioled, entire or few-toothed; pods somewhat turgid, elliptic, entire at apex. 25. HUTCHINIA.
 9. Plant more or less hirsute below; stems relatively stout; stem leaves sessile, auriculate, the basal ones pinnatifid; pods flat, obdeltoid, notched at apex. 26. CAPELLA.
 3. Pods not compressed contrary to the partition (although sometimes appearing so in dried specimens), dehiscent (10).
 10. Capsules not more than twice as long as wide (11).
 11. Pods flat, strongly compressed parallel to the broad partition; herbage commonly with stellate or forked hairs. 28. DRABA.
 11. Pods more or less turgid (12).
 12. Valves of the obovoid pods with a distinct central nerve extending from base to apex; leaf blades entire or denticulate. 27. CAMELINA.
 12. Valves of the ovoid, ellipsoid, or globose pods without a distinct central nerve, or the nerve not extending to the apex (13).
 13. Seeds plump; herbage glabrous or sparsely pubescent with simple hairs; leaf blades pinnate or pinnatifid; aquatic or marsh plants. 19. RORIPPA.

13. Seeds flat; herbage densely stellate-pubescent or lepidote; leaf blades entire or nearly so (the basal ones lyrate in one species); dry-land plants----- 24. LESQUERELLA.
10. Capsules more than twice as long as wide (14).
14. Sepals in anthesis divaricate or reflexed; anthers soon becoming sharply curved or coiled, sagittate; stigma entire or very nearly so; leaf blades, at least the lower ones, usually coarsely toothed, cleft, or pinnatifid; blades of the petals narrow, flat or nearly so; pods elongate, slender, terete or subterete, commonly stipitate (15).
15. Petals yellow or ochroleucous, 8 mm. long or longer; pods spreading or decurved, slender but not filiform, the stipe at least 10 mm. long.
1. STANLEYA.
15. Petals white or pinkish, 5 to 7 mm. long; pods spreading or curved upward, almost filiform, the stipe seldom more than 3 mm. long, sometimes almost none----- 8. STANLEYELLA.
14. Sepals in anthesis erect or ascending (16).
16. Calyx closed or nearly so in anthesis, usually somewhat flask-shaped, the sepals spreading, if at all, only at the tip; herbage glabrous or nearly so, commonly more or less glaucous; anthers sagittate; pods elongate (17).
17. Petals violet purple, 10 to 15 mm. long, the blades flat or nearly so, much wider than the claws; anthers soon becoming strongly curved or coiled; stigma entire or slightly 2-lobed, with lobes parallel to the placentas and septum----- 12. SISYMBRIUM.
17. Petals not violet purple, the blades strongly crisped, channeled, or cucullate, little if any wider than the claws; anthers straight or moderately curved; stigma entire or, if 2-lobed, then with lobes at a right angle to the placentas and septum, hence over the valves; pods sessile or very nearly so (18).
18. Valves of the mature pods remaining attached to the frame (replum) toward the apex; stem leaves not clasping; flowers inconspicuous; pods conspicuously beaked, becoming reflexed, somewhat compressed, less than 2 mm. wide; seeds winged----- 7. STREPTANTHELLA.
18. Valves of the mature pods separating completely from the frame (19).
19. Pods at maturity terete or nearly so (immature pods of *C. cooperi* appearing flat in dried specimens), about 2 mm. wide; seeds not or scarcely winged; stem leaves various; petals brown purple or ochroleucous--- 6. CAULANTHUS.
19. Pods at maturity strongly compressed, 3 mm. wide or wider (or, if narrower, then the inflorescence bracteate, diffusely paniculate); seeds flat, conspicuously winged; stem leaves clasping, cordate, or sagittate at base; petals (at least the veins) brown purple----- 9. STREPTANTHUS.
16. Calyx open in anthesis, not flask-shaped; petals not strongly crisped, channeled, or cucullate, or sometimes moderately so in *Sisymbrium* and *Thelypodium* (20).
20. Mature pods strongly compressed parallel to the partition, flat or twisted, or, if subterete (in *Arabis glabra*), then erect, crowded, and not more than 1 mm. wide; pubescence, if any, usually at least partly of stellate or forked hairs (21).
21. Pods not more than 12 mm. long, often twisted; petals white or yellow----- 28. DRABA.
21. Pods much more than 12 mm. long, not twisted; petals white, ochroleucous, or purplish pink----- 32. ARABIS.
20. Mature pods terete or tetragonal, not strongly compressed (except in *Diploaxis*) but sometimes appearing so in immature dried specimens (22).
22. Pods becoming strongly reflexed (23).
23. Pubescence partly of forked hairs; stem leaves entire or merely dentate; sepals and petals purple.
5. LAMPROPHRAGMA.
23. Pubescence of simple hairs only; stem leaves pinnately cleft; sepals greenish; petals whitish-- 14. MICROSISYMBRIUM.

22. Pods not strongly reflexed but sometimes recurved-spreading (24).
24. Beak of the pods stout, indehiscent, extending much beyond the valves; leaf blades (at least the lower ones) commonly lyrate-pinnatifid (25).
25. Pods moderately compressed, the beak not tapering, 2 to 3 mm. long; seeds in 2 rows----- 15. DIPLLOTAXIS.
25. Pods terete or only slightly compressed, with a distinctly tapering (conic or subulate) beak usually more than 3 mm. long; seeds in one row----- 16. BRASSICA.
24. Beak of the pods none, or slender, or not more than 3 mm. long (occasionally longer in *Erysimum*, *Conringia*, and *Cardamine*); pods dehiscent (26).
26. Petals deeply lobed----- 18. DRYOPETALON.
26. Petals entire or inconspicuously dentate (27).
27. Pubescence partly of forked or stellate hairs (28).
28. Leaves pinnate, bipinnate, or very deeply pinnatifid; pubescence often partly glandular.
31. DESCURAINIA.
28. Leaves entire to moderately pinnatifid; glandular hairs none (29).
29. Pubescence closely appressed, harsh; petals 6 mm. long or longer, yellow, orange, or maroon; stigma large, deeply 2-lobed; pods tetragonal, rigid----- 33. ERYSIMUM.
29. Pubescence not closely appressed; petals 6 mm. long or shorter, white, whitish, or pink; stigma small, entire or nearly so (30).
30. Stems virgate, simple or strictly few-branched; leaf blades entire to coarsely dentate.
4. PENNELLIA.
30. Stems not virgate, more or less branched above, the branches ascending or spreading (31).
31. Herbage finely and softly pubescent; stems lax; petals white; pods not more than 2 cm. long, not rigid, terete, with a relatively long, very slender beak ----- 13. HALIMOLOBUS.
31. Herbage coarsely and harshly pubescent; stems somewhat rigid; petals purplish pink; pods 4 to 6 cm. long, rigid, tetragonal, very short beaked----- 34. MALCOLMIA.
27. Pubescence of simple hairs or none (32).
32. Cauline leaves pinnately cleft to pinnate (33).
33. Pods rounded-tetragonal, elongate. 17. BARBAREA.
33. Pods terete (34).
34. Pods 3 cm. long or longer, about 1 mm. wide; weeds of fields and roadsides, or plants of dry land----- 12. SISYMBRIUM.
34. Pods not more than 2 cm. long, often more than 1 mm. wide; aquatic or marsh plants.
19. RORIPPA.
32. Cauline leaves entire or merely dentate; pods elongate (35).
35. Petals yellow; plants glabrous (36).
36. Plant perennial; stem leaves narrow, not clasping; petals somewhat channeled or crisped; pods terete or nearly so; anthers deeply sagittate.
12. SISYMBRIUM.
36. Plant annual; stem leaves broad, clasping; petals flat; pods sharply tetragonal; anthers not or scarcely sagittate----- 35. CONRINGIA.
35. Petals white, pink, or purple; plants mostly perennial (37).
37. Stem leaves conspicuously petiolate, the blades deeply cordate; plant glabrous or soft-pilose; anthers not sagittate----- 20. CARDAMINE.

37. Stem leaves sessile or nearly so, the blades not cordate but often auriculate or sagittate; plants glabrous or very nearly so; anthers sagittate (38).
38. Stigma conic, often pointed, entire or nearly so; outer sepals strongly gibbous at base; petals 10 to 15 mm. long, purplish pink; stem leaves not clasping..... 3. *HESPERIDANTHUS*.
38. Stigma not conic or pointed; outer sepals not or not strongly gibbous; petals less than 10 mm. long or, if longer, violet purple; stem leaves often clasping (39).
39. Pods torulose, the septum with a central strip of elongate cells appearing, at low magnification, like a broad yellowish mid-vein; stigma lobes, if any, at a right angle to the septum, hence over the valves.
2. *THELPODIUM*.
39. Pods not torulose, the septum undifferentiated; stigma lobes, if any, parallel to the septum..... 12. *SISYMBRIUM*.

1. *STANLEYA*.⁴⁴ DESERTPLUME

Plants perennial, herbaceous or slightly suffrutescent, rather coarse; stems tall, stout; leaves with entire or pinnatifid blades; flowers large for the family, in elongate terminal racemes; petals yellow or cream-colored, with long claws; stamens not or scarcely tetradynamous, the anthers long and narrow, often curved; capsules long-stipitate, slender, nearly terete.

The plants grow usually on seleniferous soils, hence are probably poisonous to livestock. *S. pinnata* is an outstanding seleniferous plant. The Indians used the plants as a potherb and made mush with the seeds.

Key to the species

1. Petals with the claw glabrous on the inner face, the blade about 1 mm. wide, the petals yellow to nearly white; leaves entire or nearly so, 3 to 10 cm. wide; plant glabrous..... 1. *S. ELATA*.
1. Petals with the claw densely pubescent on the inner face, the blade 1.5 mm. wide or wider; lower stem leaves usually pinnatifid (2).
2. Plant suffrutescent; petal blades oblong, 1.5 to 3 mm. wide, bright yellow.
2. *S. PINNATA*.
2. Plant herbaceous; petal blades obovate, 4 to 10 mm. wide, pale yellow or whitish..... 3. *S. ALBESCENS*.

1. *Stanleya elata* M. E. Jones, *Zoe* 2:16. 1891.

North of Tuba, Coconino County (*Jaeger* in 1927, cited by Rollins). Northern Arizona to southeastern California.

2. *Stanleya pinnata* (Pursh) Britton, *N. Y. Acad. Sci. Trans.* 8: 62. 1889.

Cleome pinnata Pursh, *Fl. Amer. Sept.* 739. 1814.

Apache County to Mohave, Yavapai, Gila, and Yuma Counties, 2,500 to 6,000 feet, dry plains and mesas, May to July. North Dakota to Idaho, south to Texas, Arizona, and California.

The Arizona specimens belong to var. *typica* Rollins.

3. *Stanleya albescens* M. E. Jones, *Zoe* 2: 17. 1891.

Moenkopi (*Jones* in 1891, the type collection) and north of Cameron (Coconino County), Hopi Villages and Coal Mine Canyon (Navajo

⁴⁴ Reference: ROLLINS, REED C. THE CRUCIFEROUS GENUS *STANLEYA*. *Lloydia* 2: 109-127. 1939.

County), 4,000 to 5,000 feet. Colorado, Utah, New Mexico, and northern Arizona.

2. THELYPODIUM ⁴⁵

Plants annual or biennial, glabrous or nearly so; stems usually freely branched, each branch ending in a short and rather crowded raceme; basal leaves very large; stem leaves sessile or nearly so but not clasping, the blades entire; pedicels conspicuously widened and flattened at base; petals with slender claws; pods long and slender, torulose.

Key to the species

1. Pedicels not more than 5 mm. long; petals white; stipe of the pod 1 to 3 mm. long ----- 1. *T. RHOMBOIDEUM*.
 1. Pedicels 5 to 10 mm. long; petals purplish pink or white; stipe not more than 1 mm. long ----- 2. *T. LILACINUM*.

1. **Thelypodium rhomboideum** Greene, Pittonia 4: 314. 1901.

Pleurophragma platypodum Rydb., Torrey Bot. Club Bul. 34: 434. 1907.

Pleurophragma rhomboideum O. E. Schulz, Bot. Jahrb. 66: 98. 1933.

Painted Desert, Coconino or Navajo County, "abundant," (*Clute* 82), also in Havasu Canyon, Coconino County, "occasional" (*Clover* 4379), July. Utah and northern Arizona.

The plant bears a considerable resemblance to *Stanleyella wrightii*.

2. **Thelypodium lilacinum** Greene, Pl. Baker. 3: 9. 1901.

"Arizona," without definite locality (*Palmer* in 1869), July to September. Nebraska to Washington, New Mexico, Arizona, and California.

3. HESPERIDANTHUS

Plant perennial, glabrous and somewhat glaucous; stems tall, branched above; stem leaves sessile or nearly so, linear, entire; flowers rather large; sepals firm, erect, the outer ones strongly gibbous at base; petals purplish pink; pods slender, terete, short-stipitate.

1. **Hesperidanthus linearifolius** (A. Gray) Rydb., Torrey Bot. Club Bul. 34: 434. 1907.

Streptanthus linearifolius A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 7. 1849.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 3,000 to 8,000 feet, common in chaparral and pine forests, June to September. Colorado to Arizona and northern Mexico.

4. PENNELLIA

Plants biennial, pubescent below with forked hairs; stems slender, erect, simple or sparingly branched with erect branches; basal leaves oblanceolate, dentate, the stem leaves narrow, mostly entire; flowers small, in long narrow racemes; sepals greenish; petals whitish, 2 to 3 mm. long; pods slender, terete, erect.

⁴⁵ Reference: PAYSON, E. B. A MONOGRAPHIC STUDY OF THELYPODIUM AND ITS IMMEDIATE ALLIES. Mo. Bot. Gard. Ann. 9: 233-324. 1922. (*Thelypodium*, pp. 260-282.)

1. *Pennellia micrantha* (A. Gray) Nieuwland, Amer. Midland Nat. 5: 224. 1918.

Streptanthus micranthus A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 7. 1849.

Heterothrix micrantha Rydb., Torrey Bot. Club Bul. 34: 435. 1907.

Graham, Cochise, and Pima Counties, 3,000 to 6,500 feet, often among bushes, July to September. Colorado and Utah to Mexico.

5. LAMPROPHRAGMA

Sepals and petals purple, the petals 4 to 5 mm. long; pods becoming strongly reflexed. Otherwise much like *Pennellia* and doubtfully distinct as a genus.

1. *Lamprophragma longifolium* (Benth.) O. E. Schulz, Pflanzenreich IV. 105: 299. 1924.

Streptanthus longifolius Benth., Pl. Hartw. 10. 1839.

Heterothrix longifolia Rydb., Torrey Bot. Club Bul. 34: 435. 1907.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,500 to 9,000 feet, dry pine forests, July to September. New Mexico, Arizona, and Mexico.

6. CAULANTHUS⁴⁶

Plants herbaceous, annual or perennial; herbage glabrous or nearly so; stem leaves sessile or short-petioled; stems either slender and flexuous, or stout, straight, and more or less inflated; calyx somewhat flask-shaped, closed at anthesis or nearly so, glabrous or pubescent; petals whitish or purplish, with channeled, crisped, or cucullate blades little wider than the claws; pods elongate, erect or reflexed, terete or, if flattened, then not more than 3 mm. wide.

Key to the species

1. Stems slender, flexuous, not inflated; stem leaves auriculate at base; calyx glabrous; petals ochroleucous, sometimes purple-veined; style evident, at least 1 mm. long at maturity of the pod; stigma entire or shallowly lobed; pods reflexed, 2 to 5 cm. long, appearing somewhat flattened in immature specimens.----- 1. *C. COOPERI*.
1. Stems stout, often inflated; stem leaves not auriculate; calyx usually pubescent; petals (and often the sepals) purple or purplish; style none; stigma deeply lobed; pods erect or strongly ascending, somewhat rigid. 2. *C. CRASSICAULIS*.

1. *Caulanthus cooperi* (S. Wats.) Payson, Mo. Bot. Gard. Ann. 9: 293. 1922.

Thelypodium cooperi S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 246. 1877.

Kingman and Chloride to the Colorado River (Mohave County), 3,500 feet or lower, March to April. Western Arizona, southern Nevada, and southern California.

This plant seems out of place in the genus *Caulanthus*. It resembles *Streptanthella longirostris* but differs in having the leaves auriculate at

⁴⁶ Reference: PAYSON, E. B. A MONOGRAPHIC STUDY OF THELYPODIUM AND ITS IMMEDIATE ALLIES. Mo. Bot. Gard. Ann. 9: 233-324. 1922. (*Caulanthus*, pp. 283-309.)

base and the valves of the pod separating completely from the partition at maturity.

2. *Caulanthus crassicaulis* (Torr.) S. Wats. in King, Geol. Expl. 40th Par. 5: 27. 1871.

Streptanthus crassicaulis Torr. in Stansb., Expl. Great Salt Lake 383. 1852.

Kaibab Plateau, Coconino County (*Plumb* 251), Navajo Mountain, Coconino County, 6,300 feet (*Peebles* and *Smith* 13923), May to June. Idaho to northern Arizona and California.

Squaw-cabbage, so called because the plant was cooked and eaten by Indians of the Great Basin region.

Caulanthus sulfureus Payson was based on a collection near Tucson, Pima County (*Griffiths* 4058). The type seems to be an immature specimen of *Brassica campestris*.

7. STREPTANTHELLA

Plant annual or biennial, glabrous, usually glaucous; stems slender, simple or sparingly branched; stem leaves linear-lanceolate, narrowed at base; flowers small, the petals with crisped or channeled blades little wider than the claws; pods conspicuously beaked, becoming reflexed, somewhat flattened, the valves at maturity not separating toward the apex; seeds winged.

1. *Streptanthea longirostris* (S. Wats.) Rydb., Fl. Rocky Mount. 364. 1917.

Arabis longirostris S. Wats. in King, Geol. Expl. 40th Par. 5: 17. 1871.

Streptanthus longirostris S. Wats., Amer. Acad. Arts and Sci. Proc. 25: 127. 1890.

Near Navajo Mountain, Coconino County, 6,900 feet (*Peebles* and *Smith* 13911), and common in Mohave, western Pima, and Yuma Counties, 3,000 feet or lower, usually in sandy soil, March to April. Wyoming to Oregon, New Mexico, Arizona, and California.

A collection near Dome, Yuma County, has been referred to var. *derelicta* J. T. Howell, a variety described as being nonglaucous and having pinnately parted leaves.

8. STANLEYELLA

Plant biennial, glabrous; stems tall (often 2 m. or more), branched; blades of the lower leaves coarsely toothed or pinnatifid, the blades of the upper leaves entire; racemes many-flowered, dense at first; sepals at anthesis spreading or reflexed; petals white; pods long, very slender, terete or nearly so, short-stipitate.

1. *Stanleyella wrightii* (Gray) Rydb., Torrey Bot. Club Bul. 34: 435. 1907.

Thelypodium wrightii A. Gray, Pl. Wright. 1: 7. 1852.

Coconino and Mohave Counties to Cochise, Gila, Pinal, and Pima Counties, 3,000 to 7,000 feet, rich soil among pines and chaparral, June to August. Colorado, Utah, New Mexico, and Arizona.

A conspicuous plant because of the tall stems and numerous racemes of white flowers.

9. STREPTANTHUS

Plants annual or biennial, glabrous, glaucous; leaves entire to lyrate-pinnatifid; stem leaves clasping, with a cordate or sagittate base; inflorescence racemose or paniculate; calyx flask-shaped, closed or nearly so at anthesis, ochroleucous, yellow, or brown purple; petals with long claws and narrow, crisped or channeled blades, these brown purple, at least the veins; pods strongly compressed; seeds flat, winged.

Key to the species

1. Stems slender, diffusely branched above; inflorescence an open panicle, bracteate, the bracts ovate or suborbicular; flowers not more than 8 mm. long; pods about 1 mm. wide, 5 to 7.5 cm. long, becoming reflexed or pendulous..... 1. *S. LEMMONI*.
1. Stems stout, simple or few-branched; inflorescence racemose, elongate, bracteate; flowers 10 mm. long or longer; pods 3 mm. wide or wider, erect or ascending (2).
 2. Leaves thick, the upper ones broadly ovate, obtuse or acutish, entire, the basal ones rather sharply dentate; calyx brown purple; plant very glaucous..... 2. *S. CORDATUS*.
 2. Leaves thin, the upper ones lanceolate, oblong, or ovate-lanceolate, acute or acuminate, the basal ones commonly lyrate-pinnatifid; calyx whitish or yellow; plant moderately glaucous..... 3. *S. ARIZONICUS*.

1. *Streptanthus lemmoni* S. Wats., Amer. Acad. Arts and Sci. Proc. 25: 125. 1890.

Known only from the type collection, Santa Catalina Mountains, Pima County, 5,000 feet (*Lemmon* 27).

2. *Streptanthus cordatus* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 77. 1838.

Streptanthus crassifolius Greene, Pittonia 3: 227. 1897.

Euklisia crassifolia Rydb., Torrey Bot. Club Bul. 33: 142. 1906.

Navajo, Coconino, and Mohave Counties, 4,000 to 6,500 feet, April to May. Wyoming to Oregon, New Mexico, northern Arizona, and California.

3. *Streptanthus arizonicus* S. Wats., Amer. Acad. Arts and Sci. Proc. 25: 125. 1890.

Greenlee County to Pinal County, south to Cochise and Pima Counties, 1,500 to 4,500 feet, January to April, type from mountains of southern Arizona (*Pringle* in 1881). Arizona and Chihuahua.

The calyx is normally ochroleucous. A form with bright-yellow calyx, differing also in having a longer style and pods more attenuate at apex, var. *luteus* Kearney and Peebles, occurs among rocks in Canyon Diablo, Ajo Mountains, Pima County (*Kearney* 10813).

10. LEPIDIUM.⁴⁷ PEPPERGRASS

Plants annual or perennial, herbaceous or suffrutescent; stems usually much branched; leaves pinnatifid to entire; flowers mostly very small, in dense racemes, these becoming elongate and open in fruit; pods 2-celled, dehiscent, orbicular or elliptic, often emarginate.

⁴⁷ Reference: HITCHCOCK, C. L. THE GENUS LEPIDIUM IN THE UNITED STATES. *Madroño* 3: 265-320. 1936.

strongly flattened at a right angle to the partition; seed solitary in each cell.

Cress (*L. sativum*), a European species, is grown for greens, and cress-seed oil is obtained from the seeds. The Arizona species are mostly weeds of roadsides and fields. The seeds of *L. fremontii* and other species were used by the Arizona Indians as food and for flavoring.

Key to the species

1. Petals 2 to 3 mm. long, with broad blades and long, narrow claws, much surpassing the sepals; style conspicuous in fruit (2).
 2. Stem leaves auriculate and clasping at base, denticulate to sharply dentate; capsules inflated, entire at apex; style in fruit 1 to 1.5 mm. long; plant perennial; stems herbaceous above the crown----- 1. *L. DRABA*.
 2. Stem leaves not auriculate and clasping; capsules scarcely inflated, retuse at apex; style in fruit barely 1 mm. long or shorter, but at least equaling and usually surpassing the very shallow notch of the capsule (3).
 3. Stems of mature plants woody well above the base; capsules at maturity 4 to 7 mm. wide, broadly obovoid; plant glabrous, slightly glaucous; leaf blades linear, very narrowly lanceolate, or oblanceolate, entire or pinnatifid with very few, narrow, entire lobes-- 2. *L. FREMONTII*.
 3. Stems not woody or only slightly so at base; capsules less than 4 mm. wide (4).
 4. Leaf blades pinnatifid or pinnately toothed; stems soft-pilose or villous, seldom merely puberulent----- 3. *L. THURBERI*.
 4. Leaf blades, at least the uppermost ones, entire; stems puberulent or glabrous, rarely short-pilose----- 4. *L. MONTANUM*.
1. Petals less than 2 mm. long, sometimes obsolete; style none or very short, less than 0.3 mm. long, usually not equaling the relatively deep notch of the capsule; plants chiefly annual or biennial; stems never woody (5).
 5. Pubescence of stiff, spreading hairs; pedicels conspicuously flattened, commonly about twice as wide as thick; plant diffusely branched from the base; stems decumbent or spreading, seldom erect; blades of the basal leaves deeply cleft or pinnatifid, those of the stem leaves coarsely toothed, cleft, or pinnatifid; capsules commonly short-hirsute or hispid, at least on the margin----- 5. *L. LASIOCARPUM*.
 5. Pubescence soft, or more or less appressed, or minute, rarely none; pedicels seldom conspicuously flattened or as much as twice as wide as thick (6).
 6. Stems prostrate or strongly decumbent; basal leaves often bipinnatifid; stem leaves mostly pinnately parted or divided; sepals usually persistent after the petals have fallen, often until the fruit is nearly mature; capsules mostly glabrous----- 6. *L. OBLONGUM*.
 6. Stems commonly erect or ascending; lower leaves coarsely toothed or cleft, the basal ones sometimes pinnatifid; upper stem leaves narrow, often entire; sepals usually deciduous with the petals (7).
 7. Petals usually well developed, often surpassing the sepals; pedicels spreading soon after anthesis; capsules glabrous.--- 7. *L. MEDIUM*.
 7. Petals shorter than the sepals, commonly not more than half as long, sometimes obsolete; pedicels remaining erect or ascending long after anthesis; capsules glabrous or sparsely pubescent; stems puberulent, pilose, or short-villous----- 8. *L. DENSIFLORUM*.

1. *Lepidium draba* L., Sp. Pl. 645. 1753.

Cardaria draba Desv., Jour. de Bot. Desv. 3: 163. 1813.

Peoples Valley and Jerome Junction, Yavapai County (*Loomis* 6900, *McLellan* and *Stitt* 1432), and reported as occurring throughout the State, local at roadsides and in fields and pastures. Introduced from Europe.

Hoary cress.

2. **Lepidium fremontii** S. Wats. in King, Geol. Expl. 40th Par. 5: 30. 1871.

Mohave and Yuma Counties, 3,000 feet or lower, dry sandy soil of plains and mesas, March to May. Southwestern Utah and western Arizona to southeastern California.

The only really shrubby species in Arizona, attaining a height of 1 meter. The fragrant flowers are showy for the genus.

3. **Lepidium thurberi** Wooton, Torrey Bot. Club Bul. 25: 259. 1898.

Graham County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 5,000 feet or lower, February to September. New Mexico and Arizona.

A common roadside weed in central and southern Arizona, conspicuous because of its relatively large, pure-white flowers.

4. **Lepidium montanum** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 116. 1838.

Apache County to Mohave and Yavapai Counties, 3,000 to 7,000 feet. April to September. Colorado to Oregon, south to Texas, Arizona, and California.

Occurs in several forms, of which the commonest in Arizona is var. *canescens* (Thell.) C. L. Hitchc., characterized by herbaceous stems, and cinereous puberulence of the herbage, and by having some of the leaves (often all of them below the inflorescence) pinnatifid. Commonly suffrutescent forms are: var. *glabrum* C. L. Hitchc., with entirely glabrous herbage, in the Grand Canyon-Flagstaff region, and var. *jonesii* (Rydb.) C. L. Hitchc. (*L. jonesii* (Rydb.) with sparsely pubescent herbage, Apache to Coconino and Yavapai Counties. A moderately puberulent, often suffrutescent form with most of the leaves entire is var. *alyssoides* (A. Gray) Jones (*L. alyssoides* A. Gray), known from Holbrook (Navajo County) and from Crater Mound and House Rock Valley (Coconino County). A collection at Fort Verde, Yavapai County (*Mearns* 309) was referred by Hitchcock doubtfully to var. *integrifolium* (Nutt.) C. L. Hitchc. (*L. integrifolium* Nutt.), a form with thick leaves, all of them entire.

5. **Lepidium lasiocarpum** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 115. 1838.

Almost throughout the State, 4,000 feet or lower, commonly in sandy soil, January to April. Southwestern Colorado to Arizona and California, southward into Mexico.

The typical form of the species occurs almost everywhere in Arizona. Differing from this only in having the hairs of the pods more or less pustular at base is var. *wrightii* (Gray) C. L. Hitchc. (*L. wrightii* A. Gray), which has been collected in Maricopa, Pinal, Santa Cruz, and Pima Counties, also on Williams River. The var. *georginum* (Rydb.) C. L. Hitchc. (*L. georginum* Rydb.), which has the pedicels pubescent only on the upper side, instead of pubescent on both sides as in the other forms, is occasional in Santa Cruz and Pima Counties.

6. **Lepidium oblongum** Small, Fl. Southeast. U. S. 468. 1903.

Lepidium bipinnatifidum of authors. Not of Desvaux?

Common in waste ground near Sacaton (Pinal County), 1,300 feet. Arkansas to Texas, Arizona, and California, probably introduced from South America.

7. *Lepidium medium* Greene, Erythea 3: 36. 1895.

Lepidium virginicum L. var. *medium* C. L. Hitchc., Madroño 3: 285. 1936.

Coconino County to Cochise and Pima Counties, 6,000 feet or lower, February to August. Montana to British Columbia, south to Texas, Arizona, and California.

Resembles the common peppergrass of the eastern United States (*L. virginicum* L.) but all Arizona specimens examined by the writers have incumbent (not accumbent) cotyledons. Occurs in two forms that are about equally common in Arizona, the typical form with upper parts of the stem and pedicels glabrous, and var. *pubescens* (Greene) Robinson (*L. hirsutum* Rydb.) with stems and pedicels puberulent or cinereous-pilose throughout.

8. *Lepidium densiflorum* Schrad., Index Sem. Hort. Goettingen 4. 1832.

Lepidium apetalum of Amer. authors. Not Willd.

Apache, Coconino, and Yavapai Counties, 5,000 to 8,000 feet. Widely distributed in the United States and Canada.

The common form in Arizona is var. *bourgeauanum* (Thell.) C. L. Hitchc., which differs from typical *L. densiflorum* in having distinctly flattened pedicels and capsules about 3 mm. long.

Lepidium perfoliatum L., a European species sparingly naturalized in southern California, has been collected in the railway yard at Flagstaff, Coconino County (Whiting 1697, in 1941). It has the lower leaves bipinnatifid into narrowly linear divisions and the upper leaves entire, broad, rounded, and cordate-clasping.

11. THLASPI

Plants herbaceous, annual or perennial, glabrous; stem leaves auriculate-clasping; flowers small, the petals white or tinged with purple; capsules 2-celled, dehiscent, flattened at a right angle to the partition; seeds 2 or more in each cell.

Key to the species

1. Plant annual; stems commonly 30 cm. long or longer, usually branched; capsules orbicular or nearly so, rounded or slightly cuneate at base, at least 10 mm. wide at maturity, broadly winged all around, deeply notched at apex; style minute, much shorter than the notch. 1. T. ARVENSE.
1. Plant perennial; stems not more (usually much less) than 30 cm. long, not branched; capsules wedge-shaped, not more than 6 mm. wide, not winged or obscurely so near the truncate or very shallowly notched apex; style elongate, much longer than the notch; sepals usually purplish. 2. T. FENDLERI.

1. *Thlaspi arvense* L., Sp. Pl. 646. 1753.

Keam Canyon, Navajo County, 6,300 feet (*Peebles* and *Smith* 13413). Pennygrass. A troublesome weed in some parts of the United States, naturalized from Europe.

2. *Thlaspi fendleri* A. Gray, Pl. Wright. 2: 14. 1853.

Thlaspi purpurascens Rydb., Torrey Bot. Club Bul. 28: 281. 1901.

Apache County to Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 5,000 to 12,000 feet, mostly in coniferous

forests, February to August, type of *T. purpurascens* collected "in Arizona" without definite locality (*Palmer 571*). Colorado, Utah, New Mexico, and Arizona.

Sometimes called wild-candytuft.

12. SISYMBRIUM ⁴⁸

Plants of diverse appearance, annual, or perennial; stems simple or branched; leaves entire, dentate, or pinnatifid, the stem leaves sometimes with auriculate-clasping bases; flowers in racemes; petals yellow or purple; style short or obsolete; stigma nearly entire, or 2-lobed with lobes over the partition and placentae; pods terete, slender.

It is doubtful that all of the following species belong properly to this genus.

Key to the species

1. Stem leaves auriculate-clasping; petals purple, their blades flat or nearly so (2).
 2. Petals 10 to 15 mm. long, rich violet purple; anthers becoming curled or coiled; pods distinctly stipitate, the stipe 2 mm. long or longer; stem tall and stout; basal leaves dentate..... 1. *S. AMBIGUUM*.
 2. Petals less than 10 mm. long, pale purple; anthers becoming curved and somewhat twisted; pods nearly sessile, the stipe not more than 1 mm. long.
 2. *S. ELEGANS*.
1. Stem leaves not auriculate-clasping; petals yellow (3).
 3. Leaves all or nearly all entire and linear or narrowly lanceolate, the basal ones sometimes pinnatifid; petals more or less crisped or somewhat cucullate; pods erect or ascending, very slender, 3 to 7 cm. long; anthers deeply sagittate..... 3. *S. LINIFOLIUM*.
 3. Leaves all or nearly all pinnate or pinnatifid; petals flat or nearly so; pods eventually spreading (4).
 4. Plants glabrous or very sparsely hirsute near the base; divisions of the upper stem leaves never filiform; pods at maturity 4 to 5 cm. long, not rigid; anthers scarcely sagittate..... 4. *S. IRIO*.
 4. Plant hirsute up to the inflorescence, usually very sparsely so above; divisions of the upper stem leaves very narrow, often nearly filiform; pods at maturity more than 5 (up to 10) cm. long, becoming rather rigid; anthers often pronouncedly sagittate..... 5. *S. ALTISSIMUM*.

1. ***Sisymbrium ambiguum*** (*S. Wats.*) Payson, Wyo. Univ. Pubs. Bot. 1: 11. 1922.

Thelypodium ambiguum *S. Wats.*, Amer. Acad. Arts and Sci. Proc. 14: 290. 1879.

Mohave and Coconino counties, 3,000 to 6,000 feet, March to June, type from Long Valley, Coconino County (*Newberry*). Also in southern Utah.

A coarse plant but very showy when in flower.

- *2. ***Sisymbrium elegans*** (*M. E. Jones*) Payson, Wyo. Univ. Pubs. Bot. 1: 13. 1922.

Thelypodium elegans *M. E. Jones*, *Zoe* 4: 265. 1893.

Thelypodopsis elegans *Rydb.*, *Torrey Bot. Club Bul.* 34: 432. 1907.

Not known definitely to occur in Arizona but has been collected at Kanab, Utah, very near the Arizona State line. Colorado and Utah.

⁴⁸ Reference: PAYSON, E. B. SPECIES OF SISYMBRIUM NATIVE TO NORTH AMERICA NORTH OF MEXICO. Wyo. Univ. Pubs. Bot. 1: 1-27. 1922.

3. *Sisymbrium linifolium* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 91. 1838.*Nasturtium linifolium* Nutt., Acad. Nat. Sci. Phila. Jour. 7: 12. 1834.*Schoenocrambe linifolia* Greene, Pittonia 3: 127. 1896.

Carrizo Mountains, Apache County, possibly collected on the New Mexico side of the State line (*Matthews* in 1892), western slope of the Kaibab Plateau (*Goodding* and *Gunning* 2959). Montana to British Columbia, Utah, and northern Arizona.

4. *Sisymbrium irio* L., Sp. Pl. 659. 1753.*Norta irio* Britton in Britton and Brown, Illus. Fl. ed. 2, 2: 174. 1913.

Maricopa, Pinal, Santa Cruz, Pima, and Yuma Counties, 4,500 feet and lower, winter and early spring. Introduced from Europe.

An extremely abundant weed in irrigated sections of southern Arizona, disappearing on the advent of hot weather, of possible value for green manure.

5. *Sisymbrium altissimum* L., Sp. Pl. 659. 1753.*Norta altissima* Britton in Britton and Brown, Illus. Fl. ed. 2, 2: 174. 1913.

Coconino, Mohave, and Yavapai Counties, a common roadside weed, 5,000 to 6,500 feet, occasional farther south and lower, May to July. Introduced from Europe.

Tumblemustard. A bad weed in grainfields in some parts of the United States.

Sisymbrium officinale (L.) Scop., an introduced weed common throughout most of the United States, is to be looked for in Arizona.

13. HALIMOLOBUS

Plant perennial, soft-canescens, with mostly forked or stellate hairs; stems diffusely branched above; leaf blades deeply sinuate or pinnatifid; petals bright white; pods terete, very slender, less than 1 mm. in diameter.

1. *Halimolobus diffusus* (A. Gray) O. E. Schulz, Pflanzenreich IV. 105: 288. 1924.*Sisymbrium diffusum* A. Gray, Pl. Wright. 1: 8. 1852.

Pine Creek, Gila County (*MacDougal* in 1891), Mule Mountains, Cochise County (*Goodding* 971), Baboquivari Mountains, Pima County, about 4,000 feet (*Peebles* et al. 2777), mostly in crevices of rocks, July and August, apparently rare in Arizona. Western Texas to southern California and northern Mexico.

14. MICROSISYMBRIUM

Plant annual or biennial, sparsely pubescent below with simple hairs; leaves coarsely pinnately cleft; petals whitish, narrow, less than 5 mm. long; pods elongate, terete.

1. *Microsymbrium lasiophyllum* (Hook. and Arn.) O. E. Schulz, Pflanzenreich IV. 105: 162. 1924.

Turritis lasiophylla Hook. and Arn., Bot. Beechey Voy. 321. 1840.

Caulanthus lasiophyllus Payson, Mo. Bot. Gard. Ann. 9: 303. 1922.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 3,500 feet or lower, common in the western and southern deserts, usually among bushes, February to April. Washington to Arizona, California, and Baja California.

Payson referred all of the Arizona specimens examined by him to *C. lasiophyllus* var. *utahensis* (Rydb.) Payson.

15. DIPLLOTAXIS

Plants annual or perennial, glabrous or sparsely hispid; leaves coarsely toothed or pinnatifid; flowers rather few, in open racemes; petals yellow; pods erect or ascending, long and narrow, somewhat flattened; seeds in 2 rows.

Key to the species

1. Plant annual or biennial; stems scapose or subscapose; leaf blades coarsely toothed, or pinnatifid with broadly oblong or triangular lobes; petals about 6 mm. long; pedicels in fruit up to 22 mm. long. 1. *D. MURALIS*.
1. Plant perennial; stems leafy nearly to the inflorescence; leaf blades usually deeply pinnatifid with elongate, linear or narrowly oblong lobes; petals usually more than 6 mm. long; pedicels in fruit up to 40 mm. long. 2. *D. TENUIFOLIA*.

1. *Diplotaxis muralis* (L.) DC., Regni Veg. Syst. 2: 634. 1821.

Sisymbrium murale L., Sp. Pl. 658. 1753.

Tuba, Coconino County, "common about buildings" (*Clute* 111), Tucson, Pima County, "streets, spreading rapidly" (*Thornber* 7545 in 1913). In waste ground here and there in the United States; introduced from Europe.

2. *Diplotaxis tenuifolia* (L.) DC., Regni Veg. Syst. 2: 632. 1821.

Sisymbrium tenuifolium L., Centuria Pl. 1: 18. 1755.

Benson, Cochise County, "common in railway yard and spreading" (*Thornber* 5365); introduced from Europe.

16. BRASSICA

Plants annual or biennial, glabrous and glaucous, or sparsely and stiffly pubescent; leaves petioled, or sessile and clasping, the blades (at least of the lower leaves) lyrate-pinnatifid; flowers rather large, in elongate racemes, the petals yellow; pods conspicuously beaked, commonly torulose, dehiscent below, the beak indehiscent; seeds in one row.

This genus includes the cultivated cabbage, cauliflower, turnip, and mustard, as well as the weedy species enumerated here. Oil of mustard, used medicinally as a skin stimulant (rubefacient), is ob-

tained from the seeds of *B. nigra* and *B. juncea*. Most of the species make palatable greens.

Key to the species

1. Beak half or more as long as the rest of the pod, flat or conspicuously angled, usually containing 1 seed in an indehiscent cell; leaves not clasping at base (2).
 2. Leaves petioled, pinnatifid; pedicels more than 5 (often 10) mm. long; pods ascending on spreading pedicels, the dehiscent part bristly, shorter than or equaling the beak----- 1. *B. HIRTA*.
 2. Leaves nearly sessile, the upper ones merely toothed; pedicels 3 to 5 mm. long; pods and pedicels strongly ascending, the dehiscent part of the pod usually smooth, longer than the beak----- 2. *B. KABER*.
1. Beak usually less than half as long as the rest of the pod, conic, seedless (3).
 3. Upper leaves clasping, glaucous and glabrous, the lower ones usually with scattered hairs; pedicels spreading; pods 4 to 9 cm. long, stout, ascending, with a stout beak forming one-eighth to one-third of the length of the pod----- 3. *B. CAMPESTRIS*.
 3. Upper leaves not clasping, not or only slightly glaucous, often sparsely hirsute (3).
 4. Pedicels in fruit less than 5 mm. long, erect; pods appressed to the stem, 1 to 2 cm. long, not more than 2 mm. in diameter, somewhat quadrangular----- 4. *B. NIGRA*.
 4. Pedicels in fruit more than 5 mm. long, spreading; pods not appressed to the stem, 3 to 5.5 cm. long, 2 to 3.5 mm. in diameter, nearly terete but the valves with a stout midnerve----- 5. *B. JUNCEA*.

1. *Brassica hirta* Moench, Meth. Pl. Sup. 84. 1802.

Sinapis alba L., Sp. Pl. 668. 1753.

Brassica alba Rabenh., Fl. Lusat. 1: 184. 1839. Not of Gilib., 1782.

Base of the Mazatzal Mountains, Gila County, 4,000 feet (*Collom* 907). Adventive in the United States from Eurasia.

White mustard.

2. *Brassica kaber* (DC.) L. C. Wheeler, Rhodora 40: 306. 1938.

Sinapis arvensis L., Sp. Pl. 668. 1753.

Sinapis kaber DC., Regni Veg. Syst. 2: 617. 1821.

Brassica arvensis (L.) Rabenh., Fl. Lusat. 1: 184. 1839.
Not *B. arvensis* L. 1767.

At roadside, Roosevelt, Gila County (*Pebbles* et al. 5205), identification somewhat questionable. Widely distributed in the United States; introduced from Europe.

Charlock.

3. *Brassica campestris* L., Sp. Pl. 666. 1753.

Mesa (Maricopa County), Sacaton and south of Florence (Pinal County), occasional at roadsides, probably an escape from cultivation. Native of Eurasia.

Turnip.

4. *Brassica nigra* (L.) Koch in Roelh., Deut. Fl. ed. 3, 4: 713. 1833.

Sinapis nigra L., Sp. Pl. 668. 1753.

Pinal, Maricopa, and Pima Counties, occasional at roadsides. Widely distributed in the United States; naturalized from Europe.

Black mustard.

5. **Brassica juncea** (L.) Cosson, Soc. Bot. France Bul. 6: 609. 1859.

Sinapis juncea L., Sp. Pl. 668. 1753.

Flagstaff (Coconino County), Prescott (Yavapai County). Widely distributed in the United States; introduced from Asia.

Indian mustard.

The garden radish, *Raphanus sativus* L. and wild radish, *R. raphanistrum* L., are likely to be found in waste places in Arizona. They are easily distinguished from *Brassica* by their indehiscent pods with spongy cross partitions between the seeds, the garden radish also by its white or pink petals.

17. BARBAREA. WINTERCRESS

Plants commonly biennial, glabrous; stems erect, branched above, angled; leaves lyrate-pinnatifid; flowers in elongate racemes, the petals yellow; pods elongate, 4-sided; seeds in 1 row in each cell.

1. **Barbarea orthoceras** Ledeb., Hort. Dorp. 1824; Fl. Ross. 1: 114. 1841.

Labrador to Alaska, south to New Hampshire, Colorado, Arizona, California, and Mexico, also in Eurasia, flowering in spring and early summer.

The typical form of the species, with pods appressed or strongly ascending and rather crowded, has been collected at Buck Springs, Coconino County (*Collom* 778), and in the Chiricahua Mountains, Cochise County (*Blumer* in 1907). A western form, var. *dolichocarpa* Fernald, with pods spreading or ascending and not crowded, occurs near Flagstaff (*MacDougal* 24, *Peebles* and *Smith* 13605).

18. DRYOPETALON

Plant annual; stems branching above, hispid below; leaves sharply incised with retrorse teeth or lobes; flowers in crowded racemes; sepals strongly gibbous at base; petals bright white, with pinnately 5- to 7-cleft blades; pods long and slender, terete, spreading or somewhat recurved.

1. **Dryopetalon runcinatum** A. Gray, Pl. Wright. 2: 12. 1853.

Greenlee, Gila, Pinal, Santa Cruz, and Pima Counties, 2,000 to 4,000 feet, commonly in moist rock crevices in canyons, February to May. New Mexico and southern Arizona, probably also northern Mexico.

19. RORIPPA

Plants annual or perennial; stems usually branched; leaves simple or pinnate; flowers in racemes, these rather short and dense at first, becoming loose and elongate; petals yellow or white; pods globose to elongate and narrowly cylindrical; seeds commonly in 2 rows, very small, turgid.

The plants all prefer wet ground and one species, the true watercress (*R. nasturtium-aquaticum*), is semiaquatic.

Key to the species

1. Petals clear white, surpassing the sepals; leaves pinnate; plant perennial, semiaquatic; leaflets entire or nearly so, the terminal one much the largest, broadly ovate or suborbicular; pods cylindric or subclavate, 8 to 20 mm. long.----- 1. *R. NASTURTIIUM-AQUATICUM*.
1. Petals yellow or whitish; leaves pinnatifid or sometimes pinnate; plants terrestrial, in moist soil (2).
2. Sepals considerably shorter than the petals; plants commonly perennial, with rootstocks; leaf segments mostly acute or acutish, the terminal one lanceolate or oblong; pods seldom less than 3 times as long as wide, acute or acutish at apex; stigma much thicker than the style (3).
3. Leaves often pinnate, the segments mostly toothed, cleft, or lacinate; inflorescence and pods glabrous; style not more than 1 mm. long; pods slender; seeds often in one row.----- 2. *R. SYLVESTRIS*.
3. Leaves pinnatifid, the segments entire or nearly so; inflorescence and pods scurfy-papillate; style more than 1 mm. long; pods rather thick, usually curved; seeds in two rows.----- 3. *R. SINUATA*.
2. Sepals not or only slightly shorter than the petals (except sometimes in *R. curvisiliqua*); plants commonly annual (4).
4. Pods very slender, linear, more or less curved, often 1 cm. long or longer, acute or acutish at apex; stigma very small, not thicker than the very short style, or sessile; leaf segments commonly acute.----- 4. *R. CURVISILIQUA*.
4. Pods thick, straight or nearly so, usually much less than 1 cm. long, very obtuse or truncate at apex (5).
5. Pedicels 2 to 4 mm. long, mostly longer than the globose pods; plant low, diffuse, glabrous or very sparsely pilose; leaf segments obtuse.----- 5. *R. SPHAEROCARPA*.
5. Pedicels mostly 4 mm. long or longer; pods longer than wide (6).
6. Stems villous or hirsutulous, commonly sparsely so; pods not more than twice as long as wide, ovoid or ellipsoid, mostly shorter than the pedicels; stigma scarcely thicker than the style.----- 6. *R. HISPIDA*.
6. Stems glabrous or very nearly so; pods usually more than twice as long as wide, cylindric or ovoid-cylindric, mostly longer than the pedicels (7).
7. Stigma thicker than the style, distinctly 2-lobed; leaf segments numerous, often acutish.----- 7. *R. ISLANDICA*.
7. Stigma not or scarcely thicker than the style, entire or very nearly so; leaf segments few, obtuse.----- 8. *R. OBTUSA*.

1. *Rorippa nasturtium-aquaticum* (L.) Schinz and Thell., Fl. Schweiz, ed. 3, 240. 1909.

Sisymbrium nasturtium-aquaticum L., Sp. Pl. 657. 1753.

Radicula nasturtium-aquaticum Britten and Rendle, Jour. Bot. [London] 14: 99. 1907.

Apache County to Coconino County, south to Graham, Pinal, and Pima Counties, 1,300 to 7,000 feet, springs, brooks, and ponds, April to July. Naturalized throughout temperate North America, from Europe.

Watercress, sometimes cultivated for salads and garnishings.

2. *Rorippa sylvestris* (L.) Besser, Enum. Pl. 27. 1821.

Sisymbrium sylvestre L., Sp. Pl. 657. 1753.

Radicula sylvestris Druce, Ann. Nat. Hist. 1906: 219. 1906.

Oak Creek, Coconino County (*Fulton* 9666), Fort Huachuca, Cochise County (*Patzky* in 1890). Yellowcress, extensively naturalized in North America, from Europe.

3. *Rorippa sinuata* (Nutt.) A. S. Hitchc., Spring Fl. Manhattan 18. 1894.

Nasturtium sinuatum Nutt. ex Torr. and Gray, Fl. North Amer. 1:73. 1838.

Radicula sinuata Greene, Leaflets 1:113. 1905.

Apache County to Coconino County, 5,000 to 6,000 feet, May to June. Illinois to Saskatchewan, south to Texas, northern Arizona, and California.

Represented in Arizona only by a form with scurfy-papillate inflorescence and pods (*Nasturtium trachycarpum* Gray).

4. *Rorippa curvisiliqua* (Hook.) Bessey, Torrey Bot. Club Mem. 5:169. 1894.

Sisymbrium curvisiliquum Hook., Fl. Bor. Amer. 1:61. 1830.

San Francisco Peaks and Bill Williams Mountain (Coconino County), Beaver Creek (Yavapai County), bed of the Gila River (Pinal County), up to 7,200 feet, June to August. Montana and Wyoming to British Columbia, south to Arizona and California.

The Arizona specimens are referred doubtfully to this species, having longer, more slender, and less curved pods than most specimens of *R. curvisiliqua* from the Pacific Coast States.

5. *Rorippa sphaerocarpa* (A. Gray) Britton, Torrey Bot. Club Mem. 5:170. 1894.

Nasturtium sphaerocarpum A. Gray, Amer. Acad. Arts and Sci. Mem., ser. 2, 4:6. 1849.

Radicula sphaerocarpa Greene, Leaflets 1:113. 1905.

San Francisco Peaks and Oak Creek (Coconino County), Tonto Basin (Gila County), 5,000 to 8,000 feet, July to September. Illinois to Wyoming, south to Texas, Arizona, and California.

6. *Rorippa hispida* (Desv.) Britton, Torrey Bot. Club Mem. 5:169. 1894.

Brachilobus hispidus Desv., Jour. de Bot. Desv. 3:183. 1814.

Radicula hispida Heller, Muhlenbergia 7:123. 1912.

Rorippa islandica var. *hispida* Butters and Abbe, Rhodora 42:26. 1940.

Arizona, without locality (*Palmer* in 1869), also Gila River bed near Sacaton, Pinal County, 1,300 feet (*Harrison* and *Peebles* 1742, 2006). New Brunswick to Alaska, south to New Mexico and Arizona.

7. *Rorippa islandica* (Oeder) Borbás, Balaton Tavának és Partmellékének. 392. 1900.

Sisymbrium islandicum Oeder, Fl. Dan. 3: fasc. 7, 8. 1768.

Rorippa palustris Besser, Enum. Pl. 27. 1821.

Radicula terrestris (R. Br.) Woot. and Standl., Contrib. U. S. Natl. Herbarium 19:284. 1915.

"Arizona" without locality (*Palmer* 563), presumably collected on the Colorado River, Yuma County. Widely distributed in North America and Eurasia.

Palmer noted on his label "used for greens by the Cocopa Indians."

8. *Rorippa obtusa* (Nutt.) Britton, Torrey Bot. Club Mem. 5:169. 1894.

Nasturtium obtusum Nutt. ex Torr. and Gray, Fl. North Amer. 1: 74. 1838.

Radicula obtusa Greene, Leaflets 1: 113. 1905.

White Mountains (Apache and Greenlee Counties) in meadows, Baker Butte (Coconino County), bed of the Gila River near Sacaton (Pinal County) where doubtless a stray from the mountains. Michigan to Washington, south to Texas, Arizona, and California.

20. CARDAMINE. BITTERCRESS

Plant perennial, glabrous or soft-pilose; leaves conspicuously petio- late, the blades broadly ovate or suborbicular, deeply cordate, shallowly sinuate-dentate; petals white; pods ascending on long pedicels, elongate, rather thick; seeds in 1 row.

1. *Cardamine cordifolia* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 8. 1849.

San Francisco Peaks (Coconino County), White Mountains (Apache County), 9,000 to 11,000 feet, July and August. Wyoming and Idaho, south to New Mexico and Arizona.

21. LYROCARPA

Plants perennial, stellate-canescant; stems weak and straggling, usually supported on shrubs; leaves lyrate-pinnatifid; petals elongate, subulate, brown-purple, 1.5 to 2 cm. long; pods indehiscent or tardily dehiscent, irregularly obovoid-triangular, obcordate, often constricted below the apex, flattened contrary to the partition.

1. *Lyrocarpa coulteri* Hook. and Harv., London Jour. Bot. 4: 76. 1845.

Western parts of Maricopa, Pinal, and Pima Counties, southern Yuma County, 2,000 feet or lower, among mesquite and other bushes in partial shade, March and August. Arizona, southeastern California, Sonora, and Baja California.

22. DITHYREA. SPECTACLE-POD

Plants annual, stellate-canescant; stems leafy, erect or decumbent; leaves sinuate-dentate to nearly entire; petals white or yellowish; pods indehiscent or tardily dehiscent, didymous (the 2 cells side by side), strongly flattened contrary to the partition, wider than long; seed 1 in each cell.

Key to the species

1. Stems decumbent or spreading; herbage yellowish green; blades of the stem leaves ovate or oblong-ovate, shallowly sinuate-dentate; petals 8 to 12 mm. long, yellowish; pedicels in fruit 2 to 3 mm. long; fruit rather deeply notched both above and below, canescent..... 1. D. CALIFORNICA.
1. Stems erect; herbage gray or whitish; blades of the stem leaves linear-lanceolate to ovate-lanceolate, deeply sinuate-dentate to nearly entire; petals 5 to 8 mm. long, white; pedicels in fruit seldom less than 10 mm. long; fruit notched below, truncate or very shallowly notched above, canescent or glabrous..... 2. D. WISLIZENI.

1. *Dithyrea californica* Harv., London Jour. Bot. 4: 77. 1845.

Mohave and Yuma Counties, 1,800 feet or lower, sandy soil, plains and mesas, March to April. Southern Nevada and western Arizona to Baja California.

2. *Dithyrea wislizeni* Engelm. in Wisliz., Mem. North. Mexico 96. 1848.

Apache County to Mohave County, south to Graham, Pinal, Maricopa, and Yuma Counties, 1,000 to 6,000 feet, sandy soil, often along streams, February to August. Colorado and Utah to Arizona and northern Mexico.

Occasional in Arizona is var. *griffithsii* (Woot. and Standl.) Payson (*D. griffithsii* Woot. and Standl.) with glabrous pods but not consistently with narrow entire leaves. It is stated that *D. wislizeni* is used by the Hopi Indians in treating wounds.

23. PHYSARIA⁴⁹

Plants small, caespitose, more or less silvery-lepidote; leaves mostly basal, or the basal leaves much larger than the stem leaves, the blades orbicular to spatulate; petals narrow, yellow; pods didymous, bladder-like, deeply notched at apex; seeds usually 2 or more in each cell.

Key to the species

1. Style 2 to 3 mm. long; replum of the pod lanceolate----- 1. *P. NEWBERRYI*.
 1. Style 6 to 8 mm. long; replum of the pod oblong----- 2. *P. CHAMBERSII*.

1. *Physaria newberryi* A. Gray in Ives, Colo. River Rpt. 6. 1860.

Apache, Navajo, and Coconino Counties, 6,000 to 7,000 feet, May, type from Tegua, Hopi villages, Navajo County (*Newberry* in 1858). Utah, Nevada, New Mexico, and northern Arizona.

2. *Physaria chambersii* Rollins, Rhodora 41: 403. 1939.

Near Pipe Springs, Mohave County, 5,000 feet, April to May (*Peebles* and *Parker* 14709). Utah, Nevada, and northwestern Arizona.

24. LESQUERELLA⁵⁰ BLADDERPOD

Plants annual or perennial; herbage stellate-canescens; leaves largely basal, the blades entire to sinuate-dentate; flowers in loose racemes, the petals yellow, or white tinged with purple; pedicels elongate in fruit; styles persistent; pods inflated, globose or ovoid, the valves nerveless; seeds 2-rowed in each cell.

The roots of one species, perhaps *L. intermedia*, are reported to be used by the Hopi Indians as an antidote for rattlesnake venom.

Key to the species

1. Plants annual, green and sparsely pubescent to densely silvery canescent; leaf blades lanceolate, oblanceolate, or spatulate, entire (exceptionally sinuate-dentate), the basal leaves sometimes lyrate, the stem leaves 2 to 12 mm. wide; petals 6 to 8 mm. long, bright yellow, sometimes fading reddish; pedicels in fruit spreading, becoming sigmoid; pods globose or nearly so, about 4 mm. in diameter, somewhat longer than the style, typically glabrous and short-stipitate----- 1. *L. GORDONI*.

⁴⁹ Reference: ROLLINS, REED C. THE CRUCIFEROUS GENUS PHYSARIA. Rhodora 41: 392-415. 1939.

⁵⁰ Reference: PAYSON, F. B. MONOGRAPH OF THE GENUS LESQUERELLA. Mo. Bot. Gard. Ann. 8: 103-236. 1921.

1. Plants perennial (2).
2. Petals at anthesis white, sometimes purple-veined, commonly fading purple, 6 to 10 mm. long; pedicels in fruit simply recurved (not sigmoid), slender, 10 to 15 mm. long; pods glabrous, sessile or nearly so, about 6 mm. in diameter; leaf blades green and sparsely pubescent to rather densely whitish pubescent, the basal ones usually lyrate, much larger than the stem leaves.----- 2. *L. PURPUREA*.
2. Petals at anthesis yellow, sometimes fading reddish; pedicels in fruit not simply recurved, or if so, then the pods pubescent (3).
3. Pods glabrous, shorter to somewhat longer than the style; fruiting inflorescence often elongate; leaf blades oblanceolate or spatulate, commonly entire; pedicels in fruit up to 20 mm. long, erect or strongly ascending, straight or nearly so; petals 8 to 10 mm. long.----- 3. *L. FENDLERI*.
3. Pods pubescent (4).
4. Pedicels in fruit simply recurved (not sigmoid), up to 15 mm. long; pods usually pendent; blades of the petals very narrow, not more than twice as wide as the claws; leaf blades linear or narrowly oblanceolate, the lower ones up to 10 cm. long. 4. *L. LUDOVICIANA*.
4. Pedicels in fruit not recurved, either straight, simply curved upward, or sigmoid; pods not pendent; blades of the petals at least twice as wide as the claws; species difficult to distinguish (5).
5. Pods short-ellipsoid or nearly globose; basal leaves usually forming a distinct rosette, the blades of some of them commonly broadly oblanceolate to nearly orbicular and 4 mm. wide or wider (6).
6. Stems erect or ascending; basal rosette not dense; stem leaves not crowded.----- 5. *L. RECTIPES*.
6. Stems decumbent or prostrate; basal rosette dense; stem leaves often crowded.----- 6. *L. CINEREA*.
5. Pods ovoid or ovoid-ellipsoid; basal leaves not forming a distinct rosette, the blades linear or narrowly oblanceolate, mostly less than 4 mm. wide (7).
7. Styles in fruit 2.5 to 6 mm. long; basal leaves mostly 3 cm. long or longer, usually involute.----- 7. *L. INTERMEDIA*.
7. Styles in fruit 1 to 2 mm. long; basal leaves not more than 2.5 cm. long, flat.----- 8. *L. ARIZONICA*.

1. *Lesquerella gordonii* (A. Gray) S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 253. 1888.

Vesicaria gordonii A. Gray, Boston Jour. Nat. Hist. 6: 149. 1850.

Greenlee County to Mohave County, south to Cochise, Pima, and Yuma Counties, 4,000 feet or lower, dry plains and mesas, February to May. Oklahoma to Utah, Arizona, and California, south to northern Mexico.

Extensive desert areas are colored in spring with the bright-yellow flowers of this plant. It is reported to afford good forage, probably after the pods mature. Throughout most of the range of the species in Arizona, often growing with the typical form, is var. *sessilis* S. Wats. (*L. palmeri* S. Wats.), characterized by pubescent, sometimes sessile pods.

2. *Lesquerella purpurea* (A. Gray) S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 253. 1888.

Vesicaria purpurea A. Gray, Pl. Wright. 2: 14. 1853.

Coconino County to Cochise and Pima Counties, 1,600 to 5,000 feet, usually in partial shade of bushes, January to May. Texas to Arizona and northern Mexico.

Easily distinguished from all other Arizona species by its white or purplish flowers.

3. *Lesquerella fendleri* (A. Gray) S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 254. 1888.

Vesicaria fendleri A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 9. 1849.

Apache and Navajo Counties to Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,000 feet, plains and mesas, April to June. Kansas to Utah, south to northern Mexico.

4. *Lesquerella ludoviciana* (Nutt.) S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 252. 1888.

Alyssum ludovicianum Nutt., Gen. Pl. 2: 63. 1818.

Lesquerella argentea (Pursh) MacMillan, Metasperm. Minn. 263. 1892.

"Arizona" without definite locality (*Palmer* in 1869), Joseph City, Navajo County, 4,900 feet (*Wooton* in 1892). Minnesota and the Dakotas to Kansas and Arizona.

5. *Lesquerella rectipes* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 127. 1913.

Navajo Experiment Station, Apache (?) County, 6,900 feet (*Klinger* and *McLanahan*), Navajo Mountain, Coconino County, about 8,000 feet (*Peebles* and *Smith* 13947), June. Colorado, Utah, northwestern New Mexico, and northeastern Arizona.

6. *Lesquerella cinerea* S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 255. 1888.

Flagstaff and vicinity, Coconino County, 6,500 to 7,000 feet, June to August, type from Arizona, without definite locality (*Palmer* in 1869). Known only from Arizona.

7. *Lesquerella intermedia* (S. Wats.) Heller, Pl. World 1: 22. 1897.

Lesquerella alpina (Nutt.) S. Wats., var. *intermedia* S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 251. 1888.

Apache County to Coconino and Yavapai Counties, 5,500 to 7,200 feet, April to August. Colorado, Utah, New Mexico, and Arizona.

The commonest species in northeastern Arizona.

8. *Lesquerella arizonica* S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 254. 1888.

Coconino, Mohave, and northern Yavapai Counties, 3,500 to 7,100 feet, rocky slopes and mesas, April to May, type from near Prescott (*Palmer* 16). Southern Utah to central Arizona.

25. HUTCHINSIA

Plant annual, small, glabrous or stellate-puberulent; stems very slender, branched, spreading; leaves mostly petioled, narrow, entire or few-toothed; petals small, whitish; pods 4 mm. long or less, not strongly compressed, ellipsoid, entire at apex.

1. *Hutchinsia procumbens* (L.) DC., Jour. de Bot. Desv. 3: 168. 1814.

Lepidium procumbens L., Sp. Pl. 643. 1753.

Pierce Spring, Mohave County, 1,700 feet (*Jones* 5077b), April. Labrador to British Columbia, south to Colorado, northern Arizona, and southern California.

26. CAPSELLA. SHEPHERDS-PURSE

Plant annual; root leaves in a rosette, lyrate-pinnatifid, the stem leaves dentate or entire, auricled at base; flowers in elongate racemes, very small, the petals white; pods flat, wedge-shaped, dehiscent; seeds numerous in each cell.

1. *Capsella bursa-pastoris* (L.) Medik., Pflanzengatt. 1: 85. 1792.

Thlaspi bursa-pastoris L., Sp. Pl. 647. 1753.

Pinal and Maricopa Counties, a weed of waste land and lawns, rare in Arizona. Extensively naturalized in North America from Europe.

27. CAMELINA. FALSEFLAX

Plant annual; stems erect, rather strict; leaves entire or denticulate, the stem leaves auriculate-clasping; flowers in elongate racemes, small, the petals yellow; pods obovoid, turgid but somewhat compressed; seeds numerous in each cell.

1. *Camelina microcarpa* Andrz. in DC., Regni Veg. Syst. 2: 517. 1821.

Grand Canyon and Flagstaff (Coconino County), Chiricahua Mountains (Cochise County), 7,000 to 8,000 feet. A weed of waste ground introduced, in many parts of the United States, from Europe.

An oil, somewhat similar to linseed oil, is obtained from the seeds.

28. DRABA.⁵¹ WHITLOWGRASS

Contributed by C. LEO HITCHCOCK

Plants of diverse habit, annual, biennial, or perennial, with scapose or leafy stems, usually pubescent with simple or forked hairs; leaf blades entire or dentate; racemes short and corymbose to elongate; petals white or yellow; pods 2-celled, dehiscent, strongly compressed parallel to the partition and flat, or elongate and often twisted; seeds numerous, in 2 rows in each cell.

Key to the species

1. Plants evidently perennial, the stems usually tall and leafy; petals yellow, often fading to white, usually as much as 4 mm. long; style evident, persistent; pods elongate, often twisted (2).
2. Plants scapose, the leaves in basal rosettes, grayish hirsute with stalked cruciform hairs; pods densely pubescent..... 1. *D. ASPRELLA*.
2. Plants not truly scapose, some of the leaves cauline; pods often glabrous (3).
3. Leaves mostly basal, narrowly oblanceolate, 1.5 to 8 cm. long, 2 to 7 mm. wide, ciliate with simple or forked hairs; pods and upper portion of the stems glabrous; styles 1 to 1.5 mm. long..... 2. *D. STANDLEYI*.
3. Leaves usually rather uniformly pubescent, many of them cauline; stems mostly pubescent throughout (4).
4. Styles less than 1.5 mm. long; pedicels strongly ascending to erect in fruit..... 3. *D. AUREA*.
4. Styles 1.5 mm. long or longer; pedicels spreading or but slightly ascending (5).
5. Basal leaves oblanceolate, 3 to 8 cm. long, their bases matted on the caudices; pubescence rather sparse, hence all of the leaves bright green..... 4. *D. PETROPHILA*.

⁵¹ Reference: HITCHCOCK, C. LEO. A REVISION OF THE DRABAS OF WESTERN NORTH AMERICA. Wash. Univ. Pubs. Biol. 11: 1-132. 1941.

5. Basal leaves not as above; whole plant usually more or less pallid with dense soft pubescence..... 5. *D. HELLERIANA*.
1. Plants winter annual, except *D. crassifolia*, a small scapose biennial or short-lived perennial (6).
6. Petals yellow at anthesis, often fading to whitish; plants of elevations at or above 6,000 feet (7).
7. Stems leafy nearly or quite to the inflorescence; whole plant, including the pods, copiously pubescent..... 6. *D. RECTIFRUCTA*.
7. Stems scapose (or with one leaf); plants sparsely pubescent, the pods nearly always glabrous..... 7. *D. CRASSIFOLIA*.
6. Petals white or whitish at anthesis; plants winter annuals of elevations usually less than 6,000 feet (8).
8. Stems leafy up to the inflorescence; basal leaves petioled; pods 2 to 5 mm. long; leaves all entire or some of them sparingly dentate.
10. *D. BRACHYCARPA*.
8. Stems not leafy up to the inflorescence; basal leaves sessile or nearly so; pods 4 to 14 mm. long; some or all of the leaves usually coarsely few-toothed (9).
9. Inflorescence and pedicels glabrous..... 8. *D. REPTANS*.
9. Inflorescence and pedicels pubescent (10).
10. Racemes elongate, usually at least half the total height of the plant; pods averaging 3.5 mm. wide; pedicels as long as the fruits or nearly so..... 9. *D. PLATYCARPA*.
10. Racemes usually not half the total height of the plant; pods averaging not more than 3 mm. wide; pedicels seldom as long as the fruit..... 11. *D. CUNEIFOLIA*.

1. *Draba asprella* Greene, Torrey Bot. Club Bul. 10: 125. 1883.

Coconino and Yavapai Counties, perhaps also in Gila County, 6,000 to 7,000 feet, pine forests, local, commencing to flower in April, type from Lynx Creek, Yavapai County (*Rusby* in 1883). Known only from Arizona.

In addition to the typical form there occur in Arizona var. *kaibensis* C. L. Hitchc. and var. *setigera* Schulz. The former, which has been collected at the Grand Canyon (*Cottam* 2650), differs in having soft, very dense pubescence, the petioles and lower portion of the scape with branched hairs only. The var. *setigera*, known from Flagstaff (*MacDougal* 22, *Purpus* in 1902), is distinguished by coarser stiffer pubescence. Both the varieties have forked to stellate pubescence on the fruits as contrasted with simple or once-forked hairs in the species.

2. *Draba standleyi* Macbr. and Payson, Mo. Bot. Gard. Ann. 5: 150. 1918.

Draba gilgiana Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 124. 1913. Not of Muschler, 1906.

Chiricahua Mountains, 8,500 feet (*Blumer* 1538). New Mexico, Texas, and southeastern Arizona.

3. *Draba aurea* Vahl in Hornem., Fl. Dan. 9¹⁵: 3. 1818.

San Francisco Peaks (Coconino County), White Mountains (Apache County), 10,000 to 12,000 feet, July to August. Widely distributed in the cooler parts of the Northern Hemisphere.

The Arizona specimens mostly belong to var. *leiocarpa* (Payson and St. John) C. L. Hitchc. (*D. aureiformis* var. *leiocarpa* Payson and St. John) with relatively small flowers, short glabrous pods, and short fruiting styles, but approaches to the typical form in some of these characters also occur.

4. *Draba petrophila* Greene, Pittonia 4: 17. 1899.

Pinaleno Mountains, Graham County (*Rothrock* 111), Rincon and Santa Rita Mountains (Pima County), 6,000 feet and higher, chiefly in crevices of rocks.

There occur in Arizona both the typical form and the var. *viridis* (Heller) C. L. Hitchc. (*D. viridis* Heller). The latter, which occurs in the Santa Catalina and Huachuca Mountains of Arizona, and in adjacent Mexico, is distinguished by its longer styles and stiff simple or forked hairs on the valves of the pod (*Goodding* 134).

5. *Draba helleriana* Greene, Pittonia 4: 17. 1899.

White Mountains (Apache County) to the mountains of Cochise and Pima Counties, usually among rocks in coniferous forests, 6,000 to 11,500 feet, July to September. New Mexico and Arizona.

The Arizona forms are: (1) var. *patens* (Heller) Schulz (*D. patens* Heller), from the White Mountains; (2) var. *blumeri* C. L. Hitchc., from the Chiricahua Mountains to the White Mountains; and (3) var. *bifurcata* C. L. Hitchc., from Monument Peak, Chiricahua Mountains. These three forms are separable as follows: Var. *bifurcata* is characterized by unbranched or forked hairs, only, on the cauline leaves, both the other entities having many 4-rayed trichomes. But, whereas var. *blumeri* has the crowns much thickened by persistent leaf bases of several years' duration, the var. *patens* is seemingly a short-lived perennial, without such marcescent leaves.

6. *Draba rectifruca* C. L. Hitchc., Wash. Univ. Pubs. Biol. 11: 110. 1941.

Draba montana S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 289. 1879. Not Bergeret, 1786.

Kaibab Plateau between Jacobs Lake and the Grand Canyon, Coconino County, 8,400 feet (*Kearney* and *Peebles* 13680), August. Colorado, New Mexico, Utah, and northern Arizona.

7. *Draba crassifolia* Graham, Edinb. New Phil. Jour. 1829: 182. 1829.

San Francisco Peaks, 10,000 to 12,000 feet, July. Greenland to Alaska, south to Colorado and northern Arizona.

A collection on the San Francisco Peaks (*Leiberg* 5758) is cited by Schulz under var. *albertina* (Greene) O. E. Schulz (*D. albertina* Greene). The variety differs merely in its more copious pubescence of stellate hairs, the typical form having simple or merely bifurcate hairs.

8. *Draba reptans* (Lam.) Fernald, Rhodora 36: 368. 1934.

Arabis reptans Lam., Encycl. 1: 222. 1783.
Draba caroliniana Walt., Fl. Carol. 174. 1788.

Pinaleno Mountains, Graham County (*Maguire* 10193), Sabino Canyon, Pima County (*Griffiths* 2571), occasional in Arizona as in most of the other Western States.

Easily distinguished from *D. cuneifolia* by the more nearly entire leaves and the glabrous inflorescence.

9. *Draba platycarpa* Torr. and Gray, Fl. North Amer. 1: 108. 1838.

Mountains of Pima County, 3,500 to 5,000 feet, March to April. Texas and southern Arizona.

10. *Draba brachycarpa* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 108. 1838.

Devils Canyon, Pinal or Gila County (*Porter* 802), between Payson and Pine, Gila County (*Eastwood* 17195a with pubescent fruits), February. Virginia to Kansas, south to Florida, Texas, and central Arizona.

11. *Draba cuneifolia* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 108. 1838.

Mohave, Yavapai, Gila, Pinal, Pima, and Yuma Counties, 1,000 to 5,000 feet, very common in sandy soil, February to April. Illinois to Idaho, south to Florida, Arizona, and California.

Both the typical form, with pubescent pods, and var. *leiocarpa* O. E. Schulz, with glabrous pods, occur in Arizona, the former being the more common. The var. *integrifolia* S. Wats. (*D. sonorae* Greene, *D. integrifolia* (S. Wats.) Greene) differs in having much-elongate racemes, and apiculate fruits with pubescence, if any, of branched or forked hairs. It occurs chiefly in southwestern Arizona.

29. THYSANOCARPUS. LACEPOD, FRINGEPOD

Plants annual, the herbage usually nearly glabrous; stems slender, erect, simple or sparingly branched, leafy; leaves sessile, usually auriculate-clasping, nearly entire to deeply dentate, the basal ones sometimes pinnatifid; flowers small, in elongate racemes; pods flat, indehiscent, 1-seeded, orbicular or nearly so, winged, the wing usually with radiating nerves and regularly incised or perforate.

The dainty and peculiar fruits make these otherwise insignificant plants singularly attractive. The taxonomy of the genus is confused, and the following disposition of the Arizona material is tentative.

Key to the species

1. Pods 3 to 4 mm. wide, glabrous.....1. *T. LACINIATUS*.
 1. Pods 4.5 to 7 mm. wide, glabrous to copiously pubescent, the wing regularly and conspicuously notched or perforate.....2. *T. AMPLECTENS*.

1. *Thysanocarpus laciniatus* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 118. 1838.

Mohave County, at Pagumpa Springs (*Jones* 5089c, 5095af), Peach Springs (*Lemmon* in 1884), and Kingman to Chloride (*Kearney* and *Peebles* 11176a), 3,500 to 5,000 feet. Western Arizona and California.

The form occurring in Arizona seems to be var. *crenatus* (Nutt.) Brewer (*T. crenatus* Nutt.), having fruits with well-defined rays, notched or perforate between the rays, and leaves mostly entire to coarsely dentate. A specimen collected between Kingman and Chloride (*Kearney* and *Peebles* 11176) approaches typical *T. laciniatus* in the rayless, subentire wing, but the fruits are pubescent and are large for the typical form.

2. *Thysanocarpus amplexens* Greene, Pittonia 3: 87. 1896.

Coconino County to Greenlee (?), Santa Cruz, Pima, and Yuma Counties, rarely above 4,000 feet, preferring moist sandy soil, January to March. Southwestern New Mexico and Arizona.

Greene's description of *T. amplexens* needs considerable amplification to include all of the Arizona specimens referred by the writers

tentatively to that species. *T. filipes* Greene, based on a collection at Clifton, Greenlee County (Davidson in 1899), may be a form of this rather variable species.

30. ATHYSANUS

Plant annual, small, pubescent with partly forked hairs; stems filiform-branched from at or near the base; racemes elongate, 1-sided; flowers on reflexed or recurved pedicels, the petals minute or wanting; pods indehiscent, 1-seeded, wingless.

1. *Athysanus pusillus* (Hook.) Greene, Calif. Acad. Sci. Bul. 1: 72. 1885.

Thysanocarpus pusillus Hook., Icon. Pl. 1: pl. 42. 1836.

Graham, Gila, Maricopa, and Pinal Counties (probably more widely distributed), 5,000 feet or lower, March to April. Idaho to British Columbia, Arizona, and California.

The type of var. *glabrior* S. Wats., a nearly glabrous form, came from Fort Mohave (Lemmon in 1884).

31. DESCURAINIA.⁵² TANSYMUSTARD

Plants annual, stellate-pubescent and sometimes glandular; stems often tall, leafy, simple or sparingly branched; leaves deeply pinnatifid or once to thrice pinnate, the segments mostly small; racemes terminal, becoming elongate; flowers small, the petals yellow or whitish; pods dehiscent, 2-celled, slender, elongate, terete or nearly so; seeds many, small, in 1 or 2 rows in each cell.

Some of the species are reported to be used by the Indians, both as greens and for making pinole (gruel or mush), from the parched and ground seeds. Among the Mexicans the seeds are used in poultices for wounds. The plants grow mainly in open ground, flowering chiefly in early spring.

Key to the species

1. Pods clavate or subclavate, spreading; upper leaves usually simply pinnate, the lower ones once or twice pinnate..... 1. *D. PINNATA*.
1. Pods not clavate, or somewhat so in *D. obtusa* var. *brevisiliqua* (2).
2. Seeds in 2 rows in some or all of the pods; herbage canescent... 2. *D. OBTUSA*.
2. Seeds in 1 row (3).
3. Leaves twice or thrice pinnate, with narrow segments; pods containing 20 or more seeds, 10 to 30 mm. long..... 3. *D. SOPHIA*.
3. Leaves simply pinnate, the leaflets often deeply incised; pods often containing fewer than 20 seeds (4).
4. Pods 3 to 7 mm. long, attenuate at apex and tipped with the prominent style..... 4. *D. CALIFORNICA*.
4. Pods 8 to 15 mm. long, not attenuate at apex, the style short or obsolete. 5. *D. RICHARDSONII*.

1. *Descurainia pinnata* (Walt.) Britton, Torrey Bot. Club Mem. 5: 173. 1894.

Erysimum pinnatum Walt., Fl. Carol 174. 1788.

Throughout the State, in several forms, the most abundant and widely distributed species, up to 7,000 feet. Southeastern United States to Mackenzie, south to Arizona, California, and northern Mexico.

⁵² Reference: DETLING, LE ROY E. A REVISION OF THE NORTH AMERICAN SPECIES OF DESCURAINIA. Amer. Midland Nat. 22: 481-520. 1939.

Key to the subspecies

1. Fruiting pedicels spreading at an angle of about 45 (30 to 70) degrees; herbage densely canescent..... subsp. PAYSONII.
1. Fruiting pedicels spreading at an angle of about 75 (60 to 90) degrees (2).
2. Leaf segments narrowly oblong to linear; plant usually short and branched below; petals mostly less than 2 mm. long, yellow or whitish.
subsp. HALICTORUM.
2. Leaf segments ovate to oblanceolate (3).
3. Herbage canescent; petals whitish to pale yellow; pods mostly 8 to 10 mm. long; plant wide-branching from the base..... subsp. OCHROLEUCA.
3. Herbage green, moderately pubescent; petals yellow; pods mostly about 6 mm. long; racemes glabrous..... subsp. GLABRA.

A collection at Betatakin, Navajo County (*Peebles* and *Fulton* 11911), is cited by Detling under his subspecies *paysonii*. The specimens in question have much the appearance of *D. obtusa* and do not resemble other forms of *D. pinnata*. Subspecies *halictorum* (Cockerell) Detling (*Sophia halictorum* Cockerell) and subspecies *glabra* (Woot. and Standl.) Detling (*Sophia glabra* Woot. and Standl.) occur throughout most of the range of the species in Arizona. Subspecies *ochroleuca* (Wooton) Detling (*Sophia ochroleuca* Wooton) has been collected in Apache, Gila, Pinal, and Pima Counties.

2. **Descurainia obtusa** (Greene) O. E. Schulz, Pflanzenreich IV. 105: 321. 1924.

Sophia obtusa Greene, Leaflets 1: 96. 1904.

This species ranges, in various forms, from Apache County to Mohave County, south to Greenlee and Pima Counties. New Mexico to southern California and northern Mexico.

Key to the subspecies

1. Plant glandular, at least in the inflorescence..... subsp. ADENOPHORA.
1. Plant not glandular (2).
2. Pods 5 to 9 mm. long..... subsp. BREVISILIQUA.
2. Pods 10 to 20 mm. long..... subsp. TYPICA.

Subsp. *adenophora* (Woot. and Standl.) Detling (*Sophia adenophora* Woot. and Standl.) is known from McNary, Apache County (*J. Whitehead* 1599) and from Prescott, Yavapai County (several collections). Subsp. *brevisiliqua* Detling has been reported from Flagstaff (Coconino County) and Fort Mohave (Mohave County). Subsp. *typica* Detling is known from Navajo, Coconino, Mohave, Greenlee, and Pima Counties.

3. **Descurainia sophia** (L.) Webb ex Prantl, Engl. and Prantl, Pflanzenfem. III. 2: 192. 1892.

Sisymbrium sophia L., Sp. Pl. 659. 1753.

Coconino, Mohave, Graham, Pinal, and Santa Cruz Counties, an abundant roadside weed in some localities. Extensively naturalized in the United States; from Eurasia.

4. **Descurainia californica** (A. Gray) O. E. Schulz, Pflanzenreich IV. 105: 300. 1924.

Smelowskia (?) *californica* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 520. 1865.

Known in Arizona only by a collection in Segi Canyon, Navajo Indian Reservation (*Clute* 119). Wyoming to Oregon, south to New Mexico, northeastern Arizona, and California.

5. *Descurainia richardsonii* (Sweet) O. E. Schulz, Pflanzenreich IV. 105: 318. 1924.

Sisymbrium richardsonii Sweet, Hort. Brit. ed. 2, 30. 1830.

Apache, Coconino, and Greenlee Counties, 6,500 to 9,500 feet. Great Lakes region to Yukon, south to northern Mexico and Baja California.

Represented in Arizona by the glandular subsp. *viscosa* (Rydb.) Detling (*Sophia viscosa* Rydb.) which was collected at Hannigan Meadow, Greenlee County (Kearney and Peebles 12366), and at Walnut Canyon, Coconino County (MacDougal in 1891); also by the non-glandular subsp. *incisa* (Engelm.) Detling (*Sisymbrium incisum* Engelm., *Descurainia serrata* O. E. Schulz), which has been collected in the Carrizo Mountains, Apache County (Standley 7377).

32. ARABIS.⁵³ ROCKCRESS

Contributed by REED C. ROLLINS

Biennial or perennial herbs with acrid juice; caudex simple or multicipitally branched; young plants rosulate; leaves entire or dentate, the basal ones petiolate, the cauline leaves sessile except in *A. tricornuta*; inflorescence racemose; siliques narrowly linear, flattened or at least slightly compressed parallel to the septum; valves 1-nerved at least below; seeds numerous, winged or rarely wingless; cotyledons accumbent.

Six of the nine Arizona species have a northerly distribution in the Sierra Nevada, Great Basin, or Rocky Mountains and are rare in Arizona. Two species, *A. gracilipes* and *A. tricornuta*, are endemic to Arizona. *A. perennans* is widely distributed in the State and is apparently the only species of the genus commonly encountered.

Key to the species

1. Mature siliques strictly erect, numerous, mostly crowded and appressed to the rachis; petals white to ochroleucous, rarely pinkish (2).
2. Siliques subterete; stigma markedly expanded, conspicuously bilobed; seeds biseriate, narrowly winged or rarely wingless; petals ochroleucous..... 1. *A. GLABRA.*
2. Siliques decidedly flattened parallel to the septum; stigma unexpanded, entire or inconspicuously bilobed; seeds uniseriate or biseriate, winged all around; petals usually white, rarely pinkish (3).
3. Stems sparsely to densely hirsute below; siliques about 1 mm. wide; seeds uniseriate; petals less than 6 mm. long..... 2. *A. HIRSUTA.*
3. Stems glabrous throughout or appressed-pubescent at base; siliques about 2 mm. wide; seeds biseriate; petals up to 1 cm. long..... 3. *A. DRUMMONDII.*
1. Mature siliques spreading or deflexed, few, not crowded; petals white to purple (4).
4. Lower cauline leaves petiolate; petals white; sepals glabrous; style about 1 mm. long..... 4. *A. TRICORNUTA.*
4. Lower cauline leaves sessile; petals pink to purple; sepals at least sparsely pubescent; stigma sessile or nearly so (5).
5. Siliques finely pubescent, strongly reflexed but the pedicles not geniculate, straight, 2.5 to 3 mm. wide; seeds broadly winged, biseriate; petals 1.5 to 2 cm. long..... 5. *A. PULCHRA.*
5. Siliques glabrous, widely spreading to pendulous, arcuate, less than 2 mm. wide; seeds narrowly winged or nearly wingless, uniseriate or biseriate; petals less than 1 cm. long (6).

⁵³ Reference: HOPKINS, MILTON. ARABIS IN EASTERN AND CENTRAL NORTH AMERICA. *Rhodora* 39: 63-98, 106-148, 155-186. 1937.

6. Cauline leaves numerous (30 to 80 on each stem), closely imbricate; stems robust, densely leafy below, single or rarely two from a simple base; pedicels 2 to 4 cm. long ----- 6. *A. GRACILIPES*.
6. Cauline leaves fewer (usually fewer than 15 on each stem), not imbricate; stems mostly slender, not densely leafy below, one to several from a simple or branched base; pedicels less than 2 cm. long (7).
7. Basal leaves narrowly oblanceolate, acute, entire, densely pubescent with minute dendritic trichomes; pubescence of the lower part of the stem closely appressed; flowering pedicels sparsely pubescent, the fruiting pedicels arched strongly downward. 7. *A. LIGNIFERA*.
7. Basal leaves broadly oblanceolate to broader, obtuse, at least the lower ones dentate to repand, pubescent with coarse, dendritic, simple or branched trichomes; pubescence of the lower part of the stem spreading, coarse; flowering pedicels glabrous, the fruiting pedicels widely spreading (8).
8. Pubescence of the basal leaves dendritic, not setaceous; leaf margins not ciliate; upper cauline leaves usually pubescent; stems pubescent below with dendritic spreading trichomes; seeds winged, uniseriate ----- 8. *A. PERENNANS*.
8. Pubescence of the basal leaves coarse, simple, or forked, setaceous; leaf margins ciliate; upper cauline leaves glabrous; stems hirsute below with simple trichomes; seeds narrowly winged or wingless, biseriate or imperfectly so ----- 9. *A. FENDLERI*.

1. *Arabis glabra* (L.) Bernh., Syst. Verz. Pflanz. 195. 1800.

Turritis glabra L., Sp. Pl. 66. 1753.

Mountains of Yavapai and Gila Counties, about 6,000 feet, open scrub, pinelands, grassy slopes, or rarely near streams, May to July. Southern Quebec to North Carolina, central Arizona, and California; Europe and Asia.

Many European and some American botanists treat this species in the segregate genus *Turritis*, on account of the subterete siliques and yellowish flowers, but so many of the characters coincide with those ordinarily attributed to *Arabis* that such a classification is misleading. The species is certainly native in many areas of the United States, but it tends to become weedy and may have been recently transported to some localities.

2. *Arabis hirsuta* (L.) Scop., Fl. Carn. ed. 2, 2: 30. 1772.

Turritis hirsuta L., Sp. Pl. 666. 1753.

? *Arabis ovata* (Pursh) Poir. in Lam., Encycl. Sup. 5: 557. 1817.

Arabis pycnocarpa Hopkins, Rhodora 39: 112. 1937.

Plateau and mountain areas of northern Arizona (Apache and Coconino Counties), 6,000 to 9,000 feet, open slopes, under small trees or shrubs, and in grassy meadows, May to July. Quebec to Yukon Territory, south to Georgia, northern Arizona, and California; Europe and Asia.

A rather variable species, with several varieties present in North America.

3. *Arabis drummondii* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 187. 1866.

Arabis oxyphylla Greene, Pittonia 4: 196. 1900.

Arabis drummondii A. Gray var. *oxyphylla* (Greene) Hopkins, Rhodora 39: 143. 1937.

Apparently rare in the plateau region of northern Coconino County, 7,000 to 9,000 feet, coarsely granitic or sandy soils, floor of pine

forests or open slopes in spruce-fir forests, May to July. Southern Labrador to Yukon Territory, south to New Jersey, northern Arizona, and California.

4. *Arabis tricornuta* Rollins, Wash. Acad. Sci. Jour. 29: 478. 1939.

Rincon and Santa Rita Mountains (Pima County), possibly also in the Chiricahua Mountains (Cochise County), 7,000 to 9,000 feet, August and September, type from the Rincon Mountains (*Blumer* 3478). Known only from southern Arizona.

This species is of particular interest because of the superficial resemblance at flowering time to *Pennellia micrantha*. The flowers are small and in long, loose, very narrow racemes.

5. *Arabis pulchra* M. E. Jones ex S. Wats., Amer. Acad. Arts and Sci. Proc. 22: 468. 1887.

The species is represented in Arizona by var. *pallens* M. E. Jones (*A. formosa* Greene), which has been collected at Kayenta (Navajo County), about 6,000 feet, sandy hillsides and open knolls among sagebrush, pinyon, and juniper, May to July. This variety occurs in the Colorado River drainage area in western Colorado, eastern Utah, and northeastern Arizona.

Other varieties of *Arabis pulchra* have not been collected in Arizona, but *A. pulchra* var. *munciensis* is known from a locality between St. George and the Beaver Dam Mountains, in adjacent Utah. This variety is distinguished from var. *pallens* by having spreading pedicels, pendulous siliques, and smaller, purple instead of white or pink flowers. Among Arizona species of *Arabis*, *A. pulchra* is unique in having relatively large, showy flowers and finely pubescent siliques.

6. *Arabis gracilipes* Greene, Pittonia 4: 193. 1900.

Arabis arcuata (Nutt.) A. Gray var. *longipes* S. Wats. in A. Gray, Syn. Fl. North Amer. 1: 164. 1897.

Arabis perennans S. Wats. var. *longipes* (S. Wats.) Jepson, Fl. Calif. 2: 70. 1936.

Coconino, Mohave, Gila, and Yavapai Counties, hot sandy canyons and lower mountain slopes, rarely collected, April to June, type of *A. gracilipes* from near Flagstaff (*N. C. Wilson* in 1893), type of *A. arcuata* var. *longipes* from near Fort Mohave (*Lemmon* in 1884). Known only from Arizona.

Arabis gracilipes is related to both *A. perennans* and *A. fendleri*, but is readily separated from them by the robust habit, numerous large cauline leaves, very long filiform pedicels, and usually solitary stems.

7. *Arabis lignifera* A. Nels., Torrey Bot. Club Bul. 24: 123. 1899.

Twelve miles east of Keam Canyon, Navajo County (*Peebles* and *Smith* 13438), the only collection known from Arizona, about 6,000 feet, sandy or stony soils, often among sagebrush, piñon, or juniper, April and May. Wyoming to Idaho, south to Colorado, northeastern Arizona, and Nevada.

This species has something of the habit of *A. perennans*, but differs markedly in having short rigid recurved pedicels, fewer stems, and a

very fine dense indument on the basal leaves and lower portions of the plant. The species is abundant in the basin ranges to the north.

8. *Arabis perennans* S. Wats., Amer. Acad. Arts and Sci. Proc. 22: 467. 1887.

Arabis eremophila Greene, Pittonia 4: 194. 1900.

Arabis gracilentata Greene, *ibid.*

Arabis recondita Greene, *ibid.*, p. 195.

Apache County to Mohave County, south to Graham and Pima Counties, 2,000 to 5,000 feet, lower mountain slopes and hot canyons, February to May, type from Santa Catalina Mountains (Pima County), type of *A. eremophila* from Peach Springs (Mohave County), type of *A. recondita* from Diamond Creek (Mohave County.) Western Colorado to Arizona, southern California, northern Mexico, and Baja California.

Arabis perennans often develops a ligneous footlike extension of the caudex between the functional basal leaves and the ground surface. This foot appears to be formed as a result of the shedding of basal leaves during successive seasons and the occurrence of new leaves at a higher level on the caudex each succeeding year. *Arabis perennans* is the earliest-flowering and most abundant species of the genus in Arizona.

9. *Arabis fendleri* (S. Wats.) Greene, Pittonia 3: 156. 1897.

Arabis holboellii Hornem. var. *fendleri* S. Wats. in A. Gray, Syn. Fl. 1: 164. 1897.

Coconino and northern Mohave Counties, 5,000 to 8,000 feet, open pine woods, April to June. Colorado and New Mexico to Nevada and northern Arizona.

Arabis fendleri is much like *A. perennans* in habit of growth, but the latter flowers much earlier, and ordinarily occurs at lower altitudes.

33. ERYSIMUM

Plants annual, biennial, or perennial, rather coarse, with appressed harsh pubescence; leaf blades entire or repand-dentate; petals 6 mm. long or longer, yellow, orange or maroon; pods elongate, 4-sided, rigid, erect to recurved-spreading, the valves strongly keeled; seeds in 1 row in each cell.

Key to the species

1. Pods divaricate, often somewhat curved, about 1 mm. wide; petals not more than 8 mm. long, pale yellow; leaf blades repand-dentate.
 1. *E. REPANDUM.*
1. Pods ascending or erect, straight or nearly so, commonly more than 1 mm. wide; petals more than 10 mm. long; leaf blades entire or sparingly dentate.
 2. *E. CAPITATUM.*

1. *Erysimum repandum* L., Amoen. Acad. 3: 415. 1756.

Cheirinia repanda Link, Enum. Pl. 2: 171. 1822.

Flagstaff and Mormon Lake (Coconino County), Ash Fork (Yavapai County), Gila River bed (Pinal County), April to June. Ohio to Oregon and Arizona; introduced from Europe.

2. *Erysimum capitatum* (Dougl.) Greene, Fl. Francisc. 269. 1891.

Cheiranthus capitatus Dougl. ex Hook., Fl. Bor. Amer. 1: 38. 1833.

Erysimum elatum Nutt. ex Torr. and Gray, Fl. North Amer. 1: 95. 1838.

Erysimum wheeleri Rothr. in Wheeler, U. S. Survey West 100th Mer. Rpt. 6: 64. 1879.

Cheirinia elata Rydb., Torrey Bot. Club Bul. 39: 323. 1912.

Cheirinia wheeleri Rydb., *ibid.*

Throughout the State except the extreme western portion, 2,500 to 9,500 feet, March to September. Saskatchewan to Washington, south to New Mexico, Arizona, and California.

Western-wallflower, a showy plant, with flowers resembling those of the cultivated wallflower. The petals are usually bright yellow, but in the form described as *E. wheeleri* they are orange or maroon, and the plant is usually found in coniferous forests at higher altitudes, rarely below 7,000 feet. This form is perhaps entitled to varietal rank.

34. MALCOLMIA

Annual; herbage roughly pubescent with mostly forked hairs; stems several, sparingly branched above; leaves petioled, the blades oblong or lanceolate, coarsely few-dentate; petals purplish pink, the blades much shorter than the claws; pods ascending-spreading, tetragonal, slender, 4 to 6 cm. long, with a short, conic beak.

1. *Malcolmia africana* (L.) R. Br. in Ait. f., Hort. Kew., ed. 2, 4: 121. 1812.

Hesperis africana L., Sp. Pl. 663. 1753.

Near Wolf Hole and Fredonia (northern Mohave County), 3,500 to 4,500 feet, April and May. Utah, southern Nevada, and north-western Arizona; introduced from the Mediterranean region.

35. CONRINGIA. HARES-EAR-MUSTARD

Plant glabrous, annual; stems tall, leafy; stem leaves sessile, the blades broad, entire or denticulate, with clasping bases; petals pale yellow; pods long and narrow, 4-sided, spreading; seeds in 1 row in each cell.

1. *Conringia orientalis* (L.) Dum., Fl. Belg. 123. 1827.

Brassica orientalis L., Sp. Pl. 666. 1753.

Keam Canyon, Navajo County, 6,300 feet (*Pebbles and Smith* 13406). Here and there in the United States; introduced from Europe.

47. CAPPARIDACEAE. CAPER FAMILY

Plants herbaceous or woody, often ill-scented; leaves alternate, simple or palmately compound; flowers perfect, regular or nearly so, commonly in bracted racemes; sepals and petals 4; stamens 6 or more, usually much exserted; ovary commonly 1-celled and stipitate; fruit a 2-valved pod, or berrylike.

The pickled flower buds of the European *Capparis spinosa* are the familiar condiment, capers. It is reported that the Hopi and other Indians use young plants of *Cleome* and *Wislizenia* as potherbs.

Key to the genera

1. Plant a shrub; leaves simple, entire; fruit berrylike..... 5. ATAMISQUEA.
1. Plants herbaceous; some or all of the leaves compound; fruit capsular (2).
2. Fruits didymous, indehiscent, the carpels divaricate, 1-seeded, becoming coriaceous; leaves trifoliolate, rarely simple; flowers numerous, small; petals yellow..... 3. WISLIZENIA.
2. Fruit not didymous, a 2-valved, thin-walled, dehiscent capsule, several- to many-seeded (2).
3. Stamens 12 or more; herbage glandular-villous, very clammy; leaves trifoliolate; petals whitish..... 4. POLANISIA.
3. Stamens 6; herbage not glandular (3).
4. Capsules slender, cylindric, at least 1 cm. long; leaflets 3 or more; petals pink or yellow..... 1. CLEOME.
4. Capsules broad, more or less triangular or quadrangular, not more than 5 mm. long; leaflets 1 to 3; petals yellow..... 2. CLEOMELLA.

1. CLEOME. SPIDERFLOWER

Herbage not glandular; stems mostly tall and branched; leaflets 3 to 5, entire or serrulate; petals clawed; stamens commonly 6, inserted on a receptacle above the petals; capsule elongate, many-seeded, long-stipitate.

Key to the species

1. Sepals separate or very nearly so, soon deciduous; leaves all very short-petioled or subsessile; leaflets 3, narrowly linear, not more (usually less) than 3 cm. long; petals pink or white, 4 to 5 mm. long; capsules 1 to 1.5 cm. long.
1. C. SONORAE.
1. Sepals united below, persistent; leaves all distinctly petioled; leaflets lanceolate, oblanceolate, or oblong, usually more than 3 cm. long; petals not less than 6 mm. long; capsules seldom less than 2 cm. long (2).
2. Petals purplish pink or white; leaflets 3..... 2. C. SERRULATA.
2. Petals yellow; leaflets commonly more than 3 (3).
3. Capsules less than 4 cm. long, the stipes not more than 1.5 cm. long; petals light yellow, 6 to 7 mm. long; longer filaments 10 to 15 mm. long.
3. C. LUTEA.
3. Capsules 4 to 6 cm. long, the stipes up to 2.5 cm. long; petals golden yellow, 10 to 13 mm. long; longer filaments 20 to 30 mm. long.
4. C. JONESII.

1. *Cleome sonorae* A. Gray, Pl. Wright. 2: 16. 1853.

"Low subsaline grounds west of the Chiricahui Mts., Sonora" (now Arizona), the type collection (*Wright*), Willcox, "alkaline sink" (*Thornber* 2231), August. Colorado, New Mexico, and southeastern Arizona.

2. *Cleome serrulata* Pursh, Fl. Amer. Sept. 441. 1814.

Peritoma serrulatum DC., Prodr. 1: 237. 1824.

Apache County to Mohave and Yavapai Counties, 4,500 to 7,000 feet, chiefly at roadsides, June to September. Saskatchewan to Kansas, Arizona, and Oregon.

Rocky Mountain beoplant. Grows as a weed and appears as if introduced in Arizona. Sometimes called skunkweed because of the unpleasant odor of the crushed herbage.

3. *Cleome lutea* Hook., Fl. Bor. Amer. 1: 70. 1830.

Peritoma breviflorum Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 128. 1913.

Apache County to Coconino and Yavapai Counties, also at Sonoita (Santa Cruz County), 4,800 to 6,000 feet, mostly along streams, May to June (and probably later). Nebraska to Washington, south to New Mexico, Arizona, and eastern California.

Peritoma breviflorum is a form with relatively small flowers and pods and short stipes.

4. *Cleome jonesii* (Macbride) Tidestrom, Biol. Soc. Wash. Proc. 48: 39. 1935.

Cleome lutea var. *jonesii* Macbride, Contrib. Gray Herbarium 65: 39. 1922.

Yavapai and Mohave Counties to Santa Cruz and Pima Counties, 1,000 to 4,200 feet, sandy soil along streams, May to September, type from the Verde River Valley, Yavapai County (*W. W. Jones* 168). Known only from Arizona.

Although intergrading occasionally with *C. lutea*, the distinguishing characters given in the key and the lower altitudinal and more southern geographical range of this form seem to warrant maintaining it as a species. The stems reach a height of 1.8 m.

2. CLEOMELLA⁶⁴

Plants annual; stems erect and branching above, or diffuse; leaves 3-foliolate or the upper ones reduced to 1 leaflet; pedicels subtended by small bracts or by leaves of normal size; petals sessile or nearly so, yellow; stamens 6, inserted on a short receptacle; capsules seldom longer than broad, the valves concave, hemispheric or conic; seeds usually few.

The species mostly prefer saline soil.

Key to the species

1. Leaflets obovate, less than 3 times as long as wide, very obtuse, pubescent, somewhat succulent; flowers not in definite racemes, crowded at the ends of the stems and branches in the axils of not greatly reduced leaves; stems diffusely branched from the base; stipules conspicuous, white, filiform-laciniate; stipes not more than 6 mm. long, becoming reflexed.
 1. *C. OBTUSIFOLIA*.
1. Leaflets linear, oblong, or oblanceolate, 3 or more times as long as wide, glabrous; flowers in definite terminal racemes and subtended by greatly reduced leaves or bracts; stems normally erect and not branched from the base; stipules inconspicuous, often reduced to a mere bristle; stipes spreading or somewhat deflexed (2).
 2. Stipes in fruit 7 to 20 mm. long; leaflets commonly oblanceolate; inflorescence becoming elongate, often 5 cm. long or longer, appearing naked or nearly so, the bracts very small, much shorter than the pedicels; stems up to 80 cm. long; capsules 3 to 6 mm. long, the valves irregularly conic; seeds broadly ovoid.-----2. *C. LONGIPES*.
 2. Stipes in fruit not more than 10 mm. long; leaflets linear or linear-lanceolate; inflorescence not conspicuously elongate, commonly not more than 3 cm. long, the bracts large, often equaling the pedicels; stems 20 to 40 cm. long; capsules 2 to 3 mm. long, rhombic, the valves broadly deltoid; seeds obovoid, often mottled.-----3. *C. PLOCASPERMA*.

⁶⁴ Reference: PAYSON, E. C. A SYNOPTICAL REVISION OF THE GENUS CLEOMELLA. Wyo. Univ. Pubs. Bot. 1: 29-46. 1922.

1. *Cleomella obtusifolia* Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 311. 1845.

Included in the Arizona flora on the basis of specimens labeled "Mohave Desert, Arizona" (*Lemmon* in 1884), possibly collected at Fort Mohave on the Colorado River, Mohave County. Southeastern California.

Plant known as Mohave-stinkweed. Doves are said to relish the seeds.

2. *Cleomella longipes* Torr., Jour. Bot. and Kew. Gard. Misc. 2: 255. 1850.

Willcox, in an "alkaline sink," doubtless the extensive playa or old lake bed west of the town (*Thornber* in 1905), August, type (*Wright* 857) from "west of the Chiricahui Mountains" with *Cleome sonorae*. Western Texas to southeastern Arizona and Sonora.

- *3. *Cleomella plocasperma* S. Wats. in King, Geol. Expl. 40th Par. 5: 33. 1871.

Collected in "southern Utah, northern Arizona, etc." (*Palmer* 44), not known certainly to occur in Arizona. Southern Utah to California and Oregon.

3. WISLIZENIA. JACKASS-CLOVER

Plant annual; stems erect, much-branched; leaves 3-foliolate, the leaflets elliptic, oblanceolate, or obovate; flowers very numerous, small, the petals yellow; stamens 6; pods long-stipitate, 1.5 to 2.5 mm. long, 2-seeded, the rounded apex nearly smooth and reticulate to tuberculate-dentate.

1. *Wislizenia refracta* Engelm. in Wisliz., Mem. North. Mex. 99. 1848.

Wislizenia scabrada Eastw., Torrey Bot. Club Bul. 30: 490. 1903.

Navajo and Coconino Counties to Pima County, 1,000 to 6,500 feet, usually in sandy soil, often very abundant, May to September, types of *W. scabrada* from near Tucson (*Lemmon* in 1880, *Pringle* in 1881). Western Texas to southern California.

Conspicuous in late summer at roadsides and in stream beds. The prevailing form in northeastern Arizona is var. *melilotoides* (Greene) Johnston (*W. melilotoides* Greene), characterized by obovate leaflets, these thicker and broader than in the presumably typical form, and by a more compact and leafy appearance.

4. POLANISIA. CLAMMYWEED

Plants annual; stems erect, branched; herbage glandular-pubescent and strong-scented; leaves trifoliolate, the leaflets elliptic or lanceolate; petals whitish or pale yellow; stamens numerous, the filaments long-exserted, purple; pods sessile or nearly so, elongate, somewhat flattened, tipped by the slender style; seeds numerous.

1. *Polanisia trachysperma* Torr. and Gray, Fl. North Amer. 1: 669. 1840.

Navajo and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 1,200 to 6,500 feet, usually in sandy stream beds, June to

September. Saskatchewan to British Columbia, south to Texas, New Mexico, and Arizona.

5. ATAMISQUEA

A shrub with rigid brittle branches, ill-scented; leaves coriaceous, dark green and glabrate above, silvery-lepidote beneath, linear or narrowly oblong, the margins entire, the apex emarginate; flowers solitary or in small fascicles; fertile stamens 6; fruit oval or subglobose, about 8 mm. long, drupelike.

1. *Atamisquea emarginata* Miers, Trav. Chile 2: 529. 1826.

Quitobaquito, southwestern Pima County (*Harbison* 26181). Southern Arizona, Sonora, Sinaloa, and Baja California; Argentina.

The plant is reported to reach a height of 6 m. (20 feet), but is doubtless smaller in Arizona.

48. RESEDACEAE. MIGNONETTE FAMILY

1. OLIGOMERIS

Plant annual, slightly succulent, glabrous; leaves numerous, alternate or fascicled, linear, entire; flowers greenish, small, in slender terminal spikes; sepals 4; petals 2; stamens 3; capsule turgid, 4-lobed, apically dehiscent.

1. *Oligomeris linifolia* (Vahl) Macbride, Contrib. Gray Herbarium ser. 2, 53: 13. 1918.

Reseda linifolia Vahl in Hornem., Hort. Hafn. 2: 501. 1815.
Dipetalia subulata Kuntze, Rev. Gen. Pl. 1: 39. 1891.

Maricopa, Pinal, Pima, Mohave, and Yuma Counties, 2,400 feet or lower, rather common in dry sandy soil, March to June. Texas to California and northern Mexico; Asia and Africa.

49. CRASSULACEAE. ORPINE FAMILY

Plants herbaceous, usually succulent, annual or perennial, glabrous or puberulent; leaves simple, entire; flowers perfect; sepals and petals mostly 4 or 5, the petals separate or united below; stamens as many or twice as many as the petals; pistils 3 to 5, becoming separate follicles.

Many members of this family are cultivated as ornamentals and are very popular with fanciers of succulent plants. Species of the genus *Sedum* are favorites in rock gardens.

Key to the genera

1. Plants annual, small; leaves opposite; flowers minute, in axillary and terminal glomerules..... 3. TILLAEA.
1. Plants perennial; leaves alternate; flowers showy, in cymes, racemes, or open panicles (2).
 2. Petals separate or very nearly so, white, pink, or pale yellow; stems not scapose, leafy up to the inflorescence, their leaves often crowded, not conspicuously smaller than the basal ones; basal leaves not in a rosette..... 1. SEDUM.
 2. Petals united below, the lower part of the corolla tubular or funnelform, yellow, orange, or red, or marked with those colors; stems scapose or subscapose, their leaves scattered, much smaller than the basal leaves or reduced to scales; basal leaves in a conspicuous rosette. 2. ECHEVERIA.

1. SEDUM. STONECROP

Plants succulent, perennial; stems erect or decumbent, leafy; leaves simple, entire or dentate, terete or flat, often crowded and imbricate; flowers in terminal cymes; stamens usually 10; pistils 4 or 5, separate or nearly so; follicles several- to many-seeded.

Key to the species

1. Flowers in axillary racemes or cymes; plant glabrous; stems erect, up to 30 cm. long, usually numerous; leaves entire or dentate, flat; petals pink or white; carpels erect, with spreading tips----- 1. *S. RHODANTHUM*.
1. Flowers in terminal cymes (2).
 2. Petals yellow, narrow, sharply acuminate; plant with creeping rootstocks and with short leafy sterile shoots at the base, the flowering stems erect or nearly so; leaves mostly linear or lanceolate, the basal ones commonly papillate; cymes mostly narrow and compact, with ascending branches; mature carpels erect or spreading only at the tip, narrowed gradually into the style----- 2. *S. STENOPETALUM*.
 2. Petals white, sometimes tinged with purple (3).
 3. Leaves mostly linear or lanceolate, not or not conspicuously broader above the middle, subterete when fresh, the basal ones not noticeably papillate; cymes broad and open, the branches commonly spreading; petals acute or acuminate; mature carpels strongly divaricate, somewhat abruptly contracted into the style----- 3. *S. STELLIFORME*.
 3. Leaves mostly spatulate or obovate, conspicuously broader above the middle, plane even when fresh; cymes commonly small and compact, with short ascending branches; mature carpels erect or spreading only at the tip----- 4. *S. WOOTONI*.

1. *Sedum rhodanthum* A. Gray, Amer. Jour. Sci. ser. 2, 33: 405. 1862.

Clemensia rhodantha Rose, N. Y. Bot. Gard. Bul. 3: 3. 1903.

San Francisco Peaks (Coconino County), Baldy Peak (Apache County), 9,000 to 12,000 feet, July to September. Montana to Utah, New Mexico, and Arizona.

2. *Sedum stenopetalum* Pursh, Fl. Amer. Sept. 324. 1814.

Coconino County, north rim of the Grand Canyon (Grand Canyon Herb. 1117), Deboschibeko, 6,500 feet (*Darsie* in 1933), June to August. Alberta to Nebraska, New Mexico, northern Arizona, and California.

3. *Sedum stelliforme* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 365. 1885.

Sedum topsenti Raymond-Hamet, Bot. Jahrb. 50: Beibl. 114. 26. 1914.

Apache, Graham, and Cochise Counties, 7,000 to 9,300 feet, August to September, type of *S. stelliforme* from the Huachuca Mountains (*Lemmon* 2702), type of *S. topsenti* from the Chiricahua Mountains (*Blumer* 2150). New Mexico, Arizona, and Chihuahua.

4. *Sedum wootoni* Britton, N. Y. Bot. Gard. Bul. 3: 44. 1903.

Apache County to Cochise, Santa Cruz, and Pima Counties, 3,600 to 11,500 feet, usually on rocks in partial shade, often among mosses, June to October. New Mexico and Arizona.

This species is perhaps too near *S. wrightii* A. Gray. The typical form is described as having the basal leaves smooth or very nearly so.

Much more common in Arizona is var. *griffithsii* (Rose) Kearney and Peebles (*S. griffithsii* Rose), with basal leaves distinctly papillate. The type of *S. griffithsii* was collected in the Santa Rita Mountains, Pima County (*Griffiths* 6061).

2. ECHEVERIA

Plants perennial, succulent; stems scapose; leaves of the stem alternate, bractlike, the basal ones much larger, in a rosette; flowers in cymes or open panicles; calyx lobes and petals 5, the petals united below into a cylindrical or funnelliform tube.

Key to the species

1. Corolla broadly campanulate or rotate-campanulate, the lobes spreading, at least as long as the tube, pale or greenish yellow and transversely banded or irregularly blotched with red; stamens in age often spreading or deflexed outside the corolla: Subgenus *Graptopetalum* (2).
 2. Basal leaves not more than 3.5 cm. long; scapes (including the inflorescence) less than 25 cm. long; inflorescence a broad, very open cyme; sepals oblong, spatulate, or obovate, very obtuse; valves of the carpels gradually attenuate into the styles.----- 1. *E. RUSBYI*.
 2. Basal leaves up to 6 cm. long; scapes and inflorescence up to 30 cm. long; inflorescence an elongate panicle, broad and much branched, or narrow and subracemose; sepals narrowly deltoid to oblong-lanceolate, acute or acuminate; valves of the carpels abruptly tipped with the styles.
 2. *E. BARTRAMII*.
 1. Corolla cylindrical or tubular-funnelform, the lobes erect or slightly spreading at apex, bright yellow or red, not banded or blotched; stamens not exerted: Subgenus *Dudleya* (3).
 3. Basal leaves abruptly acuminate, ovate-lanceolate to rhombic-ovate, usually widest above the base, the larger ones 2 to 4 cm. wide; calyx 4 to 5 mm. long, green when fresh; corolla 10 to 12 mm. long, deep red to apricot yellow fading reddish, the tube about equaling the lobes and longer than the calyx----- 3. *E. ARIZONICA*.
 3. Basal leaves gradually long-acuminate, lanceolate, widest at or near the base, not more (usually less) than 2 cm. wide; calyx 5 to 8 mm. long, bright red when fresh; corolla 12 to 17 mm. long, clear yellow, the tube shorter than the lobes and shorter than the calyx.--- 4. *E. COLLOMAE*.
1. *Echeveria rusbyi* (Greene) Nels. and Macbr., Bot. Gaz. 56: 476. 1913.

Cotyledon rusbyi Greene, Torrey Bot. Club Bul. 10: 125. 1883.

Graptopetalum rusbyi Rose, Addisonia 9: 31. 1924.

Graptopetalum orpettii E. Walther, Cactus and Succulent Soc. Amer. Jour. 1: 185. 1930.

Greenlee, Graham, Gila, Maricopa, Pinal, and Pima Counties, 2,500 to 5,000 feet, open places among rocks, May, type of *Cotyledon rusbyi* from the San Francisco River region, Greenlee County (*Rusby* in 1881), type of *Graptopetalum orpettii* from near Superior, Pinal County (*Howard*). Known only from Arizona.

2. *Echeveria bartramii* (Rose) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 479. 1939.

Graptopetalum bartramii Rose, Addisonia 11: 1. 1926.

Patagonia and Tumacacori Mountains (Santa Cruz County), Baboquivari Mountains (Pima County), 4,000 to 5,000 feet, growing with scrub oaks, September to February, type from the Patagonia Mountains (*Bartram* in 1924). Known only from southern Arizona.

The flowers are reported to be ill-scented.

3. *Echeveria arizonica* (Rose) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 479. 1939.

Dudleya arizonica Rose, Addisonia 8: 35. 1923.

Maricopa, Mohave, and Yuma Counties, 500 to 2,500 feet, on cliffs, April, October, and December, type from Yucca, Mohave County (Bly in 1921). Known only from western Arizona.

Related to *Echeveria pulverulenta* Nutt. of southern California, but the plant is smaller and less pulverulent, with smaller flowers.

4. *Echeveria collomae* (Rose) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 479. 1939.

Dudleya collomae Rose ex Morton, Desert Plant Life 6: 68. 1934.

Yavapai, Gila, Maricopa, and Pinal Counties, 2,000 to 6,000 feet, among rocks, March to May, type from near Payson, Gila County (Collom in 1924). Known only from central Arizona.

This, the showiest and commonest *Echeveria* of Arizona, is handsome in flower and well worthy of cultivation. It is closely related to several California species and was presumably included under *Dudleya parishii* Rose in North American Flora (22: 41. 1905). M. E. Jones referred this form to his *Cotyledon saxosum* (*Dudleya saxosa* Britton and Rose, *Echeveria saxosa* Nels. and Macbr.), the type of which, a smaller plant, was collected in the Panamint Mountains, Calif.

3. TILLAEA. PIGMYWEED

Plant annual, not more than 10 cm. high, glabrous, soon becoming reddish brown; stems slender, branched, winged; leaves opposite, connate-perfoliate; flowers minute, in small axillary clusters; sepals, petals, and stamens usually 4; seeds 1 or 2 in each follicle.

1. *Tillaea erecta* Hook. and Arn., Bot. Beechey Voy. 24. 1830.

Maricopa, Pinal, and Pima Counties, 1,500 to 4,000 feet, March and April. Oregon to Baja California and southern Arizona; Chile.

SAXIFRAGE FAMILY

Plants perennial, herbaceous or shrubby; leaves simple, alternate, opposite, or mostly basal; flowers perfect or some of them unisexual, regular or nearly so, in racemes, cymes, or panicles, usually with a well-developed hypanthium and often with a disk; sepals and petals usually 5, the petals rarely wanting; stamens 4 to 12; pistil 1 and compound, or in some genera of 2 nearly separate carpels; ovary inferior, or nearly free from the calyx; fruit follicular, capsular, or baccate.

The best-known members of this family are the currants and gooseberries. It includes many species, both herbaceous and shrubby, that are highly esteemed as cultivated ornamentals.

Key to the genera

1. Plants herbaceous (2).
2. Fertile stamens 10; staminodia none (3).
 3. Styles 2; capsule 2-celled and 2-beaked, the carpels sometimes nearly separate; petals entire or nearly so..... 1. SAXIFRAGA.
 3. Styles 3; capsule 1-celled, 3-valved, not beaked; petals usually lacinate or deeply dentate..... 3. LITHOPHRAGMA.

2. Fertile stamens 5; plants scapose, the leaves mostly basal (4).
4. Staminodia none; flowers small, in racemes or cymose panicles; leaf blades round-reniform, crenate or dentate; carpels 2, separate and divergent above----- 2. HEUCHERA.
4. Staminodia in clusters alternating with the fertile stamens; flowers relatively large, solitary on long peduncles; leaf blades oval or ovate, acute or short-cuneate at base, entire; carpels 3 or 4, united. 4. PARNASSIA.
1. Plants shrubby (5).
5. Leaves alternate, those of the branchlets usually appearing fasciated, the blades more or less deeply palmately lobed; ovary wholly adnate to the calyx tube; fruit a juicy berry; stems often spiny or bristly -- 9. RIBES.
5. Leaves opposite, the blades entire or merely toothed; fruit a dry capsule, partly free from the calyx; stems unarmed (6).
6. Sepals and petals 4 (rarely 5); leaf blades entire or shallowly few-toothed (7).
7. Petals not clawed; stamens many more than 8 (commonly 20 or more), the filaments terete, not lobed; capsule urceolate or obovoid, abruptly beaked, adnate to the calyx half or more of its length. 5. PHILADELPHUS.
7. Petals long-clawed; stamens 8, the filaments broad and flat, 2-lobed, the anthers borne between the lobes; capsule ovoid or conic, attenuate-beaked, free except at base----- 7. FENDLERA.
6. Sepals and petals 5; stamens 10, the filaments not lobed (8).
8. Leaf blades broad, thin, deeply and regularly crenate, long-petioled. 6. JAMESIA.
8. Leaf blades narrow, thickish, entire, sessile or nearly so. 8. FENDLERELLA.

1. SAXIFRAGA. SAXIFRAGE

Plants herbaceous; stems leafy or scapelike, erect, decumbent, or prostrate; flowers perfect, regular, solitary or in simple or compound cymes; calyx lobes and petals 5; stamens 10; carpels 2, united below or nearly separate; ovary nearly free or partly inferior; follicles beaked, divergent, many-seeded.

Plants mostly of relatively high altitudes, in moist soil of coniferous forests, usually among rocks. Two Arctic-alpine species are found near the summit of the highest mountains in Arizona.

Key to the species

1. Foliage leaves all basal; flowers numerous, borne on scapes, these naked below the inflorescence, the latter small-bracteate: Section *Micranthes* (2).
2. Inflorescence a very open panicle; leaf blades thin, commonly much shorter than the petioles, orbicular or nearly so, more or less cordate at base, deeply crenate-dentate with numerous teeth----- 1. S. ARGUTA.
2. Inflorescence a contracted panicle of cymules; leaf blades thickish, commonly longer than the petioles, oblong, ovate, or rhombic, truncate or cuneate at base, shallowly crenate or crenate-dentate (3).
3. Leaf blades lanate beneath with long, reddish hairs; petioles copiously ciliate with similar hairs; cymules lax, few-flowered, the inflorescence becoming relatively open----- 2. S. ERIOPHORA.
3. Leaf blades glabrous or sparsely pubescent beneath; petioles sparsely ciliate; cymules dense, subcapitate, the inflorescence remaining contracted; scapes up to 30 cm. long; inflorescence up to 10 cm. long, the cymules solitary to several----- 3. S. RHOMBOIDEA.
1. Foliage leaves not all basal, the stems leafy below the inflorescence, but the cauline leaves sometimes much reduced (4).
4. Leaf blades entire, conspicuously ciliate with thick, bristlelike hairs; plant with slender, elongate, naked stolons ending in a tuft of small leaves; leaves soft, those of the flowering stems scarcely reduced; flowering stems commonly solitary, erect, very leafy, bearing one or very few flowers; petals yellow, broadly obovate, 6 to 9 mm. long: Section *Leplasea*.
4. S. FLAGELLARIS.

4. Leaf blades deeply dentate or lobed, not bristly-ciliate, the hairs, if any, soft and slender, or glandular (5).
 5. Plant densely caespitose, not bulbiferous at base, copiously glandular-pubescent; flowering stems several or numerous; basal leaf blades flabelliform-cuneate, deeply, narrowly, and acutely 3-lobed at apex; petioles very short or none: Section *Muscaria*. 5. *S. CAESPITOSA*.
 5. Plant not caespitose, bulbiferous at base, glabrous or sparsely pubescent; flowering stems few or solitary, 1- to 3-flowered; basal leaf blades sub-orbicular or reniform, palmately several-lobed or coarsely crenate; petioles elongate----- 6. *S. DEBILIS*.

1. *Saxifraga arguta* D. Don, Linn. Soc. London Trans. 13: 356. 1822.

Micranthes arguta Small, North Amer. Fl. 22: 147. 1905.

Baldy Peak, Apache County (*Goodding* 626, *Peebles* and *Smith* 12514), 11,000 feet, July and August. Montana to British Columbia, New Mexico, eastern Arizona, and California.

2. *Saxifraga eriophora* S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 372. 1882.

Micranthes eriophora Small, North Amer. Fl. 22: 142. 1905.

Pinaleno Mountains (Graham County), Santa Rita and Santa Catalina Mountains (Pima County), 6,000 to 8,500 feet, April and May, type from the Santa Catalina Mountains (*Lemmon* in 1881). Southern New Mexico and southern Arizona.

Less pubescent specimens collected in the Mazatzal Mountains, Gila County (*Collom* 46), seem to be intermediate between this and the next species.

3. *Saxifraga rhomboidea* Greene, Pittonia 3: 343. 1898.

Micranthes rhomboidea Small, North Amer. Fl. 22: 136. 1905.

Apache County to Coconino and Gila Counties, 7,000 (?) to 11,000 feet, May to July. Montana to New Mexico and Arizona.

A small form, with scapes not more than 10 cm. long and inflorescence reduced to 1 to 3 cymules, is var. *franciscana* (Small) Kearney and *Peebles* (*Micranthes franciscana* Small). It occurs on the San Francisco Peaks, 11,500 to 12,000 feet.

4. *Saxifraga flagellaris* Willd. in Sternb., Rev. Saxifr. 25. 1810.

Leptasea flagellaris Small, North Amer. Fl. 22: 154. 1905.

San Francisco Peaks (Coconino County), 9,800 to 12,000 feet, July to September. Circumpolar, south in the Rocky Mountains to New Mexico and northern Arizona.

5. *Saxifraga caespitosa* L., Sp. Pl. 404. 1753.

Muscaria caespitosa Haw., Saxifr. Enum. 37. 1821.

San Francisco Peaks, 11,500 to 12,000 feet, July and August. Circumpolar, southward in the mountains of North America to Colorado, northern Arizona, and Oregon.

The form occurring in Arizona is var. *lemmonii* Engl. and *Irmscher*, of which the type was collected on Mount Agassiz (*Lemmon* in 1884).

6. *Saxifraga debilis* Engelm., Acad. Nat. Sci. Phila. Proc. 1863: 62. 1863.

San Francisco Peaks, 10,000 to 12,000 feet, July and August. Montana to Colorado and northern Arizona.

2. HEUCHERA.⁵⁵ ALUMROOT

Perennial herbs with scapose stems from a large, somewhat woody, scaly caudex; leaves nearly all basal, long-petioled, with orbicular or broadly ovate, cordate, dentate blades; flowers in narrow racemes or in cymose panicles, slightly irregular, with a well-developed hypanthium; petals small, rarely wanting; ovary 1-celled; fruit of 2 divergent beaked follicles, these several-seeded.

The rootstocks have astringent properties, as indicated by the common name, and have been used by hunters and others in cases of diarrhea caused by drinking alkali water.

Key to the species

1. Stamens surpassing the sepals; pistils exerted (sometimes tardily); styles slender, elongate, gradually expanded below into the conic beaks of the carpels; flowers pink or pinkish; petals much surpassing the sepals, with narrow blades and long, slender claws (2).
 2. Filaments noticeably widened and flattened at base; stamens inserted at or slightly below the level of insertion of the petals; inferior part of the ovary at anthesis not longer than wide; petioles finely glandular-puberulent, sometimes also very sparsely hirtellous..... 1. *H. RUBESCENS*.
 2. Filaments not noticeably widened and flattened at base; stamens usually inserted well below the level of insertion of the petals; petioles commonly villous or hirsute with long hairs, sometimes merely glandular-puberulent..... 2. *H. VERSICOLOR*.
1. Stamens not equaling the sepals; pistils included (3).
 3. Flowers deep pink to carmine; inflorescence relatively short and expanded, the lower branches seldom less than 2 and up to 6 cm. long; hypanthium funnellform, becoming urceolate; petals much shorter than the sepals. 3. *H. SANGUINEA*.
 3. Flowers greenish or yellowish, the petals often whitish; inflorescence elongate and contracted, the lower branches usually less than 2 cm. long; hypanthium broadly turbinate, or campanulate (4).
 4. Sepals broadly triangular, more or less spreading; petals commonly surpassing the sepals, the blade usually at least twice as wide as the short claw; pistils commonly shorter than the tube of the hypanthium. 4. *H. PARVIFOLIA*.
 4. Sepals oblong or ovate, erect or incurved at tip; petals, when present, shorter than the sepals, the blade usually not much wider than the claw; pistils equaling or surpassing the tube of the hypanthium (5).
 5. Flowers hexamerous, glandular-puberulent, sometimes also slightly hirtellous; petals none, or much reduced..... 5. *H. EASTWOODIAE*.
 5. Flowers normally pentamerous; petals present (6).
 6. Flowers merely glandular-puberulent; petioles hirsute. 6. *H. NOVOMEXICANA*.
 6. Flowers copiously white-hirsute, also puberulent; petioles finely puberulent..... 7. *H. GLOMERULATA*.

1. *Heuchera rubescens* Torr. in Stansb., Expl. Great Salt Lake 388. 1852.

Heuchera clutei A. Nels., Amer. Bot. 28:22. 1922.

Hidden Spring, Navajo Mountain, Coconino County (*Clute* 80, the type collection of *H. clutei*). Utah to Oregon, northern Arizona, and California.

2. *Heuchera versicolor* Greene, Leaflets 1:112. 1905.

Heuchera sitgreavesii Rydb., North Amer. Fl. 22:110. 1935.

Apache County to Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 7,100 to 12,000 feet, moist shaded rocks

⁵⁵ Reference: ROSENDAHL, C. O., BUTTERS, F. K., and LAKELA, O. A MONOGRAPH ON THE GENUS HEUCHERA. Minn. Studies Plant Sci. 2: 1-180. 1936.

in coniferous forest, June to October, type of *H. sitgreavesii* from between Williams and Flagstaff, Coconino County (Woodhouse in 1851). Western Texas and southern Utah to Arizona, California, and northern Mexico.

An attractive plant, suitable for rock gardens in cool climates. A depauperate form (f. *pumila* Rosendahl et al.) is found on the San Francisco Peaks at 10,000 to 12,000 feet. Having practically the same range in Arizona as the typical form, but less common is var. *leptomeria* (Greene) Kearney and Peebles (*H. leptomeria* Greene) which has the inferior portion of the ovary narrower.

3. *Heuchera sanguinea* Engelm. in Wisliz., Mem. North Mex. 107. 1848.

Southern Apache County to Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, moist shaded rocks, March to September. Arizona and northern Mexico.

Coralbells. The showiest of the Arizona species, with bright-pink to carmine flowers, often cultivated as an ornamental. Distinguished by its more pubescent calyx, with longer hairs, is var. *pulchra* (Rydb.) Rosendahl (*H. pulchra* Rydb.) occasional throughout the range of the species. It is not a well-marked variety.

4. *Heuchera parvifolia* Nutt. ex Torr. and Gray, Fl. North Amer. 1:581. 1840.

The typical form of the species, widely distributed in the Rocky Mountains, apparently is not found in Arizona, but two varieties occur. These are: (1) var. *arizonica* Rosendahl et al., apparently limited to Coconino County, on both sides of the Grand Canyon, 7,000 to 9,000 feet, type from the Grand Canyon (*Eastwood* 5775); and (2) var. *flavescens* (Rydb.) Rosendahl et al. (*H. flavescens* Rydb.), found in the White Mountains (Apache County), and in Navajo County, 7,000 to 11,500 feet. In var. *arizonica* the petioles are hirsute or villous, whereas in var. *flavescens* they are commonly glabrous or slightly glandular-puberulent.

5. *Heuchera eastwoodiae* Rosendahl, Butters, and Lakela, Minn. Studies Plant Sci. 2:152. 1936.

Yavapai and Gila Counties, 5,000 to 6,000 feet, and perhaps higher, May to August, type from Senator Mine near Prescott (*Eastwood* 17659). Known only from central Arizona.

6. *Heuchera novomexicana* Wheelock, Torrey Bot. Club Bul. 17:200. 1890.

Coconino County, near Flagstaff (*Leiberg* 5538), and at Deboschibeko (*Darsie* in 1933), 6,000 to 7,000 feet, June. New Mexico and Arizona.

7. *Heuchera glomerulata* Rosendahl, Butters, and Lakela, Minn. Studies Plant Sci. 2:155. 1936.

Pinaleno Mountains, Graham County, 4,600 feet (*Eggleston* 19913), Pinery Canyon, Chiricahua Mountains (*Stone* 385, the type collection). Known only from southeastern Arizona.

3. LITHOPHRAGMA. WOODLAND-STAR

Plant herbaceous, perennial, small, with slender rootstocks bearing bulblets; stems slender; leaves mostly basal, with round, variously

cleft or divided blades; flowers few, rather showy, in a narrow raceme; petals white or pink, clawed, deeply cleft; stamens 10, not exerted.

1. Lithophragma tenella Nutt. ex Torr. and Gray, Fl. North Amer. 1:584. 1840.

Coconino and Gila Counties, 5,000 to 8,000 feet, pine forests, May to June. Alberta to New Mexico, north-central Arizona, and California.

A very attractive little plant. The Arizona specimens have been referred to *L. australis* Rydb. and *L. breviloba* Rydb., but the writers have been unable to discover satisfactory characters for distinguishing these forms, even as varieties, from *L. tenella*.

4. PARNASSIA. GRASS-OF-PARNASSUS

Plant herbaceous, perennial, with a short rootstock; leaves in a basal rosette and a single one borne on the scape (usually below the middle), the blades entire, several-veined from near the base; petals oval, conspicuously veined, 6 to 10 mm. long; staminodia 5 to 7 in the cluster, united below.

The popular name is misleading, as these plants are not at all grasslike.

1. Parnassia parviflora DC., Prodr. 1: 320. 1824.

Near Greer, Apache County, 8,800 feet (*Eggleston* 17098), in wet meadows, August. Canada to New Mexico and eastern Arizona.

5. PHILADELPHUS. MOCKORANGE

Shrubs with branching stems and exfoliating bark; leaves opposite, the blades thickish, entire or dentate, white-sericeous beneath; flowers solitary or very few in the cluster, rather large and showy; petals white, broad and rounded; stamens numerous; ovary partly inferior.

The Old World *P. coronarius* L., and other species are favorite ornamental shrubs, often known by the inappropriate name "syringa." *P. lewisii* is the State flower of Idaho.

1. Philadelphus microphyllus A. Gray, Amer. Acad. Arts and Sci. Mem., ser. 2, 4: 54. 1849.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,000 feet, rocky slopes and canyons in the chaparral and yellow pine belts, June and July. Southern Colorado, New Mexico, Arizona, and California.

The Mexican bighorn or "mountain sheep" is reported to browse these plants. Occurring in most parts of the range of the species in Arizona is var. *argenteus* (Rydb.) Kearney and Peebles (*P. argenteus* Rydb.), which has the upper leaf surface and hypanthium sericeous (these merely strigose, or glabrate, in the typical form).

6. JAMESIA. CLIFFBUSH

Shrub, often 2 m. or more high, with shreddy bark; leaves with large, thin, ovate, crenate blades, these bright green above, whitish pubescent beneath; flowers numerous, rather small, in dense cymes; petals white or pink; filaments broad and flat, not lobed; styles 3 to 5.

1. **Jamesia americana** Torr. and Gray, Fl. North Amer. 1: 593. 1840.

Edwinia americana Heller, Torrey Bot. Club Bul. 24: 477. 1897.

Mountains of Graham, Cochise, and Pima Counties, 7,500 to 9,500 feet, coniferous forests, along streams, and on the walls of canyons, July. Wyoming to New Mexico and southeastern Arizona.

Sometimes cultivated as an ornamental.

7. FENDLERA

Straggling shrubs, usually 1 to 2 (sometimes 3) m. high, widely branched; leaves opposite, with linear-lanceolate to narrowly ovate, entire, thickish blades, the margins often revolute; flowers large and showy, mostly solitary, the petals white or tinged with purple; fruit a 4-celled capsule.

Browsed by goats and deer, to a less extent by cattle when other feed is scarce. Shrub beautiful when in flower, worthy of more extensive cultivation as an ornamental.

1. **Fendlera rupicola** A. Gray, Pl. Wright 1: 77. 1852.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 4,000 to 7,000 feet, dry rocky and gravelly slopes, March to June. Southern Colorado to western Texas and Arizona.

In northeastern Arizona, the prevailing form is var. *falcata* (Thornber) Rehder (*F. falcata* Thornber) with leaf blades narrow, usually strongly revolute, and green and glabrate on both surfaces. In the southeastern mountains (Graham, Cochise, and Pima Counties), var. *wrightii* A. Gray (*F. tomentella* Thornber) is about as common as the typical form. Compared with the latter, it has the leaf blades more densely pubescent and white beneath, also usually narrower and more revolute.

8. FENDLERELLA

Small, much-branched shrubs, 0.5 to 1 m. high; leaves small, with lanceolate entire blades; flowers inconspicuous, in small cymose clusters; hypanthium turbinate; capsule longer than the calyx.

1. **Fendlerella utahensis** (S. Wats.) Heller, Torrey Bot. Club Bul. 25: 626. 1898.

Whipplea utahensis S. Wats., Amer. Nat. 7: 300. 1873.

Coconino County (and probably northern Mohave County, common in and about the Grand Canyon, 5,000 to 8,000 feet, dry open pine woods, June to July. Southern Utah, northern Arizona, and southern California.

The distribution of the typical form is given above. In southern Arizona, southern New Mexico, and northern Mexico occurs var. *cymosa* (Greene) Kearney and Peebles (*F. cymosa* Greene) which has the leaf blades commonly narrower and more pointed than in the typical form. The variety occurs in the mountains of Graham, Cochise, and Pima Counties, 4,500 to 6,500 feet, often on limestone, May to September. The type of *F. cymosa* was collected in the Santa Rita Mountains, Pima County (*Pringle* in 1884). The plants are browsed by deer.

9. RIBES.⁵⁶ CURRANT, GOOSEBERRY

Shrubs, usually straggling, often spiny; leaves alternate, or appearing fasciated because of the much-shortened internodes, the blades broad, rounded, commonly lobed; flowers in fascicles or somewhat elongate racemes, sometimes solitary, usually inconspicuous; petals much reduced, these and the stamens 4 or 5, inserted on the calyx throat; ovary inferior; berry globose or nearly so, juicy, several-seeded, crowned by the persistent calyx lobes.

These shrubs harbor one stage of the white pine blister rust (*Cronartium ribicola*) and are being exterminated wherever commercially important stands of white pines occur. The fruits of some of the wild species are eaten by the Indians fresh or dried. They are sometimes used for making jelly and are much liked by birds. *R. cereum* was used by the Hopi to alleviate stomach ache. Both domestic animals and deer browse the plants.

Key to the species

1. Pedicels jointed beneath the ovary, often bearing a pair of bractlets just below the joint; fruit disarticulating from the pedicel; spines and bristles at the nodes of the stem none, or, if present, the hypanthium very shallow: Subgenus *Ribesia* (2).
 2. Spines present, usually numerous and conspicuous, often clustered; leaf blades seldom more than 3 cm. wide, deeply 5-lobed or 5-parted, copiously pubescent on both faces to nearly glabrous; inflorescence few-flowered; flowers dull pink or red; berries bright red, glandular-bristly.
 1. *R. MONTIGENUM.*
 2. Spines none (3).
 3. Anthers without an apical gland but sometimes apiculate (4).
 4. Hypanthium glabrous, yellow (as are the calyx lobes), tubular-funnel-form, equaling or longer than the calyx lobes; berries at maturity smooth, red, black, or yellow, 6 to 8 mm. in diameter; leaf blades deeply 3-lobed, the lobes commonly sparingly crenate-dentate or shallowly cleft, cuneate to subcordate at base, up to 5 cm. wide; flowers very showy for the genus..... 2. *R. AUREUM.*
 4. Hypanthium glandular-pubescent, greenish white or pinkish (as are the calyx lobes), turbinate, shorter than the calyx lobes; berries at maturity glandular-pubescent, black (sometimes with a bloom), 8 to 12 mm. in diameter; leaf blades shallowly to rather deeply 3- to 5-lobed with acutish lobes, dentate with numerous teeth, cordate at base, up to 9 cm. wide but commonly smaller... 3. *R. WOLFII.*
 3. Anthers with a cup-shaped apical gland; leaf blades shallowly lobed with rounded lobes, crenate-dentate (5).
 5. Flowers (from the base of the ovary) 14 to 17 mm. long; hypanthium less than twice as long as wide, cylindric-campanulate; berry at maturity black, glandular-bristly; herbage not resinous or obscurely so, copiously puberulent and glandular-pubescent; leaf blades commonly 5 cm. wide or wider, crenate-dentate with numerous teeth, cordate..... 4. *R. VISCOSISSIMUM.*
 5. Flowers less than 14 (seldom more than 10) mm. long; hypanthium more than twice as long as wide, tubular; berry at maturity bright red, smooth or glandular-pubescent but not bristly; herbage noticeably resinous-granular as well as glandular-pubescent, fragrant; leaf blades not more (commonly much less) than 4 cm. wide, orbicular-reniform, cuneate to subcordate at base (6).
 6. Bracts cuneate-obovate, deeply toothed or lobed at the (commonly) truncate or rounded apex..... 5. *R. CEREUM.*
 6. Bracts rhombic, often narrowly so, entire or denticulate at the acutish apex..... 6. *R. INEBRIANS.*

⁵⁶ The writers are indebted to the late F. V. Coville for much help in identifying specimens of *Ribes*.

1. Pedicels not jointed; bractlets, if any, at base of the pedicel and covered by the bract; fruit not disarticulating; spines present at the nodes of the stem, the stems often also bristly; hypanthium always deep; leaf blades in all of the species very similar in shape and lobation: Subgenus *Grossularia* (7).
7. Styles hairy below; hypanthium, calyx lobes, and ovary glabrous; stems sometimes with a few short bristles; spines few or none, seldom as much as 10 mm. long; leaf blades up to 6 cm. wide; flowers (including the ovary) 7 to 9 mm. long; calyx lobes 1 to 2 times as long as the hypanthium; berry at maturity wine-colored, smooth, about 8 mm. in diameter.
7. R. INERME.
7. Styles not hairy, glabrous or puberulent; hypanthium and calyx lobes pubescent (8).
8. Ovary densely bristly; leaf blades up to 4 cm. wide; berry densely spiny, at maturity 10 to 15 mm. in diameter (excluding the spines), dark purple; stems without bristles, glabrous or puberulent when young; nodal spines stout, up to 12 mm. long, often somewhat curved; flowers (including the ovary) 15 to 18 mm. long; calyx lobes narrow, longer than the hypanthium, often twice as long. 8. R. PINETORUM.
8. Ovary not bristly, the hairs, if any, soft, glandular or nonglandular; leaf blades not more than 2 cm. wide; berry not spiny, less than 10 mm. in diameter (9).
9. Hypanthium as wide as or wider than long; berry at maturity yellow (sometimes purple?), copiously soft-pubescent; leaves, young stems, etc., almost tomentose; stems without bristles; spines straw-colored, mostly straight and slender, up to 2 cm. long; flower when dry (including the ovary) not more than 7 mm. long. 9. R. VELUTINUM.
9. Hypanthium longer than wide; berry black or dark red, commonly glabrous; leaves, etc., glabrous or moderately pubescent; stems sometimes bristly but commonly not so; spines yellowish brown to brownish gray (10).
10. Calyx lobes and hypanthium white; hypanthium 4 to 6 mm. long.
10. R. LEPTANTHUM.
10. Calyx lobes and hypanthium yellow; hypanthium 2 to 3 mm. long.
11. R. QUERCETORUM.

1. Ribes montigenum McClatchie, Erythea 5: 38. 1897.

San Francisco Peaks and Navajo Mountain (Coconino County), White Mountains (Apache County) 6,500 to 11,500 feet. June to August. Montana to British Columbia, south to New Mexico, northern Arizona, and California.

Gooseberry currant.

2. Ribes aureum Pursh, Fl. Amer. Sept. 164. 1814.

Navajo and Yavapai Counties to Cochise County, 5,000 to 6,000 feet. March to June. South Dakota to Assiniboia and Washington, south to New Mexico, Arizona, and California.

Variouly known as golden, Missouri, and buffalo currant, often cultivated as an ornamental. The showiest wild currant, with bright-yellow, fragrant flowers.

3. Ribes wolfii Rothr., Amer. Nat. 8: 358. 1874.

Kaibab Plateau (Coconino County), White Mountains (Apache County), Pinaleno Mountains (Graham County), 8,500 to 11,500 feet. moist woods and springy places, May to August. Colorado, Utah, New Mexico, and Arizona.

4. Ribes viscosissimum Pursh, Fl. Amer. Sept. 163. 1814.

Grand View, Grand Canyon (*Bailey* 1025), about 7,000 feet, May to July. Montana to British Columbia, Colorado, northern Arizona, (?) and California.

Sticky currant.

The writers are not sure that the specimen cited is correctly identified. Seemingly this is the only record of the occurrence of the species in Arizona.

5. *Ribes cereum* Dougl., Hort. Soc. London Trans. 7: 512. 1830.

Navajo and Coconino Counties, 6,500 to 8,200 feet, very common among pines, sometimes on cliffs, May to July. Montana to British Columbia, south to northern Arizona and California.

Wax currant.

6. *Ribes inebrians* Lindl., Bot. Reg. 18: pl. 1471. 1832.

Apache County to Mohave County, south to Greenlee and Yavapai Counties, 5,000 to 8,000 feet, May to August. South Dakota and Nebraska to Idaho, New Mexico, Arizona, and California.

Squaw currant. Closely resembles *R. cereum* and intergrades completely with it in Arizona, being probably not more than varietally distinct. It is reported that the berries are eaten by the Hopi Indians, although causing illness.

7. *Ribes inerme* Rydb., N. Y. Bot. Gard. Mem. 1: 202. 1900.

Grossularia inermis Cov. and Britt., North Amer. Fl. 22: 224. 1908.

Lake Mary, Coconino County (*Fulton* 7134), Greer, Apache County (*Fulton* 8215), 7,000 to 8,300 feet. Montana to British Columbia, south to New Mexico, Arizona, and California.

Whitstem gooseberry. At Lake Mary it grows as a semitrailing bush not more than 1 m. high.

8. *Ribes pinetorum* Greene, Bot. Gaz. 6: 157. 1881.

Grossularia pinetorum Cov. and Britt., North Amer. Fl. 22: 217. 1908.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 8,000 to 10,000 (rarely only 7,000) feet, coniferous forests, May to July. New Mexico and Arizona.

Orange gooseberry. The most abundant species in the mountains of southern Arizona, and the handsomest of the wild gooseberries, with reddish flowers and large, densely prickly berries, these purple at maturity.

9. *Ribes velutinum* Greene, Calif. Acad. Sci. Bul. 1: 83. 1885.

Grossularia velutina Cov. and Britt., North Amer. Fl. 22: 220. 1908.

Coconino County, on both sides of the Grand Canyon, 6,800 to 8,000 feet. Utah and northern Arizona to Oregon and California.

10. *Ribes leptanthum* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 53. 1849.

Grossularia leptantha Cov. and Britt., North Amer. Fl. 22: 219. 1908.

Apache, Navajo, and Coconino Counties, south to Cochise (and Pima?) Counties, 6,000 to 9,500 feet, along streams, etc., May and June. Colorado, Utah, New Mexico, and Arizona.

11. Ribes quercetorum Greene, Calif. Acad. Sci. Bul. 1: 83. 1885.

Grossularia quercetorum Cov. and Britt., North Amer. Fl. 22: 220. 1908.

Superstition Mountains (Pinal County), Sierra Estrella (Maricopa County), 3,500 to 4,500 feet, steep rocky slopes and canyon walls, growing in the Sierra Estrella with scrub oaks, *Vauquelinia*, *Penstemon microphyllus*, etc., November to March. South-central Arizona, California, and Baja California.

A shrub barely 1 m. high, tending to form low thickets. The Arizona specimens approach *R. leptanthum* in length of the hypanthium but have the yellow flowers of *R. quercetorum*.

51. PLATANACEAE. PLANETREE FAMILY**1. PLATANUS. SYCAMORE, BUTTONWOOD, PLANETREE**

Trees, with the outer bark flaking off and exposing the smooth, whitish inner bark; buds enclosed in the dilated bases of the petioles; leaves large, alternate, with palmately lobed blades; flowers monocious, very many in dense globular heads; sepals and petals minute; pistils 3 or 4, separate; fruit a 4-sided achene, with a basal tuft of long hairs.

1. Platanus wrightii S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 349. 1875.

Southern parts of Coconino and Mohave Counties to Greenlee, Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,000 feet, along streams, April to May. The Mogollon Escarpment coincides approximately with the northern limit of this species in Arizona. New Mexico, Arizona, and northern Mexico.

Arizona sycamore. A large, spreading tree, attaining a height of 24 m. (80 feet), with beautifully arched, white-barked branches. The roots effectively bind the soil, preventing excessive erosion. This tree is perhaps not specifically distinct from the California sycamore (*P. racemosa* Nutt).⁵⁷

52. CROSSOSOMATACEAE. CROSSOSOMA FAMILY**1. CROSSOSOMA**

Rough-barked shrubs; leaves alternate, narrow, entire, thickish, smooth and somewhat glaucous; flowers solitary, rather large; sepals 5; petals 5, white; stamens numerous, borne on a disk in the turbinate hypanthium; pistils 2 to 5, becoming separate, several-seeded follicles, these with thickish, reticulate-veined walls.

Key to the species

1. Follicles seldom less than 9 mm. long, oblong, ovoid, or somewhat obovoid, usually conspicuously beaked..... 1. C. BIGELOVII.
1. Follicles about 6 mm. long, broadly ovoid, abruptly short-beaked..... 2. C. PARVIFLORUM.

⁵⁷ WOLF, CARL B. CALIFORNIA PLANT NOTES. Occasional papers Rancho Santa Ana Bot. Gard. 1: 31-43. 1935. (See p. 34.)

1. *Crossosoma bigelovii* S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 122. 1876.

Southern parts of Yavapai, Mohave, and Gila Counties to Pinal, Maricopa, Pima, and Yuma Counties, 4,000 feet or (usually) lower, dry rocky slopes and cliffs, February to May (rarely September). Southern and western Arizona, southeastern California, and northwestern Mexico.

A straggling shrub, up to 2.4 m. (8 feet) high, with very astringent bark and white flowers, these sometimes tinged with purple. Worthy of cultivation on account of the delicious fragrance of the flowers. In the eastern part of its range, var. *glaucum* (Small) Kearney and Peebles (*C. glaucum* Small) largely replaces the typical form. The variety is distinguished by broader and more glaucous follicles, but intergradation between the two forms is complete. The type of *C. glaucum* is Palmer 560, Arizona, without definite locality.

2. *Crossosoma parviflorum* Robins. and Fern., Amer. Acad. Arts and Sci. Proc. 30: 114. 1894.

Known certainly only from the type specimen collected in the Grand Canyon (*Gray* in 1885), with fruit only. The material is insufficient to permit a conclusion as to whether this form is specifically distinct from *C. bigelovii*.

53. ROSACEAE. ROSE FAMILY

Plants herbaceous or woody; leaves alternate (except in *Coleogyne*), simple or compound, usually with stipules; flowers mostly perfect, regular or nearly so; sepals partly united; petals commonly 5, occasionally none; stamens commonly numerous, rarely fewer than 5, nearly always borne on the throat of the calyx or on a disk surrounding the ovary or ovaries; pistils 1 to many; ovary free from or adnate to the calyx; fruit various.

This large and very diverse family includes many of the most important cultivated fruits, such as the apple, pear, peach, plum, cherry, apricot, almond, strawberry, raspberry, and blackberry. The flowers and foliage are usually attractive, often beautiful, and many plants of this family, first and foremost the roses, are highly prized as cultivated ornamentals. Many of the species in Arizona are important browse plants, both for domestic animals and deer, and the fruits supply much food for birds and other wild animals. Most of the Rosaceae are harmless, but a few are reputed to be somewhat poisonous.

Key to the genera

1. Carpel solitary; fruit a dry or fleshy, usually 1-seeded drupe (plumlike); calyx more or less persistent at base of the fruit; plants small trees or large shrubs; leaves simple; flowers white or greenish, in racemes or corymbs, or solitary in the leaf axils..... 22. PRUNUS.
1. Carpels more than one or, if solitary, the fruit an achene (2).
 2. Ovary inferior, enclosed in and adnate to the calyx tube (hypanthium), the latter becoming more or less fleshy; fruit a pome (applelike); calyx lobes more or less persistent at apex of the fruit; plants shrubby or tree-like; petals white (3).
 3. Leaves pinnate; flowers small, in short broad compound many-flowered cymes..... 6. SORBUS.

3. Leaves simple (4).
 4. Plants unarmed; ovary with complete and false partitions, the cells twice as many as the number of styles; flowers relatively large, in racemes or corymbose fascicles..... 7. AMELANCHIER.
 4. Plants armed with strong spines; ovary without false partitions, the cells of the same number as the styles; flowers relatively small, in corymblike cymes..... 8. CRATAEGUS.
2. Ovary superior; calyx tube not fleshy and enclosing the pistils or, if so, then not adnate to them (5).
 5. Calyx tube (hypanthium) enclosing the numerous carpels, becoming fleshy; fruit simulating a pome, crowned by the persistent calyx lobes..... 21. ROSA.
 5. Calyx tube not enclosing the carpels, or not becoming fleshy (6).
 6. Fruits becoming juicy and more or less edible (7).
 7. Plants shrubby, often with prickly stems; receptacle not becoming greatly enlarged and fleshy, bearing a conic, ovoid, or nearly globose mass of more or less juicy drupelets..... 9. RUBUS.
 7. Plants herbaceous, unarmed, acaulescent; receptacle becoming greatly enlarged and very fleshy, the numerous dry achenes embedded in its surface..... 10. FRAGARIA.
 6. Fruits not becoming juicy (8).
 8. Carpels becoming dehiscent capsules or follicles, containing usually more than one seed (9).
 9. Seeds with a thin, elongate, terminal wing; leaves evergreen, simple; plant a large shrub or small tree... 4. VAUQUELINIA.
 9. Seeds not winged; leaves not evergreen or, if so, then compound (10).
 10. Leaves more or less evergreen, bipinnate; stipules persistent; herbage scurfy with stellate hairs and somewhat viscid.
 3. CHAMAEBATIARIA.
 10. Leaves deciduous, simple; stipules deciduous or none; herbage not scurfy or viscid (11).
 11. Plant a shrub; leaf blades large, rounded-cordate, usually shallowly 3-lobed; flowers in corymbs; fruits much-inflated..... 1. PHYSCARPUS.
 11. Plant an undershrub; leaf blades small, spatulate, entire; flowers in dense spikelike inflorescences; fruits not inflated..... 2. SPIRAEA.
 3. Carpels becoming indehiscent 1-seeded achenes, or sometimes tardily dehiscent in *Holodiscus* (12).
 12. Plants herbaceous above ground, the caudex often somewhat woody; leaves pinnately or digitately compound (13).
 13. Calyx tube 4-winged; bracts and margins of the calyx lobes scarious; petals none; flowers in dense cylindrical spikes.
 20. SANGUISORBA.
 13. Calyx tube not winged; bracts and calyx lobes herbaceous; petals present, sometimes minute; flowers not in dense spikes (14).
 14. Hypanthium bearing numerous hooked bristles; stems tall; leaves pinnate, with several much smaller leaflets interspersed among the large ones; flowers in slender, elongate, spikelike racemes; petals yellow; pistils 2.
 19. AGRIMONIA.
 14. Hypanthium not bristly (15).
 15. Style (at least the lower portion) persistent on the achene often plumose..... 13. GEUM.
 15. Style wholly deciduous from the mature achene (16).
 16. Hypanthium with small bractlets, these alternate with the sepals and simulating an outer series of calyx lobes; pistils borne on a sessile receptacle, this flat, hemispheric, or low-conic..... 11. POTENTILLA.
 16. Hypanthium without bractlets; pistils borne on a stalked, cylindrical or conic receptacle.
 12. PURPUSIA.
 12. Plants shrubby (17).
 17. Flowers in panicles, very numerous, very small; leaves simple, deeply cleft or coarsely toothed.... 5. HOLODISCUS.

- 17. Flowers solitary or in few-flowered cymes or fascicles (18).
- 18. Style wholly deciduous from the mature achene; leaves pinnately compound; bark exfoliating; flowers showy, the petals bright yellow----- 11. POTENTILLA.
- 18. Style persistent; leaves simple but sometimes deeply cleft or pinnatifid (19).
- 19. Petals normally none (exceptionally present in *Coleogyne*); leaf blades entire or merely dentate; pistil solitary (20).
- 20. Pistil not enclosed in a sheath; style terminal, not twisted or bent, in fruit greatly elongate and plumose nearly to the apex ----- 16. CERCOCARPUS.
- 20. Pistil at anthesis enclosed in a thin sheathlike prolongation of the disk; style lateral, much twisted and bent, villous only near the base.
- 17. COLEOGYNE.
- 19. Petals present; leaf blades wedge-shaped, usually deeply cleft or pinnatifid (21).
- 21. Style not greatly elongate or plumose in fruit, stout, beaklike; petals spatulate, cream-colored or yellow; pistil solitary or rarely 2 ----- 18. PURSHIA.
- 21. Style greatly elongate and plumose in fruit; petals broadly obovate or nearly orbicular, white; pistils several or numerous (22).
- 22. Bark exfoliating; bractlets present, alternating with the sepals; achenes with purplish tails.
- 14. FALLUGIA.
- 22. Bark not exfoliating; bractlets none; achenes with white tails----- 15. COWANIA.

1. PHYSOCARPUS. NINEBARK

Plant a small shrub, with bark exfoliating in strips; leaves simple, petioled, the blades palmately lobed; flowers in terminal corymbs; petals 5, these and the numerous stamens inserted on the throat of the calyx; pistils 1 to 5, short-stipitate, becoming inflated few-seeded capsules dehiscent on both sutures.

1. *Physocarpus monogynus* (Torr.) Coult., Contrib. U. S. Natl. Herbarium 2: 104. 1891.

Spiraea monogyna Torr., Ann. Lyc. N. Y. 2: 194. 1827.

Opulaster monogynus Kuntze, Rev. Gen. Pl. 2: 949. 1891.

White Mountains (Apache County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), 8,000 to 9,500 feet, pine and spruce forests, June. South Dakota to Texas, eastern Arizona, and Nevada.

2. SPIRAEA

A small undershrub, or the numerous stems woody only at base, forming mats; leaves with small spatulate entire blades; flowers many in very dense, simple or sparingly branched spikelike inflorescences terminating the few-bracted scapes; stamens numerous; pistils few, becoming follicles (dehiscent on one suture).

1. *Spiraea caespitosa* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 418. 1840.

Petrophyton caespitosum Rydb., N. Y. Bot. Gard. Mem. 1: 206. 1900.

Navajo, Coconino, and Yavapai Counties, also Huachuca Mountains (Cochise County), 5,000 to 8,000 feet, common on both rims of

the Grand Canyon, dry rock ledges, often of limestone, July to September. South Dakota and Montana to New Mexico, Arizona, and California.

Both the typical form and var. *elatior* S. Wats. (*Petrophyton elatius* Heller) are common, intergrading freely but the variety normally with a longer, frequently branched inflorescence and longer floral bracts.

3. CHAMAEBATIARIA. FERNBUSH

A shrub, commonly 1.5 to 2 m. high, very leafy, aromatic; leaves more or less evergreen, much dissected, the ultimate segments very small; flowers numerous, in panicles; petals white; fruits of follicles.

1. *Chamaebatiaria millefolium* (Torr.) Maxim., Acta Hort. Petrop. 6: 225. 1879.

Spiraea millefolium Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 83. 1857.

Coconino, eastern Mohave, and northern Yavapai Counties, 4,500 to 7,000 feet, often with pinyons and junipers, July and August. Idaho to Arizona and California.

Browsed by sheep, goats, and deer, apparently not by cattle.

4. VAUQUELINIA

A large shrub or small tree; leaves evergreen, simple, with lanceolate serrate blades; flowers numerous, in flat-topped cymose panicles; petals white; stamens 15 or more; pistils 5, coherent at base, becoming somewhat woody follicles.

1. *Vauquelinia californica* (Torr.) Sarg., Gard. and Forest 2: 400. 1889.

Spiraea californica Torr. in Emory, Mil. Recon. 140. 1848.

Mountains of Maricopa, Pinal, and Pima Counties, 2,500 to 5,000 feet, often among live oaks, May and June, type collected by Emory on mountains along the Gila River. Arizona and northern Mexico.

Arizona-rosewood. The wood is close-grained, hard, and heavy, but the trunks probably are too small to warrant exploitation.

5. HOLODISCUS. OCEANSPRAY

Shrub, up to 3 m. high, much branched; leaves deciduous, simple, the blades obovate-cuneate, coarsely crenate with few teeth, white-sericeous or sparsely villous beneath; flowers in ample terminal panicles, or the inflorescence reduced to a small raceme; flowers small; calyx and petals cream-colored; stamens many; pistils 5.

1. *Holodiscus discolor* (Pursh) Maxim., Acta Hort. Petrop. 6: 253. 1879.

Spiraea discolor Pursh, Fl. Amer. Sept. 342. 1814.

Sericotheca discolor Rydb., North Amer. Fl. 22: 262. 1908.

Apache County to Mohave County, south to Cochise and Pima Counties, 5,500 to 9,500 feet, commonly in pine or spruce forests, often on cliffs, June to September. Montana to Oregon, south to northern Mexico.

A beautiful shrub with aromatic foliage, sometimes called foambush,

and creambush. Occurs in Arizona in two forms: (1) var. *dumosus* (Nutt.) Dippel (*H. dumosus* Heller, *Sericotheca dumosa* Rydb.) with leaf blades seldom less than 2 cm. long, normally densely white-sericeous beneath, the inflorescence an ample much-branched panicle; and (2) var. *glabrescens* (Greenman) Jepson (*H. glabrescens* Heller, *Sericotheca glabrescens* Rydb.) a smaller shrub with leaf blades smaller, their lower surface green and glabrate or loosely villous on the veins and granular, the inflorescence racemose or a reduced panicle. The var. *glabrescens* occurs in Arizona only in the northern part and is most abundant in the Grand Canyon region.

6. SORBUS.⁵⁸ MOUNTAIN-ASH

A shrub commonly about 2.5 m. high; leaves odd-pinnate, the leaflets numerous, lanceolate, sharply serrate; flowers small, in terminal compound cymes; petals white; stamens many; pistil one, compound, the styles usually 3, the ovary inferior; fruit a small, berrylike pome.

The plants are favorite cultivated ornamentals, because of their attractive foliage and highly colored, usually bright-red, mature fruits, which are much relished by birds and other wild animals. Some species are small trees. The bark of *Sorbus americana* Marshall, of eastern North America, is used medicinally for its tonic, astringent, and antiseptic properties.

1. *Sorbus dumosa* Greene, Pittonia 4: 129. 1900.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 8,000 to 10,000 feet, moist rich soil of coniferous forests, June and July, type from the San Francisco Peaks (*Greene* in 1889). New Mexico and Arizona.

7. AMELANCHIER. SERVICEBERRY

Large shrubs or small trees; leaves simple, petioled, the blades serrate, dentate, or nearly entire; flowers rather large, in few-flowered racemes or fascicles, seldom solitary; calyx lobes narrow, reflexed; petals rather large, oblong or narrowly obovate, white; stamens numerous; pistil 1, compound; styles 2 to 5, separate or more or less connate; ovary inferior; fruit a small several-celled pome; seed solitary in each cell.

The small applelike fruits are edible, but insipid. The juicy fruits of certain species are esteemed by the Indians and are said to make good jelly. They are greedily devoured by birds and other animals. The plants are said to afford good browse for sheep, goats, and deer, and in spring for cattle. These plants are hosts of the cedar-apple fungus.

The taxonomy of this genus is in great confusion and the following treatment of the Arizona forms is necessarily tentative.

Key to the species

1. Styles normally 2 or 3; fruit at maturity orange or yellow, rather dry and mealy; twigs rigid, the bark soon becoming gray; leaves commonly finely pubescent or subtomentose, at least beneath; hypanthium, calyx lobes, and the top of the ovary commonly pubescent; styles separate to the base or nearly so (2).

⁵⁸ Reference: JONES, G. N. A SYNOPSIS OF THE NORTH AMERICAN SPECIES OF SORBUS. Arnold Arboretum Jour. 20: 1-43. 1939.

2. Leaf blades elliptic or oblong-ovate, finely and usually bluntly toothed, often somewhat narrowed to the obtuse or acutish apex. 1. *A. UTAHENSIS*.
2. Leaf blades mostly suborbicular, coarsely and often sharply toothed, broadly rounded or truncate and often retuse at apex.----- 2. *A. BAKERI*.
1. Styles normally 4 or 5; fruit at maturity dark plum purple, glaucous, more or less juicy; leaf blades broadly oval, ovate, or suborbicular, broadly rounded or truncate at apex, glabrate or loosely villous beneath (3).
3. Top of the ovary and the calyx glabrous from the beginning, as is the whole plant; bark of the twigs dark reddish brown, becoming gray; leaf blades coarsely serrate.----- 3. *A. POLYCARPA*.
3. Top of the ovary and usually also the calyx persistently pubescent (4).
4. Leaf blades broadly crenate-dentate, often nearly to the base, cordate or subcordate at base, 3 to 5 cm. long and about equally wide, usually soon glabrate on both faces; bark of the twigs dark reddish brown, finally becoming gray.----- 4. *A. GOLDMANII*.
4. Leaf blades serrate-dentate, rounded, truncate, or short-cuneate (rarely subcordate) at base, persistently pubescent, at least on the lower surface (5).
5. Hypanthium at anthesis commonly villous, often copiously so; calyx lobes pubescent on both faces; leaf blades seldom more than 2.5 cm. long, becoming thickish, more or less persistently pubescent on both faces, grayish green above, the margin finely toothed, usually not to far below the middle; bark of the twigs soon becoming gray.----- 5. *A. OREOPHILA*.
5. Hypanthium at anthesis glabrous or nearly so; calyx lobes commonly glabrate externally; leaf blades mostly not less than 3 cm. long, remaining thin, glabrate and bright green above, the margin coarsely toothed, often nearly to the base; bark of the twigs more persistently reddish brown.----- 6. *A. MORMONICA*.

1. *Amelanchier utahensis* Koehne, Gatt. Pomac. 25. 1890.

Amelanchier rubescens Greene, Pittonia 4: 128. 1900.

Apache County to Mohave County, 2,000 to 7,000 feet, dry rocky slopes, common in and around the Grand Canyon, May. Colorado to Nevada, New Mexico, and northern Arizona.

Occasional specimens with the upper leaf surface glabrous or glabrate and somewhat shiny approach *A. nitens* Tidestrom.

2. *Amelanchier bakeri* Greene, Pittonia 4: 128. 1900.

Apache (?), Navajo, Coconino, and Gila Counties, 4,000 to 7,000 feet, April and May. Colorado, New Mexico, and Arizona.

Commonly about 2.5 m. (8 feet) high.

3. *Amelanchier polycarpa* Greene, Pittonia 4: 127. 1900.

North rim of the Grand Canyon (*Eastwood* and *Howell* 1047a, 7069). Wyoming to New Mexico and northern Arizona.

Other specimens from the Grand Canyon (*Eastwood* 6047, *Eastwood* and *Howell* 948), having exceptionally small and shallowly dentate leaves and small flowers, are referred doubtfully to this species.

4. *Amelanchier goldmanii* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 131. 1913.

North rim of the Grand Canyon, San Francisco Peaks, and Flagstaff (Coconino County), Lukachukai Mountains and Willow Spring near Fort Apache (Apache County), 7,000 to 8,000 feet, May and June. New Mexico and Arizona.

It is doubtful that this and the two following are more than varieties of *A. alnifolia* Nutt., a species widely distributed in western North America.

5. *Amelanchier oreophila* A. Nels., Bot. Gaz. 40: 65. 1905.

Apache, Navajo, Coconino, Gila, and Yavapai Counties, 4,000 to 7,000 feet, April and May. Montana to New Mexico, Arizona, and Nevada.

In the absence of mature fruit, this species is likely to be confused with *A. bakeri*, but the latter has usually more coarsely toothed leaf blades.

6. *Amelanchier mormonica* C. K. Schneid., Repert. Spec. Novarum Regni Veg. 3: 182. 1906.

Apache, Navajo, Coconino, and Gila Counties, 6,300 to 9,500 feet, May and June, also Sycamore Canyon near Ruby, Santa Cruz County, about 4,000 feet (*Goodding* 6488), type from Mormon Lake, Coconino County (*MacDougal* 102). Wyoming to New Mexico and Arizona.

This shrub attains a height of at least 3.6 m. (12 feet). The species seems to be intermediate between *A. goldmanii* and *A. oreophila*.

Peraphyllum ramosissimum Nutt., the so-called squaw-apple, is to be sought in northern Arizona. It is closely related to *Amelanchier* but has the flowers solitary or 2 or 3 in a cluster, petals pink, and leaf blades narrowly oblanceolate.

8. CRATAEGUS. HAWTHORN

Shrubs or small trees, armed with strong sharp thorns; leaves simple, petioled, serrate to shallowly lobed, strongly veined, sparsely pubescent beneath or glabrate; flowers in several-flowered corymbs; petals rather small, round, usually white; fruits nearly globose, thin-fleshed, nearly filled by the large bony seeds.

Key to the species

1. Spines few, not more than 2.5 cm. long; leaf blades elliptic, about twice as long as wide, not or scarcely lobed, tapering at base.----- 1. *C. RIVULARIS*.
1. Spines numerous, 3 to 5 cm. long; leaf blades ovate, less than twice as long as wide, often distinctly lobed, rather abruptly contracted at base.
 2. *C. ERYTHROPODA*.

1. *Crataegus rivularis* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 464. 1840.

Clear Creek Canyon southeast of Winslow, Navajo County, about 5,000 feet (*Vaughn* and *Benham* 6463). Wyoming and Idaho, south to New Mexico and northern Arizona.

2. *Crataegus erythropoda* Ashe, N. C. Agr. Expt. Sta. Bul. 175: 113. 1900.

Bonito Creek, White Mountains, Apache County (*Goldman* 2495), Oak Creek Canyon, Coconino County (*Pearson* 445, *Goldman* 2184), 5,400 to 6,000 feet, along streams in canyons. Wyoming to New Mexico and Arizona.

The specimens from Oak Creek Canyon approach *C. wootoniana* Eggleston in their rather deeply lobed leaves.

9. RUBUS

Plants shrubby, of diverse habit and appearance, often prickly; leaves simple or pinnate; flowers in few-flowered racemes or corymbs, sometimes solitary, the petals white or tinged with pink; stamens numerous; pistils several or numerous, on a convex receptacle, becoming 1-seeded drupelets aggregated in a more or less fleshy fruit.

This large genus includes the cultivated blackberries and raspberries. In Arizona, *R. strigosus* var. *arizonicus*, a raspberry, and *R. oligospermus*, a blackberry, produce edible fruits, good for eating raw and often used locally for making jam and jelly. The fruits are much relished by birds and other wild animals. The most ornamental of the species, with large white flowers, are the thimbleberries, *R. neomexicanus* and *R. parviflorus*, which are reported to be extensively browsed by deer.

Key to the species

1. Stems unarmed, not prickly or bristly; bark exfoliating; leaves simple, 3- to 5-lobed; petals 15 to 30 mm. long; fruit red, not very juicy, hemispheric or flatter; styles short, club-shaped (2).
 2. Leaf blades 5 to 20 cm. wide, the lobes acute or acuminate; flowers usually in loose clusters of 3 or more, seldom solitary; styles glabrous; drupelets capped by a hard, pubescent cushion----- 1. *R. PARVIFLORUS*.
 2. Leaf blades 3 to 10 cm. wide, the lobes acute or obtuse; flowers solitary, or in 2's; styles hairy; drupelets not capped by a pubescent cushion.
 2. *R. NEOMEXICANUS*.
1. Stems prickly or at least bristly; bark not exfoliating; leaves compound; petals less than 15 mm. long; styles elongate (3).
 3. Sepals shorter than the petals; fruit globose or nearly so; drupelets glabrous at maturity or very nearly so; stems, petioles, and leaf veins, beneath, armed with short, flattened, reflexed or recurved prickles; leaves of the shoots pedately 5-foliolate, those of the flowering stems 3-foliolate (4).
 4. Stems prostrate, only the flowering branches erect; lower surface of the leaf blades green, soon glabrate, the veins only slightly prominent; inflorescence corymbiform, 1- to 5-flowered; fruit dark red at maturity, the drupelets large----- 3. *R. OLIGOSPERMUS*.
 4. Stems erect, ascending, or recurved; lower surface of the leaf blades permanently white-tomentose, the veins prominent; inflorescence cymose-paniculate, elongate, several- to many-flowered; fruit black at maturity.
 4. *R. PRO CERUS*.
 3. Sepals equaling or longer than the petals, caudate-acuminate; fruit hemispheric or somewhat higher; drupelets pubescent; leaflets sharply double-serrate, white-tomentose beneath (5).
 5. Spines slender or reduced to bristles, straight or nearly so; inflorescence and hypanthium spinose-bristly, more or less glandular; leaves all pinnate, on the shoots 5- to 7- (rarely 9-) foliolate, on the flowering branches usually 5- (sometimes 3-) foliolate; terminal leaflet ovate or ovate-lanceolate; mature fruit bright red----- 5. *R. STRIGOSUS*.
 5. Spines stout, laterally flattened, those of the branchlets strongly curved; inflorescence and hypanthium not bristly, the pubescence soft; leaves of the shoots often pedately 5-foliolate, those of the flowering branches 3-foliolate; terminal leaflet broadly ovate; mature fruit dark red to nearly black----- 6. *R. LEUCODERMIS*.

1. *Rubus parviflorus* Nutt., Gen. Pl. 1: 308. 1818.

Rubacer parviflorum Rydb., Torrey Bot. Club Bul. 30: 274. 1903.

Tunitcha Mountains and White Mountains (Apache County), 8,000 to 9,500 feet, July. Michigan to Alaska, south to New Mexico, eastern Arizona, and California.

2. *Rubus neomexicanus* A. Gray, Pl. Wright. 2: 55. 1853.

Oreobatus neomericanus Rydb., Torrey Bot. Club Bul. 30: 275. 1903.

Coconino County to Cochise and Pima Counties, 5,000 to 9,000 feet, May to September. New Mexico, Arizona, and northern Mexico.

3. **Rubus oligospermus** Thornber ex Rydb., North Amer. Fl. 22: 470. 1913.

Graham, Gila, Pinal, and Pima Counties, 3,500 to 5,000 feet, often along streams in partial shade, March to May, type from the Santa Rita Mountains, Pima County (*Pringle* in 1881). Arizona and northern Mexico.

Closely related to *R. trivialis* Michx., the southern dewberry of the eastern United States, but lacks bristles on the stems and has more finely serrate leaf blades. The trailing habit of the plant makes it a good ground cover, protecting the soil against erosion.

4. **Rubus procerus** Muell., Soc. Acad. Maine et Loire Mém. 24: 209. 1868.

?*Rubus thyrsanthus* of authors. Not of Focke?

Oak Creek Canyon, Coconino County (*Fulton* 9695), Sierra Ancha, Gila County (*Kearney* and *Harrison* 5950), about 6,000 feet.

This is an introduced species, probably the one cultivated under the name Himalaya-berry and, although growing semiwild at the stations mentioned, it can scarcely be regarded as established in the Arizona flora. The identity of the species is uncertain.

5. **Rubus strigosus** Michx., Fl. Bor. Amer. 1: 297. 1803.

Apache County to Mohave County, south to Cochise and Pima Counties, 8,500 to 11,500 feet, rich soil of pine and spruce forests, June and July. Widely distributed in the cooler parts of North America.

This species is the progenitor of some of the cultivated raspberries. It is represented in Arizona by var. *arizonicus* (Greene) *Kearney* and *Peebles* (*Batidaea arizonica* Greene, *Rubus arizonicus* Rydb.), which seems to differ from typical *R. strigosus* only in having usually more numerous leaflets, up to 9 on the shoots, mostly 5 on the flowering branches.

6. **Rubus leucodermis** Dougl. ex. Torr. and Gray, Fl. North Amer. 1: 454. 1840.

Melanobatus bernardinus Greene, Leaflets 1: 244. 1906.

Rubus bernardinus Rydb., North Amer. Fl. 22: 444. 1913.

Along Oak Creek, Coconino County, about 5,500 feet (*Goldman* 2171, *Fulton* 4356). Montana to British Columbia, south to New Mexico, central Arizona, and California.

10. FRAGARIA. STRAWBERRY

Plants herbaceous, acaulescent; scapes from short rootstocks, these emitting long runners; leaves long-petioled, digitately trifoliolate, the leaflets obovate or wedge-shaped, coarsely toothed; flowers rather large, the petals broad and rounded, white; stamens many; pistils numerous, becoming achenes embedded in pits on the surface of the enlarged fleshy receptacle.

The fruits of the wild strawberries, although edible, are too small to be of much use to man, although doubtless they are relished by birds and other animals.

Key to the species

1. Hairs of the scapes (and commonly of the petioles) appressed or ascending; leaves commonly somewhat glaucous, thickish; leaflets obovate-oblong to nearly spatulate, long-cuneate at base, few-toothed, mainly toward the apex; fruit deeply pitted, the seeds partly buried in the flesh.
1. Hairs of the scapes and petioles soon spreading or somewhat reflexed; leaves not glaucous, thin; leaflets rhombic-ovate or obovate, short-cuneate at base, toothed to well below the middle; fruit shallowly pitted, the seeds superficial..... 2. *F. CALIFORNICA*.
1. ***Fragaria cuneifolia*** Nutt. ex Howell, Fl. Northwest Amer. 1: 174. 1898.

Fragaria ovalis (Lehm.) Rydb., Torrey Bot. Club Bul. 33: 143. 1906.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 7,000 to 11,000 feet, common in coniferous forests, May to October. Idaho to British Columbia, south to New Mexico, Arizona, and Oregon.

2. ***Fragaria californica*** Cham. and Schlecht., Linnaea 2: 20. 1827.

Fragaria bracteata Heller, Torrey Bot. Club Bul. 25: 194. 1896.

Pinaleno Mountains, Graham County (*Shreve* 5231), Chiricahua Mountains, Cochise County (*Eggleston* 10805), 8,000 to 9,000 feet, June to September. Montana to British Columbia, New Mexico, southeastern Arizona, and California.

11. POTENTILLA.⁵⁹ CINQUEFOIL

Plants biennial or perennial, mostly herbaceous (one species shrubby); stems leafy or scapose, often from a somewhat woody branched caudex or rootstock; inflorescence cymose (the flowers seldom solitary); sepals alternating with bractlets; petals commonly yellow but sometimes whitish, red, or purple; stamens 5 to many, inserted at base of the low receptacle or on the margin of the flat to hemispheric hypanthium; pistils few to numerous, the style basal to terminal; fruits of achenes.

Some of the species are grazed by sheep.

Key to the species

1. Styles lateral; petals yellow or yellowish (2).
2. Achenes silky-villous; plant shrubby, the bark shreddy; leaves pinnately 3- to 7-foliolate, sericeous, the leaflets linear or narrowly oblanceolate, entire; flowers large and showy, the petals bright yellow, 10 mm. long or longer, much surpassing the bractlets and sepals; stamens and pistils numerous; Section *Dasiphora*..... 1. *P. FRUTICOSA*.
2. Achenes glabrous; plants herbaceous (3).
3. Plants caulescent, viscid-villous; stems 30 cm. long or longer, leafy; basal leaves pinnate, with 5 to 9 broadly ovate or obovate, coarsely toothed leaflets; stamens and pistils numerous; style attached near the base of the achene: Section *Drymocallis* (4).
4. Herbage conspicuously villous; leaflets thickish, densely pubescent to glabrate above, the terminal one oval to rhombic-obovate; inflorescence dense, strict; sepals at anthesis 5 to 9 mm. long.
2. *P. ARGUTA*.

⁵⁹ The writers are indebted to David D. Keck for valuable suggestions concerning this genus.

- 4. Herbage not conspicuously villous; leaflets thin, sparsely pubescent to glabrate above, the terminal one obovate; inflorescence dense or rather open; sepals at anthesis 4 to 6 mm. long. 3. P. GLANDULOSA.
- 3. Plants acaulescent or nearly so, not viscid (5).
- 5. Plants without runners; leaves green on both faces, digitately 3-foliolate; leaflets cuneate-obovate, 3- to 5-dentate at the truncate apex; petals ochroleucous or pale yellow, shorter than the sepals; stamens usually 5; Section *Sibbaldia*..... 4. P. SIBBALDI.
- 5. Plants with runners; leaves silvery-sericeous at least beneath, pinnately multifoliolate with much smaller leaflets interspersed with the large ones; leaflets oblong, elliptic, or obovate, coarsely toothed; petals bright yellow, much longer than the sepals; stamens numerous; Section *Argentina*..... 5. P. ANSERINA.
- 1. Styles terminal or nearly so (6).
- 6. Stamens 5, inserted at a considerable distance from the base of the receptacle and from the pistils; pistils 1 to 5; leaves pinnate; hypanthium with a flat or saucer-shaped peripheral expansion, on which the stamens are inserted; leaves elongate, narrow, with very many small leaflets; stems erect, 30 cm. long or longer; Section *Ivesia*, *Comarella* (7).
- 7. Leaflets cleft at apex; petals dark purple..... 6. P. MULTIFOLIOLATA.
- 7. Leaflets parted or divided; petals yellow..... 7. P. SABULOSA.
- 6. Stamens seldom fewer than 10, inserted close to the pistils, these 5 or more; Section *Eupotentilla* (8).
- 8. Petals rose red or dark red; plants caulescent; stems erect or nearly so, seldom less than 30 cm. long; basal leaves with 5 to 7 leaflets, digitate or nearly so..... 8. P. THURBERI.
- 8. Petals yellow (9).
- 9. Inflorescence usually many-flowered, conspicuously leafy, its leaves not bractlike although usually smaller than the other stem leaves; plants annual or biennial; flowers inconspicuous, the petals seldom surpassing the sepals; styles short, fusiform; leaves digitate or the lower ones pinnate with a short rachis; leaflets coarsely toothed or shallowly cleft (10).
- 10. Petals not much shorter than the sepals; achenes commonly finely rugose; hairs of the stem mostly rather stiff, long, and spreading or widely ascending; leaves all 3-foliolate or the lower ones pinnately 5-foliolate..... 9. P. MONSPELIENSIS.
- 10. Petals much shorter than the sepals; achenes usually smooth; hairs of the stem soft, mostly short and subappressed (11).
- 11. Branches erect or ascending at a narrow angle; cymes elongate, racemiform; pubescence partly glandular; leaves all digitate, trifoliolate..... 10. P. BIENNIS.
- 11. Branches spreading or ascending at a wide angle; cymes not racemiform; pubescence not glandular..... 11. P. RIVALIS.
- 9. Inflorescence few-flowered or, if many-flowered, then not conspicuously leafy, its leaves mostly much reduced; plants perennial; flowers commonly showy; petals usually surpassing the sepals (12).
- 12. Basal leaves pinnate, the rachis elongate (except in *P. pulcherrima*); plants caulescent; inflorescence several- to many-flowered (13).
- 13. Leaves at base of the plant bipinnate, the primary divisions parted or divided into linear, lanceolate, or oblanceolate lobes; pubescence strigose or villous; flowering stems decumbent, seldom more than 20 cm. long; cymes few-flowered; pedicels elongate, slender, often somewhat arcuate; bractlets nearly equaling the ovate-lanceolate, acuminate sepals; petals considerably longer than the sepals..... 12. P. PLATTENSIS.
- 13. Leaves at base of the plant simply pinnate, the primary divisions at most coarsely toothed (14).
- 14. Leaflets shallowly toothed toward the apex, usually entire below the middle..... 13. P. CRINITA.
- 14. Leaflets deeply toothed or cleft more than half of their length, usually nearly to the base; stems seldom less than 25 cm. long; inflorescence open, often many-flowered; petals distinctly surpassing the sepals (15).
- 15. Basal leaves obscurely pinnate, the rachis very short (3 to 8 mm. long); leaflets 5 to 9, crowded, green above, usually conspicuously white-tomentose as well as sericeous beneath.
- 14. P. PULCHERRIMA.

15. Basal leaves noticeably pinnate, the rachis 10 to 50 mm. long; leaflets densely silvery-sericeous and often white-tomentose beneath..... 15. *P. HIPPIANA*.
12. Basal leaves digitate or nearly so, the rachis if any very short; leaflets 7 (rarely 9) or fewer (16).
16. Plants caulescent, the flowering stems erect or ascending, seldom less and usually more than 20 cm. long; inflorescence several- (usually more than 5-) to many-flowered; petals 6 to 10 mm. long (17).
17. Leaves sparsely villous with subappressed hairs, or glabrate, light or yellowish green on both faces; leaflets merely coarsely toothed..... 16. *P. DIVERSIFOLIA*.
17. Leaves sericeous on both faces, copiously so beneath, dark green above, white or whitish on the lower face; leaflets cleft nearly to the midvein into linear divisions..... 17. *P. PECTINISECTA*.
16. Plants subcaulescent, strongly cespitose, the flowering stems spreading or prostrate, less than 20 cm. long; inflorescence few- (usually not more than 5-) flowered (18).
18. Leaves more or less white-tomentose as well as sericeous beneath, green and sericeous above; styles rather short and thick..... 18. *P. CONCINNA*.
18. Leaves not white-tomentose beneath; styles elongate, filiform (19).
19. Plant conspicuously and densely silky-villous, obscurely if at all glandular..... 19. *P. WHEELERI*.
19. Plants sparsely villous or subhirsute, often also glandular-puberulent, especially in the inflorescence (20).
20. Leaflets of the basal leaves 5 (occasionally 7); inflorescence usually with numerous tack-shaped glandular hairs..... 20. *P. SUBVISCOSA*.
20. Leaflets of the basal leaves 3; inflorescence viscid but without tack-shaped hairs..... 21. *P. ALBIFLORA*.

1. *Potentilla fruticosa* L., Sp. Pl. 495. 1753.

Dasiphora fruticosa Rydb., Columbia Col. Bot. Mem. 2: 188. 1898.

San Francisco Peaks and vicinity of Flagstaff (Coconino County), White Mountains (Apache County), 7,000 to 9,500 feet, along streams and in wet meadows, June to August. Widely distributed in the cooler parts of the Northern Hemisphere.

The only shrubby species in Arizona, browsed by sheep, goats, and deer, sometimes until the plants are stunted. Rated as an excellent erosion control species in localities to which it is adapted. Very handsome when flowering.

2. *Potentilla arguta* Pursh, Fl. Amer. Sept. 736. 1814.

Potentilla convallaria Rydb., Torr. Bot. Club Bul. 24: 249. 1897.

Drymocallis agrimonioides Rydb., North Amer. Fl. 22: 368. 1908.

Drymocallis convallaria Rydb., Columbia Col. Bot. Mem. 2: 193. 1898.

White Mountains, Apache County, on the White River (*Hough* in 1918) and on Bonito Creek, in meadows (*Goodding* 1219), Clear Creek Canyon, Navajo County (*Goodding* 6473), June and July. New Brunswick to Mackenzie, south to the District of Columbia, New Mexico, and eastern Arizona.

Hough's specimen is glabrate, *Goodding's* is more pubescent.

3. *Potentilla glandulosa* Lindl., Edwards's Bot. Reg. 19: pl. 1583. 1833.

Drymocallis glandulosa Rydb., Columbia Col. Bot. Mem. 2: 198. 1898.

Drymocallis arizonica Rydb., North Amer. Fl. 22: 373. 1908.

Near Williams and Mormon Lake (Coconino County), Mazatzal Mountains (Gila County), 5,000 to 7,000 feet, wet places, May and June, type of *D. arizonica* from Mormon Lake (*MacDougal* 64). South Dakota to British Columbia south to New Mexico, central Arizona, and California.

It is stated that the petals are white.

4. *Potentilla sibbaldi* Hall. f. ex. Ser., Mus. Helv. 1: 51. 1818.

Sibbaldia procumbens L., Sp. Pl. 284. 1753. Not *Potentilla procumbens* Sibth.

San Francisco Peaks (Coconino County), 11,000 to 12,000 feet, July and August. Circumpolar and alpine in the Northern Hemisphere.

5. *Potentilla anserina* L., Sp. Pl. 495. 1753.

Argentina anserina Rydb., Columbia Col. Bot. Mem. 2: 159. 1898.

White Mountains (Apache and Greenlee Counties), Flagstaff and vicinity (Coconino County), wet mountain meadows, May to August. Widely distributed in the cooler parts of the Northern Hemisphere.

Silverweed. The typical form, with leaves green above, occurs in the White Mountains, and var. *concolor* Seringe (*Argentina argentea* Rydb.), with leaves silvery-sericeous on both faces, in the Flagstaff region.

6. *Potentilla multifoliolata* (Torr.) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 481. 1939.

Horkelia(?) *multifoliolata* Torr. in Sitgreaves, Zuñi and Colo. Rpt. 159. 1853.

Comarella multifoliolata Rydb., Columbia Col. Bot. Mem. 2: 156. 1898.

Ivesia multifoliolata Keck, Lloydia 1: 125. 1938.

San Francisco Peaks, Mormon Lake, Oak Creek, Mogollon Escarpment (Coconino County), 5,900 to 7,500 feet, in washes, etc., June to August, type collected in "western New Mexico" (now Arizona) by Woodhouse. Known only from Arizona.

- *7. *Potentilla sabulosa* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 680. 1895.

Horkelia mutabilis T. S. Brandeg., Bot. Gaz. 27: 446. 1899.

Ivesia sabulosa Keck, Lloydia 1: 124. 1938.

Not known definitely from Arizona, but occurs in southern Utah and Nevada.

8. *Potentilla thurberi* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 318. 1855.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 6,000 to 9,000 feet, rich soil of coniferous forests, July

to October. New Mexico to southern California and northern Mexico.

The typical form, with leaflets rather sparsely sericeous beneath, and var. *atrorubens* (Rydb.) Kearney and Peebles (*P. atrorubens* Rydb.), with leaflets densely silvery-sericeous beneath, are about equally common. The type of this variety was collected in Arizona (*Rothrock* 399). The var. *sanguinea* (Rydb.) Kearney and Peebles (*P. sanguinea* Rydb.), with basal leaves subpinnate rather than strictly digitate, as in the other forms, has been collected only in Coconino County, at Walnut Canyon (*MacDougal* 331, the type collection), and in Oak Creek Canyon (*Fulton* 9661).

9. *Potentilla monspeliensis* L., Sp. Pl. 499. 1753.

Kaibab Plateau, San Francisco Peaks, Flagstaff (Coconino County), White Mountains (Apache and Greenlee Counties), 7,000 to 9,500 feet, wet meadows, June to August. Almost throughout North America; probably introduced from Europe.

10. *Potentilla biennis* Greene, Fl. Francisc. 65. 1891.

Grand Canyon (*Toumey* 98), July. Saskatchewan to British Columbia, south to Colorado, northern Arizona, and Baja California.

11. *Potentilla rivalis* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 437. 1840.

San Francisco Peaks (*Wootton* in 1892), Bangharts Ranch (Del Rio), Yavapai County (*Rusby* in 1883), Gila River bed, Sacaton, Pinal County (*Harrison* and *Peebles* 1744, 1968), the last doubtless strays from the mountains, April to July. Illinois to Washington, south to Arizona, northern Mexico, and California.

The var. *millegrana* (Engelm.) S. Wats. (*P. millegrana* Engelm.), a smaller and more diffuse plant with basal leaves all digitately 3-foliolate (these usually pinnately 5- to 7-foliolate in typical *P. rivalis*), was collected in "southern Utah, northern Arizona, etc." (*Palmer* 143).

12. *Potentilla plattensis* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 439. 1840.

Ivesia pinnatifida S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 364. 1885.

Potentilla arizonica Greene, Pittonia 1: 104. 1887.

Flagstaff, Coconino County (*Lemmon* 3200, type collection of *Ivesia pinnatifida*), White Mountains, Apache County (*Gooding* 1192, *Kearney* and *Peebles* 12421), 7,000 to 8,500 feet, moist grassy meadows, July and August. Saskatchewan to New Mexico and Arizona.

The Arizona specimens apparently differ from most of the specimens from farther east and north only in the more villous herbage.

13. *Potentilla crinita* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 41. 1849.

Apache County to Coconino County, also in the Huachuca Mountains (Cochise County), 6,000 to 8,000 feet, commonly in pine forests, July to September (April and May in Cochise County). Colorado, Utah, New Mexico, and Arizona.

The var. *lemmoni* (S. Wats.) Kearney and Peebles (*Ivesia lemmoni* S. Wats., *Potentilla lemmoni* Greene), occurs in the vicinity of Flag-

staff, Coconino County, type from Oak Creek Canyon (*Lemmon* in 1884). It differs from typical *P. crinita* in the more erect, stiffer stems, leaflets toothed only at or very near the apex, and petals usually not surpassing the sepals.

14. *Potentilla pulcherrima* Lehm., Nov. Stirp. Pugill. 2: 10. 1830.

Apache County to Coconino County, 8,000 to 11,300 feet, open coniferous forests, July and August. Canada to New Mexico and northern Arizona.

This species apparently intergrades with *P. hippiana*.

15. *Potentilla hippiana* Lehm., Nov. Stirp. Pugill. 2: 7. 1830.

Apache, Navajo, and Coconino Counties, and in the Pinaleno Mountains (Graham County), 7,500 to 11,500 feet, grassy meadows and open coniferous forests, June to September. South Dakota to Alberta, south to New Mexico and Arizona.

The typical form has the leaves almost equally sericeous on both faces. In var. *diffusa* (A. Gray) Lehm. (*P. propinqua* Rydb.), which has much the same distribution in Arizona as the typical form and is at least equally abundant, the upper surface of the leaves is green and much less sericeous than the lower surface.

16. *Potentilla diversifolia* Lehm., Nov. Stirp. Pugill. 2: 9. 1830.

Potentilla glaucophylla Lehm., Delect. Sem. Hort. Hamburg. 7. 1836.

Kaibab Plateau and San Francisco Peaks (Coconino County), White Mountains (Apache County), perhaps also in the Pinaleno Mountains (Graham County), 9,000 to 12,000 feet, July to September. Canada to New Mexico, Arizona, and California.

The Arizona specimens are of the sparsely pubescent or glabrate form (*P. glaucophylla*).

17. *Potentilla pectinsecta Rydb., Torrey Bot. Club Bul. 24: 7. 1897.

Collected, possibly in extreme northern Arizona, by *E. Palmer* in 1877 (No. 145). Wyoming, Utah, and (?) northern Arizona.

18. *Potentilla concinna* Richards., Bot. App. Frankl. Jour. ed. 2, 20. 1823.

Betatakin, Navajo County (*Wetherill* 76), San Francisco Peaks, Coconino County, 11,000 to 12,000 feet (*Lemmon* in 1884, *Whiting* 756, *Little* 4613, 4650).

Wetherill's and *Lemmon's* specimens probably belong to *P. concinnaeformis* Rydb., with leaflets merely strigose above. *Whiting's* and *Little's* specimens seem to be *P. modesta* Rydb., with leaflets densely sericeous above. It is doubtful that these forms are specifically distinct from *P. concinna*, which ranges from Canada to Colorado and Utah (probably also to New Mexico and Arizona).

19. *Potentilla wheeleri* S. Wats., Amer. Acad. Arts and Sci. Proc. 11:148. 1876.

Potentilla viscidula Rydb., North Amer. Fl. 22: 327. 1908.

Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), 8,000 feet and probably higher, rock crevices, May,

type of *P. viscidula* from the Santa Rita Mountains (*Pringle* in 1881). Southeastern Arizona, Chihuahua, California, and Baja California.

20. *Potentilla subviscosa* Greene, Torrey Bot. Club Bul. 8: 97. 1881.

Coconino County, 6,500 to 12,000 feet, coniferous forests and mountain meadows, May and June. New Mexico and Arizona.

More widely distributed than the typical form in Arizona is var. *ramulosa* (Rydb.) Kearney and Peebles (*P. ramulosa* Rydb.), which ranges in the mountains from Coconino to Pima County. It is distinguished by the less deeply and more coarsely incised leaflets, and often by a less strictly acaulescent habit of growth. The type of *P. ramulosa* was collected in Arizona (*Lemmon* 399).

21. *Potentilla albiflora* L. Williams, Torrey Bot. Club Bul. 61: 260. 1934.

Known only from the Pinaleno Mountains, Graham County (*Goodding* 1045 the type collection, *Kearney* and *Peebles* 9794, etc.), 7,500 to 9,500 feet, abundant on rocky slopes and in open coniferous forests, May to August.

The petals were described by Williams as white, but they are pale yellow when fresh.

12. PURPUSIA

Plants small, herbaceous, perennial, glandular-pubescent; stems from a branched caudex; basal leaves pinnate with 5 to 11 leaflets, these broad, deeply toothed or cleft; flowers few, in loose cymose panicles; hypanthium campanulate or turbinate, without bractlets; petals small, yellow or whitish; stamens 5, inserted on the margin of the hypanthium remote from the pistils; pistils several (up to 11), borne on an elongate, conic or cylindric, stalked, hairy receptacle; achenes longitudinally ribbed (in the Arizona species).

1. *Purpusia arizonica* Eastw., Madroño 2: 12. 1930.

Purpusia osterhoutii A. Nels., Amer. Jour. Bot. 21: 574. 1934.

Known only from the Grand Canyon, both rims, 6,500 to 7,500 feet, crevices of rocks, June to August.

P. osterhoutii (type *Osterhout* 7103) was described as having a glabrous receptacle, but in other characters the description corresponds closely with that of *P. arizonica*.

13. GEUM. AVENS

Plants herbaceous, perennial; flowering stems from a thick root-stock or caudex, leafy or subscapose; leaves pinnate or deeply pinnatifid; flowers solitary or in few-flowered cymes, relatively large; petals yellow, sometimes tinged with purple or pink; stamens and pistils numerous; achenes tipped by the long, often plumose, sometimes jointed, persistent styles.

Key to the species

1. Stems leafy, the lower stem leaves not much smaller than the basal ones; leaves with few divisions, the terminal one much the largest; styles conspicuously geniculate above the middle, the upper section promptly deciduous, the persistent lower section becoming sharply hooked (2).
2. Upper section of the style hirsute, the lower section glabrous or sparsely pubescent toward the base, not glandular-----1. G. STRICTUM.

2. Upper section of the style short-pubescent near the base or glabrate, the lower section glandular-puberulent..... 2. *G. MACROPHYLLUM*.
1. Stems subscapose, all of their leaves greatly reduced; basal leaves with many divisions, the terminal one not much larger than the other upper ones; styles not conspicuously geniculate, straight or somewhat curved toward the apex, the upper section persistent or tardily deciduous, glabrous (3).
3. Styles not greatly elongate in fruit, glabrous; hypanthium turbinate, acute at base; plant not conspicuously pubescent..... 3. *G. TURBINATUM*.
3. Styles greatly elongate in fruit, plumose below the short terminal section; hypanthium not turbinate, broad, rounded, and more or less depressed at base; plant conspicuously hirsute; leaflets cuneate, few-toothed or cleft..... 4. *G. CILIATUM*.

1. *Geum strictum* Ait., Hort. Kew. 2: 217. 1789.

Coconino and Yavapai Counties, 5,300 to 7,000 feet, rich soil of pine forests, July and August. Widely distributed in the cooler parts of the Northern Hemisphere.

The Arizona specimens belong to var. *decurrens* (Rydb.) Kearney and Peebles (*G. decurrens* Rydb.), the common form of the Rocky Mountain region, with the upper leaf segments more or less decurrent on the rachis.

2. *Geum macrophyllum* Willd., Enum. Pl. 557. 1809.

Geum oregonense (Scheutz) Rydb., Torrey Bot. Club Bul. 25: 56. 1898.

White Mountains, Apache County (*Goodding* 530, *Kearney* and *Peebles* 12389), Pinaleno Mountains, Graham County (*Peebles* et al. 4452), about 9,000 feet, rich soil along streams, July and August. Throughout most of the cooler part of North America.

3. *Geum turbinatum* Rydb., Torrey Bot. Club Bul. 24: 91. 1897.

Acomastylis turbinata Greene, Leaflets 1: 174. 1906.

San Francisco Peaks (Coconino County), 10,000 to 12,000 feet, July to September. Montana to New Mexico, northern Arizona, and Nevada.

4. *Geum ciliatum* Pursh, Fl. Amer. Sept. 352. 1814.

Sieversia ciliata G. Don, Hist. Dichl. Pl. 2: 528. 1832.

Apache, Navajo, Coconino, and northern Gila Counties, 6,000 to 9,000 feet, pine forests, May to August. Alberta and British Columbia, south to New Mexico, Arizona, and Washington.

Oldman-whiskers, grandfathers-beard. An attractive plant with pink flowers and silvery-plumose tails to the fruits, said to make good forage for sheep. The Arizona form is var. *griseum* (Greene) Kearney and Peebles (*Erythrocoma grisea* Greene, *Sieversia grisea* Rydb.) with shorter bracts and less deeply incised leaflets than in most specimens of *G. ciliatum* from farther north. The type of *E. grisea* was collected on the San Francisco Peaks, Coconino County (*Leiberg* 5578). E. L. Greene described also *Erythrocoma arizonica* and *E. tridentata*, both based on Arizona types, but these seem not to differ appreciably from *E. grisea*.

14. FALLUGIA. APACHE-PLUME

Plant a much-branched, somewhat straggling shrub, 1 to 2 m. high; branches slender, with white bark; leaves more or less evergreen, fascicled, obovate-cuneate, pinnately cleft or divided; flowers large,

commonly solitary; hypanthium hemispheric, bearing 5 narrow bractlets alternating with the sepals; petals broad, white; stamens and pistils numerous; achenes with long purplish plumose persistent styles.

1. *Fallugia paradoxa* (D. Don) Endl., Genera Pl. 1246. 1840.

Sieversia paradoxa D. Don, Linn. Soc. London Trans. 14: 576. 1825.

Navajo, Coconino, and Mohave Counties south to Cochise and Pima Counties, 3,700 to 8,000 feet, common, often in chaparral, April to October. Southern Colorado, Utah, Arizona, and northern Mexico.

This handsome shrub affords fairly good browse for cattle and sheep and is of value as a soil binder. The Hopi Indians use an infusion of the leaves as a stimulant of hair growth.

15. COWANIA. CLIFFROSE

Plants shrubby or arborescent, often resinous and strong smelling, the stems usually erect and rather stiff; leaves evergreen, thick, obovate-cuneate and pinnately cleft or parted, to entire and narrowly spatulate, with revolute margins, loosely lanate or glabrate above, densely white-lanate beneath; flowers solitary at the ends of the branchlets, rather large; hypanthium turbinate; petals broadly obovate, white or pale yellow; pistils few, with long plumose whitish persistent styles.

1. *Cowania stansburiana* Torr. in Stansb., Expl. Great Salt Lake 386. 1853.

Cowania davidsonii Rydb., North Amer. Fl. 22: 416. 1913.

Apache County to Mohave County, south to Cochise and Santa Cruz Counties, 3,500 to 8,000 feet, very common on dry slopes and mesas, especially in the juniper-pinyon association, often on limestone, April to September, type of *C. davidsonii* from Blue River, Greenlee County (*Davidson* 754). Southern Colorado to Nevada, Arizona, southern California, and northern Mexico.

Sometimes called quinine-bush. This is one of the most important winter browse plants for cattle, sheep, and deer, despite the bitter taste of the foliage. It is reported that strips of the inner bark were braided together by the aborigines of Utah and Nevada and used for clothing, sandals, rope, and mats. The plant is used by the Hopi Indians as an emetic and as a wash for wounds, and the wood, formerly, for making arrows. Under favorable circumstances the shrub attains a height of 7.5 m. (25 feet), but is ordinarily much smaller. The flowers are fragrant.

What appears to be an undescribed species of *Cowania* has been collected in eastern Mohave County near the Aquarius Mountains, altitude 2,500 feet (*Darrow* and *Crooks* 3, *Darrow* and *Benson* 10891), flowering in April. It is a straggling shrub 0.3 to 0.75 m. high, not glandular-punctate or viscid, with leaves narrowly spatulate, strongly revolute, commonly entire but occasionally with 1 or 2 small teeth, and without glands on the pedicels and hypanthium; whereas, in *C. stansburiana*, the leaves are pinnately several-cleft or -parted and commonly glandular-punctate and viscid, and stipitate glands are nearly always present on the pedicels and hypanthium. The *Darrow* and *Crooks* collection bears some resemblance to *C. ericaefolia* Torr. of western Texas, but the latter has linear, sharply cuspidate leaves and has stipitate glands on the pedicels or the hypanthium, or both.

16. CERCOCARPUS. MOUNTAIN-MAHOGANY

Shrubs or small trees; leaves simple, fascicled, with thickish, entire or dentate blades, these linear to obovate, often prominently veined beneath; flowers solitary or in small fascicles, inconspicuous, with small yellowish sepals and no petals; stamens numerous; hypanthium sheathlike in fruit, enclosing the slender villous achene, the long, persistent, plumose style exerted.

The plants are sometimes known locally as "deerbrowse," and certain species are important elements of the chaparral in central and southern Arizona, useful in protecting the soil against erosion and affording excellent browse for cattle, sheep, and goats, as well as for deer. Cases have been reported of hydrocyanic-acid poisoning of animals eating the leaves of *C. montanus*. The Hopi Indians are reported to use the bark of one species to dye leather red brown. The wood is hard and that of some species was used by the Indians for making digging sticks and is occasionally used for making tool handles. The sharp-pointed basal end of the achene and the corkscrewlike tail enable it to penetrate the ground, as in *Stipa* and *Erodium*.

Key to the species

1. Leaves evergreen, the blades coriaceous, resinous, linear or elliptic, acute at both ends, entire, the lateral veins not very prominent beneath (2).
2. Margins of the blades slightly to rather strongly revolute but with much of the lower surface exposed; blades elliptic, 10 to 30 mm. long, 5 to 10 mm. wide; style in fruit 4 to 7 cm. long----- 1. *C. LEDIFOLIUS*.
2. Margins of the blades very strongly revolute, with little of the lower surface exposed except the midvein; blades narrowly linear, 5 to 15 mm. long; style in fruit 2.5 to 5 cm. long----- 2. *C. INTRICATUS*.
1. Leaves deciduous, the blades often thickish but scarcely coriaceous, not noticeably resinous, obovate-cuneate or oblanceolate, rounded or truncate at apex, flat or slightly revolute, usually dentate at least at apex, the lateral veins very prominent beneath (3).
3. Blades entire or toothed only at or very near the apex, commonly oblanceolate or spatulate, thickish----- 3. *C. BREVIFLORUS*.
3. Blades toothed well below the apex (4).
4. Leaf blades thickish, finely dentate with triangular teeth, mostly obovate, commonly 2 to 3 times as long as wide, pale green or grayish beneath.----- 4. *C. BETULOIDES*.
4. Leaf blades thin, coarsely dentate with ovate teeth, broadly obovate, commonly less than twice as long as wide, white or whitish beneath.----- 5. *C. MONTANUS*.

1. **Cercocarpus ledifolius** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 427. 1840.

Both rims of the Grand Canyon, Coconino County (*Thornber* 8515, *Loomis* 6926), April. Montana to Washington, south to Colorado, northern Arizona, and California.

Curlleaf mountain-mahogany. Loomis reports that the plants observed by him were treelike, widely branching, about 4.5 m. high and 0.6 m. in trunk diameter. A height of 6 m. (20 feet), in Grand Canyon National Park, has been reported.

2. **Cercocarpus intricatus** S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 346. 1875.

Navajo and Coconino Counties, especially common in and near the Grand Canyon, 3,000 to 7,200 feet. Utah, Nevada, and northern Arizona.

Littleleaf mountain-mahogany. A much-branched shrub, up to about 2.5 m. (8 feet) high. The typical form, with young branches

loosely villous and the upper leaf surface and hypanthium subtrigose when young, then glabrate, seems to have been collected in Arizona only in the Navajo Reservation (*Vorkies* 81, *L. Whitehead* in 1916). The common form in the Grand Canyon region, occurring also on Black Mesa (Apache and Navajo Counties), is var. *villosus* C. K. Schneider (*C. arizonicus* M. E. Jones), with young branches villous-tomentose and the upper leaf surface and hypanthium pilose with curly hairs, sometimes permanently so. The type of *C. arizonicus* was collected at Willow Spring, Coconino County (*Jones* in 1890).

3. *Cercocarpus breviflorus* A. Gray, Pl. Wright. 2: 54. 1853.

Southern Apache, Coconino, and Yavapai Counties to Cochise and Pima Counties, 5,500 to 8,000 feet, common in chaparral on dry slopes and mesas, March to November. Western Texas to Arizona and Mexico.

A shrub, sometimes treelike and up to about 4.5 m. (15 feet) high. The Arizona specimens all seem to belong to var. *eximius* C. K. Schneider (*C. eximius* Rydb.) which, as compared with the typical form, has more spreading pubescence, larger and more distinctly dentate leaf blades, and usually a longer hypanthium and style.

4. *Cercocarpus betuloides* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 427. 1840.

Cercocarpus douglasii Rydb., North Amer. Fl. 22: 421. 1913.

Apache County to Mohave County, south to Greenlee, Gila, Pinal, Maricopa, and Cochise Counties, 3,000 to 6,500 feet, mostly in chaparral, March to July. Arizona, Oregon, and California.

Birchleaf mountain-mahogany. A large shrub or small tree, sometimes attaining a height of about 6 m. (20 feet). Probably the most important of the Arizona species as a browse plant. Intergradations with *C. breviflorus* occur.

5. *Cercocarpus montanus* Raf., Atlant. Jour. 146. 1832.

Grand Canyon, Coconino County (*Thornber, Goldman*), McMillenville (Gila County), 4,500 to 6,800 feet. South Dakota and Montana to Kansas, New Mexico, and Arizona.

Alderleaf mountain-mahogany. The Arizona plants belong to var. *flabellifolius* (Rydb.) Kearney and Peebles (*C. flabellifolius* Rydb.), which apparently differs from the typical form only in the more appressed pubescence of the leaves and hypanthium.

17. COLEOGYNE. BLACKBRUSH

A small to rather large shrub with rigid spinescent branches and strigose-pubescent herbage; leaves opposite, crowded, with narrowly spatulate entire blades; flowers solitary; sepals 4, yellow; petals usually none; stamens numerous; disk at base of the hypanthium with a sheathlike prolongation enclosing the solitary pistil.

1. *Coleogyne ramosissima* Torr., Pl. Frémont. 8. 1853.

Navajo County to Mohave County, 3,000 to 5,500 feet, well-drained, usually gravelly soils of open plains and mesas, sometimes in pure stands to the exclusion of other shrubs, March to May. Colorado to northern Arizona and southeastern California.

Sometimes erroneously called "burrobrush." It is browsed by sheep and goats, to a lesser extent by cattle, and withstands heavy browsing successfully. The plant is described as apetalous and is so, normally, but a specimen collected in Mohave County (*Kearney* and *Peebles* 11219) had two pale yellow obovate petals opposite to and considerably longer than the outer sepals.

18. PURSHIA. ANTELOPE-BRUSH

Shrub, intricately branched, erect or sprawling; leaves fascicled, small, tomentose, with wedge-shaped blades 3-toothed at apex; flowers solitary at the ends of the branchlets; sepals and petals 5, the petals yellow; stamens many, in one series; disk none; pistil usually solitary (sometimes 2, rarely 3); style stout, beaklike.

1. *Purshia tridentata* (Pursh) DC., Linn. Soc. London Trans. 12: 158. 1817.

Tigarea tridentata Pursh, Fl. Amer. Sept. 333. 1814.

Apache County to Coconino County, 4,000 to 9,000 feet, open slopes and mesas and in coniferous forests, April to June. Montana to British Columbia, New Mexico, northern Arizona, and California.

Also known as bitterbrush. A very important browse plant for sheep and cattle in regions where it is more abundant than in Arizona. The often prostrate stems, rooting where they touch the ground, doubtless give this plant value for control of soil erosion.

19. AGRIMONIA. AGRIMONY

Plants herbaceous, perennial; stems erect, leafy, usually branched above; leaves alternate, with conspicuous stipules and odd-pinnate blades, the leaflets alternately large and small, serrate-dentate; flowers numerous, small, in long slender spikelike racemes; hypanthium obconic to hemispheric, with hooked bristles; petals yellow; stamens 5 to 15; achenes 1 or 2.

Key to the species

1. Bristles of the hypanthium (at least the outer ones) strongly reflexed at maturity; leaflets oblong or ovate-oblong, scarcely acuminate at apex, thin, sparsely pubescent to glabrate beneath----- 1. *A. GRYPOSEPALA*.
1. Bristles all erect, or the outer ones ascending-spreading at maturity; leaflets lanceolate or oblong-lanceolate (seldom broader), acuminate at apex, usually thickish and copiously pubescent beneath---- 2. *A. STRIATA*.

1. *Agrimonia gryposepala* Wallr., Beitr. Bot. 1: 49. 1842.

Coconino County, at Walnut Canyon (*Leiberg* 5791), and Oak Creek (*Fulton* 7332), about 6,000 feet, August and September, apparently rare in Arizona. Almost throughout North America.

2. *Agrimonia striata* Michx., Fl. Bor. Amer. 1: 287. 1803.

Apache County to Coconino County, south to Cochise and Pima Counties, 7,000 to 8,500 feet, frequent in rich soil in pine forests, July to October. Nova Scotia to British Columbia, south to West Virginia, New Mexico, and Arizona.

20. SANGUISORBA. BURNET

Plant herbaceous, biennial; leaves pinnate, the divisions pinnatifid; flowers perfect or unisexual, small, in dense cylindric terminal spikes; sepals 4; petals none; hypanthium turbinate, 4-winged in fruit, enclosing the solitary achene.

1. *Sanguisorba occidentalis* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 429. 1840.

On a hillside near Superior, Pinal County (*Harrison* 1877), also reported by Mrs. Collom as occurring near Globe and at the eastern base of the Mazatzal Mountains (Gila County). Montana to British Columbia, Arizona, and California.

21. ROSA. ROSE

Shrubs with prickly (and often also bristly) stems; leaves alternate, odd-pinnate, with conspicuous stipules adnate to the petioles; flowers large and showy, fragrant, solitary or in few-flowered clusters; petals broad, pink; stamens numerous, inserted on an annular disk in the hypanthium, the latter globose or ellipsoid, often constricted below the throat, enclosing, but not adhering to, the numerous pistils, berrylike and usually bright red at maturity.

The plants are browsed. They probably have some value in controlling soil erosion where they form thickets, but this is seldom the case in Arizona. The fruits are much eaten by birds and other animals. Like nearly all species of this genus, those of Arizona are beautiful in flower and fruit.

Erlanson⁶⁰ gives *R. fendleri*, *R. neomexicana*, and *R. arizonica* as synonyms of *R. woodsii* Lindl.

Key to the species

1. Leaflets wedge-shaped, coarsely toothed at and near the apex, commonly less than 1 cm. long, nearly as wide as long; stems stellate-tomentose when young, the older ones with numerous long, nearly straight prickles, commonly also bristly; flowers solitary, bractless..... 1. *R. STELLATA*.
1. Leaflets not wedge-shaped, but often cuneate at base, toothed well below the apex, commonly more than 1 cm. long, distinctly longer than wide; stems not stellate-tomentose; inflorescence commonly of 2 or more flowers and bracteate (2).
 2. Prickles of the stem straight or nearly so, normally very slender; hypanthium globose or nearly so..... 2. *R. FENDLERI*.
 2. Prickles mostly recurved, normally rather stout (3).
 3. Hypanthium ellipsoid, noticeably longer than wide, strongly constricted below the calyx lobes..... 3. *R. NEOMEXICANA*.
 3. Hypanthium globose or nearly so, not strongly constricted below the calyx lobes (4).
 4. Leaflets glabrous on both faces..... 4. *R. MANCA*.
 4. Leaflets puberulent and more or less graniferous beneath.
 5. *R. ARIZONICA*.

1. *Rosa stellata* Wooton, Torrey Bot. Club Bul. 25: 152. 1898.

Powells Plateau, Grand Canyon, Coconino County, "in a dry rocky situation" (*Ferriss* in 1908). Western Texas, southern New Mexico, and northern Arizona.

The specimen cited belongs unquestionably to this very well-marked species, but the extension of range is extraordinary.

⁶⁰ ERLANSON, EILEEN WHITEHEAD. EXPERIMENTAL DATA FOR A REVISION OF THE NORTH AMERICAN WILD ROSES. Bot. Gaz. 96: 197-259. 1934. (See pp. 251-252.)

2. *Rosa fendleri* Crépin, Soc. Roy. Bot. Belg. Bul. 15: 91. 1876.

Apache, Coconino, and Yavapai Counties, also in the Chiricahua and Huachuca Mountains (Cochise County), 5,500 to 9,000 feet, July and August. Minnesota to British Columbia, south to northern Mexico.

3. *Rosa neomexicana* Cockerell, Ent. News 1901: 41. 1901.

White River, Apache Indian Reservation, 6,300 feet (*Goldman* 2492), Pinchot Ranger Station, Coconino County, 7,600 feet (*Collom* 246), July. Colorado, Utah, New Mexico, and Arizona.

The Arizona specimens are scarcely typical, seemingly approaching *R. arizonica*.

4. *Rosa manca Greene, Pittonia 4: 11. 1899.

Given for Arizona in North American Flora (22: 518), but the writers have seen no specimens from this State. Colorado and Utah.

5. *Rosa arizonica* Rydb., North Amer. Fl. 22: 516. 1918.

Apache, Navajo, and Coconino Counties, south to Pima and Cochise Counties, 4,000 to 8,000 feet, along streams and in pine forests in partial shade, May to July, type from near Flagstaff (*MacDougal* 110). New Mexico and Arizona.

The most abundant and most widely distributed wild rose in Arizona. A form with usually double-serrate leaflets, these copiously granular beneath, and sepals more constantly bearing stipitate glands, is found occasionally in northern and central Arizona, but seems to be absent in the southernmost counties. It is var. *granulifera* (Rydb.) Kearney and Peebles (*R. granulifera* Rydb.), the type of which was collected west of Holbrook, Navajo County (*Zuck* in 1896).

22. PRUNUS. PLUM, CHERRY

Small trees or large shrubs; leaves alternate or fascicled, simple; flowers usually perfect, in racemes or corymbs, or solitary in the leaf axils; calyx free from the ovary, 5-lobed, with a disk at the bottom; petals 5, these and the numerous stamens inserted on the calyx; pistil 1, the ovary 1-celled; fruit a dry or fleshy drupe, with 1 bony seed.

The plants are browsed, but cases have been reported of hydrocyanic acid poisoning of cattle and sheep. The foliage is usually supposed to be more dangerous when wilted, but this is disputed. The fruits are much eaten by birds and animals, and preserves are sometimes made from those of the chokecherry (subgenus *Padus*).

Key to the species

1. Drupe pubescent, the exocarp almost dry, splitting on one side; leaves entire or sparingly and irregularly dentate, sessile or nearly so, fascicled, linear-spatulate, puberulent; flowers mostly solitary in the leaf axils, sessile or nearly so, polygamo-dioecious; petals 2 to 3 mm. long; plant a shrub, divaricately branched: Subgenus *Emplectocladus*.... 1. P. FASCICULATA.
1. Drupe glabrous, the exocarp juicy; leaves regularly crenate or serrate, petioled (2).
2. Flowers few, in short corymbiform inflorescences; pedicels commonly villous; leaf blades crenate or crenulate, with conspicuously gland-tipped teeth; petals 4 to 6 mm. long: Subgenus *Cerasus*..... 2. P. EMARGINATA.

2. Flowers numerous, in elongate racemes; pedicels glabrous or puberulent; leaf blades serrate or serrulate, the teeth not conspicuously glandular, commonly appressed or incurved: Subgenus *Padus* (3).
3. Calyx deciduous long before maturity of the fruit; leaf blades mostly rounded or subcordate at base; petals about 5 mm. long.
3. Calyx persistent until maturity of the fruit; leaf blades mostly acute or acutish at base; petals about 3 mm. long.----- 4. *P. VIRENS*.

1. **Prunus fasciculata** (Torr.) A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 70. 1874.

Emplectocladus fasciculatus Torr., Pl. Frémont. 10. 1853.

Coconino County (bottom of the Grand Canyon), Mohave County (many localities) and near Wickenburg (Maricopa County), 4,500 feet or lower, dry plains and slopes, often forming thickets, March. Southern Utah, Arizona, and southern California.

Desert-almond. Browsed by sheep and goats.

2. **Prunus emarginata** (Dougl.) Walp., Repert. Bot. 2: 9. 1843.

Cerasus emarginata Dougl. ex Hook., Fl. Bor. Amer. 1: 169. 1830.

Coconino County and Hualpai Mountain (Mohave County) to Cochise and Pima Counties, 5,000 to 9,000 feet, mostly in pine forests, April to June. Idaho to British Columbia, south to New Mexico, Arizona, and California.

Bitter cherry. In Arizona there occur both the typical form, with leaf blades oval or obovate, mostly obtuse or rounded at apex, sometimes sparsely pubescent beneath; and var. *crenulata* (Greene) Kearney and Peebles (*Cerasus crenulata* Greene) with leaf blades elliptic or oblanceolate, mostly acute or acutish at apex, commonly glabrous beneath. The variety has been collected on the San Francisco Peaks and Bill Williams Mountain (Coconino County) and in the Pinaleno Mountains (Graham County).

3. **Prunus virginiana** L., Sp. Pl. 473. 1753.

Apache, Navajo, and Coconino Counties, south to Greenlee and Gila Counties, 4,500 to 8,000 feet, coniferous forests, April and May. Canada to Georgia, New Mexico, Arizona, and California.

Common chokecherry. The tree reaches a height of 7.5 m. (25 feet) and a trunk diameter of 20 cm. Represented in Arizona by var. *demissa* (Nutt.) Torr. (*Prunus demissa* D. Dietr.), the western chokecherry, with the twigs and the lower surface of the leaves pubescent when young, the mature fruit dark red; and by var. *melanocarpa* (A. Nels.) Sarg. (*Prunus melanocarpa* Rydb.), the black western chokecherry, with the twigs and the lower surface of the leaves glabrous or nearly so, the mature fruit nearly black.

4. **Prunus virens** (Woot. and Standl.) Shreve, Carnegie Inst. Wash. Pub. 217: 43. 1915.

Padus virens Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 132. 1913.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 4,500 to 6,000 feet, common, usually along streams, April and May. Western Texas to Arizona and northern Mexico.

Southwestern chokecherry. Usually a large shrub, up to 6 m. (20 feet) high, sometimes arborescent, with semi-evergreen foliage, handsome in flower. The typical, glabrous form is much more common in Arizona than var. *rufula* (Woot. and Standl.) Sarg. (*Padus rufula* Woot. and Standl.), the Gila chokecherry, which has the young twigs, petioles, and midribs pubescent with more or less tawny pubescence.

54. LEGUMINOSAE. PEA FAMILY

Herbs, shrubs, or small trees; leaves alternate, mostly compound, but simple in 2 genera; flowers mostly perfect, commonly irregular, the petals separate or partly united (especially the 2 lowest or keel petals in papilionaceous flowers), commonly 5, rarely only 1 or none; stamens few or many, frequently 10, separate or more often with the filaments variously united; pistil 1, the ovary superior, usually 1-celled; fruit commonly a dehiscent, 2-valved pod, but indehiscent in a few genera.

This huge family includes many plants used as human food, such as beans and peas, many forage plants of first importance, such as clovers and alfalfa, and valuable timber trees, especially in the Tropics. Some members (logwood, indigo) are or were important commercially as dye plants. Species of several tropical genera are used locally as fish poisons and contain rotenone, a substance now finding wide application as an insecticide. In Arizona the native Leguminosae are of great value as range forage and as soil-binding plants, useful for controlling erosion. On the other hand, several species of the genera *Astragalus* and *Oxytropis*, the so-called locoweeds, and certain species of *Astragalus* that prefer soils rich in selenium, are the cause of fatal poisoning in domestic animals

Key to the subfamilies

1. Corolla valvate in bud, regular or very nearly so; leaves bipinnate, the leaflets usually small; flowers small, in many-flowered heads, spikes, or spikelike racemes; calyx 4- or 5-lobed; petals 4 or 5, small and inconspicuous; stamens conspicuously exerted, the filaments separate or united, at least at base..... 1. MIMOSOIDEAE.
1. Corolla imbricate in bud, more or less irregular, the petals unlike in size or in shape, or in both (2).
 2. Uppermost petal internal in bud, enveloped by the lateral ones, the corolla therefore not papilionaceous, moderately to strongly irregular.
 2. CAESALPINOIDEAE.
 2. Uppermost (odd or banner) petal external in bud, the corolla commonly very irregular (papilionaceous), with the 2 lowest (keel) petals often more or less united; petals commonly 5 (1 in *Amorpha*, none in *Parryella*); pods mostly dehiscent (indehiscent in a few genera), commonly 1-celled but sometimes 2-celled..... 3. PAPILIONOIDEAE.

1. MIMOSOIDEAE. MIMOSA SUBFAMILY

Key to the genera

1. Filaments united below, more than 10 mm. long; stamens very numerous; plants unarmed; flowers in heads (2).
2. Plants undershrubs or herbaceous above ground; pods less than 10 mm. wide, elastically dehiscent from the apex, the valves not separating from the margins; seeds not more than 6 mm. long..... 1. CALLIANDRA.
2. Plant a large shrub; pods 15 to 30 mm. wide, not elastically dehiscent from the apex, the valves finally separating from the margins; seeds 8 to 10 mm. long..... 2. LYSILOMA.

1. Filaments separate to the base or very nearly so, less than 10 mm. long (3).
3. Stamens many more than 10; plants suffrutescent to large shrubs or small trees; flowers in heads or spikes..... 3. ACACIA.
3. Stamens not more than 10 (4).
4. Anthers gland-tipped; pods indehiscent, flat or spirally coiled; plants large shrubs or small trees; flowers in spikes..... 6. PROSOPIS.
4. Anthers not gland-tipped (5).
5. Valves of the pod finally separating from the persistent margins, often in sections; plants shrubby; stems (and often the pods) prickly; flowers in round heads or spikelike racemes..... 4. MIMOSA.
5. Valves of the pod not separating from the margins; plants suffrutescent; stems and pods unarmed; flowers in round heads... 5. DESMANTHUS.

1. CALLIANDRA. FALSE-MESQUITE

Plants perennial, herbs or low shrubs, not prickly; flowers in heads, pink or white; stamens many, long and conspicuous; pods with thick riblike margins, the valves recurved after dehiscence.

These plants are also known as mesquitilla and fairyduster. All of the Arizona species of *Calliandra* are valuable as soil binders and are palatable to livestock, but *C. eriophylla*, because of its relatively large size, resistance to browsing, and abundance, far exceeds the other species in economic value, and is highly palatable to deer.

Key to the species

1. Stems herbaceous above ground, rarely more than 20 cm. long (2).
2. Plant glabrous or sparsely pilose; pinnae 1 to 4 pairs; leaflets not more (usually fewer) than 12 pairs, 7 to 14 mm. long, 3 to 6 mm. wide, obliquely oval or oblong, conspicuously reticulate-veined... 1. *C. RETICULATA*.
2. Plant pilose, usually copiously so; pinnae 4 to 9 pairs; leaflets 10 to 18 pairs, rarely more than 5 mm. long, 1 to 2 mm. wide, linear or narrowly oblong, seldom conspicuously reticulate..... 2. *C. HUMILIS*.
1. Stems woody above ground, commonly more than 20 cm. long (3).
3. Branches slender, not rigid, erect or ascending at a narrow angle, moderately woody; leaflets few (not more than 7 pairs), not imbricate, spreading thin, bright green, glabrous or pubescent, 5 to 12 mm. long, 2 to 5 mm. wide; flowers glabrous; stamens not more than 15 mm. long; pods glabrous or inconspicuously puberulent..... 3. *C. SCHOTTII*.
3. Branches stout, rigid, often divaricate, very woody; leaflets numerous (usually more than 7 pairs), imbricate, ascending, rather thick, grayish-pubescent, not more than 7 mm. long, 1 to 2 mm. wide; flowers pubescent; stamens about 20 mm. long; pods densely and conspicuously pubescent..... 4. *C. ERIOPHYLLA*.

1. *Calliandra reticulata* A. Gray, Pl. Wright, 2:53. 1853.

Acacia humilis Schlecht., Linnaea 12: 567. 1838. Not
Calliandra humilis Benth.
Anneslia humilis Britt. and Rose, North Amer. Fl. 23: 57.
 1928.

Southern Coconino County to Cochise, Santa Cruz, and Pima Counties, 5,500 to 8,000 feet, commonly in dry pine forests, May to September. New Mexico, Arizona, and Mexico.

2. *Calliandra humilis* Benth., London Jour. Bot. 5: 103. 1846.

Calliandra herbacea Engelm., Amer. Acad. Arts and Sci. Mem.
 ser. 2, 4: 39. 1849.
Anneslia herbacea Britt. and Rose, North Amer. Fl. 23: 57.
 1928.

Navajo and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 4,000 to 9,000 feet, dry soil among oaks or pines, June to August. Western Texas to Arizona and northern Mexico.

More common than *C. humilis*, especially in central and northern Arizona. Intergrades with that species, but most of the specimens are readily distinguishable.

3. *Calliandra schottii* Torr. ex S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 364. 1885.

Anneslia schottii Britt. and Rose, North Amer. Fl. 23: 67. 1928.

Pima County, especially in the Santa Catalina and Baboquivari Mountains, 3,000 to 5,000 feet, rocky slopes, ascending to the pinyon belt, August. Southern Arizona and northern Mexico.

Stems much-branched, up to 1.2 m. high. It is reported that the root system is extraordinarily well developed and that the stems are often frozen back, but the plants soon recover.

4. *Calliandra eriophylla* Benth., London Jour. Bot. 3: 105. 1844.

Anneslia eriophylla Britton, N. Y. Acad. Sci. Trans. 14: 32. 1894.

Greenlee County to Yavapai County, south to Cochise, Santa Cruz, Pima, and Yuma Counties, 5,000 feet or lower, very common on dry gravelly slopes and mesas, February to May. Western Texas to southeastern California and Mexico.

A straggling shrub, up to 1.2 m. high.

2. LYSILOMA

A large, spreading, unarmed shrub with dense foliage; leaves large, with numerous pinnae and many leaflets; flowers in heads, white; stamens very numerous; pods large, flat.

1. *Lysiloma thornberi* Britt. and Rose, North Amer. Fl. 23: 83. 1928.

Pima County, on rock ledges along Chimney Creek in the foothills of the Rincon Mountains, about 3,500 feet, May and June, type collected by Thornber in 1926. Known only from the type locality.

A very rare and handsome shrub with hard, brittle, dark-brown wood and feathery canopied foliage, well worth cultivating as an ornamental. As seen by the writers at Chimney Creek, it has the appearance of being very long lived and occasionally frozen back.

3. ACACIA

Plants shrubs, small trees, or sometimes nearly herbaceous, spiny or unarmed; flowers whitish to bright yellow; stamens numerous.

Several of the Arizona species, especially the nearly herbaceous *A. hirta*, are browsed by cattle and horses, and the pods are eaten with relish.

Key to the species

1. Inflorescence racemose or spicate; corolla and stamens ochroleucous or cream-colored; pods flat or compressed, thin-walled, oblong, 15 to 20 mm. wide; small trees or large shrubs: Section *Senegalia* (2).
2. Branches unarmed or bearing slender, straight spines; pinnae 5 to 12 pairs; leaflets very numerous, linear, cuspidate, usually glabrous or merely ciliolate; pods very flat, not twisted or torulose... 1. *A. MILLEFOLIA*.

2. Branches usually armed with stout, curved spines; pinnae 1 to 3 pairs; leaflets 2 to 7 pairs, oblong or obovate, obtuse or retuse, pilose, rarely glabrous; pods not very flat, often somewhat twisted and torulose.
2. A. GREGGII.
1. Inflorescence capitate (3).
3. Flowers distinctly pedicelled; calyx undulate or very shallowly dentate; corolla and stamens white or whitish; pods rather promptly dehiscent, flat, thin-walled, not or scarcely torulose; leaflets glabrous or sparsely ciliate; stems woody below or almost completely herbaceous above the crown, unarmed, commonly pilose or hirsute: Section *Acaciella* (4).
4. Leaflets acute and strongly cuspidate at apex, 7 to 9 mm. long, 2.5 mm. wide, strongly pinnate-veined..... 3. A. LEMMONI.
4. Leaflets obtuse or acutish, seldom more than 6 mm. long..... 4. A. HIRTA.
3. Flowers sessile or nearly so; calyx deeply dentate; corolla and stamens bright yellow; pods indehiscent or tardily dehiscent; shrubs or small trees, usually armed with straight or nearly straight, commonly slender spines (5).
5. Pods turgid, woody, somewhat curved, not conspicuously torulose, 4 to 7 cm. long, less than 10 times as long as wide; leaflets 10 to 25 pairs: Section *Vachellia*..... 5. A. FARNESIANA.
5. Pods compressed, not woody, strongly torulose, more than 10 times as long as wide; leaflets 6 to 12 pairs: Section *Acaciopsis* (6).
6. Plant not, or scarcely, viscid, usually pilose; pinnae seldom fewer and often more than 3 pairs; bracts and calyx teeth ciliate; pods 6 to 12 cm. long..... 6. A. CONSTRICTA.
6. Plant very viscid, glabrous or nearly so; pinnae 1 to 3 pairs; bracts and calyx teeth glandular-denticulate, not ciliate; pods usually not more than 6 cm. long..... 7. A. VERNICOSA.

1. *Acacia millefolia* S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 427. 1886.

Senegalia millefolia Britt. and Rose, North Amer. Fl. 23: 111. 1928.

Cochise and Pima Counties, 3,500 to 4,500 feet, July and August, apparently rare. Southern Arizona and northern Mexico.

2. *Acacia greggii* A. Gray, Pl. Wright. 1: 65. 1852.

Senegalia greggii Britt. and Rose, North Amer. Fl. 23: 110. 1928.

Coconino County (bottom of the Grand Canyon) and Mohave County to Greenlee, Cochise, Pima, and Yuma Counties, 4,500 feet or lower, often forming thickets along streams and washes, April to October. Texas to southern Nevada, Arizona, southeastern California, and northern Mexico.

Catclaw acacia, devilsclaw. A common, often abundant, large shrub or small tree, reaching a height of 6 m. (20 feet) and a stem diameter of 20 cm., the sapwood yellow, the heartwood reddish brown. The new foliage is relished by cattle in early spring, otherwise catclaw is valuable chiefly as a reserve food in times of drought or on depleted ranges. The Arizona Indians made meal of the pods, using it as mush and cakes. The flowers are one of the most important sources of honey for bees kept on the desert. The wood is very strong and is used locally for making doubletrees and singletrees, as well as for firewood. This is probably the most heartily disliked plant in the State, the sharp strong prickles tearing the clothes and lacerating the flesh.

3. **Acacia lemmoni** Rose, Contrib. U. S. Natl. Herbarium 12: 409. 1909.

Acaciella lemmoni Britt. and Rose, North Amer. Fl. 23: 103. 1928.

Huachuca Mountains, Cochise County (*Lemmon* in 1882, the type collection, *Hilend* 758), about 6,000 feet. Known only from south-eastern Arizona.

4. **Acacia hirta** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 404. 1840.

Acaciella hirta Britt. and Rose, North Amer. Fl. 23: 102. 1928.

Gila County to Cochise, Santa Cruz, and Pima Counties, 3,000 to 6,500 feet, dry rocky slopes, usually in chaparral, May to September. Missouri to Texas, Arizona, and northern Mexico.

A very handsome plant, with feathery foliage and paniced round heads of cream-colored flowers, easily cultivated. The habit of growth is well adapted to protecting soil against erosion. The stems reach a height of about 1.5 m. Two varieties occur in Arizona: (1) var. *suffrutescens* (Rose) Kearney and Peebles (*Acacia suffrutescens* Rose), with lateral veins of the leaflets obsolete or obscure and leaflets seldom more than 1.5 mm. wide; (2) var. *shrevei* (Britt. and Rose) Kearney and Peebles (*Acaciella shrevei* Britt. and Rose), with several distinct lateral veins and broader leaflets, these up to 2.5 mm. wide. The second variety approaches *A. lemmoni*. The intergradation between these varieties, and between var. *suffrutescens* and typical *A. hirta* is complete. The type of *A. suffrutescens* was collected near Tucson (*Pringle* in 1881), and that of *A. shrevei* in the Huachuca Mountains (*Shreve* 5064). There is much variation in pubescence of the stems from glabrate to hirsute, in the number and length of the pinnae, and in the number of leaflets, but, except as stated above, no definite segregation has been found practicable by the writers. A form occurring in the Baboquivari Mountains (*Jones* 25024, *Goodding* 4321) with extraordinarily broad pods, 12 to 15 mm. wide, broad and rounded at the apex, may belong to a different species.

5. **Acacia farnesiana** (L.) Willd., Sp. Pl. 4: 1083. 1806.

Mimosa farnesiana L., Sp. Pl. 521. 1753.

Vachellia farnesiana Wight and Arn., Prodr. Fl. Ind. Or. 272. 1834.

Canyons on the west slope of the Baboquivari Mountains (Pima County), reported as occurring also near Ruby (Santa Cruz County), about 4,000 feet, April to November. Florida to southern California, southward to Argentina.

Sweet acacia, huisache. Extensively cultivated as an ornamental, because of the exquisite fragrance of the flowers, which are used in France in the manufacture of perfumery. In Arizona, a small tree up to 6 m. (20 feet) high, rare.

6. **Acacia constricta** Benth. in A. Gray, Pl. Wright. 1: 66. 1852.

Acaciopsis constricta Britt. and Rose, North Amer. Fl. 23: 96. 1928.

Greenlee, Gila, and Yavapai Counties to Cochise, Pima, and Yuma Counties, 2,500 to 5,000 feet, shallow "caliche" soil on dry slopes and

mesas, May to August (occasionally November). Texas to Arizona and Mexico.

Abundant over large areas in southeastern Arizona. A pretty shrub, especially when covered with the small orange-yellow balls of very fragrant flowers. The foliage is not palatable to livestock, although the pods are eaten. The plants are mostly well armed with long slender straight white spines, but var. *paucispina* Woot. and Standl., with few or no spines, is occasionally met with.

7. *Acacia vernicosa* Standl., Contrib. U. S. Natl. Herbarium 20: 187. 1919.

Acaciopsis vernicosa Britt. and Rose, North Amer. Fl. 23: 96. 1928.

San Bernardino Ranch, vicinity of Fort Huachuca, and Benson, (Cochise County), 3,500 to 5,000 feet, June to September. Western Texas to southeastern Arizona and Mexico.

A species generally similar to *A. constricta* but readily distinguished by the characters given in the key, some of which were brought to the attention of the writers by Ira L. Wiggins (personal communication).

4. MIMOSA

Plants shrubby, usually armed; leaves with numerous small leaflets; flowers small, sessile, whitish or pink, in many-flowered heads or spikes; stamens not more than 10; pods with or without prickles, in some species breaking up into 1-seeded sections.

These plants are mostly very attractive in flower, and the flowers are commonly fragrant.

Key to the species

1. Inflorescence elongate, spicate or racemose; flowers purplish pink; valves of the pods jointed, the segments separating at maturity (2).
2. Young stems, leaves, and flowers glabrous or inconspicuously pubescent; spines few or none; pinnae 1 to 4 pairs; leaflets 2 to 5 pairs, elliptic to obovate, rounded and often mucronulate at apex, 5 to 10 mm. long, at least half as wide; flowers short-pedicelled; pods very flat, thin-walled, glabrous, unarmed, not, or scarcely, torulose----- 1. *M. LAXIFLORA*.
2. Young stems, leaves, and flowers sericeous or villous; spines numerous; pinnae 5 or more pairs; leaflets 7 or more pairs, linear-lanceolate or narrowly oblong (the terminal one sometimes obovate), acute or acutish at apex, 3 to 6 mm. long, less than half as wide; flowers sessile; pods not very flat, thickish-walled, tomentose, strongly torulose.
 2. *M. DYSOCARPA*.
1. Inflorescence capitate; flowers pale pink or whitish; valves of the pods not jointed, usually prickly-margined (3).
3. Spines of the stem stout, conspicuously flattened and broadened to far above the base, strongly recurved toward the apex; leaves, including the petiole, 1.5 to 4 cm. long, the pinnae crowded, the internodes of the rachis seldom more than 5 mm. long, the leaflets 2 to 3.5 mm. long, not apparently pinnate-veined; calyx and corolla pubescent; pods 3 to 4 mm. wide, acute or acuminate at apex, more or less curved.
 3. *M. BIUNCIFERA*.
3. Spines of the stem relatively slender, conspicuously broadened only near the base, often straight or nearly so; leaves, including the petiole, 5 to 10 cm. long, the pinnae not crowded, the internodes of the rachis commonly at least 6 mm. long, the leaflets 3 to 6 mm. long, distinctly pinnate-veined; pods 5 mm. wide or wider, rounded and often apiculate at apex, straight or nearly so----- 4. *M. GRAHAMI*.

1. *Mimosa laxiflora* Benth., London Jour. Bot. 5: 93. 1846.

Known in Arizona only from near Quijotoa and Sells, Papago Indian Reservation, western Pima County, about 2,500 feet, rocky slopes and along washes, with *Acacia greggii*, *Cercidium*, *Simmondsia*, *Cereus giganteus*, etc., August. Southern Arizona and northern Mexico.

2. *Mimosa dysocarpa* Benth. in A. Gray, Pl. Wright. 1: 62. 1852.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,500 feet, commonly along arroyos and washes, July to September. Western Texas to southern Arizona and northern Mexico.

Arizona's showiest and handsomest *Mimosa*, with long spikes of purplish pink flowers. Occupying the same region and commoner than the typical form is var. *wrightii* (A. Gray) Kearney and Peebles (*M. wrightii* A. Gray), which has the pods normally somewhat narrower and unarmed (sparsely prickly in typical *dysocarpa*) and leaflets glabrous or glabrate above, but the correlation between these characters is low.

3. *Mimosa biuncifera* Benth., Pl. Hartw. 12. 1839.

Mimosopsis biuncifera Britt. and Rose, North Amer. Fl. 23: 176. 1928.

Southern Apache County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, dry soil of mesas and rocky slopes, commonly in chaparral, May to August. Western Texas to Arizona and northern Mexico.

Wait-a-bit, wait-a-minute, often also called "catclaw," but this name belongs properly to *Acacia greggii*. A common straggling shrub in south central Arizona, reaching, exceptionally, a height of 2.4 m. (8 feet). It often forms dense thickets of considerable extent, making a very efficient soil binder. When other food is scarce it furnishes forage for livestock. It is reputed to be a good honey plant.

The var. *glabrescens* Gray, much less pubescent than the typical form, occurs throughout the range of the species in Arizona.

4. *Mimosa grahami* A. Gray, Pl. Wright. 2: 52. 1853.

Mimosopsis grahami Britt. and Rose, North Amer. Fl. 23: 178. 1928.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, dry slopes, April to August, type from "between the San Pedro and the Sonoita" (Wright 1042). Southwestern New Mexico, southeastern Arizona, and northern Mexico.

About equally common in Arizona are the typical form and var. *lemmoni* (A. Gray) Kearney and Peebles (*Mimosa lemmoni* A. Gray), which seems to differ only in the copious pubescence of the herbage, flowers, and pods (these glabrous or sparsely pubescent in typical *M. grahami*). Numerous specimens are intermediate. The type of *M. lemmoni* was collected in the Huachuca Mountains (*Lemmon* 2692).

5. DESMANTHUS

Plants herbaceous or shrubby, unarmed; leaflets very numerous, small; flowers sessile, in axillary heads, whitish; stamens 10; pods slender, elongate.

Key to the species

1. Stems decumbent or spreading; stipules 1 to 2 mm. long, sometimes wanting; leaves 3 to 5 cm. long, the leaflets ciliate, at least when young; peduncle not more than 2 cm. long; pods few or solitary----- 1. *D. COOLEYI*.
1. Stems erect or ascending; stipules commonly more than 2 mm. long; leaves 4 to 10 cm. long, the leaflets glabrous; peduncle 2 to 5 cm. long; pods usually several or numerous (2).
2. Pinnae 1 to 7 pairs; petiolar gland oblong or elliptic, usually borne just below the lowest pair of pinnae and not subtended by stipels.
2. *D. VIRGATUS*.
2. Pinnae 7 to 13 pairs; petiolar gland suborbicular, borne near the base of the petiole, subtended by a pair of subulate stipels---- 3. *D. BICORNUTUS*.

1. ***Desmanthus cooleyi*** (Eaton) Trel., Ark. Geol. Survey Rpt. 1888. 4: 178. 1891.

Acacia cooleyi Eaton, Man. ed. 5, 89. 1829.

Desmanthus jamesii Torr. and Gray, Fl. North Amer. 1: 402. 1840.

Acacia cooleyi Britt. and Rose, North Amer. Fl. 23: 134. 1928.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, dry slopes, mesas, and plains, May to September. Nebraska to Arizona and northern Mexico.

2. ***Desmanthus virgatus*** (L.) Willd., Sp. Pl. 4: 1047. 1806.

Mimosa virgata L., Sp. Pl. 519. 1753.

Acacia virgatum Medik., Theod. Sp. 62. 1786.

Guadalupe Canyon, Cochise County, about 4,000 feet (*Goodding* 8330, A9734), Baboquivari Mountains, Pima County (*Gilman* B6). Widely distributed in tropical and subtropical America.

3. ***Desmanthus bicornutus*** S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 426. 1886.

Acacia bicornutum Britt. and Rose, North Amer. Fl. 23: 136. 1928.

Near Ruby, Santa Cruz County, about 4,000 feet (*Goodding* in 1938), August and September. Southeastern Arizona and Chihuahua.

6. PROSOPIS. ⁶¹ MESQUITE

Shrubs or small trees, usually armed with straight spines; leaves with 2 to 4 pinnae, and numerous narrow leaflets; flowers in cylindric spikes, small, greenish yellow, somewhat fragrant; pods indehiscent, compressed but somewhat turgid, or spirally coiled.

Key to the species

1. Pods not coiled, compressed, more or less constricted between the seeds, much more than 4 cm. long; leaflets commonly many more than 9 pairs; spines, if any, yellowish, often stout----- 1. *P. JULIFLORA*.
1. Pods tightly spirally coiled, 2 to 4 cm. long; leaflets 5 to 9 pairs; spines white, slender; herbage sparsely to copiously grayish pubescent. 2. *P. ODORATA*.

⁶¹ Reference: BURKART, A. MATERIALES PARA UNA MONOGRAFÍA DEL GÉNERO PROSOPIS (LEGUMINOSAE). Darwiniana 4: 57-128. 1940.

1. *Prosopis juliflora* (Swartz) DC., Prodr. 2: 447. 1825.

Mimosa juliflora Swartz, Prodr. Veg. Ind. Occ. 85. 1788.

Cocconino County (Little Colorado River, bottom of the Grand Canyon) to Mohave County, southward to Cochise, Santa Cruz, Pima, and Yuma Counties, 5,000 (exceptionally 6,000) feet or lower, very common, chiefly along streams and where the water table is relatively high, April to August. Southern Kansas to southeastern California and Mexico; southern South America.

Two intergrading forms occur in Arizona: (1) var. *velutina* (Woot.) Sarg. (*P. velutina* Woot.), the more common form, with pubescent foliage and leaflets less than 15 mm. long; (2) var. *glandulosa* (Torr.) Cockerell (*P. glandulosa* Torr.) with glabrous or glabrate foliage and leaflets commonly more than 15 mm. long. Burkart apparently excludes from *P. juliflora* the forms of the southwestern United States, referring them, at least as to var. *velutina*, to *P. articulata* S. Wats.

Common mesquite, known also as honey mesquite. A large shrub or small tree along watercourses, reaching a height of 9 m. (30 feet) or more, and a trunk diameter of nearly 1 m.; and scattered as a smaller shrub on grasslands and lower mountain slopes, with much of the trunk underground. It is reported that the roots sometimes penetrate to a depth of 60 feet. The foliage, and particularly the pods, are eaten by livestock. The sapwood is yellow, the heavy reddish-brown heartwood hard and slow burning. With the exception of *Olneya*, mesquite is the best firewood obtainable in the semidesert region. Trees cut to the ground sprout again. The wood is used for fence posts and the heartwood is said to take a fine polish. Mesquite increases rapidly on overgrazed grassland in southeastern Arizona and is considered a serious range pest under such circumstances.

This plant has been a mainstay of existence to the aborigines of the Southwest. When cultivated crops failed, the Indians subsisted mainly upon mesquite beans. Pinole, a meal made from the long sweet pods, prepared in the form of cakes and in other ways, was a staple food with the Pimas and still is eaten by them to some extent. Fermented pinole was a favorite intoxicating drink. The gum which exudes from the bark was used to make candy, to mend pottery, and as a black dye. Several hundred pounds of mesquite gum are said to be exported annually to Australia, for what purpose is not known. The inner bark furnished the Indians material for basketry and coarse fabrics, as well as medicine to treat a variety of disorders. Under normal conditions large quantities of excellent honey are obtained from the flowers of mesquite, which is rated by beemen as the most valuable honey plant of the State.

2. *Prosopis odorata* Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 313. 1845.

Strombocarpa pubescens A. Gray, Pl. Wright. 1: 60. 1852.

Mohave County to Cochise, Pima, and (doubtless) Yuma Counties, 4,000 feet or (usually) lower, flood plains of streams, often in saline soil, May (and doubtless later). Western Texas to southern Nevada, southern California and northern Mexico.

Fremont screwbean, also known as screwpod mesquite, and tornillo. A shrub or small tree up to 6 m. (20 feet) high. Not generally so abundant as the true mesquite, but the sweet pods were used by the

Indians in much the same way. Livestock browse on the leaves and the pods. The bark of the roots was used by the Pima Indians to treat wounds. Fence posts and handles for tools are obtained locally from the screwbean.

2. CAESALPINIOIDEAE. SENNA SUBFAMILY

Key to the genera

1. Corolla pink or purple; leaves simple, entire (2).
2. Fruits indehiscent, turgid, globose or ovoid, spiny; plants small straggling shrubs or perennial herbs; leaf blades small, linear or narrowly lanceolate; flowers borne on the branchlets----- 7. *KRAMERIA*.
2. Fruits dehiscent, flat, oblong, not spiny; plant a large shrub or small tree; leaf blades large, round-cordate; flowers borne on the old wood. 8. *CERCIS*.
1. Corolla yellow; leaves compound (3).
3. Leaves once-pinnate; plants herbaceous or shrubby----- 9. *CASSIA*.
3. Leaves twice-pinnate, sometimes appearing simply pinnate in *Parkinsonia* because of the shortening of the primary rachis (4).
4. Filaments 3 or 4 times as long as the petals, bright red, very conspicuous; plant a shrub; pods 5 cm. long or longer, broad, very flat. 13. *CAESALPINIA*.
4. Filaments not or but slightly surpassing the petals (5).
5. Plants unarmed, herbaceous or somewhat woody; pods not torulose. 12. *HOFFMANSEGGIA*.
5. Plants spiny, large shrubs or small trees; pods often torulose; young bark green (6).
6. Rachis of the pinnae flattened, 10 cm. long or longer; leaflets alternate; inflorescence an elongate raceme up to 20 cm. long; calyx lobes strongly imbricate in bud----- 10. *PARKINSONIA*.
6. Rachis of the pinnae terete, not more than 4 cm. long; leaflets opposite; inflorescence a short raceme or a corymb; calyx lobes valvate or induplicate-valvate in bud----- 11. *CERCIDIUM*.

7. *KRAMERIA*. RATANY

Straggling low shrubs or perennial herbs, the herbage grayish pubescent and sometimes glandular; leaves alternate, simple, without stipules; flowers very irregular, rather showy, purplish, in racemes, or solitary and axillary; petals 5, smaller than the sepals, the upper 3 petals long-clawed, the others reduced to nearly orbicular fleshy glands; stamens 3 or 4, more or less united; pod globose or nearly so, indehiscent, thick-walled, spiny, 1-seeded.

These plants, sometimes called chacate, are supposed to be root parasites. With the exception, perhaps, of *K. lanceolata* they are relished by livestock. *K. grayi*, sometimes called crimsonbeak, is very drought resistant. The common name ratany is sometimes applied to native species on account of their relationship with the South American species from which the powerfully astringent rhatany root of commerce is obtained. The Papago Indians treat sore eyes with an infusion of the twigs of *K. parvifolia*, and a dye, used to color wool and other materials, is obtained from the roots. All of the species grow on dry plains and mesas. They are peculiar in this family in the structure of the flowers and fruits.

Key to the species

1. Stems herbaceous above ground from a thick woody caudex, prostrate or nearly so, the leaves and flowers more or less secund; upper petals with broad blades, more or less united below; spines of the fruit not barbed; glands none----- 1. *K. LANCEOLATA*.

1. Stems woody; plants straggling shrubs; spines of the fruit rarely without barbs (2).
2. Herbage densely sericeous-tomentose, the pubescence not closely appressed, soft; branchlets spinescent; upper petals separate to the base, with narrow blades; spines of the fruit with barbs in one series at the apex of the spine; glands none.----- 2. *K. GRAYI*.
2. Herbage densely to sparsely strigose, the pubescence rather harsh; branchlets rigid but scarcely spinescent; upper petals more or less united toward the base, with broad blades; spines of the fruit with scattered barbs below the apex, rarely barbless; glands present or absent. 3. *K. PARVIFOLIA*.

1. ***Krameria lanceolata*** Torr., Ann. Lyc. N. Y. 2: 168. 1827.

Krameria secundiflora of authors. Not of DC.

Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,000 feet, May to August. Kansas and Arkansas to southeastern Arizona and Mexico.

2. ***Krameria grayi*** Rose and Painter, Contrib. U. S. Natl. Herbarium 10: 108. 1906.

Krameria canescens A. Gray, Pl. Wright. 1:42. 1852. Not of Willd., 1825.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 4,000 feet or (usually) lower, April and May. Western Texas to southern Nevada, Arizona, southern California, and northern Mexico.

White ratany.

3. ***Krameria parvifolia*** Benth., Bot. Voy. Sulph. 6. 1844.

Coconino County (bottom of the Grand Canyon) and Mohave County to Cochise, Santa Cruz, Pima, and Yuma Counties, 5,000 feet or lower, April to October. Texas to southern Nevada, Arizona, southern California, and northern Mexico.

Range ratany. The species occurs in Arizona in 2 nearly equally common forms: (1) var. *glandulosa* (Rose and Painter) Macbride (*K. glandulosa* Rose and Painter), with stipitate glands on the pedicels and often elsewhere; (2) var. *imparata* Macbride (*K. imparata* Britton) without glands.

8. CERCIS. REDBUD

Usually a small tree, glabrous or glabrate; leaves large, simple, with round-cordate entire blades; flowers appearing before the leaves, in scattered fascicles on the old wood, irregular, falsely pealike, purplish red; stamens 10, separate; pods flat, dehiscent, thin-walled, several-seeded.

Several species very like that of Arizona are grown as ornamentals. The astringent bark of *C. canadensis* L. has been used as a remedy for diarrhea and dysentery.

1. ***Cercis occidentalis*** Torr. in A. Gray, Boston Jour. Nat. Hist. 6: 177. 1850.

Grand Canyon (Coconino County), Pagumpa Springs (Mohave County), Superstition Mountains (Pinal County), about 4,000 feet, March to April. Southern Utah, Arizona, and California.

In Arizona the stems reach a height of 3.5 m. (12 feet) and have smooth gray bark.

9. CASSIA. SENNA

Plants annual or perennial, herbaceous or shrubby; leaves pinnate, the leaflets few or numerous; flowers moderately irregular, in racemes

or panicles, or solitary in the leaf axils, the petals yellow; stamens 5 or 10, often unequal, some of them sometimes sterile; pods dehiscent or indehiscent, flat or turgid, the walls thin, or thick and almost woody.

A very large genus, chiefly tropical and subtropical, of which a few species are cultivated as ornamentals in the warmer parts of the United States. The cathartic drug senna is obtained from certain Old World species.

Key to the species

1. Pods indehiscent or tardily and not elastically dehiscent; stems usually 1 m. long or longer (2).
2. Stipules none; leaflets fugacious, few and distant, less than 1 cm. long, thickish, oval or oblong-ovate; pods turgid, spinulose-tipped, not more than 4 cm. long; plant shrubby; rachis spinescent; petiole and rachis gland-bearing; flowers in loose terminal panicles.----- 1. *C. ARMATA*.
2. Stipules present; leaflets persistent; pods compressed, linear, 6 cm. long or longer (3).
3. Petiole not gland-bearing; plant a shrub, with rigid branches; leaflets 2 or 3 pairs, less than 1 cm. long, oval or obovate, often cuspidate, thickish, glabrous or strigose, the veins usually thick and prominent beneath; inflorescences few-flowered, axillary and terminal; pods up to 12 cm. long, flat, black and shiny at maturity, rigidly apiculate.
 2. *C. WISLIZENI*.
3. Petiole bearing a large gland near the base; plant herbaceous or at most suffrutescent, appearing glabrous but usually puberulent; leaflets 4 to 8 pairs, 2 cm. long or longer, lanceolate or oblong-lanceolate, sharply acuminate, thin; inflorescences usually many-flowered, terminal; pods up to 25 cm. long, compressed but not flat, brown and not shiny at maturity.----- 3. *C. LEPTOCARPA*.
1. Pods more or less promptly and elastically dehiscent; plants herbaceous or barely suffrutescent; stems usually much less than 1 m. long (4).
4. Rachis of the leaves normally eglandular; petals not conspicuously veined (5).
5. Leaflets 2 pairs, 6 mm. wide, or wider, obovate or oval, thin, ciliate; petioles normally eglandular; petals nearly equal, about 5 mm. long; pods sparsely long-hirsute; seeds obovate, smooth, black and shining; plant annual; stems glandular-hirsute.----- 4. *C. ABSUS*.
5. Leaflets 6 or more pairs, not more than 3 mm. wide, narrowly oblong or oblanceolate, mucronate or cuspidate; petioles bearing a cup-shaped, usually stipitate gland; petals conspicuously unequal; pods appressed-pubescent; seeds not black and shiny (6).
6. Plant perennial; stems decumbent or prostrate, glabrous or nearly so; leaflets 6 to 9 pairs, glabrous; pedicels seldom less than 10 mm. long; longest petal not less than 12 mm. long; seeds obovate, smooth.
 5. *C. WRIGHTII*.
6. Plant annual; stems erect or ascending, pubescent with short, subappressed, and longer, spreading hairs; leaflets usually more than 9 pairs, long-ciliate; pedicels seldom more than 5 mm. long; longest petal 5 to 7 mm. long; seeds irregularly triangular or quadrangular, rugose.----- 6. *C. LEPTADENIA*.
4. Rachis usually bearing 1 or more subulate glands, these situated between the opposite leaflets; petals conspicuously veined; leaflets oblong, elliptic, or obovate, 6 mm. wide, or wider; plants perennial; pubescence of the leaves, stems, and pods soft; seeds gray or olive brown, dull, rugose (7).
7. Leaflets one pair; flowers all axillary, solitary or in 2's on peduncles surpassing the petioles; pubescence all appressed or partly spreading; pods obliquely cuspidate.----- 7. *C. BAUHNIODES*.
7. Leaflets 2 or more pairs; flowers in terminal leafy panicles, as well as in axillary clusters (8).
8. Leaflets 2 or 3 pairs; pubescence closely appressed; anthers orange; pods 2 to 3 cm. long, with the cusp central, erect or nearly so, 2 to 4 mm. long.----- 8. *C. COVESII*.
8. Leaflets 4 to 8 pairs; pubescence not closely appressed; anthers red; pods 3.5 to 6 cm. long, with the cusp usually somewhat lateral and ascending, 1 to 2 mm. long.----- 9. *C. LINDHEIMERIANA*.

1. *Cassia armata* S. Wats., Amer. Acad. Arts and Sci. Proc. 9: 136. 1876.

Xerocassia armata Britt. and Rose, North Amer. Fl. 23: 246. 1930.

Yucca, Mohave County (*Meire* in 1917), 1,800 feet, February to October. Deserts of western Arizona, southern Nevada, and southeastern California.

A shrub about 1 m. high, leafless most of the year.

2. *Cassia wislizeni* A. Gray, Pl. Wright. 1: 60. 1852.

Palmerocassia wislizeni Britton, North Amer. Fl. 23: 254. 1930.

Cochise County, 4,000 to 5,000 feet, dry slopes and mesas, usually on limestone, August and September. Southern Texas to southeastern Arizona and northern Mexico.

A much-branched shrub up to 1.5 m. (5 feet) high, with dark-colored bark and prominent lenticels.

3. *Cassia leptocarpa* Benth., Linnaea 22: 528. 1849.

Ditremexa leptocarpa Britt and Rose, North Amer. Fl. 23: 256. 1930.

Cochise, Pinal, and Pima Counties, 2,500 to 5,000 feet, along streams and washes, July to September. New Mexico and southern Arizona to South America.

A handsome but rather coarse plant, with large terminal panicles of bright yellow flowers, the foliage ill smelling. The Arizona form is var. *glaberrima* M. E. Jones (*Ditremexa glaberrima* Britton, *Cassia gooddingii* A. Nels.), less pubescent and with narrower leaflets than most Mexican specimens of *C. leptocarpa*.

4. *Cassia absus* L., Sp. Pl. 376. 1753.

Grimaldia absus Britt. and Rose, North Amer. Fl. 23: 299. 1930.

Western slope of the Baboquivari Mountains, Pima County, 5,000 feet(?), granitic slopes and ridges (*Gilman* B212, B234), September. Widely distributed in tropical America, supposed to have been introduced from the Old World.

The presence of the plant in such a remote locality in Arizona is difficult to explain.

5. *Cassia wrightii* A. Gray, Pl. Wright. 2: 50. 1853.

Chamaecrista wrightii Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 335. 1915.

Santa Cruz County (probably elsewhere in southern Arizona), 3,500 to 5,000 feet, open chaparral, August. Southeastern Arizona and northeastern Sonora.

Partridge-pea, sensitive-pea, names applied generally to the subgenus *Chamaecrista*.

6. *Cassia leptadenia* Greenm., Amer. Acad. Arts and Sci. Proc. 41: 238. 1905.

Chamaecrista leptadenia Cockerell, Muhlenbergia 4: 68. 1908.

Greenlee, Pinal (or Gila), Cochise, Santa Cruz, and Pima Counties, 3,500 to 4,000 feet, dry plains and mesas, August to October. Western Texas to Arizona and Mexico.

Very similar to *C. nictitans* L. of the eastern United States, but the plant has ciliate leaflets, narrower pods, and stems usually with long spreading hairs, as well as shorter more appressed ones.

7. *Cassia bauhinioides* A. Gray, Boston Jour. Nat. Hist. 6: 180-1850.

Earleocassia bauhinioides Britton, North Amer. Fl. 23: 248. 1930.

Coconino, Mohave, Yavapai, and Greenlee Counties to Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,000 feet, dry rocky slopes and mesas, May to August. Texas to Arizona and Mexico.

The common form in this State is var. *arizonica* Robinson, with hairs of the stem appressed or subappressed, but the typical form, also with spreading hairs, likewise occurs.

8. *Cassia covesii* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 399. 1868.

Earleocassia covesii Britton, North Amer. Fl. 23: 249. 1930.

Distribution in Arizona and habitat same as for *C. bauhinioides*, but usually at somewhat lower altitudes, mostly 1,000 to 3,000 feet. New Mexico to Nevada, Arizona, California, and northwestern Mexico.

9. *Cassia lindheimeriana* Scheele, Linnaea 21: 457. 1848.

Earleocassia lindheimeriana Britton, North Amer. Fl. 23: 249. 1930.

Cochise County, 4,900 to 5,600 feet, dry mesas and foothills, June to September. Texas to southeastern Arizona and northern Mexico.

10. PARKINSONIA.⁶² PALOVERDE

A large shrub or small tree, attaining a height of 12 m. (40 feet) and a trunk diameter of 30 cm. (1 foot); bark smooth, yellowish green, becoming brown; leaves bipinnate but simulating a pair of elongate, simply pinnate leaves (the common rachis almost none), the rachis of the pinnae broad, flat, up to 60 cm. long, the leaflets many, fugacious; flowers moderately irregular, showy, bright yellow, in elongate racemes; pods turgid, nearly terete, torulose.

1. *Parkinsonia aculeata* L., Sp. Pl. 375. 1753.

Foothills of the Coyote and Baboquivari Mountains, Pima County, occasional in sandy soil along washes, also south of Tucson, where

⁶² Reference: JOHNSTON, I. M. PARKINSONIA AND CERCIIDIUM. Contrib. Gray Herbarium ser. 2, 70: 61-68. 1924.

perhaps an escape from cultivation, 2,000 to 3,000 feet, May (probably other months). Florida, southern Texas, and southern Arizona, to South America.

A very attractive, rapid-growing plant, much used for ornamental planting in warmer parts of the United States. Sometimes known as horsebean.

11. CERCIDIUM.⁶³ PALOVERDE

Large shrubs or small trees, attaining a height of about 8 m. (25 feet); young bark smooth, green; rachis of the pinnae short, terete; flowers showy, yellow, in corymbose fascicles; pods more or less torulose.

The Arizona paloverdes of the genus *Cercidium* are very common and characteristic plants of the lower and drier parts of the State and are a glorious sight when in full flower. They are leafless in the dry season but always conspicuous because of the green bark. The wood is soft and brittle and burns very quickly, giving off an unpleasant odor and leaving few coals. The pods are fairly palatable but are not much eaten by livestock, except during prolonged droughts. It is stated that the Indians ate the seeds sometimes after grinding them into meal. The flowers are reported to yield good honey.

Key to the species

1. Young bark yellowish green; leaves appearing simply pinnate, the common rachis nearly obsolete; leaflets of each pinna commonly 4 to 8 pairs, very small, not more than 3 mm. long; flowers pale yellow, the odd petal often whitish; pod turgid, ending in a flat triangular or sword-shaped beak.
 1. *C. MICROPHYLLUM*.
1. Young bark bluish green; leaves evidently bipinnate, the common rachis short but apparent; leaflets of each pinna 1 to 3 pairs, 4 to 8 mm. long; flowers bright yellow, all of the petals alike in color; pod flat, with a short triangular beak or almost beakless..... 2. *C. FLORIDUM*.

1. ***Cercidium microphyllum*** (Torr.) Rose and Johnston in Johnston, Contrib. Gray Herbarium, ser. 2, 70: 66. 1924.

Parkinsonia microphylla Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 82. 1857.

Cercidiopsis microphylla Britt. and Rose, North Amer. Fl. 23: 306. 1930.

Northern Mohave County to Cochise, Pima, and Yuma Counties, 4,000 feet or lower, dry rocky hillsides and mesas, April to May. Southern and western Arizona, southeastern California, Sonora, and Baja California.

Yellow paloverde. Ends of the leafy branchlets spinescent.

2. ***Cercidium floridum*** Benth. in A. Gray, Pl. Wright. 1: 58. 1852.

Cercidium torreyanum (S. Wats.) Sarg., Gard. and Forest 2: 388. 1889.

Gila, Pinal, and Pima Counties to Mohave and Yuma Counties, 3,500 feet or lower, common along washes and on flood plains, less frequently on dry lower slopes, April to May (occasionally August to October). Range outside Arizona same as that of *C. microphyllum*.

Blue paloverde. Leafy branchlets not or not strongly spine-tipped,

⁶³ Reference: See under *Parkinsonia*, p. 425.

the rudimentary branchlets transformed into spines. A handsomer plant when in flower than *C. microphyllum*, because of the more highly colored flowers. It appears to be less xerophytic and usually grows larger, having a better water supply. It is somewhat earlier flowering than *C. microphyllum*.

12. HOFFMANSEGGIA

Plants perennial, herbaceous or shrubby; leaves bipinnate, the leaflets small; flowers in terminal or lateral racemes, moderately irregular; petals yellow; stamens 10, sometimes red; pods flat.

Key to the species

1. Plant a shrub; stems erect, virgate, densely puberulent, up to 1.2 m. long; leaves soon deciduous, the pinnae 3, the terminal one much the longest; racemes elongate; pods lunate, 1.5 to 2 cm. long, 5 to 7 mm. wide.
 1. H. MICROPHYLLA.
1. Plants herbaceous or suffrutescent; stems decumbent or spreading, seldom more than 30 cm. long; leaves persistent, the pinnae 5 or more, the terminal one not conspicuously longer (2).
 2. Leaflets dotted beneath with conspicuous black glands, the stems, flowers, and pods similarly punctate; pods asymmetrically lunate, conspicuously wider above the middle; root large, woody, fusiform. 2. H. JAMESII.
 2. Leaflets, etc., not punctate with black glands; pods not or not conspicuously wider above the middle; leaves mostly basal (3).
 3. Flowering stems from a thick woody taproot; herbage finely appressed-pubescent; petals short-clawed, glandless; pods strongly falcate, often forming nearly a semicircle. 3. H. DREPANOCARPA.
 3. Flowering stems from creeping rootstocks; herbage conspicuously glandular in the inflorescence; petals long-clawed, the claws bearing subulate glands; pods moderately falcate to nearly straight.
 4. H. DENSIFLORA

1. **Hoffmanseggia microphylla** Torr., U. S. and Mex. Bound. Bot. 58. 1859.

Larrea microphylla Britton, North Amer. Fl. 23: 310. 1930.

Southern Yuma County, in and around the Gila and Tinajas Altas Mountains, 1,000 feet or lower, dry sandy or rocky mesas and slopes, March to October. Southwestern Arizona, southeastern California, Sonora, and Baja California.

Very different in appearance from the other Arizona species and much more xerophytic.

2. **Hoffmanseggia jamesii** Torr. and Gray, Fl. North Amer. 1: 393. 1840.

Larrea jamesii Britton, North Amer. Fl. 23: 316. 1930.

Apache County to Coconino County, also near Sonoita (Santa Cruz County), 4,800 to 5,500 feet, dry plains and mesas, sometimes with pinyons and junipers, May to August. Kansas and Colorado to Texas and Arizona.

3. **Hoffmanseggia drepanocarpa** A. Gray, Pl. Wright. 1: 58. 1852.

Larrea drepanocarpa Britton, North Amer. Fl. 23: 312. 1930.

Coconino, Mohave, Yavapai, Gila, and Cochise Counties, 3,000 to 5,000 feet, May to September. Colorado and western Texas to Arizona and Chihuahua.

4. *Hoffmanseggia densiflora* Benth. in A. Gray, Pl. Wright. 1: 55. 1852.

Larrea densiflora Britton, North Amer. Fl. 23: 311. 1930.

Navajo County to Mohave County, south to Cochise, Pima, and Yuma Counties, 5,000 feet or lower, April to September. Kansas to Arizona, southern California, and central Mexico.

Hogpotato, camote-de-ration. Common at roadsides in the irrigated districts, often forming large colonies and becoming a troublesome weed in cultivated fields and pastures, difficult to eradicate, especially on heavy soils. The tuberous enlargements of the roots are valuable hog feed and after roasting were used for food by the Indians. The plant is considered a good soil binder.

The species is closely related to the South American *H. falcaria* Cav., to which it was reduced by Fisher.⁶⁴ He described several varieties under *H. falcaria* of which the following were stated to occur in Arizona: var. *stricta* (Benth.) Fisher; var. *demissa* Fisher; var. *pringlei* Fisher (type, near Tucson, *Pringle* in 1881, part); and var. *capitata* Fisher (type, near Tucson, *Pringle* in 1881, part).

13. CAESALPINIA

Shrub, up to 3 m. (10 feet) high; leaves bipinnate, large, with many small leaflets; flowers in terminal racemes, large and showy, the petals yellow; stamens and pistil red, the stamens with very long filaments; pods large, flat.

1. *Caesalpinia gilliesii* Wall., Bot. Misc. Hook. 1: 129. 1830.

Poinciana gilliesii Hook., *ibid.*

Occasionally escaped and perhaps naturalized near Kingman (Mohave County), Globe (Gila County), and in Cochise and Pima Counties, May to August. Introduced from South America.

Bird-of-paradise-flower. Much grown as an ornamental, especially by the Mexican population. Plant ill smelling, very showy because of the extraordinary long red filaments.

3. PAPILIONOIDEAE. BEAN SUBFAMILY

Key to the genera

1. Filaments all separate to the base or very nearly so (2).
2. Leaves pinnate with numerous leaflets; stipules very small; corolla white, blue, or lilac; pods torulose; plants small herbs or good-sized shrubs.
 14. SOPHORA.
 15. THERMOPSIS.
2. Leaves digitately 3-foliolate; stipules large, foliaceous; corolla yellow; pods not torulose; plant a tall herb.....
1. Filaments all, or 9 of them, united at least near the base or, if separate (*Parryella*), then attached at base to the calyx, and corolla none (3).
3. Anthers strongly differentiated, some very small and versatile (dorsifixed), others much larger and basifixed; plants herbaceous (4).
4. Leaves unifoliolate or pinnately trifoliolate; corolla yellow or orange; pods much inflated, bladderlike; plants annual.....
16. CROTALARIA.
4. Leaves palmately compound with usually more than 3 leaflets; corolla violet, purple, or whitish; pods not bladderlike; plants annual or perennial.....
17. LUPINUS.

⁶⁴ FISHER, E. M. REVISION OF THE NORTH AMERICAN SPECIES OF HOFFMANSEGGLIA. Contrib. U. S. Natl. Herbarium 1: 143-150. 1892. (See pp. 144, 145.)

3. Anthers not sharply differentiated, all of approximately the same size or, if sharply differentiated (*Glycyrrhiza*, *Stylosanthes*, *Zornia*), then the pods prickly, or else the inflorescence conspicuously bracted, the corolla yellow, and the pods jointed or ending in a hook (5).
5. Rachis of the leaf extended into a simple or forked tendril, this, in *Lathyrus*, sometimes reduced to a soft bristle, or rudimentary; plants herbaceous; stems weak; leaves pinnate with several leaflets; corolla purple, pink, or whitish (6).
6. Style with a tuft of hairs on the back or all around, just below the stigma; stamen tube oblique at apex..... 49. VICIA.
6. Style hairy along the inner side only, with no apical tuft; stamen tube not oblique..... 50. LATHYRUS.
5. Rachis of the leaf not ending in a tendril, but greatly prolonged in place of a terminal leaflet in certain species of *Astragalus* (7).
7. Fruit (loment) of several indehiscent 1-seeded segments, these often separating at maturity, or, it reduced to 1 seed-bearing segment, then ending in a wing (*Nissolia*), or a hook (*Stylosanthes*), or the plant a spiny shrub (8).
8. Corolla pink or purple, exceptionally white (9).
9. Plant an intricately branched, spiny, glabrous shrub; leaves small, unifoliolate; fruit of 1 to 3 segments, these not separating at maturity..... 43. ALHAGI.
9. Plants herbaceous above ground or suffrutescent, not spiny; leaves pinnately compound, sometimes reduced to one leaflet in *Desmodium* (10).
10. Leaflets more than 3, without stipels..... 42. HEDYSARUM.
10. Leaflets 1 or 3, with stipels..... 48. DESMODIUM.
8. Corolla yellow or orange (11).
11. Anthers all alike; inflorescences not conspicuously bracteate, few-flowered, axillary (12).
12. Stems twining or prostrate, often suffrutescent; leaflets usually 5, rather large, ovate or ovate-lanceolate; segments of the fruit 1 to 3, the terminal one-winged..... 44. NISSOLIA.
12. Stems erect; leaflets many, small, linear; segments of the fruit commonly more than 3, all alike..... 45. AESCHYNOMENE.
11. Anthers conspicuously different, some large and basifixed, others very small and versatile; inflorescences conspicuously bracteate; plants herbaceous; stems decumbent to erect (13).
13. Leaves 3-foliolate; bracts of the inflorescence not valvelike, often 3-foliolate, sharply cuspidate; fruit 1- or 2-jointed, tipped by the hooked persistent style... 46. STYLOSANTHES.
13. Leaves 2-foliolate; bracts valvelike, a closely appressed pair partly hiding each flower, entire, conspicuously veined, not sharply cuspidate; fruit several-jointed, without a hooked tip..... 47. ZORNIA.
7. Fruit not segmented, but sometimes constricted between the seeds (14).
14. Leaves (and usually the calyx) glandular-punctate, sometimes obscurely so (15).
15. Stems trailing or twining; flowers few, in axillary racemes or fascicles; corolla bright yellow; pods completely dehiscent, strongly compressed; leaves pinnately trifoliolate... 55. RHYNCHOSIA.
15. Stems erect or ascending; flowers numerous, in mostly terminal racemes or spikes; corolla not bright yellow, sometimes ochroleucous or pale yellow; pods not or very tardily dehiscent (16).
16. Pods prickly; plant a tall, leafy-stemmed herb; leaves pinnate with numerous leaflets; flowers in dense spikelike racemes; corolla whitish..... 41. GLYCYRRHIZA.
16. Pods not prickly (17).
17. Ovule solitary; plants perennial herbs; leaves digitately 3-foliolate to 5-foliolate..... 23. PSORALEA.
17. Ovules 2 or more; leaves mostly pinnate with several or many leaflets, seldom digitately trifoliolate (18).
18. Petals none or only one; plants shrubby; leaves pinnate with numerous leaflets, these stipellate; flowers in elongate spikelike racemes (19).
19. Leaflets very numerous, small; stipels glandular, persistent; corolla none; stamens separate, attached at base to the calyx..... 24. PARIYELLA.

- 19. Leaflets several, large; stipels subulate, caducous; corolla of one petal, this dark violet; stamens united at base..... 25. AMORPHA.
- 18. Petals 5 (20).
- 20. Stamens 5; plants herbaceous; flowers in dense cylindrical spikes; corolla white, pink, or purplish. 28. PETALOSTEMUM.
- 20. Stamens 9 or 10 (21).
- 21. Plant shrubby; leaflets numerous, with subulate stipels; flowers in elongate spikelike racemes; corolla white; style bearing a large sessile gland near the apex; pods thin, flat, long-exserted from the calyx. 26. EYSENHARDTIA.
- 21. Plants small herbs to large shrubs, when shrubby the corolla not white; leaflets few or numerous, without stipels or these mostly glandlike; flowers in loose or dense heads, spikes, or racemes; style not gland-bearing; pods turgid, included in the calyx, or long-exserted in a few shrubby species. 27. DALEA.
- 14. Leaves not glandular-punctate (22).
- 22. Margins of the leaflets denticulate to serrate, rarely entire in *Trifolium*; leaves 3-foliolate; plants herbaceous (23).
- 23. Pods scythe-shaped to spirally coiled..... 18. MEDICAGO.
- 23. Pods straight or nearly so (24).
- 24. Flowers in elongate rather loose racemes; corolla yellow or white; plants strongly aromatic when dry. 19. MELILOTUS.
- 24. Flowers in heads or short dense spikes; corolla white, pink, or purple; plants not noticeably aromatic when dry. 20. TRIFOLIUM.
- 22. Margins of the leaflets entire (25).
- 25. Plants shrubby or arborescent (26).
- 26. Leaves 3-foliolate; corolla about 5 cm. long, scarlet; banner petal narrow, strongly keeled, much longer than the other petals; pods very large, coriaceous; seeds bright red. 53. ERYTHRINA.
- 26. Leaves multifoliolate; corolla much less than 5 cm. long, not scarlet; banner petal not strongly keeled, not much longer than the other petals; pods not very large, not coriaceous; seeds not bright red (27).
- 27. Calyx in bud closely subtended by 2 caducous bractlets; corolla yellowish; outer wall of the pod separating from the inner wall; plant a low shrub..... 33. DIPHYSA.
- 27. Calyx without bractlets; corolla purple, pink, or white; outer wall of the pod not separating from the inner wall (28).
- 28. Herbage with malpighiaceus hairs (hairs attached at the middle); pods subglobose, 1-seeded, very tardily dehiscent; plant a low shrub; leaflets numerous. 22. INDIGOFERA.
- 28. Herbage without malpighiaceus hairs; pods elongate, several-seeded, rather promptly dehiscent; plants large shrubs or small trees (29).
- 29. Inflorescence not glandular; leaflets not cuspidate; plant a small tree; corolla purple and white, about 12 mm. long; pods torulose..... 32. OLNEYA.
- 29. Inflorescence glandular; leaflets cuspidate (30).
- 30. Corolla 20 to 25 mm. long, purplish pink; pods not torulose, hispid and usually glandular. 31. ROBINIA.
- 30. Corolla not more than 15 mm. long, white or tinged with pink; pods torulose, puberulent. 34. COURSETIA.

25. Plants herbaceous or suffrutescent (31).
31. Filaments all or some of them broad and flat, or dilated just below the anther; flowers solitary in the leaf axils, or in few-flowered umbellike clusters; leaflets few; corolla usually yellow..... 21. LOTUS.
31. Filaments all filiform or, if flat, then narrow (32).
32. Leaves pinnately 3-foliolate; corolla purple or purplish (33).
33. Style bearded (34).
34. Corolla 5 to 6 cm. long, lavender purple, the keel not strongly curled or spirally coiled; stems erect or ascending..... 51. CLITORIA.
34. Corolla not more than 2 cm. long, the keel strongly curled or spirally coiled at apex; stems usually trailing or twining..... 56. PHASEOLUS.
33. Style not bearded (35).
35. Stems not or barely twining; flowers solitary or in pairs in the axils; corolla deep red purple.
52. COLOGANIA.
35. Stems more or less twining; flowers in bracted racemes; corolla pale..... 54. GALACTIA.
32. Leaves all or some of them with more than 3 leaflets, or reduced to a single leaflet, or sometimes (in *Astragalus*), none and the rachis greatly prolonged (36).
36. Calyx closely subtended by a pair of small, caducous bractlets; plants tall; leaflets numerous, linear, narrowly oblong, or narrowly elliptic; flowers in axillary racemes (37).
37. Plant annual; pods very long and slender, completely dehiscent; corolla pale yellow, usually with purple markings..... 37. SESBANIA.
37. Plant perennial with rootstocks, resembling some species of *Astragalus*; pods bladderlike, indehiscent or tardily and irregularly dehiscent; corolla dull red.
38. SWAINSONA.
36. Calyx without bractlets (38).
38. Pods with cross partitions between the seeds, narrow, elongate, flat, completely dehiscent; seeds more or less quadrangular in outline (39).
39. Leaflets several, broad and thin; flowers several, in loose, long-stalked racemes; seeds not constricted; plants perennial..... 35. CRACCA.
39. Leaflet one, narrowly linear, elongate; flowers 1 or 2 in the leaf axils, short-pedicel; seeds constricted at the middle; plant annual.
36. SPHINCTOSPERMUM.
38. Pods without cross partitions; seeds commonly rounded, often reniform, quadrangular in a few species of *Astragalus* (40).
40. Sutures of the pods not introverted, the pods completely 1-celled, flat, 10 or more times as long as wide (41).
41. Stipules not spinescent; lateral veins of the leaflets conspicuous..... 29. TEPHROSIA.
41. Stipules spinescent; lateral veins inconspicuous or obsolete..... 30. PETERIA.
40. Sutures one or both of them introverted, the pods often more or less completely 2-celled, less (usually much less) than 10 times as long as wide (42).
42. Keel not beaked or, if so, then the plant caulescent and the stems decumbent or prostrate.
39. ASTRAGALUS.
42. Keel with a prominent, erect or ascending beak; plants acaulescent, the scapes erect or ascending..... 40. OXYTROPIS.

14. SOPHORA

Shrubs or perennial herbs; leaves pinnate, with several or many leaflets; flowers in racemes, the petals white, blue, or lilac; stamens 10, separate to the base or very nearly so; pods flat or turgid, moderately torulose to moniliform, tardily dehiscent.

The herbage and seeds of some (perhaps all) of the species are poisonous to livestock when eaten in quantity. The herbaceous species, which resemble some species of *Astragalus*, colonize freely by means of horizontal roots and thus are efficient soil binders, especially in the sandy areas of northeastern Arizona. Several shrubby and arboreous species from different parts of the world are grown as ornamentals and the native *S. arizonica* and *S. formosa*, with their large wisteria-colored flowers, are well worth cultivating.

Key to the species

1. Plants shrubby, up to 3.5 m. high; leaves coriaceous, evergreen; seeds red; leaves and twigs sericeous, at least when young; corolla lilac or violet; pods flat, about 10 mm. wide, moderately torulose (2).
2. Leaflets acutish to obtuse, not more (usually less) than 10 mm. wide; upper calyx teeth 1 to 1.5 mm. long; corolla about 22 mm. long, lilac, the banner petal obovate-oblong (distinctly wider above the middle), about two-thirds as wide as long, the keel petals with claws less than half as long as the blades..... 1. *S. ARIZONICA*.
2. Leaflets obtuse or slightly retuse to acutish, up to 12 mm. wide; upper calyx teeth 2.5 to 3 mm. long; corolla about 16 mm. long, violet, the banner petal broadly oval (not wider above the middle), four-fifths as wide as long, the keel petals with claws one-half to three-fifths as long as the blades..... 2. *S. FORMOSA*.
1. Plants herbaceous, seldom more than 30 cm. high; leaves not coriaceous or evergreen; seeds not red; pods turgid, about 5 mm. wide, usually moniliform (3).
3. Leaflets narrowly linear, 15 to 25 mm. long, pubescent on both faces; corolla blue; plant velvety-tomentose..... 3. *S. STENOPHYLLA*.
3. Leaflets oblong or oblong-obovate, commonly not more than 10 mm. long, glabrous or glabrate above; corolla white or ochroleucous; plant sericeous..... 4. *S. SERICEA*.

1. *Sophora arizonica* S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 135. 1876.

Mohave County, "Cactus Pass and on White Cliff Creek" (*Bigelow*, the type collection), foothills of Hualpai Mountain, Big Sandy River, 60 miles southeast of Kingman, about 4,000 feet, dry rocky hillsides and banks of arroyos, with *Quercus turbinella*, *Canotia*, etc., March. Known only from western Arizona.

2. *Sophora formosa* Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 482. 1939.

Graham County, foothills of the Pinaleno Mountains (*Maguire* 10993, the type collection, *Humphrey* in 1937, *Kearney* and *Peebles* 14233), about 3,500 feet, habitat similar to that of *S. arizonica*, associated with *Quercus turbinella*, *Yucca*, *Dasyllirion*, *Prosopis*, *Larrea*, and *Fouquieria*, April. Known only from southeastern Arizona.

Both this species and the closely related *S. arizonica* are very local, but are fairly abundant at the stations where they occur. They appear to be relict species, barely holding their own under present conditions.

3. *Sophora stenophylla* A. Gray in Ives, Colo. Riv. Rpt. 10. 1860.

Hopi Indian Reservation and Betatakin (Navajo County), 6,000 to 7,000 feet, June, type from Oraibi (*Newberry* in 1858). Southern Utah, New Mexico, and northeastern Arizona.

4. *Sophora sericea* Nutt., Gen. Pl. 1: 280. 1818.

Apache County to Yavapai and eastern Mohave Counties, also in Cochise County, 4,000 to 7,000 feet, often growing in dense colonies, April to June. South Dakota and Wyoming to Texas and Arizona.

15. THERMOPSIS. GOLDENPEA

Plant herbaceous, perennial; stems erect, branching, leafy; leaves 3-foliolate, the leaflets large, lanceolate to ovate or somewhat rhombic, the stipules large, foliaceous; flowers large, in rather dense terminal racemes, the petals bright yellow; stamens 10, incurved, separate; pods sessile or nearly so.

1. *Thermopsis pinetorum* Greene, Pittonia 4: 138. 1900.

Apache to Coconino Counties south to Graham, Gila, and Yavapai Counties, 6,000 to 9,500 feet, common in pine forests, May to July. Colorado, Utah, New Mexico, and Arizona.

A showy plant when in flower, reported to be unpalatable to cattle. The plants spread by rootstocks, forming patches.

16. CROTALARIA.⁶⁵ RATTLEBOX

Plants herbaceous or suffrutescent; leaves unifoliolate or trifoliolate, with stipules; flowers in lateral or terminal racemes, these few- to many-flowered; calyx somewhat bilabiate; petals yellow, the keel curved or bent; stamens dimorphic; pods much inflated, many-seeded, oblong to nearly globose.

The plants are palatable to livestock.

Key to the species

1. Leaves unifoliolate, the leaflet linear, lanceolate, elliptic, oval, or the lowest obovate; stems simple, or branched only near the base; herbage (including the upper surface of the leaves) loosely villous or subhirsute with long, more or less spreading hairs; peduncles lateral, 1- to 3-flowered; calyx 6 to 9 mm. long; corolla pale yellow, scarcely surpassing the calyx; pods sometimes black at maturity..... 1. *C. SAGITTALIS*.
1. Leaves trifoliolate, the leaflets commonly oblanceolate or obovate; stems branched well above the base, rarely simple; herbage strigose-pubescent, the upper leaf surface glabrous; peduncles often appearing terminal as well as lateral, 1- to many-flowered; calyx 3 to 4 mm. long; corolla orange yellow, greatly surpassing the calyx; pods reddish brown at maturity.
 2. *C. PUMILA*.

1. *Crotalaria sagittalis* L., Sp. Pl. 714. 1753.

Cochise, Santa Cruz, and Pima Counties, 4,300 to 6,000 feet, sandy soil usually along brooks, August to October. New England to South Dakota and Texas, southern Arizona, and south to Panama.

The Arizona forms are: (1) var. *blumeriana* Senn, differing from typical *C. sagittalis* in its shorter stems, shorter and relatively broader

⁶⁵ Reference: SENN, HAROLD A. THE NORTH AMERICAN SPECIES OF CROTALARIA. *Rhodora* 41: 317-367. 1939.

leaflets, inconspicuous or obsolete stipules, and smaller pods; and (2) var. *fruticosa* (Mill.) Fawc. and Rend. (*C. pringlei* A. Gray), which is suffruticose and has uniformly linear leaves. The second variety is known in Arizona only from the type collection of *C. pringlei* in the Santa Catalina Mountains (*Pringle* 276).

2. *Crotalaria pumila* Ortega, Hort. Matr. Dec. 2: 23. 1797.

Crotalaria lupulina H. B. K., Nov. Gen. et Sp. 6: 402. 1824.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,500 feet, preferring sandy soil, August to October. Florida; Texas to southern Arizona and Mexico.

Varies greatly in size of the plant and the flowers, and in the number of flowers in the racemes, these 1 to many. The petals are often tinged or streaked with reddish color.

17. LUPINUS.⁶⁶ LUPINE

Plants herbaceous (the Arizona species), annual or perennial; stems leafy or subscapose; leaves digitately compound with 4 to 15 leaflets; flowers in terminal racemes or spikes, often showy; calyx strongly bilabiate; petals blue, purple, or white, the keel usually curved and enclosed by the connivent wing petals; stamens dimorphic; pods more or less compressed, sometimes constricted between the seeds.

Several species are cultivated as ornamentals and most of those occurring in Arizona are handsome plants. The seeds of *L. albus* are used as food in Europe. It is known that some of the American species, including *L. sparsiflorus*, common in Arizona, contain alkaloids that are poisonous to livestock, especially to sheep. The seeds are especially toxic, the pods less so, and the herbage is relatively harmless, often containing so little of the dangerous alkaloids that sheep graze the plants without ill effect. Bluebonnets (*L. subcarnosus* or *L. texensis*) is the State flower of Texas.

The taxonomy of this genus is difficult, and authorities differ greatly in their interpretations, particularly of the perennial species.

Key to the species

1. Plants annual or biennial (2).
2. Keel ciliate; pods oblong, several-seeded (3).
3. Flowers verticillate, 10 mm. long or longer, the corolla violet blue, the keel ciliate toward the base, both above and below; stems strigose or glabrate, stout, fistulous; leaflets wedge-shaped, widest at the truncate (often slightly retuse) apex, thickish, glabrous above, sparsely strigose beneath..... 1. *L. SUCCULENTUS*.
3. Flowers not verticillate, not more (usually less) than 10 mm. long, the keel ciliate toward the base on the lower side, only (4).
4. Plant not succulent, drying green; stems slender, or stout but scarcely fistulous; leaflets narrowly lanceolate or oblanceolate, seldom more than 4 mm. wide, acute or acutish at apex, thin, usually sparsely strigose above; corolla when fresh violet blue, occasionally white.
 2. *L. SPARSIFLORUS*.
4. Plant somewhat succulent, drying brownish; stems stout, fistulous; leaflets broadly oblanceolate, 5 to 12 mm. wide, rounded and mucronate or mucronulate at apex, thickish, glabrous or glabrate above; corolla when fresh pale purplish pink, sometimes drying violet.
 3. *L. ARIZONICUS*.

⁶⁶ Reference: SMITH, C. P. SPECIES LUPINORUM. A DISTRIBUTIONAL CATALOG OF LUPINUS IN ARIZONA. 119-143. 1939-40.

2. Keel not ciliate (5).
5. Pods commonly 3- or 4-seeded; cotyledons petioled after germination; racemes not or but little surpassing the leaves, even in fruit; herbage villous; stems decumbent or spreading; leaflets usually more than 6, commonly obtuse; lower lip of the calyx 3-dentate; corolla about 7 mm. long, the banner and wings pale purple, the tip of the keel deeper purple..... 4. *L. CONCINNUS*.
5. Pods 2-seeded (except sometimes in *L. odoratus*); cotyledons sessile after germination (6).
6. Racemes in flower dense, often subcapitate, usually less than 2 cm. long; pods not noticeably constricted between the seeds, ovate or lance-ovate in outline, villous all over (7).
7. Plant acaulescent or nearly so, the stems scarcely 1 cm. long, the leaves mostly basal; lower lip of the calyx more than twice as long as the (often obsolete) upper lip; pods broadly ovate.
5. *L. BREVICAULIS*.
7. Plant caulescent, the stems 3 cm. long or longer, branched, leafy; lower lip of the calyx less than twice as long as the upper lip, the lips often nearly equal; pods ovate or lance-ovate..... 6. *L. KINGII*.
6. Racemes in flower loose (if rather dense, then the pods distinctly constricted between the seeds), the racemes seldom less than 2 cm. long (8).
8. Pods lance-oblong in outline, distinctly constricted between the seeds, hirsute all over; plants more or less caulescent; stems and the lower surface of the leaves hirsute (9).
9. Leaflets obtuse at apex; racemes slightly if at all surpassing the foliage; pedicels hirsute; calyx hirsute all over, the upper lip 4 to 5 mm. long..... 7. *L. PUSILLUS*.
9. Leaflets acutish at apex; racemes usually considerably surpassing the foliage; pedicels glabrous or nearly so; calyx glabrous or nearly so toward the base, the upper lip not more than 3 mm. long..... 8. *L. RUBENS*.
8. Pods ovate in outline, not noticeably constricted between the seeds, smooth or scaly on the sides, villous or hirsute on the upper (ventral) suture (10).
10. Plant loosely pilose, acaulescent or nearly so; racemes 5 to 12 cm. long, greatly surpassing the foliage; pedicels and calyx tube glabrous or nearly so..... 9. *L. ODORATUS*.
10. Plant conspicuously silky-villous, more or less caulescent but short-stemmed; racemes usually less than 5 cm. long, not or but slightly surpassing the foliage; pedicels and calyx tube villous.
10. *L. SHOCKLEYI*.
1. Plants perennial, but the young plants sometimes appearing annual, especially in *L. huachucanus*; ovules and seeds normally more than 2 (11).
11. Petals whitish or ochroleucous; beak of the keel long, attenuate, almost at a right angle to the lower part and usually exerted from the wings at anthesis, the keel sparsely ciliate toward the base; herbage sparsely strigose, appearing glabrous; stems tall, stout, erect; racemes 10 cm. long or longer, many-flowered, the flowers large..... 11. *L. LATIFOLIUS*.
11. Petals normally violet to pale purple; beak of the keel shorter and less attenuate, not or barely exerted at anthesis, the keel usually ciliate toward the apex (12).
12. Plant acaulescent and caespitose or, if caulescent, then the stems not more than about 20 cm. long; herbage copiously villous-hirsute with long spreading hairs; leaflets 5 to 7, acute at both ends; corolla 7 to 9 mm. long, the banner and wings violet blue, the tip of the keel purple.
12. *L. HUACHUCANUS*.
12. Plants caulescent, the stems leafy, usually more than 20 cm. long; species difficult to distinguish and apparently largely confluent (13).
13. Hairs of the stems and petioles appressed or subappressed (14).
14. Base of the calyx distinctly short-spurred on one side; herbage commonly densely silvery-sericeous, the leaflets seldom glabrate above..... 13. *L. ADUNCUS*.
14. Base of the calyx not spurred but sometimes strongly gibbous on one side (15).
15. Banner petal sericeous in the center of the back; flowers 8 to 9 mm. long..... 14. *L. GREENEI*.

15. Banner petal glabrous or nearly so; flowers 10 to 12 (rarely only 9) mm. long (16).
 16. Herbage, including the upper surface of the leaflets, densely sericeous; southern..... 15. *L. LEMMONII*.
 16. Herbage green, the pubescence sparse, the leaflets often glabrate above; northern..... 16. *L. ARGENTEUS*.
 13. Hairs of the stems and petioles, at least the longer ones, spreading or ascending (17).
 17. Banner petal sericeous in the center of the back; herbage copiously pubescent; pedicels commonly 4 to 6 mm. long; flowers seldom less than 12 mm. long..... 17. *L. BARBIGER*.
 17. Banner petal glabrous or nearly so (18).
 18. Flowers 5 to 7 mm. long; racemes normally dense, many-flowered, more or less verticillate; herbage copiously pubescent.
 18. *L. HILLII*.
 18. Flowers 8 to 14 mm. long; racemes not noticeably verticillate (19).
 19. Leaflets sericeous above; stems copiously to densely pubescent; flowers 8 to 10 mm. long, the corolla normally violet; long-petioled basal leaves usually present at anthesis. 19. *L. PALMERI*.
 19. Leaflets sparsely strigose or glabrate above; stems not densely pubescent; long-petioled basal leaves usually disappearing before anthesis (20).
 20. Flowers 12 to 14 mm. long, the corolla pale lavender to reddish purple; stems sparsely to copiously hirsute with long, spreading hairs..... 20. *L. BLUMERI*.
 20. Flowers 9 to 11 (rarely 12) mm. long, the corolla normally violet; stems not hirsute, the longer hairs relatively short, ascending..... 21. *L. SITGREAVESII*.

1. *Lupinus succulentus* Dougl. ex C. Koch, Wochenschr. Gaertn. Pflanzenk. 4: 277. 1861.

Roosevelt (Gila County), Canyon Lake and Camp Creek (Maricopa County), 1,500 to 3,300 feet, open slopes and mesas, March. Arizona, California, and Baja California.

The plants have extraordinarily large root nodules. The Arizona form is relatively small-flowered.

2. *Lupinus sparsiflorus* Benth., Pl. Hartw. 303. 1848.

Mohave, Graham, Gila, Maricopa, Pinal, Pima, and eastern Yuma Counties, 4,500 feet or lower, mesas and foothills, preferring sandy soil, January to May. Nevada and Arizona to California, Sonora, and Baja California.

In favorable springs this handsome lupine colors extensive areas with the rich violet of its flowers. The common form in Arizona, with flowers not more (usually less) than 1 cm. long, is interpreted by Smith as var. *arizonicus* S. Wats. (See footnote 66, p. 434, Smith, p. 121).

3. *Lupinus arizonicus* S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 250. 1877 (in part).

Lupinus concinnus var. *arizonicus* S. Wats., Amer. Acad. Arts and Sci. Proc. 8: 537. 1873.

Lupinus sparsiflorus var. *barbatulus* Thornber ex C. P. Smith, Torrey Bot. Club Bul. 47: 497. 1920.

Mohave and Yuma Counties, eastward to the western part of Maricopa, Pinal, and Pima Counties, 3,000 feet or lower, usually in sandy washes, February to May. Western Arizona, southeastern California, Sonora, and Baja California.

Occurs usually at lower altitudes and in deeper sand than *L. sparsiflorus*, the two forms seldom commingling and, when they do, rarely intergrading, in Arizona at any rate. Watson's description of *L. concinnus* var. *arizonicus* seems clearly applicable to the form published subsequently as *L. sparsiflorus* var. *barbatulus* Thornber, but Watson's description of *L. arizonicus* as a species (with citation of *L. concinnus* var. *arizonicus* S. Wats. as a synonym), seems to include both *L. sparsiflorus* and the form here under consideration.

4. *Lupinus concinnus* Agardh, Syn. Gen. Lupin. 6: pl. 1. 1835.

Mohave County to Graham, Gila, Cochise, Santa Cruz, Pima, and (doubtless) Yuma Counties, 5,000 feet or (usually) lower, March to May. New Mexico to southern Nevada, Arizona, California, and northern Mexico.

Very abundant in the sandy desert areas, in spring. The commoner Arizona form is the relatively small-flowered var. *orcuttii* (S. Wats.) C. P. Smith (*L. orcuttii* S. Wats., *L. micensis* M. E. Jones), but Smith has identified numerous Arizona specimens as of the typical form of the species (see footnote 66, p. 434, Smith, p. 122).

5. *Lupinus brevicaulis* S. Wats. in King, Geol. Expl. 40th Par. 5: 53. 1871.

Lupinus dispersus Heller, Muhlenbergia 5: 141. 1909.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 7,000 feet, dry slopes and mesas, April to July. Colorado to Oregon, New Mexico, Arizona, and California.

6. *Lupinus kingii* S. Wats., Amer. Acad. Arts and Sci. Proc. 8: 534-1873.

Lupinus capitatus Greene, Pittonia 1: 171. 1888.

Apache, Navajo, Coconino, and Yavapai Counties, 6,000 to 8,000 feet, usually in open pine forests, June to August. Utah, Colorado, New Mexico, and Arizona.

7. *Lupinus pusillus* Pursh, Fl. Amer. Sept. 468. 1814.

Apache County to northeastern Mohave County, 4,700 to 7,000 feet, sandy plains, May and June. Saskatchewan to Washington, south to Kansas, New Mexico, and northern Arizona.

The Arizona specimens belong mostly to the relatively small-flowered var. *intermontanus* (Heller) C. P. Smith (*L. intermontanus* Heller), which intergrades completely with the typical form.

8. *Lupinus rubens* Rydb., Torrey Bot. Club Bul. 34: 45. 1907.

Navajo County to Mohave County, 2,000 to 5,000 feet, April to June. Southern Utah and northern Arizona to southeastern California.

Probably not more than a variety of *L. pusillus*. Some of the few Arizona specimens referred to *L. rubens* are nearly intermediate.

9. *Lupinus odoratus* Heller, Muhlenbergia 2: 71. 1905.

Near Peach Springs, Hackberry, Kingman, and Chloride (Mohave County), 3,000 to 4,500 feet, April and May. Western Arizona, Nevada, and southeastern California.

The Arizona specimens are not typical and probably belong to var. *pilosellus* C. P. Smith. The handsome flowers are fragrant.

10. *Lupinus shockleyi* S. Wats., Amer. Acad. Arts and Sci. Proc. 22: 470. 1887.

Kingman to Peach Springs, Mohave County (*Lemmon* in 1884, *Eastwood* 18443), 3,300 to 5,000 feet. Western Arizona, Nevada, and southeastern California.

11. *Lupinus latifolius* Agardh, Syn. Gen. Lupin. 18. 1835.

Williams, Coconino County (*Toumey* 578), Prescott, Yavapai County (*Rusby* 555, *Peebles* et al. 2702, etc.), 5,000 to 7,000 feet, at Prescott along a stream in partial shade, May to July. Central Arizona and California.

The Arizona specimens, all of which have whitish or ochroleucous corollas, are referred by Smith to var. *parishii* C. P. Smith (*L. parishii* Eastw.). (See footnote 66, p. 434, Smith, p. 139.)

12. *Lupinus huachucanus* M. E. Jones, Contrib. West. Bot. 12: 10. 1908.

Lupinus platanophilus M. E. Jones, *ibid.* 17: 29. 1930.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), 5,000 to 6,000 feet, pine woods, March to May, type of *L. huachucanus* from the Santa Rita Mountains (*Jones* in 1903), type of *L. platanophilus* from the Huachuca Mountains (*Jones* 26135). Southern Arizona and Chihuahua.

The plant resembles *L. concinnus*, but is readily distinguished by its ciliate keel and racemes surpassing the foliage. A specimen from the Chiricahua Mountains (*Price* in 1894), with exceptionally narrow leaflets, was referred by Smith (see footnote 66, p. 434, Smith, p. 124), to *L. chihuahuensis* Wats., but that species, although evidently related to *L. huachucanus*, differs from it in its much more sparsely pubescent herbage, interrupted-verticillate inflorescence, larger flowers, and appressed or subappressed pubescence of the pedicels and calyx.

13. *Lupinus aduncus* Greene, Pittonia 4: 132. 1900.

† Carrizo, Tunitcha, and Lukachukai Mountains (Apache County), Jacobs Lake (Coconino County), 5,500 to 9,000 feet, June to September. Wyoming and Utah to New Mexico and northern Arizona.

14. *Lupinus greenei* A. Nels. in Coult., New Man. Bot. Rocky Mount. 274. 1909.

Lupinus oreophilus Greene, Pittonia 4: 135. 1909. Not Philippi, 1891.

This species is known definitely only from southern Colorado, but specimens from Navajo Mountain, Coconino County, Ariz. (*Darsie* in 1933, *Peebles* and *Smith* 13954), are referred here tentatively, having the banner sericeous on the back, as described by Greene. They are aberrant, however, in their very narrow, almost linear, acute leaflets, resembling, in this respect, the type of *L. marcusianus* C. P. Smith, which came from the Grand Canyon (*Jones* in 1920). (See footnote 66, p. 434, Smith, p. 137.) *Darsie's* specimen is aberrant also in its sparse pubescence.

15. *Lupinus lemmonii* C. P. Smith, Sp. Lupin. 127. 1939.

Apache Pass and Sulphur Springs, Cochise County (*Lemmon* in 1881, *Rothrock* 543), Santa Rita Mountains, Pima County (*Pringle* in 1884),

4,000 to 4,500 feet, type from Sulphur Springs (*Lemmon* in 1881). Known only from southern Arizona.

Rothrock's specimens are referred by Smith to *L. greenii*, but they correspond closely with his description of *L. lemmonii*. (See footnote 66, p. 434, Smith, p. 125.) The stems are apparently slightly woody toward the base. Except in the closely appressed pubescence, this species greatly resembles *L. palmeri*, to which Pringle's collection was referred by Smith.

16. *Lupinus argenteus* Pursh, Fl. Amer. Sept. 468. 1814.

Carrizo Mountains and White Mountains (Apache and Greenlee Counties), Grand Canyon, San Francisco Peaks, Flagstaff, etc. (Coconino County), 7,000 to 10,000 feet, mostly in open coniferous forests, June to October. North Dakota and Montana, south to New Mexico and northern Arizona.

Five varieties, all based on types from the Flagstaff region, are described by Smith. (See footnote 66, p. 434, Smith, pp. 133-135.)

17. *Lupinus barbiger* S. Wats., Amer. Acad. Arts and Sci. Proc. 8: 528. 1873.

Kaibab Plateau to the south rim of the Grand Canyon (Coconino County), 8,000 to 8,600 feet, August. Colorado, Utah, and northern Arizona.

L. barbiger is given as a synonym of *L. sericeus* Pursh by Smith. (See footnote 66, p. 434, Smith, p. 138.)

18. *Lupinus hillii* Greene, Leaflets 2: 236. 1912.

Kaibab Plateau (Coconino County) to southern Apache and northern Gila Counties, 6,000 to 9,000 feet, often very abundant in yellow pine forests in the Flagstaff region, May to September, type from the Coconino National Forest (*Hill* in 1911). Known only from northern Arizona.

This species resembles *L. palmeri* except in the smaller and usually more numerous and crowded flowers. Greene (*ibid.*) stated: "the flowers are the smallest known among those of perennial lupines." The type of *L. ingratus* Greene var. *arizonicus* C. P. Smith, from the Grand Canyon (*Eggleston* 15664), seems to the writers to be *L. hillii*.

19. *Lupinus palmeri* S. Wats., Amer. Acad. Arts and Sci. Proc. 8: 530. 1873.

Kaibab Plateau (Coconino County), Hualpai Mountain (Mohave County), southward through Yavapai and Gila Counties to the mountains of Pima County, 4,000 to 8,000 feet, mostly in yellow pine forests, May to October, type from near Prescott (*Palmer* 754). New Mexico and Arizona.

The commonest and most widely distributed of the perennial lupines of Arizona. Two varieties, based on types from Coconino County, are described by Smith. (See footnote 66, p. 434, Smith, p. 126.)

Apparently nearly related to *L. palmeri* is *L. osterhoutianus* Smith, type from near the Grand Canyon (*Osterhout* 6971), described as having stems with short velvety pubescence and whitish foliage. (See footnote 66, p. 434, Smith, p. 126.)

20. *Lupinus blumeri* Greene, Leaflets 2: 23. 1909.

Pinaleno, Chiricahua, Huachuca, and Santa Rita Mountains (Graham, Cochise, and Pima Counties), 6,000 to 8,000 feet, April to

June, type from the Chiricahua Mountains (*Blumer* 1357). Apparently endemic in southeastern Arizona.

With the exception of *L. latifolius*, this is the largest-flowered of the Arizona lupines and is very showy in flower, according to *Blumer*. The leaflets are up to 15 mm. wide.

21. *Lupinus sitgreavesii* S. Wats., Amer. Acad. Arts and Sci. Proc. 8: 527. 1873. (As *L. sitgreavii*).

Lukachukai and White Mountains (Apache County), San Francisco Peaks and vicinity (Coconino County), 6,700 to 8,000 feet, open coniferous forests, July to October, type from the San Francisco Peaks (*Sitgreaves* in 1851). Reported to occur also in southern Utah and western New Mexico.

This species seems ill-defined, differing from *L. argenteus* as here interpreted chiefly in the more spreading pubescence. What appears to be a glabrate form of *L. sitgreavesii*, although referred by *Smith* (see footnote 66, p. 434, *Smith*, p. 136) to *L. alpestris* A. Nels., was collected between Springerville and Cooley Ranch, Apache or Navajo County (*Ferris* 1273).

18. MEDICAGO. MEDICK

Plants herbaceous, annual or perennial; leaves trifoliate, the leaflets dentate; flowers small, in axillary racemes or heads; calyx nearly regular; corolla yellow or violet; stamens diadelphous (1 separate from the other 9), the anthers all alike; pods indehiscent, strongly curved or spirally coiled.

All of the species are natives of the Old World. Alfalfa (*M. sativa*) is, of course, the outstanding cultivated forage plant of the western United States and the other weedlike species afford nutritious and palatable feed, although not sufficiently abundant in Arizona to be important. *M. hispida* is much used in California as a winter cover crop and green-manure crop.

Key to the species

1. Plant perennial; stems erect; corolla violet; flowers numerous, in rather dense racemes; pods spirally coiled, several-seeded, unarmed, glabrous. 1. *M. SATIVA*.
1. Plants usually annual; stems procumbent; corolla yellow; pods strongly veined (2).
 2. Pods kidney-shaped, coiled in 1 plane, 1-seeded, pubescent, without marginal prickles or tubercles, black at maturity; flowers rather numerous, in ovoid spikes, these becoming oblong in fruit. . . . 2. *M. LUPULINA*.
 2. Pods spirally coiled, several-seeded, glabrous, with marginal hooked prickles or tubercles, straw-colored at maturity; flowers few, in subcapitate clusters (3).
 3. Marginal prickles long. 3. *M. HISPIDA*.
 3. Marginal prickles very short or reduced to tubercles. . . . 4. *M. APICULATA*.

1. *Medicago sativa* L., Sp. Pl. 778. 1753.

Carrizo Mountains (Apache County), San Bernardino Ranch and Chiricahua Mountains (Cochise County), an occasional escape from cultivation but apparently nowhere naturalized in the State.

Alfalfa, lucerne.

2. *Medicago lupulina* L., Sp. Pl. 779. 1753.

Navajo, Gila, and Yavapai Counties, 4,000 to 6,000 feet, occasional at roadsides, etc.

Black medick, nonesuch. A troublesome weed in lawns in some parts of the United States. Although usually annual, this plant shows a tendency to perennial growth in Arizona.

3. *Medicago hispida* Gaertn., Fruct. et Sem. 2: 349. 1791.

Maricopa, Pinal, Cochise, and Pima Counties, occasional in waste land, March to April.

Bur-clover. Extensively naturalized in California and elsewhere in the United States.

4. *Medicago apiculata* Willd., Sp. Pl. 3: 1414. 1805.

Eloy (Pinal County), at roadside.

Often regarded as merely a variety of *M. hispida*.

19. MELILOTUS. SWEETCLOVER

Plants annual or biennial, with leafy branched stems; herbage fragrant when dried; leaves trifoliate, the leaflets dentate; flowers small, in elongate narrow racemes; calyx nearly regular; petals white or yellow; stamens diadelphous, the anthers all alike; pods small, ovoid or globose; seeds 1 or few.

Coumarin, the substance that gives the strong odor to these plants, makes them distasteful to livestock at first, but animals acquire a liking for them, especially for the cured hay; and white sweetclover (*M. alba*) is now cultivated as a forage plant in some parts of the United States. Sourclover (*M. indica*) is extensively grown in the Southwest as a winter cover crop and occasionally escapes from cultivation. These plants, especially *M. alba*, do well on moderately saline soil. They are excellent honey plants. The Arizona species are all introductions from Eurasia.

Key to the species

1. Flowers not more than 2.5 mm. long; stems commonly less than 1 m. long; corolla yellow; pods alveolate-rugose----- 1. *M. INDICA*.
1. Flowers not less than 4 mm. long; stems often more than 1 m. long (2).
 2. Corolla yellow, the banner not or but slightly surpassing the wings; pods rugose. 2. *M. OFFICINALIS*.
 2. Corolla white, the banner considerably surpassing the wings; pods not rugose, inconspicuously reticulate----- 3. *M. ALBA*.

1. *Melilotus indica* (L.) All., Fl. Pedem. 1: 308. 1785.

Trifolium melilotus indica L., Sp. Pl. 765. 1753.

Coconino County (Havasu Canyon), Maricopa, Pinal, and Pima Counties, occasional at roadsides, along ditches, and in fields, April to September. Sourclover.

2. *Melilotus officinalis* (L.) Lam., Fl. Franç. 2: 594. 1778.

Trifolium melilotus officinalis L., Sp. Pl. 765. 1753.

Coconino County, near Flagstaff and Williams, about 7,000 feet, Pinal Mountains (Gila County), July to October. Yellow sweetclover.

3. *Melilotus alba* Desr. in Lam., Encycl. 4: 63. 1797.

Lees Ferry and Havasu Canyon (Coconino County), Chiricahua Mountains (Cochise County), Sacaton (Pinal County), nowhere abundant in Arizona. White sweetclover.

20. TRIFOLIUM. CLOVER

Plants herbaceous, annual, biennial, or perennial, leafy stemmed or (a few) subscapose; leaves trifoliate, the leaflets denticulate to deeply serrate; flowers in dense globose heads or short spikes, these frequently subtended by an involucre, the flowers often reflexed after anthesis; calyx nearly regular; corolla rose red or purple to nearly white, usually persistent; pods small, usually terete, indehiscent or tardily dehiscent; seeds 1 or few.

The clovers, although palatable and nutritious to livestock and beneficial for the soil, are not sufficiently abundant in Arizona to be of much economic importance. Most of the native species grow in wet soil along streams in the yellow pine belt. Several of them are sod forming, but in the situations where they grow can have little importance in protecting against erosion. The introduced red clover (*T. pratense*) and alsike clover (*T. hybridum*) are important forage plants elsewhere in the United States and in Europe. White clover (*T. repens*), likewise an introduced species, is a useful constituent of pastures and lawns in cooler climates, and the flowers yield honey of the highest quality. The plants and seeds of the native species are reported to have been used as food by the Arizona Indians.

Key to the species

1. Heads manifestly subtended by an involucre, the bracts in a whorl and usually more or less united (2).
 2. Pubescence copious, at least on the peduncles and involucres; leaflets obcordate to oblanceolate; involucre saucer-shaped, the bracts united at least one-third of their length, their lobes entire, ovate, aristate; heads 8 to 12 mm. in diameter, very dense; flowers not reflexed; corolla not, or but slightly, surpassing the calyx----- 1. *T. MICROCEPHALUM*.
 2. Pubescence sparse or none (3).
 3. Heads normally not more than 10 mm. in diameter and not more than 10-flowered; plant annual; stems prostrate to ascending, slender; leaflets oblanceolate or obovate; involucre one-half to two-thirds as long as the calyces, with usually obovate, deeply toothed lobes; lower flowers becoming strongly reflexed; calyx teeth usually dark purple; corolla 6 to 9 mm. long, much surpassing the calyx----- 2. *T. VARIEGATUM*.
 3. Heads normally more than 10 mm. in diameter and more than 10-flowered (4).
 4. Involucre cleft nearly to the base, the lobes subulate-setaceous to narrowly lanceolate, entire; peduncles (and sometimes the petioles and the upper part of the stems) often loosely and sparsely villous; leaflets oblanceolate or obovate, obtuse, truncate, or retuse, serrulate----- 3. *T. PINETORUM*.
 4. Involucre cleft usually not more than two-thirds of the distance to the base, the lobes oblong or deltoid, dentate, usually deeply so, the teeth subulate-setaceous; plant entirely glabrous (5).
 5. Heads 2 cm. in diameter or larger; corolla 12 mm. long or longer (6).
 6. Leaflets prevailing elliptic or in the lower leaves obovate, usually less than 3 cm. long----- 4. *T. FENDLERI*.
 6. Leaflets prevailing linear-lanceolate, 3 to 4 cm. long.
 5. *T. FISTULOSUM*.
5. Heads 1 to 2 cm. in diameter; corolla 11 mm. long or shorter (7).
 7. Leaflets narrowly linear or lanceolate, often conspicuously cuspidate, spinulose serrate, often deeply so---- 6. *T. LACERUM*.
 7. Leaflets oblong-lanceolate, not conspicuously cuspidate, serrulate.
 7. *T. ARIZONICUM*.
1. Heads not involucre, or the involucre greatly reduced (8).
 8. Involucre very small but usually evident (9).
 9. Plant caulescent; stems prostrate; leaflets cuneate-obovate, glabrous or glabrate; petioles, peduncles, and calyx villous; involucre minute, the bracts seldom more than 1 mm. long; flowers strongly reflexed.
 8. *T. AMABILE*.

9. Plant acaulescent or nearly so, caespitose (10).
 10. Leaflets never more than 3, narrowly lanceolate, entire, acerose; involucre often much reduced but some of the bracts 2 mm. long or longer, subulate to ovate-lanceolate, scariosus-margined; calyx rather sparsely villous.----- 9. *T. DASYPHYLLUM*.
 10. Leaflets often more than 3, elliptic to obovate, doubly dentate, mucronate; involucre minute, almost obsolete, all of the bracts less than 2 mm. long, truncate or erose, entirely scariosus; calyx densely villous.----- 10. *T. SUBCAULESCENS*.
8. Involucre none (11).
 11. Plants annual or biennial; flowers not becoming reflexed (12).
 12. Calyx villous with long hairs; rachis of the head not conspicuously prolonged; flowers not becoming noticeably reflexed; corolla dark purple and whitish.----- 11. *T. ALBOPURPUREUM*.
 12. Calyx glabrous or nearly so; rachis of the head conspicuously prolonged and exserted, especially after anthesis; outer flowers strongly reflexed after anthesis; corolla pink to reddish purple.----- 12. *T. GRACILENTUM*.
11. Plants perennial, but sometimes short-lived (13).
 13. Leaves (the uppermost pair) subtending the sessile or subsessile head; stipules very large and conspicuously veined; leaflets ovate or elliptic, the larger ones 2 cm. long or longer; heads at anthesis seldom less than 20 mm. in diameter; flowers not becoming reflexed; corolla rose-colored.----- 13. *T. PRATENSE*.
 13. Leaves not subtending the head; flowers (the lower ones) becoming reflexed after anthesis (14).
 14. Calyx teeth glabrous or nearly so, less than twice as long as the tube; leaf blades thin; peduncle glabrous or nearly so (15).
 15. Stems repent and often rooting at the nodes; corolla white or tinged with pink.----- 14. *T. REPENS*.
 15. Stems erect or ascending (16).
 16. Calyx teeth setaceous, more or less flexuous; banner petal broad and retuse at apex.----- 15. *T. MACILENTUM*.
 16. Calyx teeth subulate, straight or nearly so; banner petal relatively narrow, acutish at apex.----- 16. *T. HYBRIDUM*.
 14. Calyx teeth villous-plumose, 2 to 3 times as long as the tube; leaf blades thickish; peduncle sparsely to densely villous, especially toward the apex (17).
 17. Heads about 15 mm. long from the summit of the peduncle; larger leaflets seldom more than 2 cm. long, elliptic to narrowly obovate, sparsely sericeous beneath with short hairs.----- 17. *T. RUSBYI*.
 17. Heads seldom less than 20 mm. long from the summit of the peduncle; larger leaflets 3 cm. long or longer, densely sericeous beneath with long hairs, at least when young (18).
 18. Leaflets narrowly lanceolate, 5 to 10 times as long as wide, sharply acuminate at apex, the marginal teeth incurved.----- 18. *T. NEUROPHYLLUM*.
 18. Leaflets oblong-lanceolate or slightly oblanceolate, 3.5 to 4 times as long as wide, obtusish and apiculate at apex, the marginal teeth spreading.----- 19. *T. VILLIFERUM*.

1. *Trifolium microcephalum* Pursh, Fl. Amer. Sept. 478. 1814.

Pinal Mountains, Gila County (*McLellan* and *Stitt* in 1935), near Superior, Pinal County (*Harrison* and *Peebles* 1707). Montana to British Columbia, south to Arizona and Baja California.

2. *Trifolium variegatum* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 317. 1838.

Near Kirkland, Yavapai County (*Harrison* and *Peebles* 4194), Santa Rita Mountains, Pima County (*Thorner* in 1905). Montana to British Columbia, south to Arizona and Baja California.

3. *Trifolium pinetorum* Greene, *Erythea* 2: 182. 1894.

Trifolium longicaule Woot. and Standl., *Contrib. U. S. Natl. Herbarium* 16: 141. 1913.

Kaibab Plateau and north rim of Grand Canyon (Coconino County), mountains of Graham, Cochise, and Pima Counties, 7,500 to 9,000 feet, moist soil of coniferous forests, June to October. New Mexico and Arizona.

What seems to be a glabrate form of this species, with few-flowered heads, occurs north of the Grand Canyon.

4. *Trifolium fendleri* Greene, *Pittonia* 3: 221. 1897.

Apache County to Coconino County, south to Greenlee and Gila Counties, 7,000 to 9,500 feet, moist soil of coniferous forests, June to September. Colorado, Utah, New Mexico, and Arizona.

5. *Trifolium fistulosum* Vaughan, *Amer. Midland Nat.* 22: 575. 1939.

Huachuca Mountains, Cochise County (*Lemmon* in 1882), July. Southeastern Arizona and Mexico.

6. *Trifolium lacerum* Greene, *Erythea* 2: 182. 1894.

Gila and Yavapai Counties to Cochise (?) and Pima Counties, 2,000 to 5,000 feet, wet places, March to July. New Mexico and Arizona.

7. *Trifolium arizonicum* Greene, *Erythea* 3: 18. 1895.

Vicinity of Flagstaff (Coconino County), about 7,000 feet, August, type from near Flagstaff (*Rusby* in 1883). Known only from northern Arizona.

Intergrades with *T. fendleri* and *T. lacerum*.

8. *Trifolium amabile* H. B. K., *Nov. Gen. et Sp.* 6: 503. 1824.

Huachuca Mountains (Cochise County), about 6,000 feet, wet sandy soil near springs and brooks, August to October. Southeastern Arizona to Central America.

9. *Trifolium dasyphyllum* Torr. and Gray, *Fl. North Amer.* 1: 315. 1838.

Grand Canyon, north rim, Coconino County (Grand Canyon Herbarium 765). Montana to Colorado, Utah, and (?) northern Arizona.

The identification of the specimen cited needs confirmation.

10. *Trifolium subcaulescens* Gray in Ives, *Colo. River Rpt.* 10. 1860.

Apache County to Coconino County, 7,000 to 10,000 feet, yellow pine and spruce-fir forests, May and June, type from near Fort Defiance, Apache County (*Newberry* in 1858). Colorado, New Mexico, and northern Arizona.

11. *Trifolium albopurpureum* Torr. and Gray, *Fl. North Amer.* 1: 313. 1838.

Gila and Maricopa Counties, 3,000 to 4,000 feet, March to May. Arizona and California.

Known in California as rancheria clover.

12. *Trifolium gracilentum* Torr. and Gray, *Fl. North Amer.* 1: 316. 1838.

Gila, Maricopa, Pinal, and Pima Counties, 2,500 to 4,000 feet, March to May. Washington to Arizona and California.

13. *Trifolium pratense* L., Sp. Pl. 768. 1753.

Occasionally growing wild in Arizona, as at Lakeside (Navajo County), and McNary (Apache County), introduced from Europe.

Red clover. Extensively cultivated in the eastern United States.

14. *Trifolium repens* L., Sp. Pl. 767. 1753.

At roadsides, etc., near Lakeside (Navajo County), Prescott (Yavapai County), Chiricahua Mountains (Cochise County), introduced from Europe.

White clover. Often used in lawn mixtures.

***15. *Trifolium macilentum* Greene, Pittonia 3: 223. 1897.**

Not known definitely from Arizona, but the type was collected in southern Utah, probably not far from the Arizona State line. *T. macilentum* is given as a synonym of *T. howellii* Wats. by McDermott (Ill. Key N. Amer. Trifolium 265. 1910).

16. *Trifolium hybridum* L., Sp. Pl. 766. 1753.

North rim of the Grand Canyon, Coconino County (*Collom* in 1940). Here and there in the United States; naturalized from Europe.

Alsike clover.

17. *Trifolium rusbyi* Greene, Pittonia 1: 5. 1887.

Trifolium longipes Nutt. var. *pygmaeum* Gray in Ives, Colo. River Rpt. 9. 1860.

White Mountains (Apache County), Kaibab Plateau, San Francisco Peaks, and Bill Williams Mountain (Coconino County), 7,000 to 8,500 feet, coniferous forests, June to September, types of *T. rusbyi* from on or near the San Francisco Peaks (*Lemmon, Rusby*), type of *T. longipes* var. *pygmaeum* from Bill Williams Mountain (*Newberry* in 1858). Colorado to Arizona, probably also Oregon and northern California.

18. *Trifolium neurophyllum* Greene, Leaflets 1: 154. 1905.

White Mountains, Apache and Greenlee Counties (*Goodding* 1076, *Kearney* and *Peebles* 12423), 8,000 to 8,600 feet, August. New Mexico and eastern Arizona.

Easily distinguished from most of the Arizona clovers by the very large heads of flowers.

***19. *Trifolium villiferum* House, Bot. Gaz. 41: 335. 1906.**

Not known definitely to occur in Arizona, but the type was collected in southern Utah, probably not far from the Arizona State line.

21. LOTUS. DEERVETCH

Plants annual or perennial, herbaceous or suffrutescent; stems leafy; leaves pinnately compound, but sometimes appearing digitate by shortening of the rachis, the leaflets 3 or more (rarely only 1), entire; flowers axillary, solitary or in few-flowered umbellike clusters. sessile or pedunculate; corolla yellow to reddish orange (in one species whitish, fading pink); filaments all or some of them flattened, at least near the apex; pods narrow, subterete or somewhat flattened, several-seeded.

These plants are also known as deerlover. Most of the species are grazed or browsed by domestic animals and deer, and the forage is

rated as of fair to good quality. *L. wrightii* and *L. alamosanus* are considered excellent for control of erosion. A decoction of the leaves and flowers of *L. rigidus* is reported to have been used as a tonic by the early settlers, under the name of Hills-tea.

Key to the species

1. Stipules membranous, subulate or narrowly lanceolate; plants perennial with creeping rootstocks; umbels 1- to 5-flowered, on peduncles much surpassing the leaves; corolla yellow; pods glabrous (2).
 2. Stems stout, erect or nearly so; leaflets 7 to 11, narrowly lanceolate or elliptic to obovate, 1 to 3 cm. long; corolla 10 to 14 mm. long, purple-veined; pods about 2 mm. wide----- 1. *L. OBLONGIFOLIUS*.
 2. Stems slender, procumbent; leaflets 3 to 5, broadly obovate, less than 1 cm. long; corolla 5 to 7 (11?) mm. long; pods about 1 mm. wide.
 2. *L. ALAMOSANUS*.
1. Stipules glandlike or obsolete (3).
 3. Corolla whitish, often fading pink; leaves mostly trifoliolate; calyx teeth subulate, much longer than the tube; plant annual, more or less pubescent; stems erect or ascending, branched----- 3. *L. PURSHIANUS*.
 3. Corolla yellow or orange; leaves (some or all of them) usually with more than 3 leaflets; calyx teeth not, or not much, longer than the tube (4).
 4. Plants annual, flowering in spring; corolla not more (usually less) than 7 mm. long; stems decumbent to prostrate (5).
 5. Pods indehiscent, with a beak (persistent style) nearly as long as to longer than the slender body and strongly incurved toward the apex like a fishhook; umbels nearly sessile----- 4. *L. HAMATUS*.
 5. Pods dehiscent, with a straight or moderately curved beak much shorter than the body (6).
 6. Stems and leaves soft-villous, usually copiously so; pods oblong, 2.5 to 4 mm. wide, villous with long hairs----- 5. *L. HUMISTRATUS*.
 6. Stems and leaves strigose with short hairs, often glabrate; pods linear, not more and usually less than 2.5 mm. wide, short-strigose or glabrate (7).
 7. Rachis of the leaves usually at least 1 mm. wide; pubescence not very closely appressed; leaflets thickish, slightly succulent, cuneate-oblancoolate to rather narrowly obovate, rounded or truncate and often emarginate at apex; calyx teeth shorter than the tube----- 6. *L. TOMENTELLUS*.
 7. Rachis of the leaves usually less than 1 mm. wide; pubescence closely strigose, sparse, the plant often glabrate; leaflets very thin, broadly obovate, rounded to acutish, and often mucronulate at apex; calyx teeth equaling or longer than the tube.
 7. *L. SALSUGINOSUS*.
 4. Plants perennial; corolla not less than 8 mm. long (8).
 8. Stems rigid, erect or ascending, somewhat woody below, the internodes commonly more than twice as long as the leaves; leaves 3- to 5-foliolate, the rachis distinct in leaves with more than 3 leaflets; leaflets mostly obtuse or truncate, sometimes emarginate; peduncles much surpassing the leaves; corolla 15 to 25 mm. long; pods glabrate----- 8. *L. RIGIDUS*.
 8. Stems not rigid, herbaceous above the caudex, the internodes usually much less than twice as long as the leaves (9).
 9. Peduncles shorter than the leaves or obsolete; leaves appearing digitate, the rachis usually obsolete; leaflets (at least those of the upper leaves) acute or acutish; corolla 10 to 15 mm. long; pods commonly strigose at maturity----- 9. *L. WRIGHTII*.
 9. Peduncles much longer than the leaves; leaves pinnate, the rachis usually distinct but often very short (10).
 10. Stems, leaves, and pods copiously villous; stems decumbent or nearly prostrate; leaflets broadly cuneate-obovate to narrowly oblanceolate, rounded and apiculate to acute at apex, up to 15 but usually less than 10 mm. long, 2 to 6 mm. wide; calyx teeth commonly shorter than the tube, villous; corolla 12 to 18 mm. long; pods 20 to 30 mm. long, 2.5 to 3.5 mm. wide.
 10. *L. GREENEI*.

10. Stems, leaves, and pods strigose or sericeous (11).
11. Pubescence silvery; pods 4 to 5 mm. wide, 15 to 25 mm. long; stems decumbent or nearly prostrate; leaflets obovate or oblanceolate, obtuse, sometimes emarginate, not more and usually less than 15 mm. long, 3 to 6 mm. wide; calyx teeth commonly shorter than the tube; corolla 12 to 18 mm. long.
11. L. MEARNsii.
11. Pubescence not silvery; pods not more and usually less than 4 mm. wide, 20 to 40 mm. long (12).
12. Stems erect or nearly so; leaflets of all but the lowest leaves linear, acute, 15 to 30 mm. long, seldom more than 2 mm. wide; calyx teeth subulate-setaceous, equaling or (commonly) somewhat longer than the tube, conspicuously villous; corolla up to 18 mm. long; pods 2 to 3 mm. wide.
12. L. OROBIDES.
12. Stems spreading, decumbent, or nearly prostrate; leaflets oblanceolate to broadly obovate, commonly obtuse or truncate at apex, not more than 20 mm. long, seldom less than 3 mm. wide; calyx teeth lanceolate, not longer and usually shorter than the tube, pubescent with appressed or subappressed hairs; corolla not more than 15 mm. long (13).
13. Leaflets seldom more than 4, oblanceolate, up to 20 (commonly about 10) mm. long; pods 3 to 4 mm. wide.
13. L. LONGBRACTEATUS.
13. Leaflets commonly 5 or 6, broadly oblanceolate to broadly obovate, seldom more than 10 and often less than 5 mm. long; pods 2 mm. wide.-----14. L. NEOMEXICANUS.

1. *Lotus oblongifolius* (Benth.) Greene, Pittonia 2: 146. 1890.

Hosackia oblongifolia Benth., Pl. Hartw. 305. 1848.

Huachuca Mountains, Cochise County (*Lemmon* 2670).

The presence of this California species of the section *Hosackia* in southeastern Arizona is remarkable, and an error in the locality as stated on the labels of Lemmon's specimens would be suspected were it not that a very similar specimen collected near Colonia García, Chihuahua (*Townsend* and *Barber* 159), was identified by Greene as *L. torreyi* Greene (*L. oblongifolius* var. *torreyi* Ottley), the form to which Lemmon's specimens also are referable.

2. *Lotus alamosanus* Rose, Contrib. U. S. Natl. Herbarium 1: 96. 1891.

Sycamore Canyon near Ruby, Santa Cruz County (*Goodding* 1830), about 4,000 feet, "abundant," April and May. Southern Arizona, Sonora, and Durango.

3. *Lotus purshianus* (Benth.) Clements and Clements, Rocky Mount. Fl. 183. 1914.

Hosackia purshiana Benth., Edwards's Bot. Reg. 15: pl. 1257. 1829.

Lotus americanus (Nutt.) Bisch., Del. Sem. Hort. Heidelb. 1839; *Linnaea* 14: Litt. 132. 1840. Not of Vellozo.

Acmispon americanum Rydb., Torrey Bot. Club Bul. 40: 45. 1913.

Apache, Yavapai, Gila, and Cochise Counties, 5,000 to 7,500 feet, open pine forests, July to October. Minnesota to Washington, New Mexico, Arizona, and California.

Spanish-clover.

4. **Lotus hamatus** Greene, Pittonia 2: 150. 1890.

Robles Ranch near Tucson, "on flats" (*Goodding* 1672), about 2,500 feet, April, probably introduced from southern California.

5. **Lotus humistratus** Greene, Pittonia 2: 139. 1890.

Lotus trispermus Greene, Erythea 1: 258. 1893.

Anisolotus trispermus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 135. 1913.

Throughout most of the State except the northeastern portion, 5,000 feet or (usually) lower, very common on sandy deserts, March to June. New Mexico to California and northern Mexico.

6. **Lotus tomentellus** Greene, Pittonia 2: 140. 1890.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 3,000 feet or lower, very common on sandy deserts, March and April. Arizona, southeastern California, and northern Mexico.

7. **Lotus salsuginosus** Greene, Pittonia 2: 140. 1890.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 2,800 feet or lower, common on dry hills and mesas, February to May. Arizona, California, and Baja California.

The Arizona specimens all belong to var. *brevixerillus* Ottley (*L. humilis* Greene), with plant and flowers smaller than in the typical form.

8. **Lotus rigidus** (Benth.) Greene, Pittonia 2: 142. 1890.

Hosackia rigida Benth., Pl. Hartw. 305. 1848.

Lotus argensis Coville, Contrib. U. S. Natl. Herbarium 4: 83. 1893.

Anisolotus rigidus Rydb., Torrey Bot. Club Bul. 33: 144. 1906.

Gila County to Mohave County, south to Pima and Yuma Counties, 4,000 feet or lower, dry rocky slopes, February to May. Utah, Arizona, southeastern California, and Baja California.

This is Arizona's most xerophytic species.

9. **Lotus wrightii** (A. Gray) Greene, Pittonia 2: 143. 1890.

Hosackia wrightii A. Gray, Pl. Wright. 2: 42. 1853.

Anisolotus wrightii Rydb., Torrey Bot. Club Bul. 33: 144. 1906.

Apache County to Coconino County, south to Greenlee and Pima Counties, 4,500 to 8,000 feet, very common in dry open pine forests, June to August. Southern Colorado and New Mexico to Arizona and southeastern California.

10. **Lotus greenei** (Woot. and Standl.) Ottley, Wash. Acad. Sci. Jour. 29: 483. 1939.

Hosackia mollis Greene, Calif. Acad. Sci. Bul. 1: 185. 1885. Not Nutt., 1838.

Lotus mollis Greene, Pittonia 2: 143. 1890. Not Balf. f., 1882.

Anisolotus greenei Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 135. 1913.

Graham, Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, mesas and rocky hillsides, March to May (sometimes August), type from the Huachuca Mountains. Southern New Mexico, southern Arizona, and northern Mexico.

11. *Lotus mearnsii* Britton in Greene, Pittonia 2: 144. 1890.

Hosackia mearnsii Britton, N. Y. Acad. Sci. Trans. 8: 65. 1889.

Navajo, Coconino, and Yavapai Counties, 3,000 to 7,000 feet, dry mesas and slopes, May to August, type from Fort Verde, Yavapai County (*Mearns* 342). Known only from Arizona.

12. *Lotus oroboides* (H. B. K.) Ottley, Wash. Acad. Sci. Jour. 29: 483. 1939.

Tephrosia oroboides H. B. K., Nov. Gen. et Sp. 6: 462. 1824.

Lotus puberulus (Benth.) Greene, Pittonia 2: 142. 1890.

Southern Apache County to Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,500 feet, mostly in pine woods, April to September. Western Texas to Arizona and Mexico.

13. *Lotus longibracteatus* Rydb., Torrey Bot. Club Bul. 30: 254. 1903.

Hosackia rigida Benth. var. *nummularia* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 633. 1895.

Anisolotus nummularius Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 135. 1913.

Coconino and Mohave Counties to Graham, Gila, and Maricopa Counties, 3,500 to 6,000 feet, March to May (sometimes also late summer). Southern Utah and Nevada to New Mexico and Arizona.

14. *Lotus neomexicanus* Greene, Pittonia 2: 144. 1890.

Anisolotus neomexicanus Heller, Muhlenbergia 8: 60. 1912.

Clifton, Greenlee County (*Rusby* 77), Devils Canyon, Pinal County (*Peebles* and *Harrison* 787), about 3,500 feet, February to April. New Mexico and Arizona.

Apparently rare in this State, and the specimens are not very typical, seemingly approaching *L. greenii*.

22. INDIGOFERA. INDIGO

Plant a low shrub, up to 1.2 m. (4 feet) high; herbage canescent with appressed hairs, these attached at the middle; leaves pinnate, the leaflets numerous; flowers in axillary racemes, small; corolla white or pink; pods small, nearly globose, 1-seeded, tardily dehiscent.

Before the invention of synthetic dyes, the blue dye indigo was obtained in large quantity from *Indigofera tinctoria* L., an Old World species, and from the Mexican species *I. suffruticosa* Mill. Indigo was an important crop at one time in the southeastern United States. Arizona's single native species is browsed but is not abundant enough to be important. It is considered useful for erosion control.

1. *Indigofera sphaerocarpa* A. Gray, Pl. Wright 2: 37. 1853.

Cochise and Santa Cruz Counties, 4,000 to 6,000 feet, July to August. Southeastern Arizona and northern Mexico.

23. PSORALEA. SCURF-PEA

Plants perennial, herbaceous; flowering stems from a thick tuberlike taproot or from branched rootstocks, scapose or leafy; herbage glandular-punctate; leaves digitately 3- to 5-foliolate; inflorescences axillary or appearing terminal in the scapose species; calyx regular or irregular; pods small, ovoid, indehiscent, 1-seeded.

The tuberous-rooted species, known as breadroot, were used for food by the Indians and early white settlers. *P. lanceolata* is an admirable soil binder in sandy areas in northern Arizona but is sometimes a troublesome weed in fields, as it propagates by creeping rootstocks. Its presence is often an indication of overgrazing. *P. tenuiflora* has been reported to poison horses and cattle.

Key to the species

1. Flowering stems from a very thick, tuberous, rounded or fusiform taproot; plants conspicuously pubescent, often subcaulescent, the main stem not more than 10 cm. long; leaves prevailingly 5-foliolate; leaflets broadly obovate to nearly orbicular; inflorescence conspicuously bracteate, very dense; pods regularly or irregularly circumscissile near the middle, the beak equaling or longer than the body of the pod: Section *Pediomelum* (2).
 2. Lowest calyx lobe much more than twice as wide as the others, resembling the bracts; seeds transversely wrinkled; petioles appressed-pubescent; leaflets cuneate-obovate or rhombic; inflorescence 2 to 4 cm. long; corolla not more than 10 mm. long----- 1. *P. CASTOREA*.
 2. Lowest calyx lobe about twice as wide as the others; seeds smooth (3).
 3. Hairs of the petiole and peduncle all appressed or ascending; corolla about 20 mm. long; leaflets cuneate-obovate; inflorescence about 2 cm. long.----- 2. *P. MEGALANTHA*.
 3. Hairs of the petiole and peduncle (the longer ones) spreading or retrorse; corolla 10 to 17 mm. long; inflorescence 2 to 7 cm. long.----- 3. *P. MEPHITICA*.
1. Flowering stems from branched rootstocks, the roots not tuberous-thickened; plants not conspicuously pubescent, strongly caulescent, the main stem seldom less than 20 cm. long; leaves mostly 3-foliolate; leaflets narrowly obovate, oblanceolate, or linear; inflorescence inconspicuously bracteate, loose or moderately dense; pods indehiscent, the beak much shorter than the body of the pod, the surface glandular-warty: Section *Psoralidium* (4).
 4. Corolla whitish, the tip of the keel often purple; pods subglobose, rounded and abruptly beaked at apex; leaves all trifoliolate; leaflets oblanceolate to nearly filiform----- 4. *P. LANCEOLATA*.
 4. Corolla violet; pods ovoid, somewhat tapering into the beak; lower leaves often 4- or 5-foliolate (5).
 5. Leaves (except those near the base of the flowering stems), reduced to small, subulate scales; flowers few, distant, subsessile; pods white-sericeous----- 5. *P. JUNCEA*.
 5. Leaves well developed, mostly 3-foliolate; flowers numerous, usually distinctly pedicelled, the pedicels 1 to 4 mm. long; pods glabrous.----- 6. *P. TENUIFLORA*.

1. *Psoralea castorea* S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 291. 1879.

Pediomelum castoreum Rydb., North Amer. Fl. 24: 22. 1919.

Northern Mohave County, at Beaver Dam and Pagumpa Springs, 2,000 to 4,000 feet, sandy soil, April and May, type from between Beaver Dam, Ariz., and St. Thomas, Nev. (*Palmer*). Southern Utah and northwestern Arizona to southeastern California.

- *2. *Psoralea megalantha* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 140. 1913.

Pediomelum megalanthum Rydb., North Amer. Fl. 24: 22. 1919.

Not known to occur in Arizona but has been collected near the borders in New Mexico and Utah.

3. *Psoralea mephitica* S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 291. 1879.

Pediomelum mephiticum Rydb., North Amer. Fl. 24: 22. 1919.

Apache County to Mohave County, 4,000 to 5,500 feet, also in western Gila County (*A. Nelson* 1795), April to June. Southern Utah and Arizona.

The type of var. *retrorsa* (Rydb.) Kearney and Peebles (*Pediomelum retrorsum* Rydb.) was collected at Peach Springs, Mohave County (*Lemmon* in 1884). The variety differs from the typical form in its larger leaflets (up to 4 cm. long), longer peduncles and inflorescences, and larger corolla.

4. *Psoralea lanceolata* Pursh, Fl. Amer. Sept. 475. 1814.

Psoralea micrantha A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 77. 1857.

Psoralidium lanceolatum Rydb., North Amer. Fl. 24: 13. 1919.

Psoralidium micranthum Rydb., *ibid*.

Apache County to Coconino County, 5,600 to 7,200 feet, sandy soil, open mesas, and pine forests, May to September. Saskatchewan, Alberta, and Washington, south to Missouri, Texas, and northern Arizona.

P. micrantha tends to have narrower leaflets than typical *P. lanceolata*, but there seem to be no other differences.

- *5. *Psoralea juncea* Eastw., Calif. Acad. Sci. Proc. ser. 2, 6: 286. 1897.

Psoralidium junceum Rydb., North Amer. Fl. 24: 17. 1919.

This species occurs in southeastern Utah and is to be looked for in northeastern Arizona.

6. *Psoralea tenuiflora* Pursh, Fl. Amer. Sept. 475. 1814.

Psoralidium tenuiflorum Rydb., North Amer. Fl. 24: 15. 1919.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties 4,000 to 7,000 feet, dry slopes and plains, often in open pine forest, May to August. North Dakota and Montana to Arizona and northern Mexico.

The prevailing form in Arizona is var. *bigelovii* (Rydb.) Macbride (*Psoralidium bigelovii* Rydb.), which seems to differ from typical *P. tenuiflora* only in its broader leaflets.

24. PARRYELLA

Much-branched shrubs with glandular-punctate herbage; leaves pinnate, the leaflets numerous; flowers small, yellowish, in terminal,

elongate, often branched, spikelike racemes; petals none; stamens 9 or 10, separate, attached at base to the calyx; pods small, conspicuously gland-dotted, 1-seeded.

These plants, which reach a height of about 1 m. and are slightly aromatic, occur sporadically in sandy soil in northern Arizona, often forming low dunes. They are well adapted to reduce wind erosion and are sometimes planted for this purpose. They are employed for making baskets and brooms by the Hopi Indians, who also are reported to use the seeds in treating toothache, and the plant as an insecticide. Tests by the Bureau of Plant Industry showed the insecticidal value of *Parryella* to be small.

Key to the species

1. Leaflets linear-filiform to narrowly elliptic, not more than 2 mm. wide, 5 to 15 mm. long; stipules minute to about 1 mm. long; racemes loose, commonly more than 2 (up to 13) cm. long; calyx 3 to 4 mm. long, eglandular or sparsely glandular-punctate, nearly or quite glabrous externally, often conspicuously white-ciliate..... 1. *P. FILIFOLIA*.
1. Leaflets broadly oval to nearly orbicular, 3 to 5 mm. wide, not more than 6 mm. long; stipules 2 to 5 mm. long; racemes dense, 1 to 2 cm. long; calyx 5 to 6 mm. long, conspicuously glandular-punctate, copiously pubescent on the whole surface externally, densely white-villous in the throat. 2. *P. ROTUNDATA*.

1. *Parryella filifolia* Torr. and Gray, Amer. Acad. Arts and Sci. Proc. 7: 397. 1868.

Apache County to Coconino County (a doubtful record from Fort Verde, Yavapai County), 4,400 to 6,000 feet, often on rolling, treeless, sandy plains with *Aplopappus heterophyllus*, June to August. New Mexico and northern Arizona.

2. *Parryella rotundata* Wooton, Torrey Bot. Club Bul. 25: 457. 1898.

Known only from the type collection at Winslow, Navajo County (Wooton in 1892). A specimen collected in the Petrified Forest, Apache County (Harrison 5532) is intermediate between *P. filifolia* and *P. rotundata*.

25. AMORPHA.⁶⁷ FALSE-INDIGO, INDIGOBUSH

Shrubs with gland-dotted herbage; leaves odd-pinnate with numerous rather large leaflets; flowers small, in dense terminal spikelike racemes; petal one (the banner or standard only), dark violet; stamens 9 or 10, united below; pods small, asymmetrically clavate or obovoid, gland-dotted, with 1 or 2 seeds, indehiscent or tardily dehiscent.

Sometimes called "spicebush" in Arizona. The plants are unpalatable to livestock but are effective in controlling erosion. They are sometimes cultivated as ornamentals.

Key to the species

1. Glands (more or less spinelike) present on the twigs, petioles, and leaf rachis; leaflets thin, with a dull upper surface; calyx pilose, the lobes triangular-lanceolate, half as long as to equaling the tube, all acute or acutish, gland-tipped; pods pubescent, asymmetrically obovate in outline; herbage soft-pilose..... 1. *A. CALIFORNICA*.

⁶⁷ Reference: PALMER, E. J. CONSPICUOUS OF THE GENUS AMORPHA. Arnold Arboretum Jour. 12: 157-220. 1931.

1. Glands absent on the twigs, petioles, and rachis; leaflets thin or thickish, often with a slightly lustrous upper surface; calyx sparsely strigose or merely ciliate, the lobes deltoid, much less than half as long as the tube, the upper ones obtuse; pods glabrous, asymmetrically oblanceolate in outline; herbage soft-pilose to nearly glabrous----- 2. *A. FRUTICOSA*.

1. ***Amorpha californica*** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 306. 1838.

Amorpha ovalis M. E. Jones, Contrib. West. Bot. 16: 32. 1930.

Yavapai, Graham, Cochise, and Pima Counties, about 5,000 feet, mostly along streams, apparently rare in Arizona, June, type of *A. ovalis* from the Huachuca Mountains (*Jones* 25027). Arizona, California, and Baja California.

Plant sometimes known as stinking-willow and mock-locust.

2. ***Amorpha fruticosa*** L., Sp. Pl. 713. 1753.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,000 to 6,000 feet, rich soil in canyons and along streams, fairly common, May to June. Ohio to Manitoba, south to Florida, Arizona, California, and northern Mexico.

The plants reach a height of 3 m. (10 feet). The Arizona form is var. *occidentalis* (Abrams) Kearney and Peebles (*A. occidentalis* Abrams), with more elongate spikes, these usually fewer on the branches, than in most of the eastern specimens. E. J. Palmer, who recognized *A. occidentalis* as a species, described under it two varieties, a glabrate one with leaflets commonly truncate or retuse at apex (var. *emarginata* E. J. Palmer), and a copiously pubescent one (var. *arizonica* (Rydb.), E. J. Palmer, *A. arizonica* Rydb.). Both of these forms occur in Arizona.

26. EYSENHARDTIA. KIDNEYWOOD

Plant shrubby or arborescent; leaves pinnate, the leaflets numerous, glandular-punctate; flowers many, small, in spikelike terminal racemes; corolla white, nearly regular; stamens 10, diadelphous; pods indehiscent, 1-seeded, flat, long-exserted.

The wood of some of the species is reputed to have diuretic properties and is fluorescent when soaked in water. The plants are browsed by cattle, horses, goats, and deer, notwithstanding the rather disagreeable odor of the herbage.

1. ***Eysenhardtia polystachya*** (Ortega) Sarg., Silv. North Amer. 3: 29. 1892.

Viborquia polystachya Ortega, Hort. Matr. Dec. 66. 1798.

Eysenhardtia orthocarpa (A. Gray) S. Wats., Amer. Acad. Arts. and Sci. Proc. 17: 339. 1882.

Pinal, Cochise, and Pima Counties, 3,500 to 5,000 feet, usually among rocks in canyons, May to August. Southern Arizona and Mexico.

27. DALEA. INDIGOBUSH, PEABUSH

Glandular-punctate herbs or shrubs; leaves odd-pinnate, rarely unifoliate or digitate; bracts deciduous; calyx 5-toothed, persistent; petals clawed; stamens 9 or 10, rarely 7 or 8; pod small, indehiscent.

Most of the perennial species are ornamental, especially when

flowering, and a number of them contribute to the forage value of the stock ranges. The Indians of southwestern Arizona formerly dyed basket material with an extract from the glandular twigs of *Dalea emoryi*. The Hopi ate the roots of *D. terminalis* as a sweet. *D. scoparia* has been suggested for use in control of soil erosion.

Key to the species

1. Petals inserted on the hypanthium at base of the staminal tube; plants shrubby or arborescent (2).
2. Leaves unifoliolate, exceptionally 3-foliolate, in one species fugacious (3).
3. Calyx externally glabrous or nearly so, shining, the glands in each interval between the ribs small, as many as 4 or sometimes wanting; flowers indigo, not crowded, racemose; arborescent shrub with spinescent branches and persistent, linear leaves..... 3. *D. SCHOTTII*.
3. Calyx pubescent (4).
4. Calyx strigose-canescenscent, with 1 large gland in each interval between the ribs; leaves fugacious; flowers indigo, racemose, not crowded; arborescent, the branches spiny..... 4. *D. SPINOSA*.
4. Calyx villous, with 2 to 4 glands in each interval; leaves persistent, spatulate-linear or oblanceolate, exceptionally 3-foliolate; flowers dark blue, crowded in subglobose or ovoid-cylindric spikes 12 to 15 mm. thick; unarmed shrub 0.5 to 2 m. high, the branches and peduncles finely retrorse-strigose..... 7. *D. SCOPARIA*.
2. Leaves several-foliolate; plants shrubby or arborescent, commonly more or less spinescent (5).
5. Branches when young retrorsely hairy and conspicuously punctate with orange-colored glands, spinescent; leaflets 2 to 4 mm. long; calyx lobes shorter than the tube; corolla pink or purple (6).
6. Calyx glabrous externally, the ribs rather prominent, the lobes ciliate, the upper ones obtuse or rounded, the lowest lobe acute; leaflets 5 to 9, elliptic or slightly obovate..... 8. *D. THOMPSONAE*.
6. Calyx copiously pubescent externally, the ribs not prominent (7).
7. Racemes dense; calyx lobes acute, lance-subulate; leaflets 7 to 13, orbicular to oblanceolate..... 5. *D. POLYADENIA*.
7. Racemes lax, few-flowered; calyx lobes obtuse or rounded, the upper ones nearly as wide as long; leaflets 11 to 19, oblong to oblanceolate..... 9. *D. WHITINGI*.
5. Branches not retrorsely hairy; leaflets 4 to 15 mm. long (8).
8. Branches velutinous-canescenscent, unarmed; flowers purple, in capitate spikes; shrub about 1 m. high; leaflets 1 to 13, more or less serrate, the terminal one 10 to 25 mm. long, usually 2 or 3 times longer than the lateral leaflets..... 6. *D. EMORYI*.
8. Branches strigose, often canescenscent but not velutinous; flowers indigo (9).
9. Calyx lobes dissimilar (the upper ones broader, deltoid to triangular-lanceolate, usually shorter than the tube)..... 1. *D. FREMONTII*.
9. Calyx lobes all alike, lance-subulate, equaling the tube..... 2. *D. AMOENA*.
1. Petals (the paired ones) manifestly inserted on the staminal tube, the scars plainly visible on the tube after the petals fall away (10).
10. Flowers evidently pediceled, but often very shortly so (11).
11. Calyx lobes foliaceous; stems not conspicuously glandular (12).
12. Stems prostrate or nearly so, entirely herbaceous; calyx densely pilose, the lobes lanceolate, nearly twice as long as the tube; leaflets 15 to 29; flowers purple and white..... 10. *D. CALYCOSA*.
12. Stems strongly ascending or erect, often somewhat suffrutescent (13).
13. Stems, leaves, and calyx glabrous; calyx lobes ovate, obtuse, shorter than the tube; leaflets of the stem leaves 13 to 23, those of the branches 3 to 9; paired petals purple, the banner yellowish..... 11. *D. DIFFUSA*.
13. Stems, leaves, and calyx strigose-canescenscent; calyx lobes triangular, acute, shorter than or equaling the tube; leaflets 15 to 33; flowers purple and white..... 12. *D. PARRYI*.
11. Calyx lobes setaceous from a deltoid base (14).
14. Plant annual; stem erect, branching above the middle, sparsely glandular, glabrous; staminal tube long-exserted..... 16. *D. LAGOPUS*.

14. Plant perennial, but flowering the first year and thus often appearing annual; stems prostrate or weakly ascending, conspicuously glandular-punctate, pubescent; staminal tube not exerted (15).
15. Racemes 4 to 8 cm. long, 15 to 20 mm. in diameter; leaflets 9 to 11, mostly oblong, 8 to 15 mm. long; stems merely pubescent; flowers purplish----- 13. *D. LACHNOSTACHYS.*
15. Racemes 1 to 5 cm. long, 10 to 15 mm. in diameter; leaflets 7 to 15, obovate, 3 to 8 mm. long; stems villous; flowers white and purple----- 14. *D. MOLLIS.*
10. Flowers sessile (16).
16. Plant annual, glabrous or glabrate; stems slender, usually erect; calyx lobes subulate or setaceous from a deltoid base, villous or plumose; color of the flowers not known for all of these species (17).
17. Leaflets many (11 to 51), oblong or oblanceolate, truncate, often retuse (18).
18. Staminal tube twice as long as the calyx; calyx tube slit dorsally to below the middle; spikes 3 to 10 cm. long, 12 to 14 mm. thick; stem erect, branching above the middle----- 16. *D. LAGOPUS.*
18. Staminal tube exerted, but less than twice as long as the calyx (19).
19. Calyx tube glabrous, slit dorsally nearly to the base; bracts glabrous; spikes 1 to 3 cm. long, about 1 cm. thick; plant usually branching at base----- 15. *D. URCEOLATA.*
19. Calyx tube villous, not slit far below the middle; bracts pilose on the margins and toward the base; spikes 2 to 5 cm. long, 8 to 10 mm. thick; stem erect, branching above the middle.----- 17. *D. LEPORINA.*
17. Leaflets few, 3 to 11 (20).
20. Leaflets 3 to 5, narrowly linear or filiform, usually much longer than the rachis, the latter obsolete in trifoliolate leaves; calyx copiously villous----- 18. *D. FILIFORMIS.*
20. Leaflets 3 to 11, narrowly oblanceolate or elliptic, only the terminal leaflet longer than the rachis (21).
21. Ribs and lobes of the calyx usually very dark colored, the lobes not longer than the tube; calyx tube slit dorsally to the middle.----- 21. *D. POLYGONOIDES.*
21. Ribs and lobes of the calyx not conspicuously dark colored; calyx tube not slit to the middle (22).
22. Bracts ovate-acuminate, short-ciliate or glabrous on the margins; calyx lobes not much longer than the tube.----- 19. *D. BRACHYSTACHYS.*
22. Bracts lanceolate-acuminate, long-ciliate; calyx lobes often twice as long as the tube and more conspicuously plumose.----- 20. *D. LEMMONI.*
16. Plant perennial (23).
23. Spikes elongate, slender, 5 to 7 mm. thick; plant entirely herbaceous, copiously pubescent except for the glabrous calyx tube; stems prostrate; leaflets 7 to 15, obovate; bracts broadly obovate, abruptly acuminate, conspicuously glandular-punctate; flowers purple.----- 22. *D. TERMINALIS.*
23. Spikes stouter, if less than 7 mm. thick, then not elongate (24).
24. Flowers yellow, usually drying pink; leaves and stems strigose, the latter entirely herbaceous from a woody caudex; calyx villous, the lobes setaceous from a deltoid base, plumose, longer than the tube (25)
25. Leaves digitately 3-foliolate; stems usually about 10 cm. long, decumbent----- 23. *D. JAMESII.*
25. Leaves pinnate; leaflets 5 to 7 (26).
26. Stems 30 to 50 cm. high, erect or nearly so, rather stout; upper leaves reduced; peduncles usually 5 to 10 cm. long; spikes 2 to 5 cm. long, 1.5 cm. thick----- 24. *D. AUREA.*
26. Stems usually less than 30 cm. high, curved-ascending or decumbent; upper leaves scarcely reduced; peduncles not more than 2 cm. long, often obsolete (27).
27. Spikes nearly 2 cm. in diameter; bracts lanceolate, attenuate; leaflets usually acute----- 25. *D. WRIGHTII.*
27. Spikes 10 to 15 mm. in diameter; bracts ovate, short-acuminate----- 26. *D. NANA.*

24. Flowers purple or white (28).
 28. Bracts conspicuously scarious-margined, prominently glandular-punctate; leaflets 3 to 7, glabrous; calyx lobes setaceous, plumose, longer than the tube; corolla purple; stems herbaceous from a woody caudex----- 27. *D. POGONATHERA*.
 28. Bracts not conspicuously scarious-margined or prominently punctate (29).
 29. Bracts densely hirsute dorsally toward the base, glabrate above, conspicuously ciliate; calyx lobes pilose, shorter than the tube; spikes ovoid, compact, 6 to 8 mm. thick; leaflets 17 to 41, linear-lanceolate, 4 to 10 mm. long; stems herbaceous from a woody caudex; corolla white, fading pink. 28. *D. LUMHOLTZII*.
 29. Bracts either glabrous or pubescent, but not as in *D. lumholtzii* (30).
 30. Paired petals inserted below the middle of the staminal tube; spikes capitate or subcapitate, rarely ovoid or short-cylindric; plants shrubby or suffrutescent; calyx lobes long, plumose; flowers purple (31).
 31. Branches and leaves glabrous, the latter usually less than 10 mm. long; leaflets 7 to 15, 1.5 to 2.5 mm. long, thickened. in dried specimens strongly involute or conduplicate; calyx tube 3 to 4 mm. long, the lobes 4 to 10 mm. long, setaceous; flowers normally not crowded----- 29. *D. FORMOSA*.
 31. Branches and leaves pubescent or, if glabrous, then the leaflets plane and thin; leaflets mostly larger and calyx lobes shorter, the latter subulate-setaceous; flowers crowded (32).
 32. Leaflets 5 to 7, abundantly sericeous-strigose, in dried specimens mostly involute or conduplicate. 30. *D. GREGGII*.
 32. Leaflets 11 to 21, not sericeous, plane or somewhat involute----- 31. *D. WISLIZENI*.
 30. Paired petals inserted above the middle of the staminal tube, short-clawed; spikes commonly cylindric, always dense; plants herbaceous above the caudex; leaflets 13 to 51 (33).
 33. Flowers purple; calyx lobes lance-subulate, commonly longer than the tube; paired petals oval or elliptic, the wings very short-clawed; stems and leaves glabrous. 32. *D. PRINGLEI*.
 33. Flowers white; calyx lobes deltoid-subulate, shorter than or barely equaling the tube (34).
 34. Stems and leaves glabrous; claws of the wing petals very short; paired petals obliquely oblong; banner often drying purple----- 33. *D. GRAYI*.
 34. Stems and leaves pubescent; claws of the wing petals longer, one-quarter to one-third as long as the blade. 34. *D. ALBIFLORA*.

1. *Dalea fremontii* Torr. in A. Gray., Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 316. 1855.

Psorodendron fremontii Rydb., North Amer. Fl. 24: 43. 1919.

Western Mohave County, up to 3,000 feet, April and May. Southern Utah to southeastern California, and Arizona.

The species is represented in Arizona mainly by var. *johnsoni* (Wats.) Munz, which has 5 to 11 linear or linear-oblong leaflets. A collection at Wolf Hole, northern Mohave County (*Peebles* and *Parker* 14751), with 1 to 7 oblong or elliptic leaflets, approaches the typical form.

Dalea californica S. Wats., distinguished from *D. fremontii* by decurrent or even confluent leaflets, is not known certainly to extend into Arizona.

2. *Dalea amoena* S. Wats., Amer. Nat. 7: 300. 1873.

Psorodendron amoenum Rydb., North Amer. Fl. 24: 44. 1919.

Coconino and Mohave Counties, 500 to 4,700 feet, occasional, April and May, type from northern Arizona. Southern Utah and and Nevada, northern Arizona.

In *D. amoena*, which is known from only a few collections, the hairs of the calyx are short and closely appressed. The var. *pubescens* (Parish) Peebles (*Parosela johnsoni* var. *pubescens* Parish, *Psorodendron pubescens* Rydb.), occurs in the vicinity of Lees Ferry, Coconino County. It is distinguished by spreading, usually longer hairs on the calyx.

3. *Dalea schottii* Torr., U. S. and Mex. Bound. Bot. 53. 1859.

Psorodendron schottii Rydb., North Amer. Fl. 24: 44. 1919.

Southwestern Yuma County, infrequent, type from the same locality. Southwestern Arizona, southern California, and Baja California.

4. *Dalea spinosa* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 315. 1855.

Psorodendron spinosum Rydb., North Amer. Fl. 24: 45. 1919.

Western Mohave, Yuma, western Maricopa, and western Pima Counties, below 1,000 feet, in sandy washes, April and May, type from Yuma County. Arizona, southern California, Baja California, and Sonora.

Smoketree.

*5. *Dalea polyadenia* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 64. 1871.

Psorothamnus polyadenius Rydb., North Amer. Fl. 24: 46. 1919.

Not known from Arizona but collected not far from the northern boundary in southern Utah (at St. George, *Siler* in 1875). Southwestern Utah to the Mohave Desert, California.

6. *Dalea emoryi* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 315. 1855.

Psorothamnus emoryi Rydb., North Amer. Fl. 24: 47. 1919.

Abundant on sandy mesas near Yuma (Yuma County), the type locality, below 500 feet, flowering in spring (occasionally in autumn). Southern California, Baja California, Arizona, and Sonora.

Host of the rare parasitic plant *Pilostyles thurberi*.

7. *Dalea scoparia* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 32. 1849.

Psorothamnus scoparius Rydb., North Amer. Fl. 24: 48. 1919.

Willcox Flat, Cochise County (*Shreve* 4256), near Leupp, eastern Coconino County (*Whiting* 3321). New Mexico, southeastern Arizona, Chihuahua, and Coahuila.

8. *Dalea thompsonae* (Vail) L. O. Williams, Mo. Bot. Gard. Ann. 23: 451. 1936.

Parosela thompsonae Vail, Torrey Bot. Club Bul. 24: 18. 1897.

Known only from the type, which was collected in northern Arizona, probably near Kanab, Utah (*Mrs. Thompson* in 1872).

9. *Dalea whitingi* Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 484. 1939.

Known only from the type locality, Wupatki National Monument, Coconino County (*Whiting* and *Jones* in 1938, the type collection, *D. J. Jones* in 1939), and from southeastern Utah.

10. *Dalea calycosa* A. Gray, Pl. Wright. 2: 40. 1853.

Parosela calycosa Heller, Cat. North Amer. Pl. ed. 2, 5. 1900.

Pinal, Cochise, Santa Cruz, and Pima Counties, about 4,000 feet, April to September. New Mexico, southern Arizona, and northern Mexico.

11. *Dalea diffusa* Moric., Soc. Phys. Hist. Nat. Genève Mém. 6: 536. 1833.

Parosela diffusa Rose, Contrib. U. S. Natl. Herbarium 8: 305. 1905.

Patagonia Mountains, Santa Cruz County, 4,500 feet (*Kearney* and *Peebles* 10054). Southeastern Arizona, Mexico, and Guatemala.

The Mexican name is escoba-colorada.

12. *Dalea parryi* Torr. and Gray in A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 397. 1868.

Parosela parryi Heller, Cat. North Amer. Pl., ed. 2, 6. 1900.

Dalea angulata M. E. Jones, Contrib. West. Bot. 16: 25. 1930.

Mohave, Yavapai, Gila, and Cochise Counties, south and west to Yuma County, March to June (October), type from Fort Mohave. Arizona, southern California, Sonora, and Baja California.

A xerophytic perennial 1 to 2.5 feet high, with more or less woody stems, common on low deserts but also ranging up to an altitude of 4,000 feet.

13. *Dalea lachnostachys* A. Gray, Pl. Wright. 1: 46. 1852.

Parosela lachnostachys Heller, Cat. North Amer. Pl. ed. 2, 6. 1900.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, September. Western Texas, southern New Mexico, Arizona, and Chihuahua.

14. *Dalea mollis* Benth., Pl. Hartw. 306. 1848.

Parosela mollis Heller, Cat. North Amer. Pl., ed. 2, 6. 1900.

Desert regions of western and southern Arizona, up to 4,000 feet, December to May. Arizona, southern California, Sonora, and Baja California.

In the typical form the calyx is from 3 to 5 mm. long and is usually surpassed by the corolla. The wing petals are commonly retuse and bear a gland in the apical notch. A form that is more frequent in Arizona has the calyx 5 to 8 mm. long, usually surpassing the

corolla, and entire wing petals. This was regarded by the writers as var. *mollissima* (Rydb.) Munz (*Parosela mollissima* Rydb.), but it is referred by Wiggins to *D. neomexicana* (A. Gray) Cory.⁶⁸

15. *Dalea urceolata* Greene, Leaflets 1: 199. 1905.

Parosela urceolata Standl., Contrib. U. S. Natl. Herbarium 13: 194. 1910.

Hilltop, Apache Indian Reservation (*Harrison* 4895), Flagstaff (*Carter* in 1927), September to October. New Mexico and Arizona.

16. *Dalea lagopus* (Cav.) Willd., Sp. Pl. 3: 1340. 1803.

Psoralea lagopus Cav., Ic. Pl. 1: 59. 1791.

Parosela lagopus Cav., Desc. Pl. 187. 1802.

Sycamore Canyon, near Ruby, Santa Cruz County, about 3,500 feet (*Goodding* in 1939), September. Southern Arizona, southern Mexico, and Central America.

17. *Dalea leporina* (Ait.) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 483. 1939.

Psoralea leporina Ait., Hort. Kew. 3: 81. 1789.

Parosela leporina Rydb., North Amer. Fl. 24: 78. 1920.

Near the San Francisco Peaks (Coconino County), near the Mogolon Escarpment (Gila County), Chiricahua and Santa Rita Mountains (Cochise and Pima Counties), 5,500 to 8,000 feet, June to October. New Mexico and Arizona to Guatemala.

This species and *D. alopecuroides* Willd. are closely related. The latter is distinguished by the entirely pubescent, mostly pale bracts, and the wholly straw-colored staminal tube.

18. *Dalea filiformis* A. Gray, Pl. Wright. 2: 39. 1853.

Parosela filiformis Heller, Cat. North Amer. Pl. ed. 2, 6. 1900.

Dalea hutchinsoniae M. E. Jones, Contrib. West. Bot. 18: 42. 1935.

White Mountains (Apache or Navajo County), Hualpai Mountain (Mohave County), and Cochise and Pima Counties, 3,500 to 8,000 feet, mountains or grassland, August and September. New Mexico, Arizona, and northern Mexico.

19. *Dalea brachystachys* A. Gray, Pl. Wright. 2: 39. 1853.

Parosela brachystachys Heller, Cat. North Amer. Pl. ed. 2, 113. 1900.

Chiricahua Mountains (*Lemmon* in 1881), September, type from "between the San Pedro and the Sonoita" (*Wright*). New Mexico, southeastern Arizona, and Mexico.

20. *Dalea lemmoni* Parry ex A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 200. 1882.

Parosela lemmoni Heller, Cat. North Amer. Pl. ed. 2, 6. 1900.

Cochise, Santa Cruz, and Pima Counties, about 5,000 feet, September, type from near Fort Bowie. Southern Arizona and Mexico.

⁶⁸ WIGGINS, IRA L. TAXONOMIC NOTES ON THE GENUS DALEA JUSS. Dudley Herbarium Contrib., Stanford University 3: 41-64, 1940. (See pp. 51-52.)

21. *Dalea polygonoides* A. Gray, Pl. Wright. 2: 39. 1853.

Parosela polygonoides Heller, Cat. North Amer. Pl. ed. 2, 6. 1900.

Near Flagstaff (*Pearson* 303). New Mexico, Arizona, and Chihuahua.

Typically the calyx tube is villous. In var. *laevituba* Kearney and Peebles (*D. hutchinsoniae* var. *anomala* M. E. Jones) the calyx tube is glabrous. The variety is not uncommon in the mountains of southeastern Arizona, 6,500 to 9,000 feet, and is found also in New Mexico.

22. *Dalea terminalis* M. E. Jones, Contrib. West. Bot. 12: 8. 1908.

Parosela terminalis Heller, Muhlenbergia 6: 96. 1910.

Navajo, Coconino, Mohave, and Graham Counties, 2,000 to 5,000 feet, sandy soil, May to September. Southern Utah, Arizona, Texas, and Chihuahua.

The essentially glabrous calyx tube distinguishes this species from the more eastern *Dalea lanata* Spreng.

23. *Dalea jamesii* (Torr.) Torr. and Gray, Fl. North Amer. 1: 308. 1838.

Psoralea jamesii Torr., Ann. Lyc. N. Y. 2: 175. 1827.

Parosela jamesii Vail, Torrey Bot. Club Bul. 24: 16. 1897.

Pima, Santa Cruz, and doubtless Cochise Counties, 5,000 feet, grassland, infrequent. Kansas and Colorado to southern Arizona and northern Mexico.

24. *Dalea aurea* Nutt. ex Pursh, Fl. Amer. Sept. 740. 1814.

Parosela aurea Britton, Torrey Bot. Club Mem. 5: 196. 1894.

Navajo County, at Fort Apache (*Palmer* 611) and Cibecue Creek (*Thornber* in 1905), June. South Dakota and Wyoming to Texas, Coahuila, and Arizona.

25. *Dalea wrightii* A. Gray, Pl. Wright. 1: 49. 1852.

Parosela wrightii Vail, Torrey Bot. Club Bul. 24: 16. 1897.

Navajo, Cochise, and Pima Counties, 3,500 to 5,000 feet, grassland, May to October. Western Texas to Arizona and Mexico.

26. *Dalea nana* Torr. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 31. 1849.

Parosela nana Heller, Bot. Expl. Texas 49. 1895.

Beaver Head, Yavapai(?) County (*Rusby* in 1883), and in Cochise County, grassland, May and June. Kansas to Texas, Arizona, and Mexico.

In the typical form the leaflets are sericeous on both faces and commonly obtuse. A more common form in Arizona is var. *carnescens* (Rydb.) Kearney and Peebles (*Parosela carnescens* Rydb.) with leaflets obtuse to acutish, green and glabrate above, and stems usually stouter.

27. **Dalea pogonathera** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 31. 1849.

Parosela pogonathera Vail, N. Y. Acad. Sci. Trans. 14: 34. 1894.

Cochise, Santa Cruz, and Pima Counties, 2,300 to 6,000 feet, grassland and hills, March to September. Texas to southern Arizona and Mexico.

28. **Dalea lumholtzii** Robins. and Fern., Amer. Acad. Arts and Sci. Proc. 30: 115. 1894.

Parosela arizonica Vail, Torrey Bot. Club Bul. 24: 14. 1897.

Parosela lumholtzii Vail, *ibid.* 26: 117. 1899.

Santa Catalina and Baboquivari Mountains (Pima County), Pajarito Mountains (Santa Cruz County), 3,600 to 7,000 feet, September and October. Southern Arizona and Sonora.

The foliage has fragrance similar to that of lemon verbena (*Lippia triphylla*).

29. **Dalea formosa** Torr., Ann. Lyc. N. Y. 2: 177. 1828.

Parosela formosa Vail, Torrey Bot. Club Bul. 24: 16. 1897.

Navajo and Yavapai Counties to Cochise and Pima Counties, 2,000 to 6,500 feet, hills and mountains, March to June (September). Colorado and New Mexico to Arizona and northern Mexico.

30. **Dalea greggii** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 314. 1855.

Parosela greggii Heller, Cat. North Amer. Pl. ed. 2, 6. 1900.

Pima and Santa Cruz Counties, rocky hills, 3,000 to 5,000 feet, February to May. Southern Arizona and Mexico.

A handsome plant with straight, more or less woody stems and globose heads of rose-purple flowers.

31. **Dalea wislizeni** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 32. 1849.

Parosela wislizeni Vail, N. Y. Acad. Sci. Trans. 14: 34. 1894.

Greenlee, Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, rocky hills, April to October. New Mexico, southeastern Arizona, and Mexico.

Spikes at the ends of the elongate branches, and leaves and twigs more or less villous, characterize the typical form. In var. *sanctae-crucis* (Rydb.) Kearney and Peebles (*Parosela sanctae-crucis* Rydb.), growing in Santa Cruz County and in the Baboquivari Mountains (Pima County), the spikes also are mainly at the ends of elongate branches but the leaves and twigs are glabrous or sparsely pubescent. The var. *sessilis* Gray, with spikes mainly at the ends of short lateral branches, occurs in Greenlee, Cochise, Pima, and Santa Cruz Counties.

32. **Dalea pringlei** A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 201. 1882.

Parosela pringlei Heller, Cat. North Amer. Pl. ed. 2, 6. 1900.

Thornbera pringlei Rydb., North Amer. Fl. 24: 119. 1920.

Pima County, 2,500 to 5,000 feet, hills and mountains, April to October, type from the Santa Catalina Mountains (*Pringle* in 1881). Southern Arizona, Sonora, and Chihuahua.

33. *Dalea grayi* (Vail) L. O. Williams, Mo. Bot. Gard. Ann. 23: 450. 1936.

Parosela grayi Vail, Torrey Bot. Club Bul. 24: 14. 1897.

Thornbera grayi Rydb., North Amer. Fl. 24: 119. 1920.

Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, hills and mountains, May to September. New Mexico, Arizona, Sonora, and Durango.

34. *Dalea albiflora* A. Gray, Pl. Wright. 2: 38. 1853.

Parosela albiflora Vail, N. Y. Acad. Sci. Trans. 14: 34. 1894.

Thornbera albiflora Rydb., N. Y. Bot. Gard. Jour. 20: 66. 1919.

Thornbera villosa Rydb., North Amer. Fl. 24: 118. 1920.

Thornbera albiflora subsp. *villosa* Wiggins, Dudley Herbarium Stanford Univ. Contrib. 3: 54. 1940.

Hualpai Mountain (Mohave County) to Cochise, Santa Cruz, and Pima Counties, 3,500 to 7,500 feet, April to October. New Mexico, Arizona, Sonora, and Chihuahua.

Dalea ordiae A. Gray is distinguished by smaller, narrower, and usually more numerous leaflets, and more slender stems, but the characters are not strongly correlated and the species appears to intergrade completely with *D. albiflora*. *Thornbera villosa* is a robust form with very villous stems. A peculiar form of *D. albiflora* collected on East Fork of White River (*Harrison* 4835) and in the Sierra Ancha (*Harrison* and *Kearney* 8311) probably represents a distinct variety. In this form the caudex is wanting, the small slender stems arising at intervals from rootstocks.

28. PETALOSTEMUM. PRAIRIECLOVER

Plants herbaceous, annual or perennial, often deep-rooted; herbage gland-dotted; leaves odd-pinnate, the leaflets several or numerous; flowers in dense spikes, only slightly irregular; petals white, lilac, or rose pink, the claws of the wings and keel adnate to the stamen tube; stamens 5; pods small, included in the calyx, containing 1 or 2 seeds.

The plants are attractive but of small economic importance. The name of the genus is often spelled *Petalostemon*.

Key to the species

1. Calyx tube glabrous or sparsely puberulent, the lobes ciliolate, about one-third as long as the very prominently 10-ribbed tube; plant perennial; stems and leaves glabrous; leaflets 3 to 9, commonly 5, linear-oblanccolate; petals white; blade of the banner cordate or reniform, wider than long.
 1. *P. CANDIDUM*.
1. Calyx tube pilose or villous (2).
 2. Plant annual; stems slender, glabrous; leaflets 3 to 5, linear, very acute, 1 to 3 cm. long, glabrous; spikes long-peduncled, slender, about 6 mm. in diameter in fruit; bracts conspicuous, dark colored, elliptic, ovate, or rhombic, subulate-tipped; corolla lilac, about 4 mm. long; blade of the banner shorter than the claw..... 2. *P. EXILE*.
 2. Plants perennial (3).
 3. Corolla white; blade of the banner equaling or longer than the claw, quadrilateral; leaflets 3 to 7; stems glabrous or sparsely pilose, rather conspicuously glandular-punctate; peduncles 10 to 20 cm. long; spikes 10 to 12 mm. in diameter..... 3. *P. FLAVESCENS*.

3. Corolla rose-colored or purplish; blade of the banner shorter than the claw (4).
4. Stems and leaves sparsely villous or glabrate; stems very leafy almost to the inflorescence, with additional leaves often fascicled in the axils; leaflets commonly 5, narrowly linear, about 1 mm. wide, mucronate, strongly involute; peduncles commonly not more than 2 cm. long; calyx tube densely silky-villous. . . 4. *P. PURPUREUM*.
4. Stems and leaves glabrous; stems not very leafy, naked for a considerable distance below the inflorescence; leaflets 5 to 9, elliptic to obovate, 2 to 4 mm. wide, not strongly involute; peduncles up to 15 cm. long; calyx tube loosely pilose or villous. . . 5. *P. SEARLSIAE*.

1. *Petalostemum candidum* Michx., Fl. Bor. Amer. 2: 49. 1803.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 7,000 feet, mesas and openings in pine forests, rather common, May to September. Indiana to Saskatchewan and Montana, south to Mississippi, Texas, Arizona, and northern Mexico.

White prairieclover. The species is represented in Arizona by a western form (*Petalostemon oligophyllus* (Torr.) Rydb., *P. sonorae* Rydb.), in which the leaflets are usually smaller and narrower than in *P. candidum* as it occurs farther east. The plant is reported to be used by the Hopi Indians as an emetic.

2. *Petalostemum exile* A. Gray, Pl. Wright. 2: 41. 1853.

Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,000 feet, mostly among pines, September. Southern New Mexico and Arizona, and northern Mexico.

3. *Petalostemum flavescens* S. Wats., Amer. Nat. 7: 299. 1873.

Navajo and Coconino Counties. 5,000 to 8,000 feet, apparently rare, June. Southern Utah and northernmost Arizona.

The corolla was described as yellow by Watson but is white in fresh specimens. The crushed foliage is lemon-scented.

4. *Petalostemum purpureum* (Vent.) Rydb., N. Y. Bot. Gard. Mem. 1: 238. 1900.

Dalea purpurea Vent., Pl. Jard. Cels. pl. 40. 1800.

Near Prescott, Yavapai County (*Peebles* et al. 4253) at roadside, July. Indiana to Saskatchewan, south to Texas and central Arizona, where perhaps introduced from farther east.

5. *Petalostemum searlsiae* A. Gray, Amer. Acad. Arts. and Sci. Proc. 8: 380. 1873.

Petalostemon rothrockii Rydb., North Amer. Fl. 24: 134. 1920.

Coconino, eastern Mohave, and northern Yavapai Counties, 3,000 to 7,000 feet, June. Southern Utah and Nevada, northern Arizona.

The type of *P. rothrockii* was collected in Arizona (*Rothrock* in 1874, without definite locality). It differs from most specimens of *P. searlsiae* in the broader, more abruptly acuminate bracts, but intergradations occur.

Petalostemon pilosulus Rydb. was described from a specimen collected by Nealley (No. 237), probably in the Rincon Mountains, Pima County. The type appears to be a form of *Dalea albiflora*.

29. TEPHROSIA

Plants perennial, herbaceous; stems either sympodial and the racemes appearing lateral, opposite the leaves, or monopodial and the racemes terminal and axillary; herbage not punctate; leaves odd-pinnate, the leaflets few to numerous; stamens more or less united; pods linear, flat, several-seeded.

Although some of the species of this genus are a source of rotenone, an extensively used insecticide, the Arizona species apparently contain little or none of this substance. They are, however, suspected of being poisonous.

Key to the species

1. Stem sympodial; racemes appearing lateral, opposite the leaves, few-flowered, the flowers very scattered; leaflets 5 to 11, linear to oblanceolate, up to 8 mm. wide but usually much narrower; corolla 8 mm. long, rose purple; pubescence of the herbage strictly appressed (strigose); plant herbaceous.
 1. *T. PURPUREA*.
1. Stem monopodial; racemes terminal and axillary; leaflets commonly more than 11; corolla more than 10 mm. long; plants suffruticose (2).
 2. Stems finely strigose-canescens; leaflets narrowly elliptic or oblanceolate, not more than 8 mm. wide, glabrous above; racemes elongate, narrow, loosely flowered, many of them axillary; blades of the petals rose purple; pods glabrous, 5 to 6 mm. wide ----- 2. *T. LEIOCARPA*.
 2. Stems with spreading as well as short appressed hairs; leaflets elliptic, oblong, or subspatulate, often more than 8 mm. wide, pubescent on both faces; racemes short, broad, densely flowered, all or nearly all terminal; blades of the petals whitish, more or less tinged with purple; pods pilose, 3 to 4 mm. wide ----- 3. *T. LEUCANTHA*.

1. *Tephrosia purpurea* (L.) Pers., Syn. Pl. 2: 329. 1807.

Cracca purpurea L., Sp. Pl. 752. 1753.

Tephrosia tenella A. Gray, Pl. Wright, 2: 36. 1853.

Cracca tenella Rose, Contrib. U. S. Natl. Herbarium 12: 271. 1909.

Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 (?) feet, slopes and mesas, usually in partial shade, May to September. Texas, southern Arizona, and Mexico; widely distributed in the tropics of both hemispheres.

2. *Tephrosia leiocarpa* A. Gray, Pl. Wright. 2: 36. 1853.

Cracca leiocarpa Kuntze, Rev. Gen. Pl. 1: 175. 1891.

Sonoita Valley, Patagonia Mountains, Sycamore Canyon near Ruby (Santa Cruz County), Baboquivari Mountains (Pima County), 4,500 to 5,500 feet, August and September. Southern Arizona and northern Mexico.

A roundish shrub, about 1 m. high.

3. *Tephrosia leucantha* H. B. K., Nov. Gen. et Sp. 6: 460. 1824.

Cracca leucantha Kuntze, Rev. Gen. Pl. 1: 175. 1891.

Cracca thurberi Rydb., North Amer. Fl. 24: 165. 1923.

Cochise, Santa Cruz, and Pima Counties, 5,000 to 6,000 feet, dry slopes among live oaks, August and September. Southern Arizona and Mexico.

30. PETERIA

Plants herbaceous, perennial; stems low, slender, rather stiff; leaves pinnate, the leaflets many, small, the stipules spiny; flowers in long-stalked loose racemes, the banner recurved, the keel incurved; pods narrow, several-seeded.

The tuberous rootstocks of *P. scoparia*, known in Texas as camote-de-monte, are reported to be edible.

Key to the species

1. Leaflets not more than 2 mm. wide, acute or acutish at apex, soon deciduous; stem freely branched above the base; calyx strigose, only slightly glandular-puberulent, the teeth deltoid, 2 to 4 mm. long; corolla 12 to 16 mm. long.
1. *P. scoparia*.
1. Leaflets 4 mm. wide or wider, obtuse, rounded, or slightly retuse and often mucronate at apex; stem simple or very sparingly branched above the base; calyx more or less hirsute, copiously glandular-pubescent, the teeth 5 mm. long or longer; corolla 16 to 25 mm. long.----- 2. *P. thompsonae*.

1. *Peteria scoparia* A. Gray, Pl. Wright. 1: 50. 1852.

Petrified Forest, Apache County (*Toole* and *Goodding* in 1936), July to August. Western Texas to northeastern Arizona.

2. *Peteria thompsonae* S. Wats., Amer. Nat. 7: 300. 1873.

Northern Coconino County, near the Utah State line (*Kelly* in 1932, *Cottam* et al. 4199), 4,000 feet, sometimes with *Coleogyne*. Southern Utah and northern Arizona.

31. ROBINIA. LOCUST

Large shrubs or small trees, thorny; leaves odd-pinnate, the leaflets numerous, rather large; flowers many in rather dense racemes, large and showy, fragrant, the corolla purplish pink; pedicels glandular; stamens diadelphous, 9 of them with the filaments united below into a tube; pods flat, 2-valved, several-seeded, hispid and usually glandular.

1. *Robinia neomexicana* A. Gray, Amer. Acad. Arts. and Sci. Mem. ser. 2, 5: 314. 1855.

Coconino County, and Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 4,000 to 8,500 feet, common and often abundant, mostly in canyons and in coniferous forests, often with *Quercus gambelii*, May to July. Southern Colorado to southern Nevada, western Texas, New Mexico, Arizona, and northern Mexico.

New Mexican locust. The plant reaches a height of 7.5 m. (25 feet) and being very handsome in flower is sometimes cultivated as an ornamental. The flowers are relished by cattle and the foliage is browsed, both by cattle and deer. The Hopi Indians are reported to use the plant as an emetic and in treating rheumatism. The habit of forming thickets and of sprouting freely from stumps and roots makes this plant valuable for control of erosion.

Two forms of this species are common in Arizona, var. *luxurians* Dieck (*R. luxurians* Rydb.) and var. *subvelutina* (Rydb.) Kearney and Peebles (*R. subvelutina* Rydb.). Both are supposed to be distinguished from typical *R. neomexicana* by the presence of gland-tipped hairs on the pods. In var. *luxurians* the pubescence of the herbage

is finer and more appressed than in var. *subvelutina*, and the petioles are usually glandular-hispid in the latter variety, not so in var. *luxurians*. But there is so much intergradation among all forms of this species that the attempt to maintain even varieties is scarcely worth while.

32. OLNEYA. TESOTA

A tree, attaining a height of 9 m. (27 feet) and a trunk diameter of 45 cm. (1.5 feet), the branches armed with spines, the bark thin and scaly; leaves pinnate, the leaflets 8 to 24 (commonly 11 to 15), grayish pubescent; flowers pealike, in short racemes; corolla about 12 mm. long, purple and white; pods glandular-pubescent, usually several-seeded and torulose.

Known commonly in Arizona as ironwood, or palo-de-hierro. A desert tree with very handsome flowers, limited to warm locations, and for this reason used as an indicator in selecting sites for citrus orchards. The foliage is evergreen except in very cold winters. The wood is brittle, hard, remarkably heavy, and burns very slowly, making good coals. The ironwood has been used so extensively for firewood that it is unusual to find a large tree that has not been cut back to the stump. The wood was used by the Indians for arrow-heads and for tool handles. Experiments have been made to utilize it commercially, but it is too hard for ordinary woodworking tools. The hard sharp spines of the branches do not prevent desert-bred horses from eating the foliage with evident relish. The seeds are an important food of desert animals and formerly were eaten parched by the Pima Indians (pl. 15).

1. *Olneya tesota* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 328. 1855.

Maricopa, Pinal, Pima, and Yuma Counties, 2,500 feet or lower, common along washes in the foothills, May and June. (A collection by B. E. Fernow, labeled "Pinery Creek" (Cochise County), must have come from an altitude of 4,000 feet or more, if correctly labeled as to locality.) The type was collected along the Gila River, Arizona. Southern Arizona, southeastern California, Sonora, and Baja California.

33. DIPHYSA

Plant a low shrub; branches of the inflorescence armed with short weak prickles; leaves pinnate, the leaflets numerous, thin, oval to suborbicular, 1 to 1.5 cm. long; flowers rather large, in axillary racemes; corolla yellow or yellowish; pods 1-celled, the outer wall separating from the inner wall, forming 2 elongate bladderlike cavities paralleling the seed cavity.

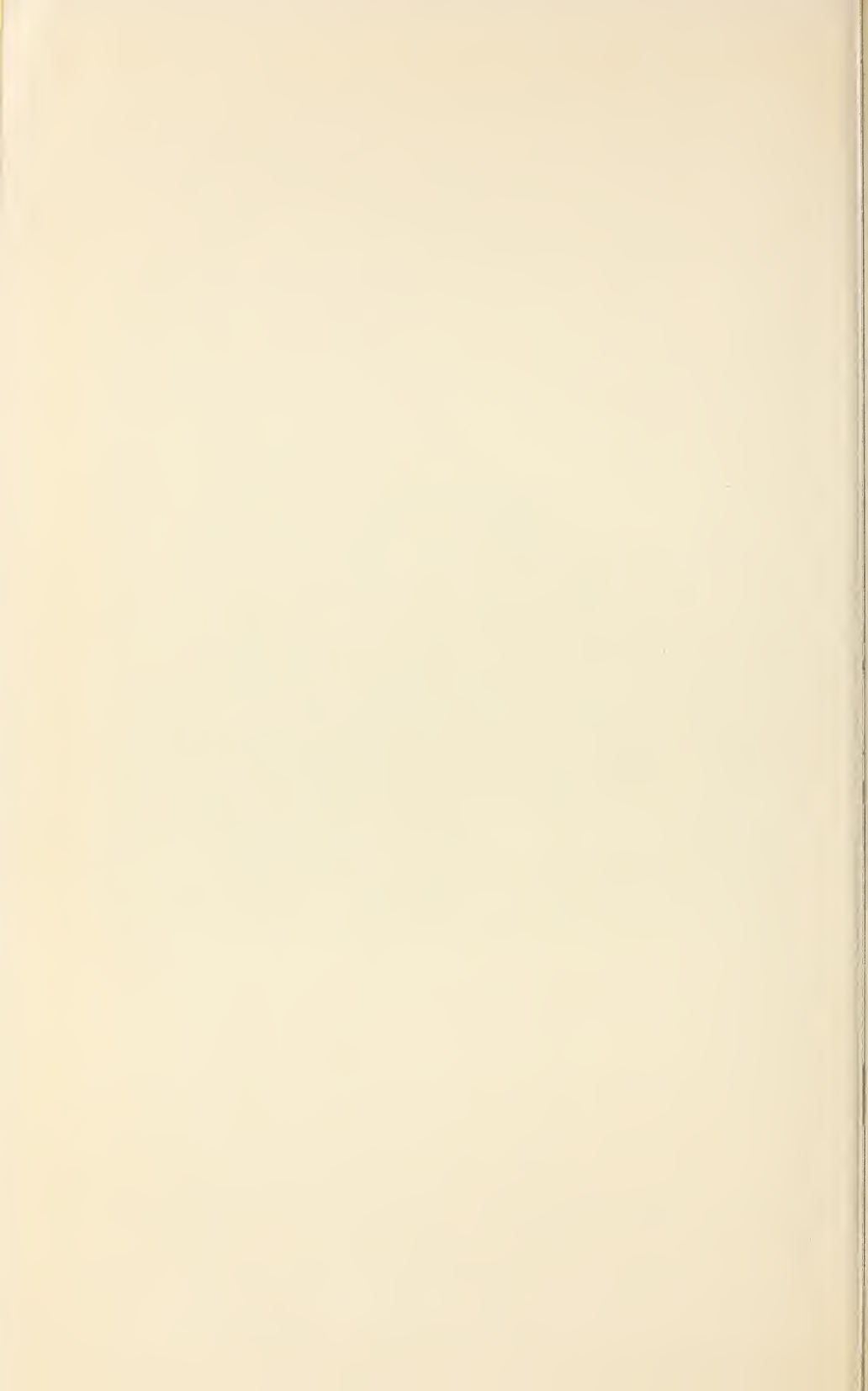
1. *Diphysa thurberi* (A. Gray) Rydb. ex Standl., Contrib. U. S. Natl. Herbarium 23: 479. 1922.

Daubentonia thurberi A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 313. 1855.

Montezuma Camp, southeast of the Huachuca Mountains (*Lemmon* 2659), the only record for Arizona. Southeastern Arizona and northern Mexico.



Tesota (*Olneya tesota*) near Gila Bend, Maricopa County, altitude 1,000 feet.
A fine specimen about 35 feet high and 3 feet in diameter of the trunk. This tree is commonly known as ironwood in Arizona.



34. COURSETIA

A shrub up to 6 m. (20 feet) high, unarmed; leaves pinnate, the leaflets numerous, thin, oval; flowers appearing with the leaves; inflorescences racemose, axillary, glandular; corolla white or tinged with pink, with a yellow center; pods linear, torulose, 2-valved.

1. *Coursetia microphylla* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 201. 1882.

Maricopa, Pima, and Yuma Counties, 4,000 feet or lower, canyons and dry rocky slopes, locally abundant, March and April, type from the Santa Catalina Mountains (*Pringle* in 1881). Southern Arizona and northern Sonora.

This species is closely related to *C. glandulosa* Gray and is perhaps only a good variety of the latter. The mature leaflets attain a length of more than 2 cm. but are usually much smaller. The plant is often browsed. The stems sometimes are heavily encrusted with orange-colored lac, resulting from infestation by an insect of the genus *Tachardia*. This was used by the Papago Indians to seal jars containing sahuaro sirup and is reported to be used by the Mexicans in treating colds and fever.

35. CRACCA

Plants herbaceous, perennial, small; herbage sericeous or villous; leaves pinnate, the leaflets several, broad, thin; flowers few, in loose long-stalked racemes; corolla with ochroleucous or pale-yellow wings and keel, the banner usually more or less purple; pods linear, flat, with cross partitions between the seeds, completely dehiscent; seeds rounded-quadrangular.

It is reported that the plants are heavily grazed but quickly recover.

1. *Cracca edwardsii* A. Gray, Pl. Wright. 2: 35. 1853.

Benthamantha edwardsii Rose, Contrib. U. S. Natl. Herbarium 10: 99. 1906.

Benthamantha wrightii Rydb., North Amer. Fl. 24: 246. 1924.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, common on rocky slopes, often with live oaks, July to September, type of *B. wrightii* from "between the San Pedro and the Sonoita" (*Wright* 963 in part). Southern Arizona and northern Mexico.

The var. *glabella* Gray (*Benthamantha glabella* Rydb.) occurs in the Huachuca and Patagonia Mountains (Cochise and Santa Cruz Counties). Normally it differs from typical *C. edwardsii* in having flowering stems from a cormlike caudex (instead of an elongate woody rootstock), some of the roots tuberous-thickened, the pubescence of the herbage looser and more spreading, the leaflets more broadly obovate and more obtuse at apex, and the banner petal yellowish, often purple-veined (instead of red or purple). Rydberg may have been justified in giving this form specific rank, although apparently it intergrades with typical *C. edwardsii*.

36. SPHINCTOSPERMUM

A small annual herb; stems slender, erect, sparingly branched; herbage sparsely strigose; leaves reduced to 1 long narrowly linear

leaflet; flowers axillary, solitary or in pairs, short-pediceled, small and inconspicuous; pods as in *Cracca*; seeds quadrangular, sharply constricted at the middle.

1. **Sphinctospermum constrictum** (S. Wats.) Rose, Contrib. U. S. Natl. Herbarium 10: 107. 1906.

Tephrosia constricta S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 46. 1889.

Santa Cruz and Pima Counties, 2,500 to 4,000 feet, not common, open sandy places, July to September. Southern Arizona, Sonora, and Baja California.

37. SESBANIA

Plant annual, glabrous; stems tall, erect, sparingly branched, leafy; leaves bright green, elongate, pinnate, the leaflets numerous, narrow, oblong or elliptic; flowers in axillary few-flowered racemes; corolla pale yellow, usually streaked and spotted with brown purple; pods long, very slender, dehiscent, with cross partitions between the numerous oblong seeds.

1. **Sesbania exaltata** (Raf.) Rydb., North Amer. Fl. 24: 204. 1924.

Darwinia exaltata Raf., Fl. Ludov. 106. 1817.

Sesban sonorae Rydb., North Amer. Fl. 24: 205. 1924.

Bottom lands along the Colorado River, Yuma County, and occasionally escaped from cultivation elsewhere in irrigated districts of southern Arizona, August to October. Missouri to Florida, Texas, southwestern Arizona, southeastern California, and northwestern Mexico.

Often planted as a soil-improvement crop on farms in irrigated sections of the Southwest and as a cover crop in citrus orchards. It is a fiber plant producing lustrous, smooth, and very strong filaments, which are used by the Yuma Indians for nets and fishlines. The stems reach a height of 3 m. (10 feet).

38. SWAINSONA

Plant herbaceous, perennial, glabrous or nearly so; flowering stems from creeping rootstocks, tall, erect, leafy, strictly branched above; leaves pinnate, the leaflets numerous, thin, narrowly elliptic or oblanceolate, about 1 cm. long; flowers in numerous loose axillary racemes, large and showy; corolla dull red; pods large, bladderlike, nearly globose, long-stipitate, with thin papery walls, indehiscent or tardily and irregularly dehiscent.

1. **Swainsona salsula** (Pall.) Taubert in Engl. and Prantl, Pflanzenfam. III. 3: 281. 1894.

Phaca salsula Pall., Reise 3: 747. 1776.

Sphaerophysa salsula DC., Prodr. 2: 271. 1825.

Navajo County, at Winslow (*Peebles* 9595, 11998), and Holbrook to Winslow (*McKelvey* 4565), May and June. Here and there in the western United States, introduced from Asia.

The plant is known to the writers only in a single roadside colony at Winslow, which has not increased greatly in size during the past 5 years. Related species are reputed to be poisonous. The plant might easily be mistaken for a large bladder-fruited *Astragalus*

39. ASTRAGALUS.⁶⁹ MILKVETCH

Plants mostly herbaceous perennials, but a few species annual and 1 species suffrutescens, of very diverse habit; stems leafy or scapose, erect to prostrate; leaves pinnate, rarely reduced to 1 leaflet; inflorescences commonly racemose, sometimes umbellike or capitate; keel petals usually arched or bent; pods diverse, dehiscent or indehiscent, with papery to leathery or woody walls, 1-celled or more or less completely 2-celled by introversion of 1 or both sutures.

This is the largest genus of flowering plants in the Arizona flora. Many of the species look much alike and can be distinguished satisfactorily only by the characters of the fruit. A few species with prostrate stems probably have a limited value for control of erosion. The name locoweed is applied to some of these plants, and species with bladderlike pods are called rattleweed. The former name implies that the species is one of those containing the poisonous constituent causing the well-known and often fatal loco disease of livestock, especially of horses. Species known to cause this disease that are found in Arizona are: *A. allochrous*, *A. diphysus*, *A. nothorys*, *A. thurberi*, and *A. wootoni*, probably also *A. arizonicus* and *A. macdougali*. Fortunately these plants are seldom eaten when better forage is available, but it is stated that animals may acquire the habit of eating locoweed.

Other species are known definitely to prefer soils rich in selenium and to take up sufficient quantities of this toxic element to make them poisonous to animals. The great majority of the Arizona species have not been proved to be injurious, and some apparently are grazed with impunity, but all are under suspicion until positive evidence of their harmlessness is forthcoming. Beath et al.⁷⁰ list the following species occurring in Arizona, all characterized by a rank disagreeable odor, as dangerously seleniferous: *A. confertiflorus*, *A. haydenianus*, *A. moencoppensis*, *A. praelongus*, *A. preussii*. Species that have been examined for selenium with negative results are: *A. diphysus*, *A. humistratus*, *A. layneae*, *A. lonchocarpus*, *A. nothorys*, *A. nuttallianus*, *A. palans*, *A. wootoni*.

Key to the species

1. Plant acaulescent or subacaulescent, more or less cespitose, the stems not more than 10 cm. long, usually covered with the leaf bases and stipules; leaves all basal or nearly so (2).
2. Pods completely or partly 2-celled, the septum well developed (3).
3. Plant and pods soft-pubescent with long, spreading or subappressed hairs; pods with very thick, almost woody walls; leaflets numerous, not more than twice as long as wide; stipules large; racemes dense; corolla more than 15 mm. long (4).
4. Pods rather narrowly ovoid, strongly arcuate, 2-celled below, 1-celled at apex, 15 to 20 mm. long..... 71. *A. THOMPSONAE*.
4. Pods broadly ovoid, nearly straight, 2-celled to the apex (5).
5. Pubescence of the leaves, peduncles, and pods very dense, many of the hairs spreading, leaflets mostly more than 10 mm. long; pods not more than 15 mm. long..... 70. *A. BIGELOVII*.
5. Pubescence rather loose, the hairs mostly subappressed; leaflets less than 10 mm. long; pods 16 to 20 mm. long..... 72. *A. MATTHEWSII*.

⁶⁹ Since the following key to species is highly artificial, it has seemed desirable to facilitate cross reference by numbering the species in the order in which they appear in Rydberg's treatment of *Astragalus* and the segregate genera recognized by him (North American Flora 24: 251-462. 1929). The very few departures from this sequence are believed to show the actual relationships better.

⁷⁰ See "Literature consulted—uses and popular interest," p. 1037.

3. Plant and pods pubescent with relatively short appressed hairs, or glabrate (6).
6. Pods 20 mm. long or longer, 5 to 6 times as long as their greatest diameter (7).
7. Pods 30 to 50 mm. long, very strongly arcuate, sometimes forming almost a complete circle; calyx hairs mostly black.
 62. A. LAYNEAE.
7. Pods 20 to 25 mm. long, moderately arcuate; calyx hairs white and black----- 64. A. ENSIFORMIS.
6. Pods not more than 15 mm. long, 3 to 4 times as long as their greatest diameter (8).
8. Leaflets 6 to 10 times as long as wide; inflorescences loose, few-flowered; pods conspicuously veined; plant strigose or glabrate.
 48. A. BRANDEGEL.
8. Leaflets seldom more than 3 times as long as wide; inflorescences short, rather compact, much surpassing the leaves; pods not conspicuously veined (9).
9. Plant silvery-sericeous, the leaflets so on both faces; wing petals deeply notched----- 63. A. SCAPOSUS.
9. Plant rather sparsely strigose, the leaflets glabrous above; wing petals not deeply notched----- 69. A. HYPOXYLUS.
2. Pods 1-celled, without a septum but with the ventral suture occasionally somewhat introverted (10).
10. Pods not more, usually less than 10 mm. long; leaflets seldom more than 10 mm. long (11).
11. Inflorescences little surpassing (usually shorter than) the leaves, loose, very few-flowered, or the flowers solitary; herbage silvery-sericeous; stipules large, connate, thin (12).
12. Keel conspicuously and sharply beaked (produced at a right angle to the claws); caudex with long creeping branches; leaflets 3 to 8 mm. long; calyx about 5 mm. long, the teeth subulate, longer than the tube; pods asymmetrically obovoid and slightly falcate, barely 10 mm. long, often mottled----- 30. A. SESQUIFLORUS.
12. Keel not beaked, obliquely truncate; caudex short-branched (the plant pulvinate); leaflets about 2 mm. long; calyx 2.5 mm. long, the teeth triangular, shorter than the tube; pods ovoid-oblong, barely 3 mm. long----- 43. A. HUMILLIMUS.
11. Inflorescences usually much surpassing the leaves, compact, several-to many-flowered; keel not beaked; pods ovoid (13).
13. Pubescence rather loose, harsh, not silvery; leaflets 4 to 6 mm. wide; bracts subulate, becoming strongly reflexed; peduncles about 15 cm. long; corolla 8 to 10 mm. long, dull red, at least when dry; pods subglobose, not more than $1\frac{1}{2}$ times as long as their greatest diameter----- 11. A. TROGLODYTUS.
13. Pubescence close, silvery-sericeous; leaflets about 3 mm. wide; bracts lanceolate, not becoming strongly reflexed; peduncles less than 10 cm. long; corolla 7 to 8 mm. long, violet or (exceptionally) whitish; pods oblong-ovoid, 2 or more times as long as their greatest diameter----- 29. A. GILENSIS.
10. Pods 10 mm. long or longer (14).
14. Walls of the pods thin, papery, mottled; plant glabrous throughout or very nearly so; pods 25 to 35 mm. long, broadly oval, stipitate.
 33. A. ARTIPES.
14. Walls of the pods thicker, more or less coriaceous, not or only exceptionally mottled (15).
15. Pubescence of the pods long and spreading (16).
16. Racemes much surpassing the leaves; leaflets 2 to 3 mm. wide; pods usually strongly reflexed, sparsely villous at maturity, oblong, strongly falcate----- 31. A. DESPERATUS.
16. Racemes not or but slightly surpassing the leaves; leaflets 4 to 11 mm. wide; pods not or only slightly reflexed, densely soft-villous at maturity, ovoid (17).
17. Leaflets 3 to 7, white-sericeous; calyx 12 to 15 mm. long; corolla 20 to 30 mm. long; pods somewhat incurved at apex.
 19. A. NEWBERRYI.
17. Leaflets 9 to 13, white-villous; calyx 8 mm. long; corolla 12 to 15 mm. long; pods crescent-shaped----- 20. A. BLYAE.

15. Pubescence of the pods, if any, relatively short and more or less appressed (18).
18. Pods stipitate, the stipes $2\frac{1}{2}$ to 3 times as long as the calyx; stems and the lower surface of the leaflets sparsely strigose; leaflets mostly broadly obovate; pods broadly ovoid, 15 to 20 mm. long----- 45. *A. AMPULLARIUS*.
18. Pods sessile or nearly so (19).
19. Calyx 4 to 7 mm. long, campanulate or cylindric-campanulate; corolla 8 to 15 mm. long; pods 10 to 15 mm. long; leaflets 2 to 4 mm. wide (20).
20. Pods rather promptly dehiscent, not rugose-veiny, deeply grooved toward the base on each side of the very prominent ventral suture; leaflets acute or acutish at apex; calyx 5 to 7 mm. long; corolla 10 to 15 mm. long.
S. *A. CONFERTIFLORUS*.
20. Pods indehiscent or tardily and incompletely dehiscent, rugose-veiny, not deeply grooved on the ventral side, the ventral suture not prominent; leaflets rounded or obtuse at apex; calyx less than 5 mm. long; corolla about 8 mm. long----- 28. *A. ACCUMBENS*.
19. Calyx 7 mm. long or longer, cylindric, corolla usually at least 15 mm. long; pods rarely less than 15 mm. long (except in *A. castaneaeformis*), indehiscent; leaflets commonly 5 mm. wide or wider, elliptic to obovate, not more than 3 times as long as wide (21).
21. Leaflets glabrous or sparsely strigose above (22).
22. Racemes little or not surpassing the leaves, usually dense in flower; calyx hairs prevailing white; pods glabrous, ovate or oblong-ovate in outline, acuminate at apex, 15 to 20 mm. long----- 14. *A. REMULCUS*.
22. Racemes greatly surpassing the leaves, rather loose in flower; calyx hairs prevailing black; pods strigose, oblong-lanceolate in outline, abruptly acute at apex, 20 to 40 mm. long----- 15. *A. CHLORIDAE*.
21. Leaflets strigose to sericeous on both faces, usually rather densely so (23).
23. Pods straight, oblong or oblong-lanceolate in outline.
18. *A. VESPERTINUS*.
23. Pods more or less curved (24).
24. Pods broadly ovate in outline, very asymmetric, not more than twice as long as their greatest diameter.
17. *A. CASTANAEFORMIS*.
24. Pods oblong-lanceolate to oblong-ovate in outline, 3 or more times as long as their greatest diameter (25).
25. Calyx in flower 10 to 14 mm. long; pods pilose with short, more or less kinky, subappressed hairs, slightly curved, not tapering at base.
13. *A. PEPHRAGMENS*.
25. Calyx in flower usually not more than 10 mm. long; pods appressed-pubescent, strigose to sericeous (26).
26. Pods strongly curved, sometimes forming nearly a semicircle, acuminate at both ends, often so much narrowed at base as to appear stipitate.
12. *A. AMPHIOXYS*.
26. Pods moderately curved, obtuse or acutish at base.
16. *A. CURTILOBUS*.
1. Plant caulescent, the stems leafy well above the base and usually more than 10 cm. long (27).
27. Leaflets and stipules rigidly spine-tipped; leaflets subulate, about one-eighth as wide as long; flowers very few, in axillary clusters shorter than the leaves; pods 1-celled, lanceolate in outline... 1. *A. IMPENSUS*.
27. Leaflets and stipules not rigidly spine-tipped but sometimes sharply cuspidate (28).
28. Walls of the pod transversely ridged and furrowed, at least in pressed specimens (29).
29. Ridges of the pod rather hard and sharp-edged, the pods completely 2-celled, not more than 4 mm. long; seeds usually only 2.
73. *A. DISPERMUS*.

29. Ridges of the pod not hard or sharp-edged, the pods 1-celled, 8 mm. long or longer, stipitate, pendulous, strigose, deeply grooved on each side of the very prominent ventral suture; seeds several; racemes dense, many-flowered----- 7. *A. HAYDENIANUS*;
28. Walls of the pods not transversely ridged and furrowed, but sometimes conspicuously cross-veined (30).
30. Pods more or less completely 2-celled, the lower suture introverted to form a septum extending at least halfway across the cavity (31).
31. Length of the pods less than 3 times the greatest diameter (32).
32. Pods incompletely 2-celled, elliptic, nearly sessile, 10 to 15 mm. long, about 6 mm. wide; flowering stems from slender creeping rootstocks; leaflets elliptic to obovate, less than 10 mm. long, mostly retuse at apex; racemes few-flowered; calyx teeth subulate, about equaling the tube; corolla about 7 mm. long.
49. *A. COBRENSIS*.
32. Pods completely 2-celled, ovoid (33).
33. Herbage copiously strigose to white-sericeous; pods often mottled, 15 to 20 mm. long; corolla 9 to 15 mm. long (34).
34. Pods glabrous or not densely strigose; plant green, strigose or somewhat canescent----- 57. *A. FREMONTII*.
34. Pods rather densely strigose or sericeous; plant whitish sericeous or tomentose.----- 58. *A. COULTERI*.
33. Herbage sparsely strigose or glabrate (the leaflets rarely sericeous beneath); pods not or only exceptionally mottled (35).
35. Calyx 5 to 9 mm. long; pods 20 to 25 mm. long.
59. *A. DIPHYSSUS*.
35. Calyx 4 to 6 mm. long; pods 9 to 15 mm. long.
60. *A. MACDOUGALI*.
31. Length of the pods 3 or more times the greatest diameter (36).
36. Pods 3 to 4 times as long as their greatest diameter (37).
37. Leaflets linear, 6 or more times as long as wide; pods conspicuously veiny, their greatest diameter above the middle.
48. *A. BRANDEGELI*.
37. Leaflets broader than linear, less than 6 times as long as wide; pods not conspicuously veiny, their greatest diameter at or below the middle (38).
38. Pods long-stipitate, glabrous, the walls coriaceous.
53. *A. EREMITICUS*.
38. Pods sessile or nearly so (39).
39. Leaflets and pods whitish sericeous; calyx 5 mm. long; pods lanceolate in outline; plant annual.
61. *A. AGNINUS*.
39. Leaflets and pods strigose or glabrate; calyx 7 to 10 mm. long (40).
40. Inflorescence rather short and compact; corolla whitish or purplish pink; pods erect or ascending, usually mottled----- 55. *A. WILSONI*.
40. Inflorescence elongate, very open; corolla purple; pods spreading, not mottled----- 56. *A. MOKIACENSIS*.
36. Pods 4 or more times as long as their greatest diameter (41).
41. Stipe of the pod conspicuous, usually equaling or surpassing the calyx; leaflets glabrous above or nearly so (42).
42. Pedicels not or seldom recurved; pods erect or ascending, glabrous, the walls coriaceous; corolla about 15 mm. long, purple or whitish----- 53. *A. EREMITICUS*.
42. Pedicels recurved, at least in fruit; pods pendulous, the walls thin; corolla 6 to 8 mm. long, whitish (43).
43. Pods strigose, the stipe often surpassing the calyx.
50. *A. RUSBYI*.
43. Pods glabrous, the stipe usually shorter than the calyx.
51. *A. EGGLESTONII*.
41. Stipe of the pod none or much shorter than the calyx (44).
44. Pods very strongly arcuate, sometimes forming almost a complete circle, 30 to 50 mm. long--- 62. *A. LAYNEAE*.

44. Pods straight to strongly arcuate but not forming more than a semicircle (except sometimes in *A. palans*), not more than 30 mm. long (45).
45. Keel noticeably produced at a right angle to the claws; stems decumbent to nearly prostrate; pods linear or linear-lanceolate in outline, straight or slightly falcate (46).
46. Prolongation of the keel obtuse, horizontal; leaflets silvery-strigose on both faces (rarely glabrate above), linear or lance-linear, 5 or more times as long as wide; keel nearly as long as the banner; pods shallowly grooved dorsally.----- 65. *A. ARIZONICUS*.
46. Prolongation of the keel sharply acuminate, often ascending at apex; leaflets glabrous above, elliptic to obovate, less than 3 times as long as wide; keel much shorter than the banner; pods deeply grooved dorsally.
66. *A. NOTHOXYS*.
45. Keel not noticeably produced, rounded to acutish at apex; pods curved or falcate (47).
47. Pedicels recurved at or very soon after anthesis, the flowers nodding; plants perennial; leaflets glabrate above, sparsely strigose beneath; corolla not more than 8 mm. long; pods more or less falcate (48).
48. Racemes loosely few-flowered; corolla apparently purplish; pods more than 15 mm. long.
52. *A. RECURVUS*.
48. Racemes densely many-flowered; corolla whitish; pods less than 15 mm. long.----- 67. *A. HARTWEGII*.
47. Pedicels not recurved at anthesis but sometimes so in fruit (49).
49. Plant annual; corolla not more than 7 mm. long; pods not more than 3 mm. wide; leaflets strigose on both faces.----- 68. *A. NUTTALLIANUS*.
49. Plants perennial; corolla 10 mm. long or longer; pods 4 to 5 mm. wide (50).
50. Leaflets glabrous on both faces or very sparsely strigose beneath; stems 15 cm. or longer; corolla 15 to 20 mm. long; walls of the pods papery.
54. *A. PALANS*.
50. Leaflets strigose on both faces; stems not more than 10 cm. long; corolla 12 mm. long; walls of the pods coriaceous.----- 64. *A. ENSIFORMIS*.
30. Pods 1-celled, the lower suture sometimes introverted but the septum, if any, not extending halfway across the cavity (51).
51. Length of the pod more than 3 times the greatest diameter (52).
52. Pods 3- or 4-winged (with a wing in the center of each valve and on one or both of the sutures), strongly arcuate, the walls woody; plant glabrous or nearly so; leaflets narrowly linear.
21. *A. TETRAPTERUS*.
52. Pods not winged or strongly arcuate, the walls not woody but sometimes coriaceous (53).
53. Stems prostrate or nearly so, very leafy; plant perennial; pods more or less falcate.----- 24. *A. HUMISTRATUS*.
53. Stems erect, ascending, or decumbent, if nearly prostrate, then the plant annual (54).
54. Plant a short-lived annual; corolla not more than 7 mm. long; pods falcate, not pendulous.----- 68. *A. NUTTALLIANUS*.
54. Plant perennial; pods straight or nearly so (55).
55. Corolla usually less than 8 mm. long; pods pendulous, sessile or very nearly so; leaflets 7 to 15.
4. *A. WINGATANUS*.
55. Corolla 8 mm. long or longer (56).
56. Pods stipitate, barely so in *A. kaibensis* (57).
57. Leaflets elliptic to broadly obovate; pods not pendulous, indehiscent or nearly so, the walls subcoriaceous; plant glabrous or very nearly so.
46. *A. PREUSSII*.

57. Leaflets narrowly linear or nearly filiform; pods pendulous (58).
58. Terminal leaflet not much longer than the others; pods flattened laterally.----- 6. *A. COLTONI*.
58. Terminal leaflet much longer than the others, often appearing as a continuation of the rachis; pods not flattened laterally (59).
59. Stipe of the pod considerably surpassing the calyx; corolla 15 mm. long or longer.
22. *A. LONCHOCARPUS*.
59. Stipe of the pod much shorter than the calyx, stout; corolla 12 mm. long. 23. *A. KAIBENSIS*.
56. Pods sessile or nearly so (60).
60. Leaflets 9 to 15, the terminal one not rachislike; stems not rushlike; inflorescence many-flowered, usually rather dense; pods erect or ascending, not more than 15 mm. long.----- 8. *A. CONFERTIFLORUS*.
60. Leaflets 3 to 9, the terminal one often appearing like a continuation of the rachis, or the upper leaves reduced to a rachis; stems rushlike, slender, flexuous; inflorescence few-flowered, open; pods more or less pendulous, at least 18 mm. long (61).
61. Pods strigose, about 10 times as long as their greatest diameter.----- 5. *A. JUNCIFORMIS*.
61. Pods glabrous or glabrate, not more than 7 times as long as their greatest diameter (62).
62. Corolla 12 to 15 mm. long; pods 3 to 4 cm. long, lance-oblong, acuminate at apex.
2. *A. EPISCOPUS*.
62. Corolla 8 mm. to 10 mm. long; pods 2 to 3 cm. long, oblong, obtuse, and apiculate to acute at apex.----- 3. *A. LANCEARIUS*.
51. Length of the pods not more than 3 times the greatest diameter (63).
63. Walls of the pod coriaceous, becoming almost woody at maturity, the pods sessile or subsessile, glabrous or nearly so (64).
64. Stems not more than 20 cm. long, the plant normally subcaulescent; calyx cylindrical; corolla purple, drying violet.
14. *A. REMULCUS*.
64. Stems 30 cm. long or longer; calyx cylindrical-campanulate; corolla whitish, the keel often tipped with purple.
47. *A. PRAELONGUS*.
63. Walls of the pod thinner, at most subcoriaceous (65).
65. Pods stipitate, sometimes (in *A. preussii*) barely so and the stipe very thick (66).
66. Flowering stems borne at intervals on long, slender, creeping rootstocks; leaflets narrowly linear or nearly filiform, the terminal one greatly elongate, the lateral leaflets sometimes wanting or the leaf reduced to a rachis; pods thin-walled, conspicuously mottled with red-brown blotches.
34. *A. CERAMICUS*.
66. Flowering stems not borne at intervals on long, slender, creeping rootstocks; terminal leaflet like the others and not greatly elongate (67).
67. Pods conspicuously mottled with red-brown blotches, 30 to 40 mm. long.----- 33. *A. ARTIPES*.
67. Pods not or not conspicuously mottled (68).
68. Plant strigose, usually canescent; stems rather slender, usually decumbent or procumbent; leaflets rather thin.
32. *A. GREENEI*.
68. Plant glabrous or nearly so; stems stout, erect or ascending; leaflets thickish (69).
69. Stipe of the pod $2\frac{1}{2}$ to 3 times as long as the calyx.
45. *A. AMPULLARIUS*.
69. Stipe of the pod not longer than the calyx, sometimes very short and thick.----- 46. *A. PREUSSII*.

65. Pods sessile or nearly so (70).
70. Stems prostrate or procumbent; keel produced at a right angle to the claws; pods more or less falcate (71).
71. Leaflets strigose or sericeous on both faces; pods 8 to 12 mm. long..... 26. *A. SONORAE*.
71. Leaflets glabrous or nearly so above (72).
72. Lower face of the leaflets sparsely strigose; pods 15 to 18 mm. long..... 24. *A. HUMISTRATUS*.
72. Lower face of the leaflets loosely pilose; pods 7 to 10 mm. long..... 25. *A. HOSACKIAE*.
70. Stems not prostrate (or sometimes so in *A. sileranus*), often decumbent; keel not noticeably produced (or somewhat so in *A. subcinereus*), rounded to acutish at apex (73).
73. Pods strongly compressed, rather promptly dehiscent at maturity or if not so, then pendulous and glabrous (74).
74. Corolla yellow, 12 to 14 mm. long; stems white-sericeous, erect or nearly so, somewhat woody at base; leaflets glabrate above, white-sericeous beneath; calyx cylindrical, 6 to 9 mm. long; pods pendulous, glabrous, about 12 mm. long..... 27. *A. ALBULUS*.
74. Corolla white or purple; stems glabrous or strigose or, if sericeous, then the corolla not more than 9 mm. long (75).
75. Terminal leaflet greatly elongate or represented by a prolongation of the rachis; stems slender, rushlike; calyx teeth one-fourth to one-third as long as the tube..... 2. *A. EPISCOPUS*.
75. Terminal leaflet not greatly elongate and always with a well-developed blade (76).
76. Pods pendulous, glabrous; calyx teeth about one-half as long as the tube..... 4. *A. WINGATANUS*.
76. Pods not pendulous, strigose; calyx teeth two-thirds as long as to nearly equaling the tube (77).
77. Plant green, sparsely strigose; stems rushlike; leaflets glabrous above, linear-lanceolate; racemes greatly surpassing the leaves; pods 6 to 7 mm. long..... 9. *A. MOENCOPENSIS*.
77. Plant grayish, densely strigose or sericeous; stems not rushlike; leaflets strigose on both faces, elliptic or oblong; racemes not or but little surpassing the leaves; pods 8 to 10 mm. long..... 10. *A. SOPHOROIDES*.
73. Pods not strongly compressed, mostly inflated, indehiscent or tardily and incompletely dehiscent (78).
78. Pubescence of the pods more or less spreading; leaflets narrow, oblong or cuneate-oblancoate, often retuse (79).
79. Plant perennial, green, sparsely pubescent; stems straggling or prostrate; pods greatly inflated, less than twice as long as wide, often mottled..... 38. *A. SILERANUS*.
79. Plant annual, grayish, copiously pubescent; stems decumbent to erect; pods moderately inflated, 2 to 3 times as long as wide, not mottled, somewhat falcate..... 42. *A. SABULONUM*.
78. Pubescence of the pods, if any, closely appressed, strigose or sericeous (80).
80. Corolla 10 to 15 mm. long; walls of the pods subcoriaceous; plant perennial; leaflets usually obovate or oblanceolate; pods 15 to 25 mm. long..... 32. *A. GREENEI*.
80. Corolla not more than 8 mm. long; walls of the pods membranous or papery; plants mostly annual (81).
81. Pods 3-angled, arcuate, about 15 mm. long..... 39. *A. TRIQUETRUS*.

- 81. Pods not 3-angled or arcuate (82).
- 82. Walls of the pods mottled, the pods 15 to 30 mm. long----- 37. *A. SUBCINEREUS*.
- 82. Walls of the pods not mottled (83).
- 83. Plant and pods white-sericeous. 40. *A. ARIDUS*.
- 83. Plant and pods strigose or glabrate (84).
- 84. Pods 5 to 11 mm. long, globose or nearly so, less than 1½ times as long as their greatest diameter, sparsely strigose. 44. *A. THURBERI*.
- 84. Pods 12 mm. long or longer, ovoid, 1½ to 3 times as long as their greatest diameter (85).
- 85. Pods erect, 12 to 15 mm. long. 41. *A. PALMERI*.
- 85. Pods spreading or pendulous (86).
- 86. Racemes surpassing the leaves; pods more than 25 mm. long. 35. *A. ALLOCHROUS*.
- 86. Racemes shorter than the leaves; pods not more than 25 mm. long. 36. *A. WOOTONI*.

1. *Astragalus impensus* (Sheld.) Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 369. 1915.

Astragalus viridis (Nutt.) Sheldon var. *impensus* Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 9: 118. 1894.

Kentrophyta impensa Rydb., Torrey Bot. Club Bul. 32: 665. 1906.

Kaibab Plateau and Grand Canyon, Coconino County (*Jaeger* in 1926, *Eastwood* and *Howell* 6413, *Korstian* and *Baker* 135), 3,500 to 8,000 feet, September. Western Colorado to eastern Oregon, south to New Mexico, Arizona, and Nevada.

Very different in appearance from any other of the Arizona *Astragalus*, with hard, almost woody, more or less prostrate stems, sharply spine-tipped leaflets and stipules, and small axillary flowers. This species is considered excellent for control of erosion. The Arizona form is *Kentrophyta coloradensis* (M. E. Jones) Rydb., the type of which was collected at Lees Ferry, Coconino County (*Jones* in 1890).

2. *Astragalus episcopus* S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 346. 1875.

Homalobus episcopus Rydb., Torrey Bot. Club Bul. 40: 53. 1913.

Coconino County, 5,000 (to 8,000?) feet. Southern Utah and Arizona.

This and the 4 following species are characterized by more or less rushlike appearance, narrow deciduous leaflets, and narrow pendulous dehiscent pods.

3. *Astragalus lancearius* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 370. 1878.

Northern Mohave County, at Beaver Dam, 1,800 feet (*Palmer* in 1877, the type collection) and west of Fredonia, 4,600 feet (*Peebles* and *Parker* 14689). Southwestern Utah and northwestern Arizona.

In the collection from near Fredonia the pods are much more obtuse

at apex than in the type. More material is required before it can be decided definitely whether *A. lancearius* is specifically distinct from *A. episcopus*.

4. **Astragalus wingatanus** S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 192. 1883.

Homalobus wingatanus Heller, Muhlenbergia 1: 145. 1906.

Apache and Navajo Counties, 6,000 to 6,500 feet, May and June. Southern Colorado and Utah, northwestern New Mexico, and northeastern Arizona.

5. **Astragalus junciformis** A. Nelson, Torrey Bot. Club Bul. 26: 9. 1899.

Homalobus junceus Nutt. ex Torr. and Gray, Fl. North Amer. 1: 351. 1838.

Astragalus junceus A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 230. 1864. Not Ledeb., 1826.

Homalobus junciformis Rydb., Torrey Bot. Club Bul. 32: 666. 1906.

Near Holbrook, Navajo County (*Hough* 37). Montana and Idaho to Arizona and Nevada.

6. **Astragalus coltoni** M. E. Jones, Zoe 2: 237. 1891.

Homalobus coltoni Rydb., Torrey Bot. Club Bul. 50: 269. 1923.

Apache County, near Sweetwater (*Peebles* and *Smith* 13557), also in New Mexico, in the Carrizo Mountains, a range which extends into Arizona (*Matthews* in 1892), about 6,000 feet, May and June. Utah and northeastern Arizona.

The Arizona form is var. *moabensis* M. E. Jones (*Homalobus canovirens* Rydb.), which has a well-developed terminal leaflet jointed to the rachis and may be specifically distinct.

7. **Astragalus haydenianus** A. Gray in T. S. Brandeg., U. S. Geol. and Geog. Survey Ter. Rpt. 2: 235. 1876.

Astragalus scobinatulus Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 24. 1894.

Diholcos scobinatulus Rydb., Torrey Bot. Club Bul. 40: 51. 1913.

House Rock, Coconino County (*Jones* 25427). Wyoming to Nevada and northern Arizona.

This is easily distinguished by its dense, many-flowered racemes and pendulous, transversely ribbed, longitudinally furrowed pods. It is common on, if not confined to seleniferous soils and hence is doubtless toxic to animals.

8. **Astragalus confertiflorus** A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 368. 1878.

Cnemidophacos confertiflorus Rydb., Torrey Bot. Club Bul. 40: 52. 1913.

Near Rock Point, Apache County (*Peebles* and *Smith* 13541), 50 miles south of Lees Ferry, Coconino County (*Jones* in 1890), northern

Mohave County (*Goodding* 4776, *Peebles* and *Parker* 14710), 5,000 to 6,000 feet, May. Colorado, Utah, New Mexico, and Arizona.

Prefers soils of relatively high selenium content and is probably poisonous.

9. *Astragalus moencoppensis* M. E. Jones, *Zoe* 2: 12. 1891.

Cnemidophacos moencoppensis Rydb., *North Amer. Fl.* 24: 286. 1929.

Navajo County and eastern Coconino County, 3,700 to 5,500 feet, May and June, type from Willow Spring, Coconino County (*Jones* in 1890). Southern Utah and northeastern Arizona.

10. *Astragalus sophoroides* M. E. Jones, *Zoe* 2: 12. 1891.

Cnemidophacos sophoroides Rydb., *North Amer. Fl.* 24: 286. 1929.

Eastern Coconino County, 4,500 to 5,000 feet, May and June, type from Willow Spring (*Jones* in 1890). Known only from northern Arizona.

11. *Astragalus troglodytus* S. Wats., *Amer. Acad. Arts and Sci. Proc.* 20: 362. 1885.

Cnemidophacos troglodytus Rydb., *North Amer. Fl.* 24: 288. 1929.

Kaibab Plateau, San Francisco Peaks, Mogollon Escarpment near Oak Creek, and Williams to Ash Fork (Coconino County), 6,500 to 7,500 (?) feet, among yellow pines, April and May, type from the San Francisco Peaks (*Lemmon* in 1884). Known only from northern Arizona.

The flowers apparently are red when fresh, a color unique among the Arizona species. The plant is characterized also by subcaulescent habit and strongly reflexed bracts.

12. *Astragalus amphioxys* A. Gray, *Amer. Acad. Arts and Sci. Proc.* 13: 366. 1878.

Xylophacos amphioxys Rydb., *Torrey Bot. Club Bul.* 32: 662. 1906.

Apache County to Mohave County, 2,000 to 7,500 feet, April to June. Texas to southern Utah and northern Arizona.

A form distinguished, apparently, only by the presence of black hairs on the calyx, var. *melanocalyx* (Rydb.) Tidestrom (*Xylophacos melanocalyx* Rydb.), is found chiefly in northern Mohave County, 1,800 to 4,000 feet, sandy plains.

13. *Astragalus pephragmenus* M. E. Jones, *Zoe* 4: 267. 1893.

Xylophacos pephragmenus Rydb., *Torrey Bot. Club Bul.* 52: 151. 1925.

Navajo County to Hualpai Mountain (Mohave County), and Greenlee, Gila, and Yavapai Counties, 4,000 to 7,000 feet, yellow pine forest, April to May, type from the Pinal Mountains (*Jones* in 1890). Southern Utah, New Mexico, and Arizona.

14. *Astragalus remuleus* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 658. 1895.

Xylophacos remuleus Rydb., Torrey Bot. Club Bul. 52: 153. 1925.

Coconino, Gila, and Yavapai Counties, 4,500 to 5,000 feet, often among chaparral, April to June, type from Bangharts (Del Rio), Yavapai County (*Rusby* 576). New Mexico and central Arizona.

15. *Astragalus chloridæ* (M. E. Jones) Tidestrom, Biol. Soc. Wash. Proc. 48: 40. 1935.

Astragalus remuleus var. *chloridæ* M. E. Jones, Rev. North Amer. Astrag. 210. 1923.

Xylophacos chloridæ Rydb., Torrey Bot. Club Bul. 52: 153. 1925.

Gila, Maricopa, and Mohave Counties, 3,500 to 4,500 feet, April, type from Chloride, Mohave County (*Jones* in 1903). Known only from Arizona.

This and the 2 preceding are connected by numerous specimens of intermediate character and should perhaps be regarded as constituting a single variable species.

16. *Astragalus curtisii* Tidestrom, Biol. Soc. Wash. Proc. 48: 40. 1935.

Astragalus shortianus Nutt. var. *brachylobus* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 367. 1878.

Xylophacos brachylobus Rydb., Torrey Bot. Club Bul. 52: 154. 1925.

Apache County to eastern Mohave and Gila Counties, 5,000 to 8,000 feet, rocky or sandy places, May to July, type from Arizona. Southern Colorado to southern Nevada, New Mexico, and Arizona.

17. *Astragalus castaneaeformis* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 361. 1885.

Xylophacos castaneaeformis Rydb., Torrey Bot. Club Bul. 52: 155. 1925.

Coconino and northern Gila Counties, 5,800 to 7,000 feet, among pines, often in rocky places, May, type from Williams (*Lemmon* in 1884). Known only from Arizona.

Distinguished from most of these nearly related, acaulescent species by its short, broad pods.

- *18. *Astragalus vespertinus* Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 150. 1894.

Xylophacos vespertinus Rydb., Torrey Bot. Club Bul. 32: 662. 1906.

Not known definitely from Arizona but has been collected in the Carrizo Mountains, New Mexico (*Matthews* in 1892), and this range of mountains extends into the northeastern corner of Arizona.

19. *Astragalus newberryi* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 55. 1876.

Xylophacos newberryi Rydb., Torrey Bot. Club Bul. 32: 662. 1906.

Apache County to Mohave County (probably also Yavapai County) 2,000 to 6,500 feet, dry stony mesas, April, type from the "frontiers of Utah and Arizona" (*Newberry* in 1858). Western New Mexico to Nevada and northern Arizona.

This and the next species are peculiar in this acaulescent group because of their pods being densely villous with long soft hairs.

20. *Astragalus blyae* (Rose) Tidestrom, Biol. Soc. Wash. Proc. 48: 40. 1935.

Xylophacos blyae Rose ex Rydb., North Amer. Fl. 24: 303. 1929.

Mohave County, type from near Kingman (*Mrs. Bly* in 1927), 3,500 to 5,000 feet, March and early April. Known only from Arizona.

Specimens collected near Hackberry, Mohave County (*Kearney* and *Peebles* 11299) are almost intermediate between this and *A. newberryi*.

21. *Astragalus tetrapterus* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 369. 1878.

Pterophacos tetrapterus Rydb., Fl. Rocky Mount. 507, 1063. 1917.

Near Bonelli Ferry, on the Colorado River near the mouth of Virgin River, Mohave County (*Jones* in 1894). Southern Utah and Nevada, and northwestern Arizona.

The remarkable winged pods distinguish this from all other species of *Astragalus* in Arizona. The plant is reported to be poisonous.

- *22. *Astragalus lonchocarpus* Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 80. 1857.

Lonchophaca macrocarpa (A. Gray) Rydb., North Amer. Fl. 24: 312. 1929.

Not known definitely to occur in Arizona but has been collected at Fort Wingate, New Mexico, and near Kanab, Utah, not far from the Arizona State line. Colorado, Utah, and New Mexico.

23. *Astragalus kaibensis* M. E. Jones, Contrib. West. Bot. 10: 64. 1902.

Lonchophaca kaibensis Rydb., North Amer. Fl. 24: 314. 1929.

Known only from the type collection at House Rock, Coconino County (*Jones* in 1890).

24. *Astragalus humistratus* A. Gray, Pl. Wright 2: 43. 1853.

Batidophaca humistrata Rydb., North Amer. Fl. 24: 315. 1929.

Apache, Navajo, Gila, and Cochise Counties, chiefly in the White Mountain region, also in the Huachuca Mountains, 7,000 to 8,500 feet, in pine forests, July to September. Southern Colorado to Arizona and Chihuahua.

The prostrate stems, closely hugging the ground, make this a good plant for control of erosion. This doubtless applies also to the 2 following species, which are very closely related to *A. humistratus* and perhaps only varietally distinct.⁷¹

25. *Astragalus hosackiae* Greene, Calif. Acad. Sci. Bul. 1: 157. 1885.

Batidophaca hosackiae Rydb., North Amer. Fl. 24: 316. 1929.

Navajo, Coconino, and Gila Counties, 5,500 to 7,000 feet, yellow pine forests, July to September, type from Flagstaff (*Rusby* in 1883). Western New Mexico and Arizona.

26. *Astragalus sonorae* A. Gray, Pl. Wright. 2: 44. 1853.

Batidophaca sonorae Rydb., North Amer. Fl. 24: 317. 1929.

Batidophaca humivagans Rydb., *ibid.* p. 316.

Apache County to Mohave County (Mt. Trumbull, Hualpai Mountain), and Yavapai County, also in southern Arizona, 5,000 to 8,000 feet, mostly in pine forests, May to September, type of *A. sonorae* from "between the San Pedro and the Sonoita" (*Wright* 1005), type of *B. humivagans* from Mokiak Pass, northern Mohave County (*Palmer* 108). Southern Utah to New Mexico and Sonora.

On the Kaibab Plateau (Buckskin Mountains), at about 8,500 feet altitude, occurs a form with smaller leaflets and very few-flowered racemes. This is var. *tenerrimus* (M. E. Jones) Kearney and Peebles (*A. humistratus* var. *tenerrimus* M. E. Jones, *Batidophaca tenerrima* Rydb.).

27. *Astragalus albulus* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 136. 1913.

Batidophaca albula Rydb., North Amer. Fl. 24: 317. 1929.

St. Johns to Springerville, Apache County, 5,600 to 6,800 feet (*Marsh* 14245, 14248), September. Western New Mexico and eastern Arizona.

28. *Astragalus accumbens Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 20. 1894.

Batidophaca accumbens Rydb., North Amer. Fl. 24: 317. 1929.

The writers have seen no Arizona specimens, but the species has been collected at Fort Wingate, New Mexico, about 30 miles east of the Arizona State line.

29. *Astragalus gilensis* Greene, Torrey Bot. Club Bul. 8: 97. 1881.

Batidophaca gilensis Rydb., North Amer. Fl. 24: 318. 1929.

Apache and Navajo Counties, 6,200 to 8,500 feet, gravelly slopes, August. Western New Mexico and eastern Arizona.

The corolla is pink and white when fresh, drying blue.

30. *Astragalus sesquiflorus* S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 346. 1875.

Batidophaca sesquiflora Rydb., North Amer. Fl. 24: 318. 1929.

Navajo County and northern Coconino County, 7,000 to 10,000 feet (in spruce-fir forests on Navajo Mountain). Southern Utah and northern Arizona.

⁷¹ See JONES, MARCUS E. REVISION OF THE NORTH AMERICAN SPECIES OF ASTRAGALUS. 1923 (p. 81),

In Arizona specimens the leaflets are only 3 to 4 mm. long and vary from acutish to truncate at apex, whereas in the type of the species they are mostly longer and vary from obtuse to very acute and cuspidate.

31. *Astragalus desperatus* M. E. Jones, *Zoe* 2: 243. 1891.

Batidophaca desperata Rydb., *North Amer. Fl.* 24: 319. 1929.

Holbrook, Navajo County (*Mrs. Hough* in 1901), Moenkopi and 50 miles south of Lees Ferry, Coconino County (*Jones* in 1890). Colorado, Utah, and northern Arizona.

32. *Astragalus greenei* A. Gray, *Amer. Acad. Arts and Sci. Proc.* 16: 105. 1880.

Astragalus famelicus Sheldon, *Minn. Geol. and Nat. Hist. Survey Bot. Studies* 1: 23. 1894.

Pisophaca greenei Rydb., *North Amer. Fl.* 24: 327. 1929.

Pisophaca famelica Rydb., *ibid.* p. 326.

Apache County to Coconino and northern Gila Counties, 5,500 to 8,300 feet, mostly in open yellow pine forests, very common in the Flagstaff region, probably also in the Santa Catalina Mountains, June to September. Southern Colorado, New Mexico, and Arizona.

33. *Astragalus artipes* A. Gray, *Amer. Acad. Arts and Sci. Proc.* 13: 370. 1878.

Phaca artipes Rydb., *Torrey Bot. Club Bul.* 32: 664. 1906.

From the Utah State line to near Ash Fork (Coconino County), Mount Trumbull, and Peach Springs (Mohave County), 5,000 to 7,000 feet, May, type from Mokiak Pass (Mohave County). Colorado to Nevada and northern Arizona.

Very showy in fruit, with large, bladderlike, thin-walled pods heavily mottled with reddish brown.

34. *Astragalus ceramicus* Sheldon, *Minn. Geol. and Nat. Hist. Survey Bot. Studies* 1: 19. 1894.

Phaca picta A. Gray, *Amer. Acad. Arts and Sci. Mem. ser.* 2, 4: 37. 1849.

Astragalus pictus A. Gray, *Amer. Acad. Arts and Sci. Proc.* 6: 214. 1864. *Not Steud.*, 1840.

Apache County to Coconino County, 5,000 to 7,000 feet, in sand, June. South Dakota to Idaho, south to New Mexico and northern Arizona.

This plant is easily recognized by its conspicuously brown-mottled pods, narrow leaflets, and habit of spreading by slender creeping rootstocks. The pods are usually much-inflated, but a form with narrow pods (*A. pictus* var. *angustus* M. E. Jones) also occurs in Arizona. About as common in this State and occupying the same region as the typical form of *A. ceramicus* is var. *imperfectus* Sheldon (*Phaca longifolia* (Pursh) Nutt.). This has not more than 6, often no lateral leaflets and the terminal leaflet is represented by a prolongation of the rachis, whereas, in typical *A. ceramicus*, the lateral leaflets are 4 to 14 and the terminal one has a distinct, although sometimes very narrow blade. The sweet roots of *A. ceramicus* are eaten in spring by Hopi Indian children.

- 35. *Astragalus allochrous*** A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 366. 1878.

Phaca allochroa Rydb., Fl. Rocky Mount. 487, 1063. 1917.

Coconino and Mohave Counties to Graham, Cochise, Santa Cruz, and Pima (doubtless also Yuma) Counties, 1,500 to 7,000 feet, very common on plains and mesas, March to May, type from Wickenburg, Maricopa County (*Palmer* 588). Southern New Mexico and Arizona.

One of the most conspicuous species in the State because of the large size of the plant and of the bladdery pods. It causes loco disease in horses.

- 36. *Astragalus wootoni*** Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 138. 1894.

Phaca wootoni Rydb., North Amer. Fl. 24: 350. 1929.

Equally common in Arizona as *A. allochrous* and having about the same range, altitude, habitat, and time of flowering. Western Texas to Arizona and northern Mexico.

Smaller in all its parts than *A. allochrous* but otherwise very similar and intergrading with it. Definitely known to produce loco disease in horses, cattle, and sheep.

- 37. *Astragalus subcinereus*** A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 366. 1878.

Phaca subcinerea Rydb., Torrey Bot. Club Bul. 40: 47. 1913.

Apache County to Coconino County, 5,000 to 7,000 feet, sandy soil, June to August, type from Mokiak Pass (*Palmer* in 1877). Southern Utah and northern Arizona.

- 38. *Astragalus sileranus*** M. E. Jones, Zoe 2: 242. 1891.

Phaca silerana Rydb., Torrey Bot. Club Bul. 40: 47. 1913.

Kaibab Plateau and north rim of Grand Canyon (Coconino County), 7,000 to 9,000 feet, openings in coniferous forests, June to August. Southern Utah and northern Arizona.

When fresh the corolla is yellowish, with a purple-tipped keel. *A. cerrusatus* Sheldon and *Phaca pardalina* Rydb. are perhaps not specifically distinct from *A. sileranus*.

- 39. *Astragalus triquetrus*** A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 367. 1878.

Phaca triquetra Rydb., North Amer. Fl. 24: 353. 1929.

Beaver Dam, Mohave County, 2,000 feet (*Peebles* and *Parker* 14678), sandy soil, April and May. Extreme southern Nevada and adjacent Arizona.

- *40. *Astragalus aridus*** A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 223. 1864.

Phaca arida Rydb., North Amer. Fl. 24: 354. 1929.

The only record for occurrence in Arizona of this species, known otherwise only from the deserts of southeastern California and Baja California, is the label of a specimen reading "southwestern Arizona" (*Gilman* 1145, Pomona College Herbarium). It greatly resembles *A. sabulonum*, differing chiefly in the appressed (sericeous) pubescence of the herbage and pods.

41. *Astragalus palmeri* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 398. 1868.

Phaca palmeri Rydb., North Amer. Fl. 24: 355. 1929.

Graham County, at Camp Grant, 4,800 feet (*Palmer* in 1867, the type collection), and San Carlos River (*Mohr* in 1873). Known only from southeastern Arizona.

42. *Astragalus sabulonum* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 368. 1878.

Phaca sabulonum Rydb., Torrey Bot. Club Bul. 40: 47. 1913.

Coconino and Mohave Counties, along the Little Colorado and Colorado Rivers, from Leupp and Lees Ferry to near the mouth of the Virgin River, up to 4,500 feet, sometimes growing with *Artemisia tridentata*, May. Northern Arizona and southern Nevada to southeastern California and Sonora.

43. *Astragalus humillimus* A. Gray in T. S. Brandeg., Rpt. U. S. Geol. and Geog. Survey Ter. 2: 235. 1876.

Phaca humillima Rydb., Torrey Bot. Club Bul. 32: 665. 1906.

Grand Canyon, Coconino County, 7,000 feet, "apparently common on sandy ledges" (*M. E. Jones* in 1903), April and May. Western Wyoming, southwestern Colorado, and northern Arizona.

Jones' specimens have flowers only, but correspond well with the type of this species from Mesa Verde, Colorado, except that the stipules are much more pubescent in the latter.

44. *Astragalus thurberi* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 312. 1855.

Phaca thurberi Kearney, N. Y. Acad. Sci. Trans. 14: 34. 1894.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, common on dry rocky slopes and mesas, April and May. Western New Mexico, southern Arizona, and Sonora.

This species is definitely known to cause loco disease. It is recognizable as a small plant with nearly globose, thin-walled pods.

- *45. *Astragalus ampullarius* S. Wats., Amer. Nat. 7: 300. 1873.

Phaca ampullaria Rydb., Torrey Bot. Club Bul. 40: 47. 1913.

Likely to be found in extreme northern Arizona, the type having been collected at Kanab, Utah, a few miles north of the State line.

46. *Astragalus preussii* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 222. 1864.

Phaca preussii Rydb., Torrey Bot. Club Bul. 40: 47. 1913.

Apache County to northern Mohave County, 3,300 to 6,000 feet, June. Western Colorado to northern Arizona and southeastern California.

Most of the Arizona specimens belong to var. *latus* M. E. Jones (var. *arctus* Sheldon, *Jonesiella arcta* Rydb.). This form, perhaps specifically distinct, has the leaflets elliptic to narrowly obovate, corolla whitish, and pods usually pronouncedly stipitate. In the

typical form of the species, which has been collected near Navajo Bridge (*Peebles* 14647), and in var. *laxiflorus* A. Gray (*Phaca laxiflora* Rydb.), the leaflets are usually broadly obovate and the corolla usually purple. The pods are very short-stipitate in var. *laxiflorus*, of which the type was collected near Beaver Dam, Mohave County, altitude about 1,800 feet (*Palmer* 104).

This species is reported to prefer seleniferous soils and is probably poisonous.

In a paper published after this treatise was prepared (Porter, C. L. A new species of *Astragalus* from Arizona. *Madroño* 6:18. 1941), *A. beathii* C. L. Porter is described. Its relationship is to *A. preussii* and it is characterized by having many erect stems from a strong taproot, dark purple flowers, and elongate, straight, cylindrical, sessile or subsessile pods. The species is based on a collection near Cameron, Coconino County (*Gooding* 34-39).

47. *Astragalus praelongus* Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 23. 1894.

Jonesiella praelonga Rydb., North Amer. Fl. 24: 404. 1929.
Jonesiella mearnsii Rydb., *ibid.* p. 403.

Apache County to Mohave and Yavapai Counties, 3,000 to 6,300 feet, common, May to July. Southern Utah and Nevada, New Mexico, and Arizona.

A coarse, ill-smelling plant with cream-colored flowers, resembling *A. preussii*, but with walls of the large pods thicker, almost woody. This plant, preferring, if not confined to seleniferous soils, has been proved by experiments with sheep to be very toxic.

48. *Astragalus brandegei* Porter in Port. and Coult., Syn. Fl. Colo. 24. 1874.

Atelophragma brandegei Rydb., Torrey Bot. Club Bul. 32: 660. 1905.

Bangharts Ranch (Del Rio), Yavapai County (*Rusby* 572), about 4,500 feet, May and June. Colorado, Utah, New Mexico, and central Arizona.

49. *Astragalus cobrensis* A. Gray, Pl. Wright. 2: 43. 1853.

Atelophragma cobrense Rydb., Torrey Bot. Club Bul. 55: 162. 1928.

White Tail Canyon, Chiricahua Mountains, sandy soil under oak and walnut (*Maguire et al.* 11079), April and May. Southwestern New Mexico and southeastern Arizona.

In the collection cited, the type of var. *maguirei* Kearney, the herbage and pods are more pubescent, with longer and more spreading hairs, than in specimens of *A. cobrensis* from New Mexico. The Arizona form may prove to be a distinct species.

50. *Astragalus rusbyi* Greene, Calif. Acad. Sci. Bul. 1: 8. 1884.

Atelophragma rusbyi Rydb., Torrey Bot. Club Bul. 55: 162. 1928.

San Francisco Peaks, Flagstaff, and Williams to Grand Canyon (Coconino County), 7,000 to 8,000 feet, June to September, type from Mount Humphreys (*Rusby* 573). Known only from northern Arizona.

51. *Astragalus egglestonii* (Rydb.) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 484. 1939.

Tium egglestonii Rydb., North Amer. Fl. 24: 396. 1929.

White Mountains, Apache County, 6,500 to 8,800 feet, August. New Mexico and eastern Arizona.

Very similar to *A. rusbyi*, and scarcely more than a variety of that species.

52. *Astragalus recurvus* Greene, Calif. Acad. Sci. Bul. 1: 155. 1885.

Tium recurvum Rydb., North Amer. Fl. 24: 397. 1929.

Coconino, Gila, and Yavapai Counties, 5,000 to 7,000 feet, June, type from "mountains of northern Arizona." Utah and Arizona.

Similar in most characters to the 2 preceding species, but the pods sessile or nearly so.

53. *Astragalus eremiticus* Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 161. 1894.

Astragalus arrectus A. Gray var. *eremiticus* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 665. 1895.

Tium eremiticum Rydb., Torrey Bot. Club Bul. 40: 49. 1913.

Peach Springs, Chloride, Pagumpa Springs, etc. (Mohave County), 3,500 to 4,500 feet. Idaho and Oregon to northwestern Arizona and Nevada.

54. *Astragalus palans* M. E. Jones, Zoe 4: 37. 1893.

Tium palans Rydb., North Amer. Fl. 24: 397. 1929.

Coconino County, especially in and near the Grand Canyon, 2,500(?) to 6,300 feet. Southern Utah and northern Arizona.

An apparently undescribed species, related to *A. palans* but with nearly straight, sparsely strigose pods and pubescent herbage, was collected at the head of Phantom Creek, Grand Canyon (*H. C. Bryant* in 1939).

55. *Astragalus wilsoni* Greene, Pittonia 3: 196. 1897.

Tium wilsoni Rydb., North Amer. Fl. 24: 398. 1929.

Coconino County, Flagstaff-Grand Canyon region, apparently also at Fish Creek and near Tempe, Maricopa County (*Peebles* et al. 5238, *Harrison* 1790), 1,100 to 7,000 feet, May and June, type from northern Arizona. Not known outside this State.

A somewhat vaguely defined species, and some of the specimens referred to it are of uncertain identity. Those from Maricopa County may represent an undescribed species.

56. *Astragalus mokiaceus* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 367. 1878.

Tium mokiaceus Rydb., North Amer. Fl. 24: 398. 1929.

Mokiak Pass, Mohave County (*Palmer* 105, the type collection), Lees(?) Ferry (*Jones* in 1890). Southwestern Utah, southern Nevada, and northern Arizona.

57. *Astragalus fremontii* A. Gray in Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 80. 1857.

Cystium fremontii Rydb., North Amer. Fl. 24: 407. 1929.

"Arizona Strip" along U. S. Route 91, Mohave or Coconino County (*Maguire* and *Blood* 4414), in sandy soil with *Larrea*, type from

"banks of Rio Virgen," possibly in Arizona (*Fremont* 44). Southern Utah and northern Arizona.

This and the 4 following species, also *A. palans* and *A. mokiacensis*, are closely related and were treated as varieties of *A. lentiginosus* Dougl. by M. E. Jones (Rev. North Amer. Astragalus. 123-127. 1923).

58. *Astragalus coulteri* Benth., Pl. Hartw. 307., 1848.

Astragalus arthu-schottii A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 209. 1864.

Cystium coulteri Rydb., Torrey Bot. Club Bul. 40: 50. 1913.

Cystium arthu-schottii Rydb., North Amer. Fl. 24: 409. 1929.

Mohave County, northwestern corner (*Tidestrom* 9217), Beaver Dam (*Jones* 5009a, *Peebles* 14767), "on the Colorado," probably in Arizona (*Schott*, type collection of *A. arthu-schottii*). Western Arizona and southern California.

A. arthu-schottii seems to be merely a form of *A. coulteri* with less pubescent pods.

59. *Astragalus diphysus* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 34. 1849.

Cystium diphysum Rydb., Torrey Bot. Club Bul. 32: 659. 1906.

Cystium yuccanum (M. E. Jones) Rydb., North Amer. Fl. 24: 429. 1929.

Almost through the State, up to 7,000 feet but usually lower, plains and mesas, sometimes in open pine forests, common and abundant, February to June, sometimes also late summer. Southern Utah, New Mexico, and Arizona.

Blue loco, rattleweed. A conspicuous plant because of the relatively large size of all the parts. The flowers vary in color from whitish to purple. The pods are occasionally mottled. This is one of the plants known to cause loco disease, and it is reported to be poisonous to horses, cattle, and sheep, in the order named.

60. *Astragalus macdougali* Sheldon, Minn. Geol. and Nat. Hist. Survey Bot. Studies 1: 169. 1894.

Cystium macdougali Rydb., North Amer. Fl. 24: 415. 1929.

Apache, Navajo, Coconino, and Yavapai Counties, 4,500 to 7,000 feet, plains and mesas, sometimes growing with junipers, May and June, type from Walnut Canyon, Coconino County (*MacDougal* 438). Known only from Arizona.

Closely related to *A. diphysus*, differing chiefly in the smaller flowers and fruits. The pods occasionally are mottled.

61. *Astragalus agninus* Jepson, Man. Fl. Pl. Calif. 577. 1925.

Cystium agninum Rydb., North Amer. Fl. 24: 408. 1929.

Near Yuma, about 200 feet, abundant in sandy soil on mesas, March and April. Southwestern Arizona, southeastern California, and northwestern Sonora.

In flower this annual species might easily be mistaken for *A. coulteri*, but the pods are much narrower and thicker-walled. Flowers showy, violet purple, the herbage whitish pubescent.

62. *Astragalus layneae* Greene, Calif. Acad. Sci. Bul. 1: 156. 1885.*Hamosa layneae* Rydb., Torrey Bot. Club Bul. 54: 15. 1927.

Chloride, 15 miles north of, Mohave County (*Jones*, and *Kearney* and *Peebles* 11210), sandy soil, April. Northwestern Arizona, southern Nevada, and southeastern California.

Unmistakable when in fruit, the long, somewhat prominently veined, thick-walled pods being curved so as often to form a nearly complete circle.

63. *Astragalus scaposus* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 366. 1878.*Hamosa scaposa* Rydb., Torrey Bot. Club Bul. 32: 659. 1906.

Apache County to eastern Mohave and northern Yavapai Counties, 3,500 to 6,500 feet, common on rocky slopes and mesas, often with juniper and pinyon, April and May, type from Mokiak Pass (Mohave County). Colorado to Nevada, New Mexico, and northern Arizona.

The silvery-sericeous foliage and the purple and white flowers make this an attractive little plant. It is closely related to *A. calycosus* Torr. and perhaps only varietally distinct. Specimens from the Grand Canyon (*Collom* in 1940) with narrowly elliptic or oblanceolate leaflets and long and slender calyx teeth are indistinguishable from *A. calycosus*.

64. *Astragalus ensiformis* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 658. 1895.*Hamosa ensiformis* Rydb., Torrey Bot. Club Bul. 54: 21. 1927.

Near Kayenta, Navajo County (*Peebles* and *Fulton* 11928), head of Grand Wash near Pagumpa Springs, Mohave County (*Jones* 5095ah, the type collection), about 5,000 feet, known only from the collections cited.

65. *Astragalus arizonicus* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 398. 1868.*Hamosa arizonica* Rydb., Torrey Bot. Club Bul. 54: 22. 1927.

Coconino and Mohave Counties to Graham, Santa Cruz, and Pima Counties, 4,500 feet and lower, common on plains and mesas, March to May, type from near Camp Grant, Graham County. New Mexico, Arizona, and Sonora.

The radiating, nearly prostrate stems, narrow, silvery-sericeous leaflets and dingy-purple flowers are characteristic. The species has been reported to cause loco disease, but apparently this has not been proved experimentally.

66. *Astragalus nothoxys* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 232. 1864.*Hamosa nothoxys* Rydb., Torrey Bot. Club Bul. 54: 330. 1927.
Hamosa gooddingii Rydb., *ibid.* p. 20.

Graham, Gila, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,600 to 6,000 feet, common on slopes and mesas, often with live oaks, March to May, type of *H. gooddingii* from the Huachuca

Mountains (*Goodding* 1299). Southwestern New Mexico, southern Arizona, and northern Mexico.

Sheep loco. Plant handsome in flower, sometimes covering the ground with its purplish-pink flowers that change to violet in drying. Easily distinguished from the related *A. arizonicus* by the less prostrate stems, glabrous upper surface of the shorter and broader leaflets, and sharply acuminate beak of the keel. Experiments with sheep and cattle have proved this plant to be as toxic as *A. diphyssus*, although it is reported to be eaten readily by deer.

67. *Astragalus hartwegii* Benth., Pl. Hartw. 10. 1839.

Hamosa hartwegii Rydb., Torrey Bot. Club Bul. 54: 333. 1927.

Babocomari Creek, Cochise County (*Lemmon* 2638). Southeastern Arizona and northern Mexico.

68. *Astragalus nuttallianus* DC., Prodr. 2: 289. 1825.

Hamosa nuttalliana Rydb., Colo. Agr. Expt. Sta. Bul. 100: 204. 1906.

Almost throughout the State, 100 to 4,000 (rarely 7,000) feet, very common on dry plains, mesas, and slopes, February to May (occasionally late summer). Arkansas and Texas to California and northern Mexico.

Arizona's most common annual species, occurring in 2 almost equally abundant forms, one with smooth pods (*Hamosa emoryana* Rydb.) and the other with pubescent pods (var. *trichocarpus* Torr. and Gray, *Hamosa austrina* Small). In the form with smooth pods, these are occasionally 1-celled (*Hamosa imperfecta* Rydb.).

69. *Astragalus hypoxylus* S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 192. 1883.

Hamosa hypoxyla Rydb., Torrey Bot. Club Bul. 54: 336. 1927.

Known certainly only from the type collection in the Huachuca Mountains, Cochise County (*Lemmon* 2656).

Plant acaulescent, loosely caespitose, the leaflets small, obovate, obtuse, the inflorescence subcapitate.

70. *Astragalus bigelovii* A. Gray., Pl. Wright. 2: 42. 1853.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,500 feet, dry slopes and mesas, April and May. Texas to southern Arizona and northern Mexico.

Very similar to *A. mollissimus* Torr., the very toxic purple or woolly loco, and reputed to cause loco disease, but the dried plants have been fed to cattle in large quantity without ill effect.

71. *Astragalus thompsonae* S. Wats., Amer. Acad. Arts and Sci. Proc. 10: 345. 1875.

Apache County to Coconino County, 4,700 to 6,800 feet, usually in sandy soil, sometimes with yellow pine, May and June. Colorado, Utah, and northeastern Arizona.

Very similar to *A. bigelovii* and often confused with it, but the geographical distribution of the 2 species in Arizona is very different and the pods of *A. thompsonae* are normally 1-celled at the apex and 2-celled below, whereas in *A. bigelovii* they are 2-celled throughout. It should be noted, however, that a specimen from Turkey Tanks, Coco-

nino County, far north of the range of *A. bigelovii* (MacDougal 439), has the pods 2-celled to the apex.

*72. *Astragalus matthewsii* S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 192. 1883.

Not known definitely to occur in Arizona, but the type was collected at Fort Wingate, New Mexico, about 30 miles east of the Arizona State line.

Resembles the 2 preceding very hairy, acaulescent species, but the pubescence is more appressed.

73. *Astragalus dispermus* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 365. 1878.

Hesperastragalus dispermus Heller, Muhlenbergia 1: 137. 1906.

Pinal, Maricopa, and Pima Counties, 1,300 to 2,500 feet, February to April, type from Wickenburg, Maricopa County. Southern Arizona, southeastern California, and Baja California.

An inconspicuous plant, differentiated from all of Arizona's other species by the hard and sharp transverse ridges of the small pods.

40. OXYTROPIS

Plants perennial, herbaceous, acaulescent; leaves all basal, pinnate, the leaflets numerous; racemes spikelike, elongate or subcapitate; flowers white or purple, the keel with a prominent erect or ascending beak; pods indehiscent, ovate or oblong in outline, 1-celled or imperfectly 2-celled.

These plants resemble some of the acaulescent species of *Astragalus*. The genus is a very weak one.

Key to the species

1. Leaflets fewer than 12, less than 1 cm. long, obtuse or acutish; inflorescence subcapitate, not more than 2 cm. long, 3- to 8-flowered; peduncles not more than 10 cm. long, ascending-spreading to (exceptionally) erect; corolla 10 to 12 mm. long..... 1. *O. OREOPHILA*.
 1. Leaflets more than 12, more than 1 cm. long, very acute; inflorescence elongate, many-flowered; peduncles seldom less than 12 cm. long, erect; corolla 15 to 20 mm. long, purple or whitish..... 2. *O. LAMBERTII*.
1. *Oxytropis oreophila* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 3. 1884-5.

Astragalus munzii L. C. Wheeler, Leaflets West. Bot. 2: 209. 1939.

Kaibab Plateau, Coconino County (Mead 664, Goodding 2454, Goodman and Hitchcock 1626), about 8,000 feet, open meadows, July. Idaho to California, Utah, and northern Arizona.

None of the Arizona specimens has fruit, but they seem to represent a rather luxuriant form of this species, which usually occurs at higher altitudes.

2. *Oxytropis lambertii* Pursh, Fl. Amer. Sept. 740. 1814.

Oxytropis sericea Nutt. ex Torr. and Gray, Fl. North Amer. 1: 339. 1838.

Aragallus knowltoni Greene, Biol. Soc. Wash. Proc. 18: 12. 1905.

Apache County to Coconino County and in the Chiricahua Mountains (Cochise County), 5,000 to 7,500 feet, open sandy land and pine

forests, June to September. Western Canada, south to Texas and Arizona.

White loco. Plant showy in flower. The densely whitish pubescent var. *sericea* A. Gray (*O. sericea* Nutt.) intergrades completely with the greener, less-pubescent form. Like the latter, but with unusually broad leaflets, is *Aragallus knowltoni*, described from a collection on the San Francisco Peaks (*Knowlton* 44). *O. lambertii* is one of the most dangerous of the locoweeds, because it is eaten readily by horses, cattle, and sheep, especially when grass is scarce, and the effects are often fatal. It seems to be a pronouncedly habit-forming plant.

41. GLYCYRRHIZA. LICORICE

Plant perennial, herbaceous; roots stout; stems tall, erect, very leafy; leaves pinnate, the leaflets numerous, narrow; racemes many-flowered, dense, spikelike; corolla whitish; alternate anthers smaller; pods indehiscent, covered with hooked prickles.

G. lepidota, which is a good soil binder but sometimes a bad weed on fertile soils, contains in its sweet roots practically as much crude glycyrrhizin as the imported licorice root of *G. glabra* L., which is used in the manufacture of tobacco, confections, and fire extinguisher compounds, as well as by druggists.

1. *Glycyrrhiza lepidota* Pursh, Fl. Amer. Sept. 480. 1814.

Apache, Navajo, Coconino, and Yavapai Counties, 2,200 to 7,000 feet, common along the Colorado River at Lees Ferry, May to July. Ontario and New York to Washington, New Mexico, Arizona, and California.

42. HEDYSARUM.⁷² SWEETVETCH

Plants perennial, herbaceous; stems erect, leafy; leaves pinnate, the leaflets numerous, finely punctate; flowers in axillary stalked racemes, rather large and showy, the corolla rose purple; fruit (loment) flat, several-jointed, deeply indented above and below between the seeds, the segments rounded, reticulate-veined.

1. *Hedysarum boreale* Nutt., Gen. Pl. 2: 110. 1818.

Hedysarum mackenzii Rydb., N. Y. Bot. Gard. Mem. 1: 257. 1900. Not of Richardson, 1823.

Hedysarum pabulare A. Nels., Biol. Soc. Wash. Proc. 15: 185. 1902.

Apache County to Coconino County, 6,000 to 7,000 feet, June. Saskatchewan and Alberta, south to Oklahoma, Nevada, and northern Arizona.

The plants make excellent forage, but the species is too rare in Arizona to be important.

43. ALHAGI. CAMELTHORN

An intricately branched, spiny, glabrous shrub; leaves small, reduced to a single leaflet; flowers numerous, in panicles of racemes, the corolla purplish pink; fruit (loment) few-jointed, of 1 to 3 segments, these not separating at maturity.

⁷² Reference: ROLLINS, R. C. STUDIES IN THE GENUS HEDYSARUM IN NORTH AMERICA. Rhodora 42: 217-239. 1940.

1. **Alhagi camelorum** Fisch., Hort. Gorenk. ed. 2, 72. 1812.

Dinnehotso (Navajo County), along the Little Colorado River in scattered colonies sometimes of considerable extent (Coconino County), near Gillespie Dam (western Maricopa County), along streams and canals, in fields, and on rocky hillsides, May. Introduced into the southwestern United States from Asia.

Of great value as a browse plant in the desert regions of Asia, but a dangerous introduction, as it is extremely difficult to eradicate from cultivated fields, having deep and extensive rootstocks. In Persia and Afghanistan an exudate, similar to the drug manna that is obtained from *Fraxinus ornus* L., is collected from the camelthorn. The identification of the Arizona specimens as *A. camelorum* is perhaps questionable.

44. NISSOLIA

Plants with twining or trailing stems, often suffrutescent; leaves pinnate, the leaflets commonly 5; flowers few, axillary, in short racemes or fascicles, the corolla yellow; fruit (loment) few-jointed, sometimes reduced to a single segment, the terminal segment winged, samaralike.

Key to the species

1. Stems prostrate or ascending; leaflets not more than 15 mm. long; calyx tube pubescent, longer than the triangular teeth; fruit turgid, commonly 2- or 3-seeded and deeply constricted between the seeds, straight, the terminal winglike segment smaller (often much smaller) than the others.
 1. **N. WISLIZENI.**
1. Stems twining; leaflets up to 30 mm. long; calyx tube glabrous, equaling or shorter than the subulate teeth; fruit flat, commonly 1- or 2-seeded and scarcely constricted between the seeds, somewhat falcate, the terminal wing much larger than the body of the fruit.----- 2. **N. SCHOTTII.**

1. **Nissolia wislizeni** A. Gray, Linn. Soc. London Jour. Bot. 5: 25. 1861.

Cochise County, about 5,000 feet, July and August. Southeastern Arizona and Mexico.

2. **Nissolia schottii** (Torr.) A. Gray, Linn. Soc. London Jour. Bot. 5: 26. 1861.

Chaetocalyx schottii Torr., U. S. and Mex. Bound. Bot. 56. 1859.

Pima County, chiefly in the Rincon, Santa Catalina, Tucson, and Baboquivari Mountains, 2,500 to 4,000 feet, July and August. Southern Arizona and northern Mexico.

45. AESCHYNOMENE. SENSITIVE-JOINTVETCH

Plant herbaceous and annual (in Arizona); stems tall, leafy, erect; leaves pinnate with many linear leaflets, these sensitive; flowers in short axillary racemes, the corolla yellow; fruit (loment) narrow, flat, of 3 or more segments, deeply indented between the seeds below but not above.

1. **Aeschynomene americana** L., Sp. Pl. 713. 1753.

Sycamore Canyon near Ruby, Santa Cruz County, about 3,500 feet (*Goodding* 408, *Kearney* and *Pebbles* 14462), locally abundant, September. Widely distributed in tropical America.

The Arizona specimens are rather exceptional in their sparse pubes-

cence and few-jointed pods (segments 3 or 4). The roots are thickly beset with bacterial nodules.

46. STYLOSANTHES. PENCILFLOWER

Perennial herbs; leaves digitately trifoliolate, with sheathing stipules, the leaflets conspicuously veined; flowers small, in interrupted terminal spikes with leaflike bracts, or some axillary, the corolla yellow; fruit (loment) of 2 segments, the terminal one reduced and infertile, dehiscent at apex, tipped by the persistent hooked style.

*1. *Stylosanthes biflora* (L.) B. S. P., Prelim. Cat. N. Y. 13. 1888.

Trifolium biflorum L., Sp. Pl. 773. 1753.

This species, of which the known range is from New York to Kansas, Florida, and Texas, is included in the Arizona flora on the basis of a specimen in the Gray Herbarium collected in "Arizona or New Mexico" (W. F. Parish 314) identified by M. L. Fernald as var. *hispidissima* (Michx.) Pollard and Ball.

47. ZORNIA

Plants herbaceous, perennial; leaves 2-foliolate (in the Arizona species), the stipules sagittate; flowers in axillary and terminal spikes or some of them solitary in the axils; bracts very different from the foliage leaves, paired, connivent, nearly enclosing the flower; corolla orange yellow, the keel incurved; fruit (loment) flat, several-jointed.

1. *Zornia diphylla* (L.) Pers., Syn. Pl. 2: 318. 1807.

Hedysarum diphyllum L., Sp. Pl. 747. 1753.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, dry rocky slopes and mesas, August to October. Southern Arizona to Central America.

A form collected at Nogales, also occasional in Mexico and Central America, has longer, much narrower, and longer-acuminate leaflets, less prominently veined and more acuminate bracts, and less copious pubescence than in the normal form of the species.

48. DESMODIUM.⁷³ TICKCLOVER

Plants annual or perennial, herbaceous or suffrutescent; stems erect to prostrate; leaves 3-foliolate or (in a few species) reduced to 1 leaflet; flowers in terminal or axillary racemes, these simple or compound, the corolla purplish pink or sometimes white; fruit (loment) flat, of several 1-seeded segments, these all alike, indehiscent or nearly so.

The name beggarticks is also sometimes used for these plants, because the joints of the pods stick tightly to clothing and to the hair of animals. There seems to be little evidence that the plants are relished by livestock although, in view of the great abundance of some of the species in Arizona and the presumable absence of any poisonous or disagreeable constituent, they would seem likely to be important range plants. Perhaps the fact that most of the species grow where grasses are abundant and are at the height of their growth in late

⁷³ Reference: SCHUBERT, BERNICE G. DESMODIUM: PRELIMINARY STUDIES. I. Contrib. Gray Herbarium. 129: 3-31. 1940.

summer when the grasses are at their best, accounts for this seeming neglect. Several of the Arizona tickclovers are recommended for erosion control.

Key to the species

1. Leaves all 1-foliolate; plant perennial; segments of the fruit normally not contorted (2).
 2. Flowering stems more or less woody near the base; leaflet very long and narrow, not more than 5 mm. wide; fruit sessile.----- 1. *D. ANGUSTIFOLIUM*.
 2. Flowering stems not woody; leaflet much shorter and broader, 12 to 28 mm. wide; fruit stipitate.----- 2. *D. WRIGHTII*.
1. Leaves 3-foliolate or, if some or all of them 1-foliolate, then the plant annual and the segments of the fruit normally somewhat contorted (3).
 3. Bracts very conspicuous before anthesis, densely imbricate at the ends of the branches, mostly ovate and 8 to 10 mm. long, attenuate-acuminate; stems procumbent to nearly erect, usually densely pubescent, the hairs uncinata; leaflets ovate-lanceolate to broadly rhombic-ovate; fruit usually pubescent, the segments normally contorted, about 3 mm. long.----- 3. *D. INTORTUM*.
 3. Bracts not very conspicuous or densely imbricate or, if so, then not more than 7 mm. long, or narrowly lanceolate or subulate (4).
 4. Fruit nearly or quite as deeply notched above as below, hence appearing moniliform (5).
 5. Plant perennial; stems diffuse or procumbent; leaflets oblong-lanceolate or ovate-lanceolate to ovate; fruit glabrous or puberulent, the segments 3 mm. long or shorter, normally not contorted.----- 4. *D. RETINENS*.
 5. Plants annual (6).
 6. Segments of the fruit orbicular to elliptic, not contorted, the margins flat or nearly so; leaves all much alike and trifoliolate (7).
 7. Leaflets ovate, the larger ones 15 to 50 mm. wide; segments of the fruit at maturity 6 to 10 mm. long, sparsely pubescent, at least on the sutures.----- 5. *D. PSILOCARPUM*.
 7. Leaflets linear or linear-lanceolate, not more than 5 mm. wide; segments of the fruit at maturity less than 5 mm. long, glabrous or nearly so.----- 6. *D. ROSEI*.
 6. Segments of the fruit rhombic or the terminal one triangular, pubescent at least on the sutures, the terminal 1 or 2 segments sometimes glabrous, all or some of them slightly to strongly contorted, the margins involute or revolute (8).
 8. Terminal segment of the fruit triangular, not contorted, distinctly larger than the others, 7 to 8.5 mm. long; leaves all trifoliolate, the leaflets of much the same shape throughout the plant and longer than wide.----- 7. *D. SCOPULORUM*.
 8. Terminal segment much like the others in shape and contortion, if larger then not triangular, none of the segments more than 4 mm. long; leaves differentiated, the basal ones with leaflets mostly wider than long, often unifoliolate (9).
 9. Fruit usually sessile or nearly so, the segments 3 to 5 (rarely only 2), moderately contorted; leaflets of the upper leaves lanceolate to ovate; bracts usually persistent; some or all of the upper leaves rarely unifoliolate.----- 8. *D. NEOMEXICANUM*.
 9. Fruit distinctly stipitate, the segments 2 or 3, strongly contorted (the 4 sides alternately involute and revolute on the margin); leaflets of the upper leaves linear or linear-lanceolate; bracts often early deciduous.----- 9. *D. PROCUMBENS*.
 4. Fruit less deeply notched above than below, the segments normally not contorted; plants perennial, often with a woody caudex (10).
 10. Stems diffuse or procumbent; leaves dark green above, pale or somewhat glaucous beneath; bracts conspicuous before anthesis, 6 mm. long or shorter, imbricate, ovate or lance-ovate, attenuate-acuminate; pubescence uncinata (11).
 11. Segments of the fruit 5 to 8 mm. long, very pubescent; leaflets ovate, often conspicuously reticulate beneath, the terminal one less than twice as long as wide; bracts ovate-lanceolate, not closely imbricate.----- 10. *D. GRAHAMI*.

11. Segments of the fruit not more than 4 mm. long, sparsely pubescent or glabrous; leaflets oblong-lanceolate, not conspicuously reticulate, the terminal one seldom less than 3 times as long as wide; bracts ovate, closely imbricate----- 11. *D. BATOCAULON*.
10. Stems erect or ascending; leaves lighter green but not glaucous beneath (12).
12. Bracts conspicuous before anthesis, imbricate, lanceolate or ovate-lanceolate, 4 to 7 mm. long; leaves nearly sessile, the terminal leaflet lanceolate, 5 or more times as long as wide; fruit sessile or very short-stipitate----- 12. *D. ARIZONICUM*.
12. Bracts not conspicuous or noticeably imbricate, subulate or narrowly lanceolate; lower leaves with petioles 1.5 cm. long or longer; fruit rather long-stipitate (13).
13. Leaflets obtuse, the terminal one 2 to 3 times as long as wide, oblong, ovate, or obovate; hairs of the fruit not uncinata. 13. *D. CINERASCENS*.
13. Leaflets acute or acutish, the terminal one up to 5 times as long as wide, oblong-lanceolate; hairs of the fruit uncinata. 14. *D. METCALFEI*.

1. *Desmodium angustifolium* (H. B. K.) DC., Prodr. 2: 328. 1825.

Hedysarum angustifolium H. B. K., Nov. Gen. et Sp. 6: 404. 1823.

Meibomia angustifolia Kuntze, Rev. Gen. Pl. 1: 197. 1891.

Southwestern Cochise County, Patagonia Mountains and Sycamore Canyon near Ruby (Santa Cruz County), Santa Catalina and Baboquivari Mountains (Pima County), 3,500 to 5,000 feet, dry rocky slopes with live oaks and grasses, September. Southern Arizona to northern South America.

The Arizona form is var. *gramineum* (Gray) Schubert (*D. gramineum* Gray), the type of which was collected "on the Sonoita," probably in southwestern Cochise County (Wright 1009), and which is limited to southern Arizona and northern Mexico. *D. angustifolium* is easily distinguished from all Arizona's other species of *Desmodium* by the somewhat woody stems and long narrow grasslike unifoliate leaves.

2. *Desmodium wrightii* A. Gray, Bost. Jour. Nat. Hist. 6: 177. 1850.

Meibomia wrightii Kuntze, Rev. Gen. Pl. 1: 198. 1891.

Sycamore Canyon near Ruby (Santa Cruz County), Santa Catalina and Baboquivari Mountains (Pima County), about 3,500 feet, August and September. Texas and southern Arizona, doubtless also in northern Mexico.

3. *Desmodium intortum* (Mill.) Urban, Symb. Ant. 8: 292. 1920.

Hedysarum intortum Mill., Gard. Dict. ed. 8, No. 11. 1768.

Desmodium sonorae A. Gray, Pl. Wright. 2: 47. 1853.

Meibomia uncinata (Jacq.) Kuntze, Rev. Gen. Pl. 1: 197. 1891.

The type of *D. sonorae* was collected "on the Sonoita," probably in what is now Cochise County (Wright 1014). The species apparently has not been collected since in Arizona. It is widely distributed in tropical America.

4. *Desmodium retinens* Schlecht., Linnæa 12: 311. 1838.

Meibomia retinens Kuntze, Rev. Gen. Pl. 1: 198. 1891.

A specimen from the Chiricahua Mountains, Cochise County (Blumer 1188), was identified by A. K. Schindler as of this species.

The Arizona form probably is *D. wislizeni* Engelm. The species is known otherwise only from Mexico.

5. **Desmodium psilocarpum** A. Gray, Pl. Wright. 2: 48. 1853.

Meibomia psilocarpa Kuntze, Rev. Gen. Pl. 1: 198. 1891.

Near Nogales (Santa Cruz County), Baboquivari Mountains (Pima County), about 4,000 feet, type from near Santa Cruz, Sonora (*Wright* 1016). Southern Arizona and northern Mexico.

6. **Desmodium rosei** Schubert, Gray Herbarium Contrib. 129: 22. 1940.

Desmodium neomexicanum of authors. Not of Gray.

Navajo and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, common on slopes and mesas, often in grassland, August and September. New Mexico, Arizona, and northern Mexico.

7. **Desmodium scopulorum** S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 47. 1889.

Meibomia scopulorum Rose and Standl., Contrib. U. S. Natl. Herbarium 16: 212. 1913.

Desmodium wigginsii Schubert, Gray Herbarium Contrib. 129: 25. 1940.

Baboquivari Mountains, Pima County (*Jones* 24903, 24904 part), September. Southern Arizona and northern Sonora.

8. **Desmodium neomexicanum** A. Gray, Pl. Wright. 1: 53. 1852.

Desmodium bigelovii A. Gray, *ibid.* 2: 47. 1853.

Meibomia parva Schindler, Repert. Spec. Novarum Regni Veg. 20: 153. 1924.

Yavapai, Gila, and Greenlee Counties, to Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, grassy slopes and mesas, very common, August and September, type of *Desmodium bigelovii* from along the San Pedro River, Cochise County (*Wright* 1012), type of *Meibomia parva* from Paradise, Cochise County (*Blumer* 1675). Western Texas to Arizona and Mexico; South America.

A form collected in Sycamore Canyon near Ruby, Santa Cruz County (*Kearney* and *Peebles* 14466), has some of the upper leaves, as well as the basal ones, unifoliolate. It resembles the type of *Desmodium annuum* Gray, collected "on the Sonoita," probably in southwestern Cochise County (*Wright* 1009a), except that the latter has all of the leaves unifoliolate.

9. **Desmodium procumbens** (Mill.) A. S. Hitchc., Mo. Bot. Gard. Ann. Rpt. 4: 76. 1893.

Hedysarum procumbens Mill., Gard. Dict. ed. 8, No. 10. 1768.

Greenlee, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, not common, August and September. Southern Arizona to South America.

The Arizona form is var. *eriguum* (A. Gray) Schubert (*D. eriguum* A. Gray), the type of which was collected "in mountain ravines on the Sonoita" (*Wright* 1010), probably in southwestern Cochise County.

10. *Desmodium grahami* A. Gray, Pl. Wright. 2: 48. 1853.*Meibomia grahami* Kuntze, Rev. Gen. Pl. 1: 198. 1891.

Navajo and Coconino Counties to Cochise and Pima Counties, 4,500 to 8,000 feet, often in pine woods, August and September. Texas to Arizona and Mexico.

11. *Desmodium batocaulon* A. Gray, Pl. Wright. 2: 47. 1853.*Meibomia batocaulis* Kuntze, Rev. Gen. Pl. 1: 197. 1891.

Graham, Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, common, often in pine woods, June to September. Southern New Mexico and Arizona, and northern Mexico.

12. *Desmodium arizonicum* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 363. 1885.*Meibomia arizonica* Vail, Torrey Bot. Club Bul. 19: 117. 1892.

Gila, Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, frequent, especially in dry pine woods, July to September. Southern New Mexico and Arizona, and northern Mexico.

13. *Desmodium cinerascens* A. Gray, Pl. Wright. 2: 48. 1853.*Meibomia cinerascens* Kuntze, Rev. Gen. Pl. 1: 197. 1891.*Meibomia canbyi* Schindler, Repert. Spec. Novarum Regni Veg. 20: 155. 1924.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, frequent on dry sunny slopes, August and September, type of *Meibomia canbyi* from the Santa Catalina Mountains (*Pringle* in 1881). Southern Arizona and northern Mexico.

The numerous stems, hard and almost woody toward the base, often form large clumps and reach a height of 1.5 m. (5 feet).

14. *Desmodium metcalfei* (Rose and Painter) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 485. 1939.*Meibomia metcalfei* Rose and Painter, Bot. Gaz. 40: 144. 1905.

A collection at Cave Creek, Chiricahua Mountains, Cochise County (*Eggleston* 11027), was identified by A. K. Schindler as of this species, otherwise known only from southwestern New Mexico.

49. VICIA. VETCH

Plants herbaceous, annual or perennial; stems leafy, weak, climbing or trailing; leaves pinnate, ending in a tendril; flowers axillary, solitary or in racemes; stamens all, or 9 of them, united below; pods narrow, flat, 2-valved, dehiscent.

Most of the vetches are excellent forage plants, and several Old World forms are much cultivated in the United States for green manure and hay, also as cover crops in orchards. The native species do not withstand close grazing.

Key to the species

1. Flowers mostly in 2's in the upper axils; peduncle almost none; pedicels not more than 3 mm. long; calyx teeth somewhat shorter to somewhat longer than the tube, setaceous-acuminate; corolla 10 to 20 mm. long, deep rose purple; leaflets mostly oblong-oblanccolate, truncate or emarginate, mucronate or cuspidate..... 1. *V. SATIVA*.

1. Flowers in peduncled racemes or, if solitary, then the peduncle well developed and the corolla less than 10 mm. long; calyx teeth much shorter than the tube, except sometimes in *V. leucophaea* (2).
2. Corolla 15 to 25 mm. long, purple; plant glabrous or sparsely (rarely copiously) pubescent; leaflets mucronate or cuspidate; racemes 2- to several-flowered..... 2. *V. AMERICANA*.
2. Corolla less than 10 mm. long (3).
3. Peduncle bearing several (usually 10 or more) flowers; corolla 5 to 7 mm. long, cream white, often with the banner purple-veined and the keel purple-tipped..... 3. *V. PULCHELLA*.
3. Peduncle bearing 1 or 2 flowers (4).
4. Stems, leaves, and calyx sparsely to copiously villous; pods sericeous; corolla 8 to 9 mm. long, whitish, the veins of the banner and the tip of the keel purple..... 4. *V. LEUCOPHAEA*.
4. Stems, leaves, and calyx sparsely pubescent with mostly appressed hairs or glabrate; pods glabrous; corolla commonly less than 8 mm. long, usually pale blue or purplish..... 5. *V. EXIGUA*.

1. *Vicia sativa* L., Sp. Pl. 736. 1753.

An occasional escape from cultivation, as at Sacaton (Pinal County), but apparently not established anywhere in Arizona. Common in the eastern United States; naturalized from Europe.

2. *Vicia americana* Muhl. ex Willd., Sp. Pl. 3: 1096. 1803.

Vicia perangusta Greene, Leaflets 2: 267. 1912.

Vicia hypolasia Greene, *ibid.* p. 268.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,000 to 10,000 feet, common, especially in pine forests, May to September, type of *V. perangusta* from the Tusayan (now the Kaibab) National Forest (*Read* in 1912), type of *V. hypolasia* from the Chiricahua Mountains (*Blumer* 1348). Canada to Virginia, New Mexico, Arizona, and California.

Flowers large and handsome for the genus. A polymorphic species, several forms of which have been segregated as species. About equally common in Arizona are (1) the typical form of the species, with relatively thin and broad leaflets, these 4 to 10 mm. wide, rounded to acutish at apex; and (2) var. *linearis* (Nutt.) Wats., with usually rather thick and prominently veined leaflets 1 to 4 mm. wide. The var. *truncata* (Nutt.) Brewer, with relatively thin and broad leaflets that are truncate and often emarginate and denticulate at apex, is less common but not rare, apparently confined to the northern and central parts of the State. All of these forms intergrade freely.

3. *Vicia pulchella* H. B. K., Nov. Gen. et Sp. 6: 499. 1824.

Vicia melilotoides Woot. and Standl., *Contrib. U. S. Natl. Herbarium* 16: 141. 1913.

Apache County to Coconino County, south to Cochise and Pima Counties, 6,000 to 8,500 feet, frequent in pine forests, July to September. Western Texas to Arizona and throughout Mexico.

The stems often are so thickly matted as to be subject to mildew.

4. *Vicia leucophaea* Greene, Bot. Gaz. 6: 217. 1881.

Southern Apache County to Cochise and Pima Counties, 5,500 to 8,000 feet, pine forests, July to September. Western New Mexico and southeastern Arizona.

5. *Vicia exigua* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 272. 1838.

Mohave County to Greenlee, Gila, Pinal, Maricopa, Pima (and probably Yuma) Counties, 4,000 feet or lower, common among bushes on slopes and in canyons, March to May. Western Texas to Oregon and California.

50. LATHYRUS. PEAVINE

Plants perennial, herbaceous; stems erect or weakly climbing; leaves pinnate, commonly ending in a tendril, the leaflets usually fewer, larger, thicker, and more prominently veined than in *Vicia*; stipules large and conspicuous; flowers large and showy, commonly in axillary racemes, the corolla purple to nearly white; pods much as in *Vicia*.

The best-known member of this genus is the sweet pea (*L. odoratus*), a native of Sicily. The native species of Arizona bear a general resemblance to this favorite of gardens. Apparently the plants are less palatable to livestock than are the vetches.

Key to the species

1. Tendrils none or very rudimentary; corolla white or whitish, 10 to 15 mm. long; stems erect or nearly so; leaflets usually 4, linear, lanceolate, or narrowly elliptic, 2.5 to 6 cm. long, 4 to 20 times as long as wide.
 1. *L. ARIZONICUS*.
1. Tendrils well developed; corolla normally purple or purplish pink (2).
 2. Flowers commonly more than 2 cm. long; stems usually erect; tendrils commonly simple; stipules usually erect or ascending; leaflets thickish, veiny, elliptic or lanceolate (exceptionally linear-lanceolate), 2.5 to 5 cm. long, 4 to 8 times as long as wide..... 2. *L. EUCOSMUS*.
 2. Flowers less than 2 cm. long; stems more or less climbing; tendrils simple or forked; stipules usually spreading or reflexed (3).
 3. Leaflets narrowly linear to almost filiform, 3 to 10 cm. long, seldom more than 5 mm. wide, 9 or more times as long as wide; tendrils often simple..... 3. *L. GRAMINIFOLIUS*.
 3. Leaflets oval, rhombic-elliptic, or oblong-lanceolate, 2 to 5 cm. long, 6 to 20 mm. wide, 2 to 6 times as long as wide; tendrils commonly forked..... 4. *L. PARVIFOLIUS*.

1. *Lathyrus arizonicus* Britton, N. Y. Acad. Sci. Trans. 8: 65. 1889.

Apache County to Coconino County, south to Graham and Pima Counties, 6,500 to 11,000 feet, chiefly in coniferous forests, May to October, type from the Mogollon Escarpment, Coconino County (*Mearns 57*). Colorado, New Mexico, and Arizona.

2. *Lathyrus eucosmus* Butters and St. John, Rhodora 19: 160. 1917.

Lathyrus decaphyllus of authors. Probably not Pursh, 1814.

Apache, Navajo, and Coconino Counties, 5,000 to 7,000 feet, often in open dry woods of pinyon and of yellow pine, May to August. Nebraska to Utah, New Mexico, and northern Arizona.

A handsome plant, with larger and showier flowers than in any other of the Arizona species. Its habit of spreading by horizontal root-stocks makes it a useful soil binder.

3. *Lathyrus graminifolius* (S. Wats.) White, Torrey Bot. Club Bul. 21: 454. 1894.

Lathyrus palustris L. var. *graminifolius* S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 263. 1888.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 6,000 to 9,500 feet, common, chiefly in pine forests, May to September. Utah, New Mexico, and Arizona, doubtless also in northern Mexico.

4. *Lathyrus parvifolius* S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 345. 1882.

Lathyrus shaffneri Rydb., N. Y. Bot. Gard. Mem. 1: 258. 1882.

Apache County to Coconino County, south to Graham and Pima Counties, 5,000 to 9,000 feet, frequent in oak chaparral and pine forests, June to August. Southern Utah and Arizona to California and southern Mexico.

51. CLITORIA. BUTTERFLY-PEA

Plant herbaceous, perennial, glabrous or nearly so; stems usually erect or ascending; leaves pinnately 3-foliolate, the leaflets large, ovate-lanceolate or oblong-lanceolate, the stipules and stipels subulate, persistent; flowers axillary, mostly solitary, sometimes 2 or 3 in a cluster, 5 to 6 cm. long; calyx tubular, 5-toothed; corolla with an erect banner much larger than the other petals; pods narrowly oblong, several-seeded.

1. *Clitoria mariana* L., Sp. Pl. 753. 1753.

Sierra Ancha (Gila County) and mountains of Cochise, Santa Cruz, and Pima Counties, from the Chiricahua to the Baboquivari Mountains, 4,000 to 5,500 feet, rich soil among live oaks and junipers, July and August. New Jersey to Florida and Texas, also southern Arizona.

This handsome plant is outstanding among the Leguminosae of Arizona in the very large size of its lilac-colored corolla. It is also remarkable as an example of interrupted distribution, being apparently absent in the area between central Texas and southeastern Arizona. It is infrequent in Arizona except in the Chiricahua Mountains and in Santa Cruz County, where it is reported to be locally abundant.

52. COLOGANIA

Plants perennial, herbaceous; stems trailing to nearly erect, scarcely twining; leaves pinnately 3-foliolate or occasionally 5-foliolate; flowers axillary, nearly sessile, solitary or in clusters of 2 or 3; calyx tubular, 4-toothed; corolla reddish purple; pods flat, narrowly oblong, several-seeded.

Plants rather insignificant except for the fairly large, richly colored flowers.

Key to the species

1. Pubescence of the herbage and pods conspicuously shaggy-villous, that of the pods tawny; petioles very short; leaflets 3, broadly obovate, the terminal one 18 to 35 mm. wide; corolla 2.5 to 3 cm. long----- 1. *C. LEMMONI*.
1. Pubescence of the herbage and pods appressed or subappressed, grayish; petioles elongate; leaflets 3 to 5, linear, linear-lanceolate, narrowly oblong, or elliptic, the terminal one not more (commonly much less) than 10 mm. wide, up to 15 cm. long; corolla 2 to 2.5 cm. long----- 2. *C. LONGIFOLIA*.

1. ***Cologania lemmoni*** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 74. 1883.

Chiricahua and Huachuca Mountains (Cochise County), Rincon Mountains (Pima County), 6,000 to 7,300 feet, openings in pine forests, August, type from the Huachuca Mountains (*Lemmon* 2681). Southern Arizona and northern Mexico.

2. ***Cologania longifolia*** A. Gray, Pl. Wright. 2: 53. 1853.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 4,000 to 9,000 feet, rich soil of coniferous forests, July and August. Western Texas to Arizona and northern Mexico.

A very variable complex, possibly separable into more than one species. The genus needs revision.

53. ERYTHRINA. CORALTREE

Plant shrubby or arborescent, with prickly stems and petioles; leaves pinnately 3-foliolate, with large fan-shaped leaflets; flowers in axillary or terminal racemes, large and showy; corolla bright red, the banner petal much longer than the others, about 5 cm. long, strongly keeled; stamens partly exerted; pods large, thick-walled, torulose; seeds several, large, normally bright red.

1. ***Erythrina flabelliformis*** Kearney, N. Y. Acad. Sci. Trans. 14: 32. 1894.

Mountains of Cochise and Pima Counties, 3,500 to 5,000 feet, fairly common on dry rocky slopes, spring and sometimes late summer. Southwestern New Mexico, southern Arizona, and Mexico.

This plant, known as western coralbean, Indian-bean, and chilicote, reaches a height of 4.5 m. (15 feet) and a trunk diameter of 25 cm. (10 inches), but is usually much smaller. The wood is brittle, the bark light brown with longitudinal white lines. The flamelike flowers appear mainly in spring before the leaves appear. The plant has been cultivated locally but scarcely can be recommended as an ornamental on account of its sensitiveness to frost and the long period when it is leafless. The plant is said to be browsed, but the attractive scarlet seeds contain poisonous alkaloids. In Mexico necklaces are made of them.

54. GALACTIA

Perennial, herbaceous or sometimes slightly suffrutescent; stems long, commonly twining; leaves pinnately 3-foliolate, the stipules small, fugacious, the leaflets with stipels, elliptic, oblong, or oblong-lanceolate; flowers in axillary, peduncled, bracted racemes; calyx 4-

cleft; corolla pale purple and greenish yellow, the wings and keel united below; pods linear, several-seeded.

The plants are of some value as forage but do not withstand heavy grazing. They make an excellent ground cover.

1. *Galactia wrightii* A. Gray, Pl. Wright. 1: 44. 1852.

Graham, Pinal, Cochise, and Pima Counties, 4,000 to 6,000 feet, common on dry slopes, often in oak chaparral, July to September. Western Texas to southern Arizona and northern Mexico.

The var. *mollissima* Kearney and Peebles, with herbage densely soft-villous (hairs more spreading than in the typical form), has been collected in the Pinaleno Mountains (Graham County), at Fish Creek (Maricopa County), in the Chiricahua Mountains (Cochise County), and in the Patagonia Mountains (Santa Cruz County).

An unidentified species, possibly undescribed, was collected near Nogales, Santa Cruz County (Harrison and Peebles 4743). It is distinguished from *G. wrightii* by sparse strigose pubescence, short broadly elliptic leaflets, these rounded or retuse at apex, and racemes scarcely surpassing the subtending leaf.

55. RHYNCHOSIA. ROSARYBEAN

Perennial herbs with trailing or weakly twining stems; leaves pinnately 3-foliolate, without stipels; flowers small, in axillary few-flowered racemes or fascicles; corolla yellow, the keel more or less falcate; pods flat, more or less asymmetric, completely dehiscent; seeds 1 or 2.

The plants afford excellent ground cover and may be useful for erosion control.

Key to the species

1. Stems retrorsely puberulent; leaflets normally more than twice as long as wide, linear or narrowly elliptic to ovate-lanceolate (exceptionally ovate), the veins often very prominent beneath; pods puberulent or short-pilose, asymmetrically oblanceolate and slightly lunate.----- 1. *R. TEXANA*.
1. Stems short-hirsute and slightly viscid; leaflets normally less than twice as long as wide, ovate or ovate-lanceolate, acute or short-acuminate, the veins not very prominent beneath; pods short-pilose and sparsely hirsute, scarcely asymmetric, elliptic.----- 2. *R. RARIFLORA*.

1. *Rhynchosia texana* Torr. and Gray, Fl. North Amer. 1: 687. 1840.

Dolicholus texanus Vail, Torrey Bot. Club Bul. 26: 108. 1899.

Greenlee County to southern Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, fairly common on dry plains and mesas, May to August. Western Texas to southern Arizona and Mexico.

An unusual form, with twining stems and exceptionally large thin leaflets, was collected in the foothills of the Rincon Mountains, Pima County (Kearney and Peebles 8752).

2. *Rhynchosia rariflora* Standl., Field Museum Nat. Hist. Bot. Ser. 17: 264. 1937.

Sycamore Canyon near Ruby, Santa Cruz County, about 3,600 feet (Goodding 1738, 1739, Kearney and Peebles 14458), September and October. Southern Arizona and Chihuahua.

A considerable extension of range, the type (and only previously known collection) from southwestern Chihuahua. The corolla of the Arizona specimens is somewhat smaller than in the type, about 8 mm. long.

56. PHASEOLUS.⁷⁴ BEAN

Plants herbaceous, annual or perennial, often with very large roots; stems usually long and trailing or weakly twining; leaves pinnately 3-foliolate, with stipels; flowers axillary, mostly in racemes; corolla purplish pink to deep purple, or brick red, the keel strongly curled or spirally coiled; pods flat, linear to broadly ovate or obovate in outline, completely dehiscent; seeds rounded, rather large.

Several exotic species are widely cultivated for human food, notably the common or string bean (*P. vulgaris*) and the lima bean (*P. lunatus*). The scarlet-runner (*P. multiflorus*) is often grown as an ornamental climbing plant. All of the native beans improve the soil, make a good ground cover, and provide excellent forage for livestock. The form of *P. acutifolius* known as tepary bean is grown to such an extent by the Papago Indians that they have been nicknamed "bean people," and it also is planted by white farmers in the Southwest both for the beans and for increasing the fertility of the soil. *P. metcalfei* produced abundant forage in an experimental planting in New Mexico. The beans of this and probably other species were eaten by the Apache Indians.

Key to the species

1. Flowering stems from a deep-seated, globose tuber, erect or slightly twining, seldom more than 30 cm. long; calyx not subtended by bractlets (bracts present at base of the pedicel only); leaflets lanceolate, entire, less than 1 cm. wide; peduncles 1- or 2-flowered; corolla purple, 15 to 20 mm. long; pods linear, 2.5 to 3.5 cm. long----- 1. *P. PARVULUS*.
1. Flowering stems not from a globose tuber, trailing or twining, usually more than 30 cm. long; calyx subtended by a pair of bractlets, these often deciduous long before anthesis (2).
 2. Plant annual, the root not thickened; stems, leaves, and pods sparsely short-pilose, puberulent, or glabrate; leaflets linear and nearly entire to triangular-lanceolate or ovate and very shallowly substately lobed on one or both sides; corolla pale purple or purplish pink; pods 3 to 7 cm. long, 4 to 10 mm. wide, somewhat abruptly slender-tipped.
 2. *P. ACUTIFOLIUS*.
 2. Plants perennial, with a thick, more or less woody, elongate root (3).
 3. Pods linear, less than 5 mm. wide (4).
 4. Pubescence soft, often very dense, the hairs mostly appressed; leaflets nearly entire to deeply lobed; corolla deep purple, 15 to 20 mm. long; pods usually spreading, 6 to 10 cm. long, 3 to 4.5 mm. wide, gradually long-acuminate----- 3. *P. ATROPURPUREUS*.
 4. Pubescence villous or subhirsute, the hairs spreading or retrorse; corolla brick-red, drying purplish, not more than 15 mm. long; pods reflexed, not more than 3 cm. long and 3 mm. wide.
 4. *P. HETEROPHYLLUS*.
 3. Pods broader than linear, commonly more than 5 mm. wide; stems and petioles puberulent, short-pilose, or glabrate; corolla pink or purple (5).
 5. Leaflets broadly rounded-ovate, entire or very nearly so, the veins reticulate and somewhat prominent beneath; corolla deep rose purple; seeds smooth or nearly so (6).
 6. Pods 7 to 10 mm. wide, short-stipitate; bractlets 1 mm. long or shorter----- 5. *P. RITENSIS*.
 6. Pods 12 to 18 mm. wide, sessile or nearly so; bractlets 1.5 mm. long or longer----- 6. *P. METCALFEI*.
 5. Leaflets linear to triangular-ovate or, if broader, then deeply lobed, the veins not noticeably reticulate and prominent beneath; corolla purplish pink; seeds irregularly rugose; pods not more (usually less) than 8 mm. wide, commonly broadest above the middle (7).

⁷⁴ Reference: PIPER, C. V. STUDIES IN AMERICAN PHASEOLINEAE. Contrib. U. S. Natl. Herbarium 22: 663-701. 1926.

7. Leaflets broadly deltoid, usually distinctly and often deeply 3-lobed, the lobes often irregularly cleft----- 7. *P. WRIGHTII*.
 7. Leaflets lanceolate to triangular-ovate, entire or merely subhastate. 8. *P. ANGUSTISSIMUS*.

1. *Phaseolus parvulus* Greene, Bot. Gaz. 6: 217. 1881.

Alepidocalyx parvulus Piper, Contrib. U. S. Natl. Herbarium 22: 672. 1926.

Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina and Rincon Mountains (Pima County), 7,500 to 8,000 feet, rich soil in coniferous forests, August and September. Southwestern New Mexico and southern Arizona.

2. *Phaseolus acutifolius* A. Gray, Pl. Wright. 1: 43. 1852.

Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, August and September. Western Texas to southern Arizona and Mexico.

The broad-leaved form, var. *latifolius* Freeman, cultivated under the name tepary bean, is believed by Vavilov to have originated in southern Mexico or Central America. It is very drought resistant. The common wild form in Arizona, with much narrower leaflets, is var. *tenuifolius* Gray (*P. tenuifolius* Woot. and Standl.).

3. *Phaseolus atropurpureus* DC., Prodr. 2: 395. 1825.

Fresnal Canyon, Baboquivari Mountains (Pima County), 4,000 (?) feet (*Gilman* B166, *Pebbles* 8802), August and September. Southern Arizona to Central America.

The Arizona specimens are exceptionally thin-leaved and only moderately sericeous. The long stems clamber over bushes.

4. *Phaseolus heterophyllus* Willd., Enum. Pl. 2: 753. 1809.

Phaseolus macropoides A. Gray, Pl. Wright. 2: 33. 1853.

Greenlee, Cochise, Santa Cruz, and Pima Counties, 5,000 to 6,700 feet, fairly common on dry plains and mesas, often with grasses, August to October. Western Texas to Arizona, south to Central America.

Distinguished from all the other Arizona species by the brick-red color of the fresh flowers. The more or less typical form (*P. macropoides*) has the leaflets oblong to rhombic-ovate and commonly lobed, and the pods usually short-pilose. In var. *rotundifolius* (A. Gray) Piper (*P. rotundifolius* A. Gray), which has about the same distribution in Arizona as the other form, the leaflets are nearly orbicular and mostly entire, and the pods are commonly villous. The type of *P. rotundifolius* was collected west of the Chiricahua Mountains, Cochise County (*Wright* 954).

5. *Phaseolus ritensis* M. E. Jones, Contrib. West. Bot. 12: 14. 1908.

White Mountains (Apache County), mountains of Cochise, Santa Cruz, and Pima Counties, 4,500 to 6,000 feet, common among live oaks and at the lower limit of the pine belt, July to September, type from the Santa Rita Mountains (*Jones* in 1903). Southern Arizona and Mexico.

6. *Phaseolus metcalfei* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 140. 1913.

Phaseolus retusus Benth., Pl. Hartw. 11. 1839. Not of Moench, 1794.

East Fork of the White River (Navajo? County), Pine (Gila County), Huachuca Mountains (Cochise County), July and August. Southwestern New Mexico and Arizona.

Perhaps only a variety of *P. ritensis*.

7. *Phaseolus wrightii* A. Gray, Pl. Wright. 1: 43. 1852.

Apache County to Coconino County, south to Cochise and Pima Counties, 1,000 to 8,000 feet, common on rocky slopes, flowering almost throughout the year. Western Texas to Arizona and Mexico.

The Arizona form is var. *grayanus* (Woot. and Standl.) Kearney and Peebles (*P. grayanus* Woot. and Standl.), with usually larger leaflets, longer peduncles, and more persistently pubescent pods than in typical *P. wrightii*, but intergrading with the latter.

8. *Phaseolus angustissimus* A. Gray, Pl. Wright. 2: 33. 1853.

Apache County to Coconino County, south to Cochise and Pima Counties, 3,500 to 7,000 feet, common on mesas, mostly among trees and shrubs, June to September. New Mexico and Arizona.

The typical form has linear-lanceolate leaflets, these entire or merely angulate at base. More common in Arizona is var. *latus* M. E. Jones (*P. dilatatus* Woot. and Standl.) with oblong-lanceolate leaflets, these subhastately lobed at base. The type of var. *latus*, which intergrades completely with the typical form, was collected along the Little Colorado River near Winslow, Navajo County (Jones in 1890).

55. GERANIACEAE. GERANIUM FAMILY

Plants herbaceous; leaves opposite, with stipules; flowers perfect, regular, in cymose or umbellike clusters; sepals and petals 5, the sepals persistent, the petals whitish to rose purple, deciduous; stamens 10, all or only 5 of them fertile, the filaments separate or united toward the base; pistil compound, the 5 carpels at first united to the central column, separating at maturity, long-beaked by the persistent styles.

Key to the genera

1. Carpels with thick, not spindle-shaped bodies, the tails (persistent styles) not bearded within, becoming recoiled, thus bringing the carpels toward the apex of the column, but not spirally twisted; stamens 10, all anther-bearing.
 1. GERANIUM.
1. Carpels with slender, spindle-shaped bodies sharp-pointed at base, the tails bearded within, becoming spirally twisted, not bringing the carpels upward; anther-bearing stamens 5, the alternate filaments scalelike or obsolete.
 2. ERODIUM.

1. GERANIUM. CRANESBILL

Leaves palmately lobed or parted; stamens all fertile, 5 of the filaments usually longer than the others; styles persistent, becoming recoiled in fruit.

The plants are reported to afford fairly good forage for sheep. The rootstock of *G. maculatum* L. of the eastern United States is used

medicinally as an astringent and the Arizona species may have the same property. These plants grow in rich soil, mostly in coniferous forests.

Key to the species

1. Plant annual or biennial, without a thick caudex, the taproot slender; petals not, or scarcely, surpassing the sepals, pale pink; plant pilose, usually glandular-pubescent in the inflorescence; leaf blades 5-parted, the divisions cleft into linear or narrowly oblong lobes----- 1. *G. CAROLINIANUM*.
1. Plant perennial, with a thick caudex, the taproot stout, woody; petals surpassing the sepals, usually considerably (2).
 2. Tips of the sepals 2 to 3 mm. long; lobes and teeth of the leaf blades acute or acuminate; stems usually slender, with subappressed, mostly retrorse hairs; leaf blades sparsely strigose or glabrate; pedicels with or without glandular pubescence; petals more than 10 mm. long, spreading (3).
 3. Petals white, usually with conspicuous dark veins; stems commonly sparsely pubescent----- 2. *G. RICHARDSONII*.
 3. Petals purplish pink; stems rather copiously pubescent.
 3. *G. EREMOPHILUM*.
 2. Tips of the sepals not more, usually less, than 2 mm. long; lobes and teeth of the leaf blades obtuse or acutish (4).
 4. Petals white or whitish, not more than 10 mm. long; stems and petioles hirsute with spreading or retrorse hairs; pedicels glandular-pubescent; sepals sparsely hirsute----- 4. *G. WISLIZENI*.
 4. Petals normally purplish pink to rose purple, commonly more than 10 mm. long (5).
 5. Stems densely and conspicuously villous-viscid with long, spreading hairs; petals spreading, sometimes white----- 5. *G. PARRYI*.
 5. Stems not conspicuously long-villous, the nonglandular hairs mostly short and retrorse or subappressed, the glandular hairs, if any, short and spreading; petals reflexed, pink to deep rose purple.
 6. *G. ATROPURPUREUM*.

1. *Geranium carolinianum* L., Sp. Pl. 682. 1753.

Mazatzal and Pinal Mountains (Gila County), about 3,500 feet, April. Canada to northern Mexico, widely distributed in the United States.

This is the only Arizona species that is not forest inhabiting.

2. *Geranium richardsonii* Fisch. and Trautv., Index Sem. Hort. Petrop. 4: 37. 1837.

Apache County to Coconino County, south to Cochise and Pima Counties, 7,500 to 11,500 feet, common, April to October. South Dakota to New Mexico, Arizona, and southern California.

3. *Geranium eremophilum* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 142. 1913.

White Mountains (Apache or Navajo County), to Cochise and Pima Counties, 7,000 (?) to 9,200 feet, July to October. Southwestern New Mexico and eastern Arizona.

Closely related to *G. richardsonii*.

4. *Geranium wislizeni* S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 421. 1886.

Ramsey Canyon, Huachuca Mountains (Cochise County), Sycamore Canyon near Ruby (Santa Cruz County), 3,600 to 6,000 feet, August to September. Southern Arizona and northern Mexico.

5. **Geranium parryi** (Engelm.) Heller, Cat. North Amer. Pl. ed. 2, 7, 1900.

Geranium fremontii Torr. var. *parryi* Engelm., Amer. Jour. Sci. ser. 2, 33: 405. 1862.

Kaibab Plateau and San Francisco Peaks (Coconino County), 7,000 to 8,500 feet, June. Wyoming, Colorado, Utah, and northern Arizona.

It is doubtful whether this form is specifically distinct from *G. fremontii* Torr.

6. **Geranium atropurpureum** Heller, Torrey Bot. Club Bul. 28: 195. 1898.

Apache County to Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 5,000 to 8,800 feet, very common in yellow pine forest, June to September. Colorado, New Mexico, Arizona, and Mexico.

A form with glandular pubescence, at least on the pedicels, var. *furcatum* (Hanks) Kearney and Peebles (*G. furcatum* Hanks), is about as common in Arizona as the typical nonglandular form, with which it sometimes grows.

2. ERODIUM. HERONBILL

Plants annual; leaves palmately lobed or pinnate; stamens 5 or, if 10, then the alternate ones rudimentary; bodies of the carpels spindle-shaped, sharp-pointed at base, the persistent styles pubescent on the inner face, becoming spirally twisted at maturity.

Both of the Arizona species are excellent spring forage plants but alfileria or "fileree" (*E. cicutarium*) is especially important because of its great abundance. It is believed that alfileria was introduced into the Southwest at an early date by the Spaniards. The plants usually survive only a few weeks in the more arid desert regions, but livestock continue to feed on the dried stems. The corkscrewlike "tails" of the fruits are tightly twisted when dry but uncoil when moist, and as a result the sharp-pointed fruits penetrate the soil as if driven by an auger, as happens also with the fruits of *Stipa* and other grasses, and with those of mountain-mahogany (*Cercocarpus*).

Key to the species

1. Leaf blades nearly to quite as wide as long, palmately lobed to almost divided, often cordate at base; herbage canescent with short appressed hairs; sepal tips not appendaged; petals commonly more than 6 mm. long.

1. *E. TEXANUM.*

1. Leaf blades much longer than wide, pinnate, the leaflets pinnatifid and their segments often cleft; herbage sparsely glandular-villous; sepal tips with 1 or 2 white bristlelike appendages; petals not more, commonly less than 6 mm. long.----- 2. *E. CICUTARIUM.*

1. **Erodium texanum** A. Gray, Genera Fl. Amer. 2: 130. 1849.

Gila, Pinal, and Pima Counties, 1,200 to 2,600 feet, common on plains and mesas, February and March. Texas to southeastern California.

2. *Erodium cicutarium* (L.) L'Her. ex Ait., Hort. Kew. 2: 414. 1789.*Geranium cicutarium* L., Sp. Pl. 680. 1753.

Throughout the State, up to 6,700 feet, common and often very abundant on plains and mesas, February and March. Extensively naturalized in the United States, from Europe.

56. OXALIDACEAE. WOODSORREL FAMILY

1. OXALIS. WOODSORREL

Plants herbaceous, mostly perennial with creeping rootstocks or bulbs, caulescent or acaulescent, the sap acid; leaves digitately compound, the leaflets 3 or more, cuneate; flowers perfect, regular; sepals 5; petals 5, yellow or purplish pink; stamens 10, the filaments united at base, 5 of them longer than the others; fruit a dehiscent 5-celled capsule.

Key to the species

1. Petals yellow; plants caulescent; bulb none; sepals not bearing callosities; capsules pubescent; leaflets 3: Section *Xanthoxalis* (2).
 2. Stems decumbent to erect (3).
 3. Hairs of the stems, petioles, and pedicels spreading or retrorse; stems conspicuously pilose or villous; capsules little shorter to longer than the pedicels..... 1. *O. PILOSA*.
 3. Hairs mostly appressed or subappressed-ascending; stems not conspicuously pubescent; capsules commonly shorter than the pedicels; leaflets ciliate, glabrous or nearly so above, usually sparsely strigose beneath.
 2. *O. STRICTA*.
 2. Stems prostrate, creeping (4).
 4. Rootstocks and taproot rather thick, more or less woody; leaflets sparsely to copiously strigose, often on both faces..... 3. *O. ALBICANS*.
 4. Rootstocks and taproot slender, not woody; leaflets nearly glabrous or sparsely strigose..... 4. *O. REPENS*.
1. Petals purplish pink, often drying violet; plants acaulescent, from a scaly bulb; sepals bearing apical callosities; capsules glabrous; flowers heterogonous: Section *Ionoxalis* (5).
 5. Leaflets 4 or more, longer than wide, broadly to narrowly wedge-shaped, entire or notched; longer filaments not appendaged, or with the appendage completely adnate to the filament; outer bulb scales several-nerved.
 5. *O. GRAYI*.
 5. Leaflets 3, wider than long, obreniform or V-shaped, the notch very broad; longer filaments appendaged, the appendage usually with a free tip (6).
 6. Outer bulb scales normally 3-nerved; leaf blades 1 to 3 cm. wide, with broadly ovate lobes usually as wide as or wider than long; scapes mostly 10 to 20 cm. long; callosities of the sepals 0.3 to 0.5 mm. long, seldom longer..... 6. *O. METCALFEI*.
 6. Outer bulb scales normally with more than 3 nerves; leaf blades 2.5 to 5 cm. wide, with oblong-ovate lobes usually longer than wide; scapes 15 to 35 mm. long; callosities of the sepals 0.5 to 0.8 mm. long.
 7. *O. AMPLIFOLIA*.

1. *Oxalis pilosa* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 212. 1838.*Xanthoxalis pilosa* Small, North Amer. Fl. 25: 54. 1907.

Ashdale, Maricopa County (*Peebles* 11627), 3,500 feet, May, Southern Arizona, California, and Sonora.

2. *Oxalis stricta* L., Sp. Pl. 435. 1753.

Xanthoxalis stricta Small, Fl. Southeast. U. S. 667. 1903.

Coconino, Yavapai, Graham, Santa Cruz, and Pima Counties, 3,000 to 6,000 feet, usually along streams, April to June. Throughout much of North America.

3. *Oxalis albicans* H. B. K., Nov. Gen. et Sp. 5: 244. 1822.

Oxalis wrightii A. Gray, Pl. Wright. 1: 27. 1852.

Xanthoxalis wrightii Abrams, Torrey Bot. Club Bul. 34: 264. 1907.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,500 feet, common, preferring moist ground and partial shade, March to September. Western Texas to Arizona and Mexico.

4. *Oxalis repens* Thunb., Diss. Oxal. 16. 1781.

Oxalis corniculata of authors, in part. Not L.

Tempe, Maricopa County, common in lawns (*McLellan* and *Stitt* 1360). Extensively naturalized in the United States, from the Old World.

5. *Oxalis grayi* (Rose) Knuth, Notizbl. Bot. Gart. u. Mus. Berlin 7: 317. 1919.

Ionoxalis grayi Rose, Contrib. U. S. Natl. Herbarium 10: 112. 1906.

Apache, Coconino, Yavapai (and Santa Cruz?) Counties, 5,000 to 9,500 feet, mostly in pine woods, July and August. New Mexico, Arizona, and northern Mexico.

A form occurring in the Patagonia Mountains (*Peebles* et al. 5599) is referred here doubtfully. It has exceptionally large leaves, the sepals bear a light-brown apical gland in addition to the ordinary callosities, and the filaments are appendaged on the back.

6. *Oxalis metcalfei* (Small) Knuth, Notizbl. Bot. Gart. u. Mus. Berlin 7: 314. 1919.

Ionoxalis metcalfei Small, North Amer. Fl. 25: 39. 1907.

Greenlee County to Yavapai County, south to Cochise and Pima Counties, 5,500 to 9,000 feet, common in rich soil of coniferous forests, July to September. New Mexico and Arizona.

Very close to *O. violacea* L., but the leaflets are more deeply orbiculate and the bulb scales less distinctly and prominently 3-nerved than in most specimens of *O. violacea* from the eastern United States.

7. *Oxalis amplifolia* (Trelease) Knuth, Notizbl. Bot. Gart. u. Mus. Berlin 7: 314. 1919.

Oxalis divergens Benth. var. *amplifolia* Trel. in A. Gray, Syn. Fl. 1¹: 368. 1897.

Ionoxalis amplifolia Rose, Contrib. U. S. Natl. Herbarium 10: 110. 1906.

Cochise, Santa Cruz, and Pima Counties, 3,700 to 5,200 feet, rich soil in shade, August. Western Texas to southern Arizona.

Specimens collected in Santa Cruz County (*Peebles* et al. 4656, 5612) differ from Trelease's description in having the sepals acutish instead of "very obtuse" and in having 2, not 4 callosities, these sometimes deeply lobed at base.

57. LINACEAE. FLAX FAMILY

1. LINUM. FLAX

Plants herbaceous, annual or perennial; stems slender, commonly erect and branched; leaves simple, sessile, mostly alternate; inflorescence cymose-paniculate or racemose; flowers regular, perfect; sepals and petals 5, the sepals persistent, the petals deciduous, blue or yellow; stamens 5, sometimes with 5 additional rudiments, the filaments united below; fruit a 5- or 10-valved capsule.

The outstanding species, of Old World origin, is flax (*L. usitatissimum* L.), from the stem fibers of which linen, and from the seeds linseed oil, are manufactured. One of Arizona's yellow-flowered species, *L. neomexicanum*, is reported to be poisonous to horses and sheep. Cyanogen is thought to be the toxic constituent.

Key to the species

1. Petals sky blue, 1 to 2 cm. long; sepals glandless; stigmas introrse, slightly longer than thick; plant perennial..... 1. *L. LEWISII*.
1. Petals yellow or orange; sepals, at least the inner ones, bearing marginal glands; stigmas terminal, capitate (2).
 2. Styles separate to the base; sepals not or scarcely aristate, the outer ones entire or with few glandular teeth (3).
 3. Inflorescence elongate, narrow, interrupted-racemiform; plant annual or biennial; outer sepals lanceolate or oblong-lanceolate; stems erect, the branches ascending at a narrow angle; capsule subglobose-ovoid.
 2. *L. NEOMEXICANUM*.
 3. Inflorescence short, fastigiate, corymbiform or compact-racemiform; plants perennial; outer sepals ovate..... 3. *L. KINGII*.
2. Styles united nearly to the apex; sepals spinose-aristate, the outer ones with numerous glandular teeth; plants mostly annual (4).
 4. Pedicels and stems densely puberulent; angles of the stem not winged; stems usually branching from near the base, the branches loosely spreading..... 4. *L. PUBERULUM*.
 4. Pedicels and stems glabrous, or sparsely and obscurely puberulent; angles of the stem narrowly winged..... 5. *L. ARISTATUM*.

1. *Linum lewisii* Pursh, Fl. Amer. Sept. 210. 1814.

Apache County to Mohave County, south to Cochise and Pima Counties, 3,500 to 9,500 feet, common on open mesas and in coniferous forests, March to September. Saskatchewan and Alaska to northern Mexico.

This handsome plant closely resembles cultivated flax but is perennial. Occasional specimens have nearly white flowers. It is stated that the Indians in some of the Western States used the long fibers of the stems for making cordage.

2. *Linum neomexicanum* Greene, Bot. Gaz. 6: 183. 1881.

Cathartolinum neomexicanum Small, North Amer. Fl. 25: 73. 1907.

Coconino County and Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 6,000 to 8,000 feet, common in yellow

pine forests, June to September. New Mexico, Arizona, and northern Mexico.

*3. *Linum kingii* S. Wats. in King, Geol. Expl. 40th Par. 5: 49. 1871.

Cathartolinum kingii Small, North Amer. Fl. 25: 73. 1907.

Not known to occur in Arizona but is found in southern Utah, near the northern border of Arizona.

4. *Linum puberulum* (Engelm.) Heller, Plant World 1: 22. 1897.

Linum rigidum Pursh var. *puberulum* Engelm. in A. Gray, Pl. Wright. 1: 25. 1852.

Cathartolinum puberulum Small, North Amer. Fl. 25: 80. 1907.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,500 feet, April to July. Colorado, Utah, New Mexico, and Arizona.

Scarcely more than a variety of *L. rigidum*, differing chiefly in its denser puberulence and in having the apex of the pedicel not or only slightly cupulate.

5. *Linum aristatum* Engelm. in Wisliz., Mem. North. Mex. 101. 1848.

Cathartolinum aristatum Small, North Amer. Fl. 25: 83. 1907.

Apache County to Hualpai Mountain (Mohave County), 5,000 to 8,000 feet, plains and mesas, mostly in sandy soil, May to September. Colorado and western Texas to northern Arizona and Mexico.

The var. *australe* (Heller) Kearney and Peebles (*L. australe* Heller) has the same range in Arizona as the typical form and also extends farther south, to the Rincon Mountains (Pima County). As compared with the typical form it has shorter outer sepals, more distinctly dentate inner sepals, more diffusely branched stems, and usually serrulate leaves, the leaves being commonly entire in the typical form of the species. *L. aristatum* is reported to be used by the Hopi Indians in cases of childbearing.

58. ZYGOPHYLLACEAE. CALTROP FAMILY

Plants herbs or shrubs; leaves digitately or pinnately compound, mostly opposite, the leaflets entire; flowers perfect, regular or nearly so; sepals and petals 5; stamens 10, in 2 whorls, the filaments separate; ovary 2- to 6-celled, sometimes splitting in fruit into as many or twice as many nutlets; styles not separating from the column.

Key to the genera

1. Leaves 3-foliolate; stipules spiny; petals purple; plant suffrutescent.
 1. FAGONIA.
1. Leaves 2-foliolate, or pinnate with numerous leaflets; stipules not spiny; petals yellow or orange (2).
 2. Plant shrubby, very glutinous, strong-scented; leaflets 2, divaricate; stamens with scalelike appendages; fruits densely villous.----- 2. LARREA.
 2. Plants herbaceous, not glutinous or strong-scented; leaflets 4 or more pairs; stamens not appendaged; carpels dorsally tuberculate or spiny (3).
 3. Fruit flat, radiate, breaking up into 5 nutlets, each with 2 strong dorsal spines and containing 2 or more seeds, these separated by transverse septa.----- 3. TRIBULUS.
 3. Fruit hemispheric or higher, not radiate, breaking up into more than 5 nutlets, these not spiny, 1-seeded.----- 4. KALLSTROEMIA.

1. FAGONIA

Plant suffrutescent, puberulent to nearly glabrous; leaves digitately 3-foliolate, the stipules spinescent; flowers small, solitary in the leaf axils; petals purplish pink; fruit of 5 united carpels.

1. *Fagonia californica* Benth., Bot. Voy. Sulph. 10. 1844.

Fagonia laevis Standl., Biol. Soc. Wash. Proc. 24: 249. 1911.

Fagonia longipes Standl., *ibid.* p. 250.

Western Pinal County and Yuma County, 2,000 feet or lower, frequent on dry rocky slopes and mesas, March and sometimes October. Southern Utah to southern California, Sonora, and Baja California.

F. laevis (type from Yuma, Jones in 1906) is a very nearly glabrous form. *F. longipes* (type from Arizona without definite locality, Palmer in 1876) has exceptionally long pedicels.

2. LARREA. CREOSOTEBUSH

Plant a much-branched shrub, up to 3.5 m. (11.5 feet) high; leaves evergreen, thick, glutinous, strong-scented, the leaflets 2, oblong to obovate, united at base; flowers axillary, solitary; petals yellow; capsule 5-celled, densely white-villous.

1. *Larrea tridentata* (DC.) Coville, Contrib. U. S. Natl. Herbarium 4: 75. 1893.

Zygophyllum tridentatum DC., Prodr. 1: 706. 1824.

Larrea glutinosa Engelm. in Wisliz., Mem. North. Mex. 93. 1848.

Covillea tridentata Vail, Torrey Bot. Club Bul. 26: 302. 1899.

Covillea glutinosa Rydb., North Amer. Fl. 25: 108. 1910.

Mohave County to Greenlee, Cochise, Santa Cruz, Pima, and Yuma Counties, 5,000 feet or lower, dry plains and mesas, flowering from time to time throughout the year but most profusely in spring. Western Texas to southern Utah, Arizona, California, and northern Mexico.

Very closely related to *L. divaricata* Cav. of southern South America and perhaps not specifically distinct, in which case the name *divaricata* has priority. Often erroneously called "greasewood" in Arizona and California. An outstanding xerophyte and a very important element of the perennial desert flora in southern and western Arizona. The plants cover thousands of square miles in the western and southwestern parts of the State, often in nearly pure stand, usually with remarkably little variation in size. The Pima Indians formerly used the leaves in decoction as an emetic and to poultice sores. Small quantities of lac are found on the branches as a resinous incrustation. This was used for fixing arrow points, mending pottery, etc. Creosotebush has a strong characteristic odor, especially noticeable when the foliage is wet. The plant ordinarily is not touched by livestock although it is reported that sheep, especially pregnant ewes, have been killed by partaking of it. This plant is reported to cause dermatitis in exceptional persons who are allergic to it.

3. TRIBULUS. CALTROP

Plant annual, with long prostrate stems radiating from the root; leaves pinnate, the leaflets 8 to 12; flowers small, axillary, solitary,

peduncled; petals yellow; fruits flat, of 5 nutlets, each dorsally armed with 2 strong spines and containing 2 or more seeds separated by transverse partitions.

1. *Tribulus terrestris* L., Sp. Pl. 387. 1753.

Here and there throughout the State, 5,000 feet or lower, often very abundant at roadsides and in fields, flowering in summer. Extensively naturalized in the United States, from southern Europe.

Plant now commonly known as puncturevine, also as bullhead and burnut. A troublesome annual weed because of the numerous spiny fruits each plant produces. Although the plants produce seeds in great quantities, and the fruits are readily disseminated by means of furred animals and automobile tires, the weed is easily controlled by cultivation. The spines of the fruit are incapable of puncturing serviceable automobile tires but do penetrate bicycle tires. A single carpel somewhat resembles the head of a bull. Hay containing the fruits may cause troublesome sores in the mouths of livestock.

4. KALLSTROEMIA

Plants very similar to *Tribulus* but the fruit more convex, breaking up at maturity into 8 to 12 nutlets, these 1-seeded and merely tuberculate on the back.

Key to the species

1. Petals 15 to 30 mm. long, orange; sepals 8 to 15 mm. long; beaks of the mature fruit slender, slightly conic at base, 8 to 11 mm. long, much longer than the nutlets (usually at least twice as long); leaflets up to 25 mm. long; stems hirsute-hispid, also usually copiously short-pilose--- 1. *K. GRANDIFLORA*.
1. Petals not more and usually less than 12 mm. long, orange yellow, often fading whitish; sepals less than 8 mm. long; beaks of the fruit stout, strongly conic at base; leaflets seldom more than 15 mm. long (2).
 2. Beaks of the mature fruit 4 to 6 mm. long, commonly longer than the nutlets; petals 6 to 12 mm. long; sepals persistent until after maturity of the fruit; nutlets usually prominently tuberculate on the back.
 2. *K. PARVIFLORA*.
 2. Beaks of the fruit not more than 3 mm. long, shorter than the nutlets; petals not more than 6 mm. long (3).
 3. Plant conspicuously hirsute, many of the hairs long and spreading; sepals persistent; beaks of the fruit copiously strigose-pubescent; nutlets with low, transversely elongate (ridgelike) tubercles.
 3. *K. HIRSUTISSIMA*.
 3. Plant not conspicuously hirsute, most of the hairs appressed; sepals usually deciduous before maturity of the fruit; beaks of the fruit glabrous or nearly so----- 4. *K. CALIFORNICA*.

1. *Kallstroemia grandiflora* Torr. in A. Gray, Pl. Wright. 1: 28. 1852.

Greenlee County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 5,000 feet or lower, common on open plains and mesas, February to September. Texas to Arizona and Mexico.

This plant, often locally known as Arizona-poppy, is one of the most attractive summer annuals in the southern part of the State. The large flowers, rich orange in color, superficially resemble those of the California-poppy (*Eschscholtzia*). There is remarkable variation in size and shape of the anthers, apparently uncorrelated with other characters. The anthers are usually nearly orbicular and 1 to 2 mm. in diameter, but in specimens collected at San Bernardino ranch, Cochise County (Mearns 1982), they are elliptic and up to 4 mm. long.

2. *Kallstroemia parviflora* Norton, Mo. Bot. Gard. Ann. Rpt. 9: 153. 1898.

Kallstroemia laetevirens Thornber ex Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 143. 1913.

Navajo County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,000 feet, plains and mesas, August to October. Mississippi to Arizona and northern Mexico.

3. *Kallstroemia hirsutissima* Vail in Small, Fl. Southeast. U. S. 670. 1903.

Cochise County, at San Bernardino Ranch (*Mearns* 597) and Benson (*Harrison* 8227), Santa Cruz County, near Elgin, (*Peebles* et al. 3449) 3,500 to 4,700 feet, apparently rare, August to October. Kansas and Colorado to Texas, southeastern Arizona, and northern Mexico.

4. *Kallstroemia californica* (S. Wats.) Vail, Torrey Bot. Club Bul. 22: 230. 1895.

Tribulus californicus S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 125. 1876.

Apache and Yavapai Counties to Santa Cruz, Pima, and Yuma Counties, 5,000 feet or (usually) lower, plains and mesas, commonly in sandy soil, May to October. Southern Colorado to Arizona, southeastern California, and Mexico.

The typical form, commonly with 4 to 7 pairs of leaflets and relatively elevated and sharp dorsal tubercles on the carpels, seems to be confined to the southern part of the State, from Graham County to Yuma County. In the northeastern and central portions, the prevailing form is var. *brachystylis* (Vail) Kearney and Peebles (*K. brachystylis* Vail), with only 3 to 5 pairs of leaflets and lower, blunter dorsal tubercles. There is, however, much intergradation.

59. RUTACEAE. RUE FAMILY

Plants large shrubs or small trees to nearly herbaceous, more or less strong scented; herbage glandular-punctate; leaves simple or digitately compound; flowers perfect or unisexual, regular; sepals and petals commonly 4 or 5, the stamens as many or twice as many; fruit various.

The most important members of this family, from an economic standpoint, are the citrus fruits—orange, grapefruit, and lemon.

Key to the genera

1. Leaves simple, linear or narrowly spatulate; petals erect; fruit a deeply 2-lobed capsule; ovules 5 or more in each carpel; plants small shrubs or nearly herbaceous..... 2. THAMNOSMA.
1. Leaves digitately compound; petals spreading; fruit not deeply lobed; ovules 1 or 2 in each carpel (2).
 2. Plants small shrubs; herbage and capsules glandular-pustulate; leaves with usually more than 3 leaflets; petals white; fruit turgid, of 2 or 3 carpels.
 1. CHOISYA.
 2. Plants large shrubs or small trees; herbage glandular-punctate, not pustulate; leaves 3-foliolate, the leaflets lanceolate or broader; petals greenish or yellowish; fruit flat, broadly winged, 1- or 2-celled..... 3. PTELEA.

1. CHOISYA. STARLEAF, ZORILLO

Contributed by C. H. MULLER

Aromatic shrubs, often prominently glandular; leaves opposite, 3- to 7- or more-foliolate, the leaflets digitate, linear, prominently glandular on the margins and petioles; flowers solitary in the axils but crowded toward the tips of the stems; sepals 5, glandular and ciliate; petals 5, at least 1 cm. long, white, glabrous; stamens 10, in 2 series of alternating unequal filaments; ovary of 5 united pubescent carpels with glabrous glandular tips; styles adnate above, the lobed stigma capitate; fruit of 2 or 3 pubescent and glandular carpels, the glandular tips migrating to form dorsal protuberances, the persistent style bases forming apical points; seeds oval or reniform, reticulately pitted.

The Arizona species belong to the subgenus *Astrophyllum*, regarded by some botanists as a distinct genus.

Key to the species

1. Herbage appressed-hirtellous or partly glabrate; leaflets narrowly linear, 1 to 2 (rarely 3) mm. wide, deeply revolute, the petioles always less than one-third the length of the leaflets; glands prominent.---1. *C. ARIZONICA*.
1. Herbage spreading-pilose; leaflets broadly linear, 3 to 5 mm. wide or rarely narrower, minutely revolute, flat and willowlike, the petioles always half as long as the leaflets or longer; glands scarcely prominent.-----2. *C. MOLLIS*.

1. *Choisya arizonica* Standl., Biol. Soc. Wash. Proc. 27: 222. 1914.

Mule and Dragoon Mountains and Coronado National Forest (Cochise County), Santa Rita Mountains (Pima County), seldom above 5,500 feet, dry, shrubby slopes, May to July, type from the Santa Rita Mountains (*Pringle* in 1884). Known only from southeastern Arizona.

An attractive shrub, 3 to 6 feet high.

2. *Choisya mollis* Standl., Biol. Soc. Wash. Proc. 27: 223. 1914.

Mountains of Santa Cruz County near Nogales and Ruby, 3,500 to 4,000 feet, dry slopes and sides of canyons, type collected by Schott in the Pajarito Mountains (Santa Cruz County, or adjacent Sonora). Known definitely only from southern Arizona.

A shrub 3 to 5 feet high, with leaflets resembling the leaves of *Salix taxifolia* H. B. K.

2. THAMNOSMA

Plants shrubby to herbaceous or nearly so; leaves simple, alternate, narrow, entire, persistent or soon deciduous; flowers in small cymose or racemose clusters; corolla cylindric to campanulate; capsule deeply 2-lobed.

Key to the species

1. Plant shrubby, more or less spinescent; herbage yellowish; leaves mostly linear-spatulate, few, soon deciduous; corolla cylindric-funnelform or slightly urceolate, 8 to 14 mm. long; petals dark blue; stipe of the capsule longer than the calyx; seeds 4 to 6 mm. long, smooth or somewhat rugose.-----1. *T. MONTANA*.
1. Plant suffrutescent or nearly herbaceous, not spinescent; herbage glaucous-green; leaves linear to nearly filiform, numerous, persistent; corolla campanulate, 3 to 5 mm. long; petals yellowish, or brownish purple; stipe of the capsule shorter than the calyx, or none; seeds not more than 2 mm. long, tuberculate.-----2. *T. TEXANA*.

1. **Thamnosma montana** Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 313. 1845.

Grand Canyon (Coconino County), Yavapai, Mohave, Pinal, Maricopa, and Yuma Counties, 4,500 feet or lower, desert mesas and slopes, frequent and locally abundant, February to April. Southern Utah and Arizona to Sonora and Baja California.

Turpentine-broom, so-called because of the appearance and strong odor of the plant. Reported to have been used by the Indians as a tonic and in treatment of gonorrhœa.

2. **Thamnosma texana** (A. Gray) Torr., U. S. and Mex. Bound. Bot. 42. 1859.

Rutosma texana A. Gray, Genera Fl. Amer. 2: 144. 1849.

Rutosma purpurea Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 143. 1913.

Coconino, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,000 to 4,000 feet, dry rocky slopes and mesas, March to June. Colorado and western Texas to southern Arizona and northern Mexico.

3. PTELEA. HOPTREE

Shrubs or small trees; leaves commonly trifoliolate, the leaflets lanceolate or ovate, somewhat rhombic; flowers small, perfect or unisexual, in compound cymes; calyx lobes, petals, and stamens 4 or 5; fruit flat, nearly orbicular, winged, mostly 2-celled, indehiscent.

The plants have a strong, somewhat disagreeable odor and are not eaten by livestock. The fruits are reported to have been used as a substitute for hops, in brewing. Most of the numerous forms that have been described as species in this genus appear to be only individual variations. There is great diversity in the shape and size of the fruits, as well as of the leaflets, but there appears to be little correlation between the characters of the 2 organs.

Key to the species

1. Bark of the twigs straw-colored to light olive-colored; leaves yellowish green, paler but not glaucous beneath, often somewhat shiny above, rather thick and firm, glabrous or sparsely pubescent beneath; leaflets prevailingly rhombic-lanceolate but sometimes rhombic-ovate, the terminal one commonly 3 or more times as long as wide..... 1. *P. PALLIDA*.
 1. Bark of the twigs brown or dark purple (commonly mahogany-colored or plum-colored); leaves bright green or bluish green, often glaucous beneath, not shiny above, thin, glabrate or permanently soft-pubescent beneath; leaflets prevailingly rhombic-ovate but sometimes rhombic-lanceolate, commonly less than 3 times as long as wide..... 2. *P. ANGUSTIFOLIA*.
1. **Ptelea pallida** Greene, Contrib. U. S. Natl. Herbarium 10: 70. 1906.

Ptelea straminea Greene, *ibid*.

? *Ptelea baldwinii* Torr. and Gray, var. *parvifolia* A. Gray in Patterson, Check List 18. 1892.

Coconino, Mohave, and Yavapai Counties, 2,000 to 7,000 feet, especially abundant in and near the Grand Canyon, May, type of *P. pallida* from Peach Springs, Mohave County (Greene in 1889), type of *P. straminea* from the Virgin Mountains, Mohave County (*Purpus* 6165). New Mexico and northern Arizona.



Crucifixion-thorn (*Holacantha emoryi*) in Pinal County, altitude 1,400 feet.
Plant about 10 feet high.



This seems to be the form interpreted by Wooton and Standley⁷⁵ as *P. angustifolia* Benth. The latter was described from Mexican specimens, whereas *P. pallida* is mainly a species of the high plateaus of central and northern Arizona. Additional names published by Greene, based on Arizona types, all probably synonyms of *P. pallida* are: *P. argentea*, *P. elegans*, *P. lutescens*, *P. neglecta*, *P. nitida*, *P. saligna*, and *P. triptera*.

2. *Ptelea angustifolia* Benth., Pl. Hartw. 9. 1839.

Ptelea baldwinii of authors. Not Torr. and Gray.

Ptelea jucunda Greene, Contrib. U. S. Natl. Herbarium 10: 63. 1906.

Apache County to Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 3,500 to 8,500 feet, commonly in the yellow pine belt, mostly in canyons, May and June. New Mexico, Arizona, and Mexico.

P. angustifolia is perhaps not specifically distinct from *P. tomentosa* Raf. It differs from the eastern *P. trifoliata* L. (and var. *mollis* Torr. and Gray) chiefly in its usually narrower leaflets and in the thicker wings and relatively large body of the fruits, which are more often emarginate at base and apex. Additional, probably synonymous, names published by Greene on the basis of Arizona types, are: *P. attrita*, *P. crenata*, *P. similis*, and *P. tortuosa*.

The typical form has the foliage and twigs more or less permanently pubescent. A glabrate form, usually with narrower leaflets, is var. *cognata* (Greene) Kearney and Peebles (*P. cognata* Greene *ibid.* p. 62), the type of which was collected in the Huachuca Mountains (*Wilcox* 477). *P. betulifolia* Greene, based on a specimen collected at Fort Bowie (*Fisher* in 1894), seems to be a synonym. This variety is more common than the typical form in the southern part of the State and begins to flower as early as March.

60. SIMARUBACEAE. SIMARUBA-FAMILY

1. HOLACANTHA. CRUCIFIXION-THORN

A large shrub, of grotesque appearance, intricately branched, with short stout sharply spinose branches; leaves reduced to small deciduous scales; inflorescences very dense, many-flowered; flowers dioecious, small, greenish yellow; petals commonly 7 or 8; stamens 12 or more in staminate flowers; fruit a ring of 5 or more nearly separate, divergent, 1-seeded, drupelike carpels.

1. *Holacantha emoryi* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 310. 1855.

Pinal, Maricopa, Pima, and Yuma Counties, 2,000 feet or lower, frequent but not abundant on desert plains. June and July, type from between Tucson and the Gila River. Southern Arizona, southeastern California, and northern Mexico.

The fruits persist for years, so it is usually possible to identify each preceding season's fruit clusters by the degree of weathering. The plant attains a height of 3.5 m. (12 feet) (pl. 16).

⁷⁵ WOOTON, E. O., and STANDLEY, P. C. FLORA OF NEW MEXICO. Contrib. U. S. Natl. Herbarium 19: 1-794. 1915. (See p. 389.)

61. BURSERACEAE. TORCHWOOD FAMILY

1. BURSERA. ELEPHANTTREE

Shrubs or small trees, unarmed, strongly aromatic; young bark smooth and brown, the older bark exfoliating; leaves alternate, pinnate, deciduous; flowers small, solitary or in very few-flowered clusters; petals inserted on a ring-shaped disk; fruit drupelike, 3-angled, with 1 large bony seed.

A resin called copal is obtained in Mexico from many of the species, including *B. odorata*. It is used for cement and varnish, and for treating bites of scorpions, etc. It is burned as incense in the churches and was formerly so employed in the Aztec and Mayan temples.

Key to the species

1. Leaflets lanceolate, acute or acutish at apex, 15 to 40 mm. long, 4 to 15 mm. wide; inflorescence several-flowered; pedicels often borne on a common peduncle as long as or longer than themselves; young bark gray brown, the old bark exfoliating in large thin sheets.----- 1. *B. ODORATA*.
1. Leaflets narrowly oblong, oval, or spatulate (the terminal one sometimes nearly orbicular), obtuse at apex, 2 to 8 mm. long, 1 to 2 mm. wide; inflorescence very few-flowered; pedicels with or without a common peduncle; young bark red brown, the old bark exfoliating in flakes.
 2. *B. MICROPHYLLA*.

1. ***Bursera odorata*** T. S. Brandeg., Calif. Acad. Sci. Proc. ser. 2, 2: 138. 1889.

Elaphrium odoratum Rose, North Amer. Fl. 25: 250. 1911.

Known in Arizona only on dry limestone cliffs near Fresno, western foothills of the Baboquivari Mountains, Pima County (*Gilman* 3529, etc.), about 4,000 feet, July. Southern Arizona and Mexico (including Baja California).

The few plants at Fresno, which reach a height of 4.5 m. (15 feet), have the appearance of being survivors from a time when conditions were more favorable to the species at this locality. The young bark is bright green and the crushed herbage has an odor of tangerine peel. The old bark can be removed in translucent sheets resembling parchment. The branches yield quantities of gum, and when cut from the tree dry very slowly.

2. ***Bursera microphylla*** A. Gray, Amer. Acad. Arts and Sci. Proc. 5: 155. 1861.

Elaphrium microphyllum Rose, North Amer. Fl. 25: 250. 1911.

Mountains of southwestern Arizona from the Salt River Mountains (Maricopa County) to the Gila and Tinajas Altas Mountains (Yuma County), 2,500 feet or lower, locally abundant on arid rocky slopes, July. Southwestern Arizona, southeastern California, and Mexico.

The trees reach a height in Arizona of 6 m. (20 feet) and a trunk diameter of 0.3 m. (1 foot). The crooked branches taper rapidly and resemble the trunk of an elephant. The plant cannot withstand much cold. The bark contains tannin and was gathered in Sonora for export. In that region the gum was used for treating venereal diseases.

62. MALPIGHIACEAE. MALPIGHIA FAMILY

Plants suffrutescent; stems trailing or twining; leaves simple, opposite, with entire blades; hairs of the herbage appearing simple

but affixed at the middle; flowers mostly perfect, some of them often cleistogamous and apetalous, axillary or terminal, solitary or in small clusters; calyx bearing 8 to 10 external glands; petals 5, yellow or orange, abruptly contracted into the claws; stamens 5 or 6, some of them often sterile.

Key to the genera

1. Carpels each with a conspicuous scarious dorsal wing, the wings divergent; leaf blades lance-linear; petals yellow, entire or denticulate. 1. JANUSIA.
1. Carpels not winged, nutlike, irregularly triangular, strongly keeled on the back, the edges margined or tuberculate; leaf blades oblong-lanceolate, oval, or ovate; petals orange, fimbriate..... 2. ASPICARPA.

1. JANUSIA

Stems slender, twining, often tangled; leaves short-petioled, the blades narrow; fruit a pair of samaras (exceptionally 3).

1. *Janusia gracilis* A. Gray, Pl. Wright. 1: 37. 1852.

Mohave County to Greenlee, Cochise, Santa Cruz, Pima, and Yuma Counties, 1,000 to 5,000 feet, dry rocky slopes, April to October. Western Texas to Arizona and northern Mexico (including Baja California).

2. ASPICARPA

Stems commonly trailing; leaves sessile or short-petioled, the blades oblong-lanceolate to ovate; flowers dimorphous, the petaliferous ones mostly in terminal clusters, the cleistogamous flowers axillary, long-peduncled to nearly sessile; fruit a pair of strongly keeled, usually tuberculate nutlets.

1. *Aspicarpa hirtella* Rich., Paris Mus. Hist. Nat. Mém. 2: 399. 1815.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,500 feet, commonly in chaparral, August and September. Southern Arizona and Mexico.

The Arizona specimens all appear to belong to one species, although identified variously as *A. longipes* Gray, *A. humilis* (Benth.) Juss., and *A. hirtella*. As these species are defined by Niedenzu⁷⁶ the description of *A. hirtella* seems to apply best to the Arizona plant.

63. POLYGALACEAE. MILKWORT FAMILY

Plants annual or perennial, herbaceous or suffruticose; leaves alternate, opposite, or verticillate, sessile or short-petioled, simple, entire; flowers perfect, very irregular; sepals 5, the lateral ones more or less petaloid; petals commonly 3, more or less united or adnate to the stamens, the lower petal concave or keel-like, often crested or beaked; stamens 6 to 8, the filaments united below into a tube, the anthers opening by pores; fruit a flat 2-celled capsule; seeds usually carunculate (appendaged around the hilum).

Key to the genera

1. Petals united below into a dorsally cleft tube, the lower one (keel) united at base with the staminal tube; fruits dehiscent, not sharply keeled or prominently veined..... 1. POLYGALA.
1. Petals nearly or quite separate, the lower one not united with the staminal tube, more or less enclosing the connivent upper petals; fruits indehiscent, sharply keeled, prominently reticulate-veined..... 2. MONINNA.

⁷⁶ NIEDENZU, FRANZ. MALPIGHIACEAE. Pflanzenreich IV. 141: 247-870. 1928. (See p. 560.)

1. POLYGALA

Herbs or undershrubs; flowers mostly in narrow terminal racemes, sometimes few or solitary in the leaf axils; petals united below, forming a dorsally-cleft tube, the lower petal (keel) attached at base to the stamen tube; capsules dehiscent; seeds with a caruncle, this usually umbrellalike or veillike, with a thickened center (umbo), and a scarios marginal portion.

These dainty plants are interesting because of the unusual structure of their flowers and seeds. Most of the species are reported to be distasteful to grazing animals, but the somewhat woody *P. macradenia* is browsed occasionally.

Key to the species

1. Keel petal not crested or beaked, at most apiculate; flowers not more than 6 mm. long: *P. acanthoclada*, an intricately branched shrub with scattered yellowish flowers, these solitary or in fascicles of not more than 4, might be sought here (2).
2. Leaves conspicuously dotted with large sessile glands, not dimorphic, very numerous, less than 10 mm. long, linear to oblong-lanceolate; flowers axillary, mostly solitary; plant suffrutescent, densely short-pilose; stems numerous, seldom more than 20 cm. long; wing petals purple, pubescent, the keel petal greenish yellow..... 1. *P. MACRADENIA*.
2. Leaves not gland-dotted, more or less dimorphic, the lower ones broader and shorter than the upper ones; flowers few or somewhat numerous in loose terminal racemes; capsules ciliolate; plants herbaceous, of very similar appearance (3).
3. Caruncle of the seed with the depth of the entire or denticulate scarios marginal portion less than the height of the umbo (4).
4. Capsules remaining more or less pubescent on the sides; middle and upper leaves linear-lanceolate or linear-elliptic, 2 to 3 mm. wide, the lower leaves oblanceolate..... 2. *P. PILIOPHORA*.
4. Capsules glabrous on the sides when mature; middle and upper leaves linear or lance-linear (5).
5. Middle and upper leaves scalelike, 5 to 10 mm. long, 1 to 1.5 mm. wide..... 3. *P. BARBEYANA*.
5. Middle and upper leaves not scalelike, 15 to 30 mm. long, 1.5 to 3 mm. wide; wing petals greenish, tinged with purple..... 4. *P. RACEMOSA*.
3. Caruncle of the seed with the depth of the lobed or lobulate scarios marginal portion equaling or exceeding the height of the umbo; wing petals greenish purple or violet (6).
6. Capsules glabrous on the sides at maturity; caruncle not veillike, covering only the tip of the seed, the scarios portion not much deeper than the height of the umbo (7).
7. Upper leaves less than 25 mm. long, the lowest leaves less than 10 mm. long; stems less than 20 cm. long; capsules oblong-oval..... 5. *P. REDUCTA*.
7. Upper leaves mostly 20 to 35 mm. long, the lowest leaves seldom less than 10 mm. long; stems commonly at least 20 (up to 45) cm. long; capsules broadly oval, ovate, or slightly obovate..... 6. *P. LONGA*.
6. Capsules pubescent on the sides at maturity (seldom glabrate); caruncle veillike, covering one-fourth or more of the seed, the scarios portion much deeper than the height of the umbo (8).
8. Hairs of the stem all incurved or subappressed; middle and upper leaves up to 12 mm. wide, but usually much narrower..... 7. *P. OBSCURA*.
8. Hairs of the stem all wide-spreading; middle and upper leaves not more than 6 mm. wide..... 8. *P. ORTHOTRICHA*.

1. Keel-petal crested or beaked (9).
9. Crest of the keel none, the keel ending in a conic or cylindrical, entire beak, this almost obsolete in *P. acanthoclada* (10).
10. Branches not or only slightly spinescent; stems less than 20 cm. long (11).
11. Herbage pilose; stems few, relatively stout; leaf blades 3 to 8 mm. wide; wing petals 8 to 10 mm. long, rose purple, the keel with a very stout and blunt yellow beak.----- 9. *P. RUSBYI*.
11. Herbage puberulent; stems numerous, slender; leaf blades commonly not more than 3 mm. wide; wing petals 4 to 5 mm. long, the keel with a relatively slender beak.----- 10. *P. TWEEDYI*.
10. Branches pronouncedly spinescent (12).
12. Plant suffrutescent; stems not more than 15 cm. long; herbage puberulent or glabrate; leaf blades 3 to 6 mm. wide; wing petals 8 to 12 mm. long, purplish pink, the keel conspicuously beaked; capsules more than 5 mm. long.----- 11. *P. SUBSPINOSA*.
12. Plant shrubby, intricately branched; stems up to 90 cm. long; herbage short-pilose; leaf blades seldom more than 3 mm. wide; wing petals not more than 5 mm. long, yellowish, sometimes tipped with purple, the keel inconspicuously or obscurely beaked; capsules 4 to 5 mm. long.----- 12. *P. ACANTHOCLADA*.
9. Crest of the keel conspicuous, fimbriate; leaves (except the lowest) linear or linear-lanceolate (13).
13. Plant annual; stems not rushlike, freely branched above the base, very slender, rarely more than 30 cm. long; flowers in loose racemes, not more than 2.5 mm. long, rose purple to nearly white; capsules not winged; lower leaves in whorls of 4 or 5.----- 13. *P. GLOCHIDIATA*.
13. Plants perennial; stems rushlike, not or sparingly branched above the base, angled, sulcate, often more than 30 cm. long; flowers in spikelike racemes (these rather dense at first), more than 2.5 mm. long, whitish, the petals often with greenish or purplish veins (14).
14. Capsules not winged, at most narrowly margined on both cells; leaves (at least the lowest) often in whorls; plant often with short, very leafy basal shoots.----- 14. *P. ALBA*.
14. Capsules with a scariosus wing on the upper cell only; leaves all alternate, scattered (15).
15. Stems glabrous or very nearly so; wing of the capsule broad.----- 15. *P. HEMIPTEROCARPA*.
15. Stems puberulent; wing of the capsule narrow.----- 16. *P. SCOPARIOIDES*.

1. *Polygala macradenia* A. Gray, Pl. Wright. 1: 39. 1852.

Gila, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,500 to 4,000 feet, dry rocky slopes, April to July. Western Texas to southern Arizona and northern Mexico.

2. *Polygala piliophora* Blake, North Amer. Fl. 25: 320. 1924.

Known only from the type collection in the Huachuca Mountains, Cochise County (*Wilcox* in 1894), August.

3. *Polygala barbeyana* Chodat, Soc. Phys. Hist. Nat. Genève Mém. 31²: 16. 1893.

Specimens from Beaver Creek, Yavapai County (*Rusby* 527, *Purpus* 8290), were identified by S. F. Blake as *P. barbeyana*, a species known otherwise only from northern Mexico. In the writers' opinion, these Arizona specimens more nearly resemble *P. racemosa* Blake, although somewhat small-fruited for that species.

4. *Polygala racemosa* Blake, Gray Herbarium Contrib. 47: 28. 1916.

Near Bisbee and near Benson, Cochise County (*Mearns* 1014, part, *Carlson* in 1915, *Harrison* and *Kearney* 5816), about 5,000 feet, May and June. Southeastern Arizona and northern Mexico.

5. *Polygala reducta* Blake, Gray Herbarium Contrib. 47: 25. 1916.
Douglas, Cochise County (*Peebles* and *Leding* 5360), 4,000 feet, May. Southeastern Arizona and northern Mexico.

6. *Polygala longa* Blake, Gray Herbarium Contrib. 47: 29. 1916.
Santa Cruz and Pima Counties, 3,000 to 5,000 feet, spring and autumn. Western Texas to southern Arizona and northern Mexico.
This species apparently intergrades with *P. reducta*.

7. *Polygala obscura* Benth., Pl. Hartw. 58. 1840.
Polygala puberula A. Gray, Pl. Wright. 1: 40. 1852.

Southern Navajo, Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, often among live oaks, July to September. Western Texas to Arizona and Mexico.
Arizona's most widely distributed and commonest species.

8. *Polygala orthotricha* Blake, Gray Herbarium Contrib. 47: 31. 1916.
Chiricahua Mountains (Cochise County), Santa Rita Mountains (Pima County), August, type from the Santa Rita Mountains (*Pringle* in 1884). Known only from southern Arizona.
The character of the pubescence, alone, seems to differentiate this form from *P. obscura*.

9. *Polygala rusbyi* Greene, Torrey Bot. Club Bul. 10: 125. 1883.
Peach Springs to Kingman (Mohave County), also Yavapai County, April to July, type from near Prescott. Known only from central Arizona.
Flowers large and showy for the genus.

10. *Polygala tweedyi* Britton in Wheelock, Torrey Bot. Club Mem. 2: 143. 1891.
Polygala parvifolia (Wheelock) Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 392. 1915.
Polygala arizonae Chodat, Soc. Phys. Hist. Nat. Genève Mém. 31²: 108. 1893.

Huachuca Mountains, Cochise County (*Lemmon* 2641), Santa Rita Mountains, Pima County, (*Pringle* in 1884, type collection of *P. arizonae*), limestone ledges, June. Oklahoma and western Texas to southern Arizona and northern Mexico.

11. *Polygala subspinosa* S. Wats., Amer. Nat. 7: 299. 1873.
Near Pipe Springs, Mohave County, 5,000 feet (*Peebles* and *Parker* 14714). Western Colorado to northwestern Arizona and southern California.

The keel is yellow, the other petals purple.

12. *Polygala acanthoclada* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 73. 1876.

Monument Valley, Navajo County, in "bad lands" (*Turner* 16), Lees Ferry, Coconino County (*Jones* in 1890), south of Marble Gorge, Coconino County (*Gunning* and *Goodding* 2693), 3,200 to 5,000 feet, June. Southwestern Colorado to northern Arizona and southeastern California.

Arizona's most shrubby species, with stems up to 1 m. (3 feet) high, intricately branched, tending to form hummocks. The typical form, represented by *Jones'* collection, has herbage with spreading hairs and

puberulent sepals. The var. *intricata* Eastw., represented by Turner's collection, has herbage with incurved or reflexed matted hairs, and glabrous sepals.

13. *Polygala glochidiata* H. B. K., Nov. Gen. et Sp. 5: 400. 1823.

Mule Mountains, Cochise County (*Goodding* in 1939), southern slopes of the Santa Rita Mountains, Pima County (*Goodding* in 1937), November. Southern Arizona, Mexico, and widely distributed in tropical America.

14. *Polygala alba* Nutt., Gen. Pl. 2: 87. 1818.

Near Winslow and Snowflake (Navajo County), Grand Canyon (Coconino County), also Cochise and Santa Cruz Counties (probably more widely distributed in Arizona), 5,000 to 7,000 feet, May to September. Dakotas to Washington, south to southern Mexico.

The var. *suspecta* Wats., with most of the leaves whorled (only the lowest whorled in the typical form), has been collected in the Huachuca Mountains (*Jones* in 1903).

15. *Polygala hemipterocarpa* A. Gray, Pl. Wright. 2: 31. 1853.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, grassy or stony slopes, type from "along the Sonoita," (Cochise? County). Texas to southern Arizona and Mexico.

16. *Polygala scoparioides* Chodat, Soc. Phys. Hist. Nat. Genève Mém. 31²: 284. 1893.

Yavapai, Gila, Cochise, and Pima Counties, 3,500 to 5,000 feet, rocky mesas and slopes, May and June, type from the Santa Rita Mountains (*Pringle* in 1884). Western Texas to Arizona and northern Mexico.

2. MONINNA

Plant annual; stems slender, leafy, erect, few-branched; herbage minutely puberulent; leaves short-petioled, the blades lanceolate, acuminate; flowers very small, in narrow terminal racemes; corolla pale blue.

1. *Moninna wrightii* A. Gray, Pl. Wright. 2: 31. 1853.

Southern Apache (or Navajo), Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,500 feet, sometimes growing on limestone with *Ceanothus*, September and October. New Mexico, Arizona, and northern Mexico.

64. EUPHORBIACEAE. SPURGE FAMILY

Contributed by LOUIS C. WHEELER

Herbs, shrubs, or trees, often with milky juice; leaves alternate, opposite, or whorled, simple or rarely compound; stipules present or absent; flowers unisexual; calyx and corolla present or absent; stamens 1 to indefinitely numerous; ovary superior, mostly 3-celled, sometimes 1- to 4-celled; ovules pendulous, 1 or 2 per cell; styles as many as the cells, distinct or partially connate, often divided; fruit capsular, the carpels usually dehiscent by 2 elastic valves, sometimes tardily dehiscent or even indehiscent; seeds carunculate or ecarunculate, the testa crustaceous, the endosperm copious, oily, the embryo straight or curved.

A very large family, chiefly tropical and subtropical. The sap is often poisonous and some of these plants, notably castor-bean, are used medicinally as purgatives. The most valuable of the rubber plants of the world, *Hevea brasiliensis*, belongs to this family and members of certain other genera also are sources of rubber. Cassava, an important food of tropical countries, and tapioca are obtained from the roots of species of *Manihot*.

Key to the genera

1. Leaves palmately lobed (2).
2. Stamens indefinitely numerous; leaves peltate; petals absent. 8. RICINUS.
2. Stamens 8 to 10; leaves not peltate (3).
3. Petals present; stinging hairs absent; filaments united. 9. JATROPHA.
3. Petals absent (4).
4. Herbage and capsule bearing harsh stinging hairs; filaments united; calyx petaloid. 10. CNIDOSCOLUS.
4. Herbage and capsule glabrous; filaments free, attached around a fleshy central disk; calyx not petaloid. 11. MANIHOT.
1. Leaves not palmately lobed (5).
5. Plants clothed with stellate, sometimes scalelike hairs (6).
6. Leaves entire or nearly so; anthers turned in and down in the bud; staminate calyx lobes 5 or, if 4, then the carpels 2; carpels 2 or 3, not carinate; seeds carunculate. 3. CROTON.
6. Leaves crenate; anthers erect in bud; staminate calyx lobes 3 or 4; carpels 3, carinate, obviously so when young, only at the apex at maturity; seeds not carunculate. 5. BERNARDIA.
5. Plants with the hairs simple or malpighiaceus (affixed at the middle), or the plants glabrous (7).
7. Flowers seemingly perfect, the cluster consisting of a central pistillate flower with mostly 5 radial fascicles of several to few or even 1 staminate flower each, all surrounded by a persistent gamophyllous involucre bearing 1 to 5 often petaloid-appendaged glands on the rim. 14. EUPHORBIA.
7. Flowers plainly unisexual (8).
8. Petals present; filaments united into a column; stamens 8 to 12; flowers monoecious or, if dioecious, then the plant clothed with malpighiaceus hairs (9).
9. Seeds ecarunculate; flowers monoecious or dioecious; some malpighiaceus hairs usually present (always present if the flowers are dioecious); petals entirely free; anthers about as wide as long. 4. DITAXIS.
9. Seeds carunculate; flowers monoecious; hairs of the ordinary simple type, or absent; petals more or less connivent; anthers evidently longer than wide. 9. JATROPHA.
8. Petals none; flowers monoecious or dioecious; malpighiaceus hairs never present; filaments free, or shortly united and the stamens only 2 (10).
10. Plant a shrub with rigid divaricate branches and small fascicled entire leaves; flowers dioecious; ovules 2 in each cell. 2. TETRACOCCLUS.
10. Plants herbaceous, often perennial or, if shrubby, then the leaves not fascicled or entire; flowers monoecious or sometimes dioecious in *Reverchonnia* (11).
11. Ovules and seeds 2 in each cell; stigmas sessile; plant a glabrous annual herb; stamens 2; staminate sepals 4. 1. REVERCHONIA.
11. Ovules and seeds 1 in each cell; styles of appreciable length; plant not a glabrous annual or, if so, then the stamens more than 2 or the calyx only 2-lobed (12).
12. Pistillate flowers subtended by accrescent foliaceous bracts; styles dissected into filiform segments; anther cells linear, flexuous, attached only at the tip. 6. ACALYPHA.
12. Pistillate flowers not subtended by foliaceous bracts; styles entire; anther cells subglobose or reniform, attached along their sides (13).

13. Calyx 2- to 6-lobed; herbage with harsh, often stinging, hairs; plants slender and often twining----- 7. *TRAGIA*.
 13. Calyx 2-lobed; herbage glabrous (14).
 14. Plants herbaceous, sometimes woody at base; styles 3; ovary and capsule 3-celled; staminate flowers solitary in the axil of each bract----- 12. *STILLINGIA*.
 14. Plant a shrub; styles 2, rarely 3; ovary and capsule 2- or rarely 3-celled; staminate flowers several in the axil of each bract----- 13. *SAPIUM*

1. REVERCHONIA

Glabrous annual herb; leaves simple, alternate, entire, linear spatulate to spatulate, petioled; stipules small, thin, triangular-subulate; flowers axillary, monoecious or dioecious; staminate sepals 4; stamens 2, the filaments free; pistillate sepals 6; glandular disk present; ovary 3-celled; seeds not carunculate.

1. *Reverchonia arenaria* A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 107. 1881.

Hopi Indian Reservation, Navajo County (*Hough* 39, *Whiting* in 1935). Utah and northeastern Arizona to Texas and northern Mexico.

This is supposed to be the only euphorbiaceous genus outside the Australian region having the cotyledons no wider than the radicle. Another unique feature is that the seeds are attached below the middle rather than near the apex. The seeds are reported to be used by the Hopi Indians in treatment of hemorrhage and also for oiling their grinding stones.

2. TETRACOCUS

Rigid divaricately branched shrub; leaves small, spatulate to obovate-spatulate, petiolate, fascicled on very short lateral branchlets; flowers dioecious; staminate flowers 1 to 5 on the branchlets, pedicelled, the sepals 5 or 6, the stamens 5 (in the limited material examined from Arizona), the filaments distinct, attached around the lobed central disk, a rudimentary pistil present; pistillate flowers solitary on the short lateral branchlets, with short thick pedicels, the ovary 3- or occasionally 4-celled, the styles 3 or occasionally 4, entire, spatulate, the ovules 2 in each cell; seeds carunculate, mostly solitary by abortion of 1 ovule and then dorsiventrally compressed, or laterally compressed when both seeds develop.

1. *Tetracoccus hallii* T. S. Brandeg., *Zoe* 5: 229. 1906.

Halliophytum hallii (T. S. Brandeg.) Johnston, Gray Herbarium Contrib. 68: 88. 1923.

Williams River near Alamo, Sheep Tanks, 1,850 feet, and Kofa Mountains (Yuma County), along sandy washes, flowering in spring. Southwestern Arizona and southeastern California.

3. CROTON ⁷⁷

Herbs or shrubs; leaves alternate, petiolate, simple; stipules obsolete; flowers monoecious or dioecious; inflorescence racemose, the staminate flowers above and the pistillate ones below in monoecious

⁷⁷ Reference: FERGUSON, A. M. CROTONS OF THE UNITED STATES. Mo. Bot. Gard. Ann. Rpt. 12: 33-73. 1901.

species; calyx 4- or 5-lobed; petals present or absent in the staminate flowers, the stamens several to many; petals absent or rudimentary in the pistillate flowers, the ovary 3- or sometimes 2-celled, the ovules solitary, the styles 3 or sometimes 2, 1-to 4-times bifid; capsules 3-or-sometimes 1-seeded; seeds small to medium, carunculate.

These plants are malodorous and probably more or less poisonous. The powerful purgative, oil of croton, is obtained from an Asiatic species, *C. tiglium* L.

Key to the species

1. Shrub; leaves green, glabrate above; flowers monoecious, the staminate flowers with petals----- 1. *C. SONORAE*.
1. Suffruticose perennials, or annuals; leaves gray with stellate hairs or, if green and glabrate above, then the flowers dioecious and the staminate flowers without petals (2).
 2. Flowers mostly monoecious; staminate flowers petaliferous; glandular disk of the pistillate flowers 4- or 5-lobed; styles once bifid (3).
 3. Suffruticose perennial; anthers about 1.5 mm. long- 2. *C. CORYMBULOSUS*.
 3. Annual; anthers about 0.5 mm. long (4).
 4. Ovary 3-celled; capsule 3-seeded; styles 3; staminate calyx 5-lobed. 3. *C. LINDHEIMERIANUS*.
 4. Ovary 2-celled; capsule 1-seeded; styles 2; staminate calyx 4-lobed. 4. *C. MONANTHOGYNUS*.
 2. Flowers dioecious; staminate flowers apetalous; styles 2 or more times bifid; glandular disk entire, or minutely crenulate, or sometimes lobed in *C. texensis* (5).
 5. Perennial; upper surface of the leaf densely covered with overlapping stellate hairs, hence grayish----- 5. *C. CALIFORNICUS*.
 5. Annual; upper surface of the leaf sparsely clothed with rarely overlapping stellate hairs, hence green----- 6. *C. TEXENSIS*.

1. **Croton sonorae** Torr., U. S. and Mex. Bound. Bot. 194. 1859.

Western part of Pinal and Pima Counties, dry rocky slopes. Southern Arizona and Mexico.

2. **Croton corymbulosus** Engelm. in Wheeler, U. S. Survey West 100th Merid. Rpt. 5: 242. 1878.

Croton eremophilus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 144. 1913.

Greenlee, Cochise, Santa Cruz, and Pima Counties, 2,600 to 6,000 feet, common on dry rocky slopes, type from Camp Bowie, Cochise County (*Rothrock* 506). Texas to southern Arizona and northern Mexico.

The leaves are reported to be used in domestic medicine, in Texas.

3. **Croton lindheimerianus** Scheele, Linnaea 25: 580. 1853.

The solitary specimen seen from Arizona, perhaps introduced, was collected at Beaver Creek, Yavapai County (*C. A. Purpus* 8258). Kansas to Texas and northern Mexico.

4. **Croton monanthogynus** Michx., Fl. Bor. Amer. 2: 215. 1803.

In Arizona known only from the Santa Cruz River at La Noria, Santa Cruz County (*Mearns* 1167), perhaps introduced from farther east. Florida to Illinois and Texas.

5. **Croton californicus** Muell. Arg. in DC., Prodr. 15²: 691. 1866.

Rillito Creek (Pima County), Verde River (Maricopa(?) County), Parker and Yuma (Yuma County), 200 to 2,300 feet. Southwestern Arizona, California, and Baja California.

The Arizona plants are best referred to var. *mohavensis* Ferguson. The varieties of this species are ill defined and vague.

6. *Croton texensis* (Klotzsch) Muell. Arg. in DC., Prodr. 15²: 692. 1866.

Hendecandra texensis Klotzsch in Wiegmann, Arch. Naturgesch. 7: 252. 1841.

Apache County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 1,200 to 7,000 feet, very common, roadsides, fields, and dry stream beds. Illinois to Wyoming, south to Arkansas, Arizona, and Mexico.

This plant is sometimes called doveweed, the seeds being a favorite food of that bird. The plant gives off a disagreeable odor, so strong as to be noticeable to passing motorists. Hay containing this plant is reported to have poisoned cattle. The Hopi Indians use it as an emetic and an eyewash.

4. DITAXIS

Herbs or shrubs with mostly malpighiaceouse hairs; leaves simple, alternate, exstipulate; flowers mostly monoecious, borne in bracteate axillary racemes, or sometimes solitary; calyx 5-lobed; petals 5 or sometimes wanting in the pistillate flowers; glands 5, alternating with the petals; stamens 8 to 12 (usually 10), the filaments united below into a column (androphore), the anthers in 2 whorls, the lower with 5 or 6, the upper with 3, 5, or 6 anthers; ovary 3-celled, the ovules solitary; styles 3, bifid, distinct or partially connate; seeds not carunculate, small.

Key to the species

1. Gland-tipped teeth present on the leaves, bracts, and pistillate sepals.
 1. *D. ADENOPHORA*.
1. Gland-tipped teeth lacking (2).
 2. Claws of the staminate petals entirely free from the column of united filaments (androphore); stigmas not flattened, sometimes subclavate; leaves petiolate (3).
 3. Pistillate petals ovate-lanceolate, with a few short hairs on the back scarcely extending beyond the tip of the petal, or the margin shortly ciliate; styles united only at base; glands in the staminate flowers mostly thickish, obtuse; seeds shallowly faveolate----- 6. *D. NEOMEXICANA*.
 3. Pistillate petals obovate-cuneate, with abundant coarse hairs on the back extending markedly beyond the tip of the petal; styles united one-third to one-half of their length; glands in the staminate flowers thin, acute; seeds nearly smooth----- 7. *D. SERRATA*.
 2. Claws of the staminate petals united to the androphore; stigmas flattened and dilated (4).
 4. Leaves sessile; anther whorls so close together as to be scarcely distinguishable; seeds ellipsoid to subspheroid, 3.4 to 4.6 mm. long (5).
 5. Pistillate petals wanting; sepals strigose outside; glands linear.
 2. *D. MERCURIALINA*.
 3. *D. CYANOPHYLLA*.
 5. Pistillate petals present; sepals glabrous outside; glands not longer than wide----- 3. *D. CYANOPHYLLA*.
 4. Leaves petiolate; anther whorls obviously distinct; seeds definitely truncate at base (6).
 6. Little-branched shrub 1 to 1.9 m. high; lateral branches more than 3 mm. thick except at tip, pithy; seeds trigonous-pyramidal, truncate, 4 mm. or more long; leaves with few hairs or none--- 4. *D. BRANDEGEEI*.
 6. Freely branching low shrub up to 0.75 m. high; main stem rarely more than 3 mm. thick; seeds ovoid-truncate, 2.3 to 2.8 mm. long; leaves thickly covered with hairs, often silvery---- 5. *D. LANCEOLATA*.

1. **Ditaxis adenophora** (A. Gray) Pax and Hoffman, Pflanzenreich IV. 147^f: 65. 1912.

Argythamnia adenophora A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 294. 1870.

Agua Caliente (western Maricopa County), mouth of Williams River (Yuma-Mohave County). Western Arizona, southeastern California, and Sonora.

2. **Ditaxis mercurialina** (Nutt.) Coult., Torrey Bot. Club Mem. 5: 213. 1894.

Aphora mercurialina Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 174. 1837.

Fort Apache (Navajo County). Kansas and Texas to eastern Arizona.

3. **Ditaxis cyanophylla** Woot. and Standl., Torrey Bot. Club Bul. 36: 106. 1909.

Slate Mountain, Flagstaff, and Walnut Canyon (Coconino County), Coyote Spring near Springerville (Apache County), 5,900 to 6,500 feet, pine forests. New Mexico to southern Nevada and northern Arizona.

The flowers impart a purple color to water on boiling.

4. **Ditaxis brandegei** (Millsp.) Rose and Standl., Contrib. U. S. Natl. Herbarium 16: 13. 1912.

Argythamnia brandegei Millsp., Calif. Acad. Sci. Proc. ser. 2, 2: 220. 1889.

Tule Tank and Gila Mountains (Yuma County), dry slopes. Southwestern Arizona to Sonora(?) and Baja California.

The plant occurring in Arizona is var. *intonsa* Johnston. The plant in Arizona attains a height of 1.8 m. The flowers impart a strong purple color to water on boiling.

5. **Ditaxis lanceolata** (Benth.) Pax and Hoffman, Pflanzenreich IV. 147^f: 71. 1912.

Serophyton lanceolatum Benth., Bot. Voy Sulph. 42. 1844.

Argythamnia sericophylla A. Gray in S. Wats., Bot. Calif. 2: 70. 1880.

Southern Yavapai County to Pima and Yuma Counties, 1,400 to 2,300 feet, dry rocky slopes. Southwestern Arizona to southeastern California, Sonora, and Baja California.

Plants from excessively dry sites show a tendency to be either wholly staminate or wholly pistillate.

6. **Ditaxis neomexicana** (Muell. Arg.) Heller, Cat. North Amer. Pl. 5. 1898.

Argythamnia neomexicana Muell. Arg., Linnaea 34: 147. 1865.

Greenlee County to Mohave, Maricopa, Pinal, Pima, and (probably) Yuma Counties, 1,000 to 3,400 feet. Texas to southern Arizona, Sonora, and Baja California.

Leaves lanceolate, acute, and serrulate or entire.

7. *Ditaxis serrata* (Torr.) Heller, Cat. North Amer. Pl. 5. 1898.*Aphora serrata* Torr., U. S. and Mex. Bound. Bot. 197. 1859.*Ditaxis odontophylla* Rose and Standl., Contrib. U. S. Natl.

Herbarium 16: 12. 1912.

Yuma Mesa and Mohawk (Yuma County), 200 to 300 feet, sandy soil. Southwestern Arizona, Sonora, and Baja California.

Leaves mostly broadly cuneate-spatulate with truncate coarsely toothed apices.

5. BERNARDIA

Deciduous shrub; leaves slightly greener above, petiolate, alternate; stipules fleshy, acuminate, small; flowers dioecious; staminate flowers 2 to several in the axil of each bract of the short lateral racemiform panicles, the calyx lobes 3 or 4, the stamens 3 to 6, the filaments distinct; pistillate flowers solitary, terminal, the sepals 5, the ovary 3-celled, the ovules solitary, the styles 3, short, verrucose, bifid; seeds medium sized, not carunculate.

1. *Bernardia incana* Morton, Wash. Acad. Sci. Jour. 29: 376. 1939.

Grand Canyon (Coconino County) and southern Yavapai County, to Cochise, Pima, and Yuma Counties, 1,600 to 5,000 feet, dry rocky slopes. Arizona and southeastern California.

6. ACALYPHA

Herbs or shrubs; leaves alternate, simple, petioled; stipules small; inflorescence of terminal or axillary spikes or spiciform racemes, entirely staminate, or staminate above and pistillate below, or wholly pistillate; staminate flowers several to numerous in the axil of each bract, pedicelled, the sepals 4, the stamens 6 to 8, the filaments distinct, the anther cells linear; pistillate flowers sessile, 1 or 2 in the axil of each bract, the sepals 3, the carpels 3 or rarely 2, the ovules solitary, the styles 3, distinct, dissected into filiform segments; capsule usually 3-celled; seeds small, ovoid, with small caruncles.

Key to the species

1. Plants herbaceous, annual (2).
 2. Pistillate bracts pectinately toothed; seeds 2 to 2.3 mm. long.
 1. *A. OSTRYAEFOLIA*.
 2. Pistillate bracts shallowly toothed; seeds 1.2 to 1.4 mm. long (3).
 3. Pistillate bracts obscurely veined, evenly toothed all around.
 2. *A. INDICA*.
 3. Pistillate bracts conspicuously veined, the middle tooth markedly prolonged----- 3. *A. NEOMEXICANA*.
1. Plants shrubby or suffrutescent (4).
 4. Leaf bases cordate to truncate; pistillate bracts with 9 to 17 small obtuse teeth; inflorescence heavily covered with stipitate glands.
 4. *A. PRINGLEI*.
 4. Leaf bases broadly cuneate; pistillate bracts with not more than 6 large acute teeth; inflorescence with a few glands on the pistillate bracts only----- 5. *A. LINDHEIMERI*.

1. *Acalypha ostryaefolia* Riddell, Syn. Fl. West. States 33. 1835.

Cochise, Santa Cruz, and Pima Counties, 3,200 to about 5,000 feet, rich woods, not common. New Jersey to Florida, west to southern Arizona and Mexico.

2. *Acalypha indica* L., Sp. Pl. 1003. 1753.

Paradise and Cave Creek, Chiricahua Mountains (Cochise County), about 5,000 feet. Introduced from the Old World tropics.

3. *Acalypha neomexicana* Muell. Arg., Linnaea 34: 19. 1865.

Verde Valley (Yavapai County), Pinal Mountains (Gila County), to Cochise and Pima Counties, 3,300 to 7,400 feet. New Mexico, Arizona, and northern Mexico.

4. *Acalypha pringlei* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 373. 1885.

Quijotoa and Ajo Mountains (western Pima County), locally abundant among rocks. Southern Arizona and Sonora.

A small shrub up to about 1 m. high.

5. *Acalypha lindheimeri* Muell. Arg., Linnaea 34: 47. 1865.

Acalypha lindheimeri var. *major* Pax and Hoffman, Pflanzenreich IV. 147¹⁶: 26. 1924.

Mountains of Cochise and Pima Counties, 5,000 to 5,500 feet. Texas to southern Arizona.

The var. *major* represents a large-leaved, subglabrous variation which is too ill defined for recognition, at least with the specimens available. The neat foliage and the spikes of crimson flowers make *A. lindheimeri* an attractive plant.

7. TRAGIA

Slender, often twining, perennial herbs clothed with stinging hairs, these sometimes sparse; leaves alternate, stipulate, petiolate, simple or compound, serrate; flowers monoecious, borne in bracteate racemes disposed terminally or laterally but not in the axils; staminate flowers above, 2 to many, the sepals and stamens 3 to 5; pistillate flowers 1 or 2 below, the sepals 6, the ovary normally 3-celled, the ovules solitary; the styles 3, more or less united below, entire, rugulose to strongly papillose; seeds small, spheroidal, not carunculate.

Key to the species

1. Leaves, except the uppermost, compound, with 3 leaflets, laciniately toothed.

1. *T. LACINIATA*.

1. Leaves simple, toothed but more shortly so (2).

2. Styles 1.9 to 3.8 mm. long, nearly smooth; racemes with 2 to 4 staminate flowers; stamens mostly 4 or 5, sometimes only 3. 2. *T. STYLARIS*.

2. Styles shorter, papillose; racemes with 6 to many staminate flowers; stamens 3. 3. *T. NEPETAEFOLIA*.

1. *Tragia laciniata* (Torr.) Muell. Arg., Linnaea 34: 182. 1865.

T. urticaefolia Michaux var. ? *laciniata* Torr., U. S. and Mex. Bound. Bot. 200. 1859.

Sycamore Canyon near Ruby, Sonoita Creek, Nogales (Santa Cruz County), 3,500 to 4,000 feet, type collected "on the Sonoita" (*Wright* 1795). Southern Arizona and Sonora.

2. *Tragia stylaris* Muell. Arg., Linnaea 34: 180. 1865.

Apache County to Mohave County and northern Gila County, also in the mountains of Cochise County, 5,200 to 6,900 feet. Colorado and Texas to California and northern Mexico.

3. *Tragia nepetaefolia* Cav., Icon. Pl. 6: 37. 1801.*Tragia ramosa* Torr., Ann. Lyc. N. Y. 2: 245. 1826.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 2,500 to 7,000 feet. Texas to Arizona and Mexico.

S. RICINUS. CASTOR-BEAN

Glabrous herb, shrub, or tree; leaves long-petioled, mostly 7- to 10-lobed; stipules membranous, sheathing, caducous; inflorescence racemose or paniculate, the pistillate flowers above, the staminate ones below; staminate calyx mostly 5-lobed, the filaments united into many dendritic androphores; pistillate calyx 5-lobed, caducous, the ovary 3-celled, mostly echinate, the ovules solitary, the styles 3, bifid, papillose, red; capsule mostly echinate; seeds large, carunculate.

1. *Ricinus communis* L., Sp. Pl. 1007. 1753.

Fort Verde (Yavapai County) and pretty well naturalized near Superior (Pinal County). Introduced from Old World tropics.

A poisonous plant well known as the source of castor oil, the use of which is not confined to medicine as it is also a valuable lubricant and enjoys many minor uses. The plant is sometimes cultivated as an ornamental and to provide shade for fowl.

9. JATROPHA

Perennial herbs, or shrubs; leaves simple, alternate; stipules small or none; flowers monocious or dioecious, borne in terminal or lateral cymes, or the pistillate flowers sometimes solitary; calyx 5-lobed; petals 5, more or less connivent into a tube; stamens 8 to 10, the filaments united below into a column, the anthers in two whorls, the lower whorl of 5 and the upper one of 3 to 5 anthers; ovary 1- to 3-celled, the ovules solitary; styles 1 to 3, entire or shortly bifid; seeds large, carunculate.

Key to the species

1. Leaves palmately lobed; perennial herb----- 1. *J. MACRORHIZA*.
1. Leaves not palmately lobed except on seedlings or suckers; shrubs (2).
2. Leaf blades obovate-obcordate to spatulate, 5 to 11 mm. long, the petioles about 1 mm. long----- 4. *J. SPATHULATA*.
2. Leaf blades about as broad as long, widest near the base, mostly 2 cm. or more long at maturity, the petioles 1 cm. or more long (3).
3. Leaves glabrous, cordate-deltoid, the apex acuminate, the margin crenate.----- 2. *J. CARDIOPHYLLA*.
3. Leaves canescent at least beneath, orbicular-reniform, the margin entire.----- 3. *J. CANESCENS*.

1. *Jatropha macrorhiza* Benth., Pl. Hartw. 8. 1839.

McNary (Apache County), Cochise, Santa Cruz, and Pima Counties, 3,700 to 7,400 feet, mesas and plains. Southern New Mexico, Arizona, and Mexico.

The species is represented in Arizona by var. *septemfida* Engelm. (*J. arizonica* Johnston). The large thick root is stated to be strongly purgative.

2. *Jatropha cardiophylla* (Torr.) Muell. Arg. in DC., Prodr. 15²: 1079. 1866.

Mozinna cardiophylla Torr., U. S. and Mex. Bound. Bot. 198. 1859.

Southwestern Maricopa County and from the Rincon Mountains to the Papago Indian Reservation (Pima County), 2,000 to 3,000 feet, dry plains, mesas, and foothills. Southern Arizona and Sonora.

Sangre-de-Cristo, sangre-de-drago. A handsome shrub with shining-green heart-shaped leaves. The roots contain both tannin and a red dye and were used by the natives of Arizona and Mexico for tanning hides. The clear sap coagulates quickly on contact with air and can be used for stanching the flow of blood from slight wounds.

3. *Jatropha canescens* (Benth.) Muell. Arg. in DC., Prodr. 15²: 1079. 1866.

Mozinna canescens Benth., Bot. Voy. Sulph. 52. 1844.

A single collection by Edward Palmer, without particular locality, is the only one purporting to have come from Arizona. Sonora and Baja California.

4. *Jatropha spathulata* (Ortega) Muell. Arg. in DC., Prodr. 15²: 1081. 1866.

Mozinna spathulata Ortega, Hort. Matr. Dec. 105. 1799.

Agua Dulce and Growler Mountains and Quitobaquito (Pima County), Tule Tank and Tinajas Altas (Yuma County), about 1,000 feet, dry mesas and slopes. Southwestern Arizona, Sonora, and Baja California.

Sangre-de-drago. A much branched shrub up to 2 m. high. The Arizona plant is referred provisionally to var. *sessiliflora* (Hook. f.) Muell. Arg., but appears distinct. Detailed study of adequate material will be necessary for a final disposal. The plant is reported to have been employed in Mexico medicinally and for the manufacture of various articles from the tough, flexible stems.

10. CNIDOSCOLUS⁷⁸

Perennial herb; leaves long-petioled, the lobes attenuate and slenderly toothed; stipules thin, lacerate; cymes terminal on the stems and branches; staminate calyx white, petaloid, 5-lobed, the stamens 10, the staminodia 3, filiform, the filaments united into a column with a ring of hairs at base, the anthers in 2 whorls of 5, the glands united with the androphore just beneath the ring of hairs; pistillate calyx white, petaloid, 5-merous, the sepals distinct, caducous, the ovary 3-celled, the ovules solitary, the styles 3, connate below, twice bifid above; seeds large, carunculate.

1. *Cnidocolus angustidens* Torr., U. S. and Mex. Bound. Bot. 198. 1859.

Cochise, Santa Cruz, and Pima Counties, 2,300 to 4,000 feet, rocky slopes. Southern Arizona, Sonora, and Baja California.

Mala-mujer. A handsome plant with transparent stinging hairs from conspicuous white pustulate bases.

⁷⁸ Reference: WHEELER, L. C. PEDILANTHUS AND CNIDOSCOLUS PROPOSED FOR CONSERVATION. Gray Herbarium Contrib. 124: 47-52. 1939.

11. MANIHOT

Leaves long-petioled, 5- to 7-lobed; stipules small, subulate; inflorescence racemose; staminate flowers several to many, at the distal end of the raceme, the calyx 5-lobed, slightly inflated in bud, the stamens 10, alternately long and short; pistillate flowers few to several at base of the raceme, the calyx caducous, the ovary 3-celled, the ovules solitary; seeds large, carunculate.

Both of the species are rather rare in Arizona and are interesting chiefly because of their kinship with *M. glaziovii* Muell. Arg., the tree that produces the Ceara rubber of commerce, and with *M. utilisissima* Pohl, from which cassava, tapioca, and other foods are derived.

Key to the species

1. Primary lobes of the leaves broadly lobed toward the apex.
1. Primary lobes of the leaves lobed only at or below the middle, narrow and tapering to the apex..... 2.

1. **Manihot carthaginensis** (Jacq.) Muell. Arg. in DC., Prodr. 15²: 1073. 1866.

Jatropha carthaginensis Jacq., Stirp. Amer. 256. 1763.

Santa Catalina and Baboquivari Mountains (Pima County). Southern Arizona to northern South America.

The plant is reported to reach tree size in tropical America but is much smaller in Arizona. It has been cultivated in Bahia, Brazil, for the starch obtained from the fleshy roots. The oil of the seeds is both emetic and cathartic, hence similar to castor oil.

2. **Manihot angustiloba** (Torr.) Muell. Arg. in DC. Prodr. 15²: 1073. 1866.

Janipha manihot var. *angustiloba* Torr., U. S. and Mex. Bound. Bot. 199. 1859.

Nogales and in the Patagonia Mountains (Santa Cruz County), Rincon, Santa Catalina, Santa Rita, and Baboquivari Mountains (Pima County), 3,000 to 4,500 feet. Southern Arizona to southern Mexico.

12. STILLINGIA

Leaves alternate to subopposite, simple, exstipulate; staminate flowers borne in terminal or axillary spikes, the calyx 2-lobed, the stamens 2; pistillate flowers 1 to 6 at base of the spikes, or axillary, the styles 3, long, entire; seeds ovoid or ovoid-ellipsoid, small, the caruncle minute or none.

Key to the species

1. Plant annual or perhaps sometimes perennial; leaves 3-nerved, the margins with sharp teeth from base to apex, mostly elliptic-cuneate, the apex attenuate..... 1.
1. Plants perennial; leaves linear or nearly so, 1-nerved, the margins entire or with a few teeth near the base or the apex but not both (2).
2. Low rounded leafy bush; inflorescence little overtopping the foliage; some of the leaves with a few slender teeth near the base; filaments exerted 1 to 1.7 mm. beyond the calyx at maturity..... 2.
2. Strictly erect with few, sparsely leafy stems; inflorescence generally overtopping the foliage; leaves entire or rarely minutely serrulate near the apex; filaments exerted 0.4 to 0.6 mm. beyond the calyx at maturity.

3. *S. LINEARIFOLIA*.

1. *Stillingia spinulosa* Torr. in Emory, Mil. Recon. 151. 1848.

Stillingia ? *annua* (Torr.) Muell. Arg. in DC., Prodr. 15²: 1160. 1866.

Southwestern Yuma County, 140 to 1,300 feet, sandy deserts. Southern Nevada to southwestern Arizona and southeastern California.

2. *Stillingia paucidentata* S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 298. 1879.

Stillingia linearifolia S. Wats. var. *paucidentata* Jepson, Man. Fl. Pl. Calif. 598. 1925.

Known in Arizona only from the type collection, "Colorado Valley, near mouth of Williams River" (*Palmer* 517 in 1876). Western Arizona and southeastern California.

3. *Stillingia linearifolia* S. Wats., Amer. Acad. Arts and Sci. Proc. 14: 297. 1879.

Yucca (Mohave County), about 1,900 feet. Western Arizona, southern California, and Baja California.

13. SAPIUM

Shrub or small tree with milky sap; leaves alternate, coriaceous, serrulate; stipules triangular, oblique; staminate flowers borne in terminal spikes, the calyx 2-lobed, the stamens 2, the filaments shortly united; pistillate flowers 1 or 2 at base of the spikes, or axillary; seeds not carunculate, subspheroidal, large.

1. *Sapium biloculare* (S. Wats.) Pax, Pflanzenreich IV. 147⁵: 153, 221. 1912.

Sebastiana (?) *bilocularis* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 374. 1885.

Near Gila Bend (southwestern Maricopa County), western Pima County, 800 to 2,000 feet, sandy washes, locally abundant. Southwestern Arizona, Sonora, and Baja California.

The plant attains a height of 4.5 m. (15 feet) in Arizona. According to Pringle it was called "yerba-de-fleche" and was used by the Apaches to poison their arrows. The juice is reputedly very poisonous and causes sore eyes when introduced in the smoke of burning wood. The natives of Mexico are said to have used the juice to stupefy fish. The seeds often are infested with larvae of a small moth, which cause them to move about, roll over, or even jump a little, like the famous Mexican jumping beans obtained from *Sebastiana pavoniana* Muell. Arg.

14. EUPHORBIA.⁷⁹ SPURGE

Annual or perennial herbs; leaves simple, alternate, opposite, or whorled; flowers monoecious, borne in cyathia simulating simple flowers; pistillate flower solitary in the center of the cyathium, pedi-

⁷⁹ References: NORTON, J. B. S. NORTH AMERICAN SPECIES OF EUPHORBIA SECTION TITHYMALUS. 60 pp., pl. 11-52. 1899. (Preprint from Mo. Bot. Gard. Ann. Rpt. 11: 85-144. 1900.)

WHEELER, L. C. REVISION OF THE EUPHORBIA POLYCARPA GROUP OF THE SOUTHWESTERN UNITED STATES AND ADJACENT MEXICO. Torrey Bot. Club Bul. 63: 397-416, 429-450. 1936.

— EUPHORBIA SUBGENUS CHAMAESYCE IN CANADA AND THE UNITED STATES EXCLUSIVE OF SOUTHERN FLORIDA. Rhodora 43: 97-154, 168-205, 223-286. 1941.

cellate, naked, the ovary 3-celled, the styles 3, usually bifid; staminate flowers in 5 fascicles, 1 to several per fascicle, naked, consisting of a pedicel jointed to the filament, the fascicles opposite the lobes of the involucre; both kinds of flowers surrounded by a hypanthium or calyxlike involucre bearing on its margin 1 to 5 nectariferous glands of various shapes alternating with the lobes of the involucre, with petaloid appendages often extending from beneath the glands; fruit a 3-celled, 3-seeded, elastically dehiscent, usually nodding capsule.

The milky acrid juice of some of the species causes dermatitis in susceptible persons, and in horses. The fresh plants are rarely eaten by livestock, but when present in hay they are reported to be toxic to cattle. *E. hirta* is an official drug plant, used in treating asthma and bronchitis. Certain prostrate species, such as *E. albomarginata*, are known as rattlesnake-weed, and by the Mexicans as golondrina. Species with this habit of growth are useful soil binders. They are popularly supposed to be efficacious in treating snake bite and the root of *E. albomarginata* is said to have been used as an emetic by the Pima Indians. The showy *E. marginata*, snow-on-the-mountain, is often cultivated as an ornamental, and its juice has been used in Texas in branding cattle. The cultivated poinsettia (*E. pulcherrima*), with bright red floral bracts, is a favorite Christmas plant.

Key to the species

1. Glands of the involucre without petaloid appendages, deeply cupped if the leaves below the inflorescence are opposite; leaves essentially symmetric (2).
2. Glands of the involucre either deeply cupped, or concealed by the inflexed linear segments of the margin; stem never branching into a symmetrical 3- to several-rayed inflorescence: Subgenus *Poinsettia* (3).
 3. Stems few to several from a thickened perennial root; cyathia in compact terminal cymes subtended by colored floral leaves, the flowering stems otherwise bearing only reduced bracteal leaves, the leafy shoots appearing later; capsules 6 to 7 mm. long.----- 1. *E. RADIANS*.
 3. Stems solitary from slender annual roots; terminal cymes subtended by leaves usually undifferentiated in color from the ordinary foliage; shoots not dimorphic; capsules 5 mm. long or shorter (4).
 4. Capsules scarcely lobed, plainly longer than thick; seeds markedly wider than thick; caruncle obvious and stipitate; glands concealed by 5 to 7 inflexed strigose segments.----- 2. *E. ERIANTHA*.
 4. Capsules strongly 3-lobed, plainly wider than long; seeds not markedly flattened dorsiventrally; caruncle minute and sessile, or wanting; glands naked (5).
 5. Leaves mostly opposite throughout, mostly slightly to coarsely many-toothed; stems mostly strigose; seeds mostly 2.6 to 2.8, rarely up to 3.1 mm. long.----- 3. *E. DENTATA*.
 5. Leaves alternate between the first pair of secondary leaves and those at the stem tip, essentially entire, or, if serrulate, then also with 1 or 2 pairs of upwardly projecting lobes; stems not strigose; seeds mostly 3 to 3.4 (rarely only 2.7) mm. long.----- 4. *E. HETEROPHYLLA*.
2. Glands of the involucre flat or convex, never concealed; leaves alternate below, in a single whorl beneath the pleiochasium (cyme resembling an umbel), opposite in the symmetrically forking inflorescence: Subgenus *Esula* (6).
 6. Involucral glands entire, elliptic; capsule verrucose to papillate; seeds reticulate, brown to nearly black; leaves serrulate; plants annual or biennial (7).
 7. Plants mostly 10 to 35 cm. high; capsules verrucose; terminal pleiochasium in mature plants mostly one-fourth to one-third of the total length of the plant.----- 5. *E. DICTYOSPERMA*.
 7. Plants mostly 28 to 60 cm. high; capsules papillate, the papillae up to 0.5 mm. long; terminal pleiochasium one-tenth to one-fifth of the total length of the mature plant.----- 6. *E. ALTA*.

6. Involucral glands either dentate or with horns and lunate; capsule smooth or hairy but never verrucose or papillate; seeds not obviously reticulate but often mottled or rugulose, usually grayish; leaves nearly always entire; plants perennial (8).
8. Stems robust, strictly erect, mostly 2 to 5 mm. thick at the base, mostly 30 to 55 cm. high, with densely leafy sterile branches on the upper half below the whorled leaves; stem leaves narrowly oblong to oblong-lanceolate, glabrous, glaucous, subsessile; capsule 4 to 5 mm. long; seeds truncate at base----- 7. *E. CHAMAESULA*.
8. Stems mostly either shorter or more slender, without sterile leafy branches; stem leaves various, often pubescent or papillate; capsule often shorter; seeds rounded at base (9).
9. Stem leaves either elliptic and tapering equally to the acute apex and the petioled base, or (at least the upper ones) widest well below the middle; leaf epidermis not papillate (10).
10. Stem leaves, at least the upper ones, widest near the base, subcordate, subsessile----- 13. *E. ROBUSTA*.
10. Stem leaves elliptic and tapering equally to the acute apex and the petioled base; stems mostly slender (about 1.5 mm. thick), mostly numerous and often sinuous (11).
11. Glands irregularly toothed all along the margin, without horns exceeding the teeth----- 10. *E. INCISA*.
11. Glands with sharp horns about one-half as long as the gland, otherwise essentially entire (12).
12. Stems more than 20 cm. long; rays commonly repeatedly branched, often forming a dense inflorescence in age.
8. *E. BRACHYCERA*.
12. Stems only about 20 cm. long; rays commonly once or twice forked----- 9. *E. ODONTADENTA*.
9. Stem leaves either orbicular to elliptic-oblong and obtuse, or obviously widest above the middle; leaf epidermis often papillate (13).
13. Rays of the pleiochasium mostly 3; first pair of floral leaves often deltoid, usually longer than wide; leaf epidermis not papillate.
8. *E. BRACHYCERA*.
13. Rays of the pleiochasium mostly 5; floral leaves all broadly rounded; leaf epidermis usually papillate (14).
14. Stem leaves mostly oblong to suborbicular; floral leaves wider than long----- 11. *E. PALMERI*.
14. Stem-leaves spatulate to oblanceolate; floral leaves about as wide as long----- 12. *E. LURIDA*.
1. Glands of the involucre with petaloid appendages or, if the appendages wanting, the leaves all strictly opposite and with inequilateral bases (15).
15. Leaves alternate, opposite, or even whorled, symmetric at base; stipules glandlike or none; Subgenus *Agaloma* (16).
16. Stems branched above into a 3- (rarely 4-) rayed, essentially symmetric pleiochasium; floral leaves with broad white margins.
14. *E. MARGINATA*.
16. Stems often forking above, never branching into a cyme with more than 2 branches; floral leaves green throughout (17).
17. Plant perennial with a thickened root; seeds smooth, ovoid.
15. *E. PLUMMERAE*.
17. Plant annual with slender roots; seeds definitely angled (18).
18. Leaves all entire; appendages all symmetrically bifid to the base; seeds often dull black----- 16. *E. BILOBATA*.
18. Leaves, at least some of them, serrulate to serrate; appendages entire to irregularly toothed; seeds brown to sordid white.
17. *E. EXSTIPULATA*.
15. Leaves all strictly opposite, usually strongly inequilateral at base; stipules mostly well developed, always evident in species with symmetric leaves; Subgenus *Chamaesyce* (19).
19. Ovary and capsule pubescent (20).
20. Plant perennial but flowering the first year; staminate flowers 16 to 60 (rarely as few as 15 in *E. melanadenia*); appendages never markedly unequal; involucre never urceolate (21).
21. Cyathia borne in dense glomerules, a few sometimes also solitary in the upper forks; leaves often serrate----- 23. *E. CAPITELLATA*.
21. Cyathia solitary in the axils and at the tips of the branches; leaves always entire (22).

22. Seeds scarcely angled, narrowly ovoid, encircled by 4 or 5 rounded ridges----- 32. *E. PEDICULIFERA*.
22. Seeds quadrangular, at most slightly wrinkled (23).
23. Herbage with short, straight, spreading hairs; appendages as narrow as the (usually) pink or red glands: Var. *hirtella*.
30. *E. POLYCARPA*.
23. Herbage with appressed curly hairs; appendages usually much wider than the dark purple glands.--- 31. *E. MELANADENIA*.
20. Plant annual (except *E. arizonica* with an urceolate involucre); staminate flowers up to 12 or, if as many as 15, 1 pair of the appendages more than twice as long as the other (24).
24. Involucres urceolate; appendages essentially equal, more than twice as wide as the glands (25).
25. Appendages entire to crenulate; hairs mostly clavate; plant perennial----- 35. *E. ARIZONICA*.
25. Appendages deeply parted into a few attenuate segments; hairs tapering; plant annual----- 36. *E. SETILOBA*.
24. Involucres obconic to campanulate; appendages less than twice as wide as the glands, or 1 pair more than twice as long as the other (26).
26. Cyathia borne in dense axillary and terminal leafless glomerules.
24. *E. HIRTA*.
26. Cyathia solitary or on short leafy lateral branchlets (27).
27. Appendages (the 2 proximal ones) greatly prolonged, often concealing the capsule----- 41. *E. INDIVISA*.
27. Appendages (proximal and distal) without marked disparity in size (28).
28. Seeds punctately pitted and mottled, depressed-truncate at base, sharply acute at apex; styles entire, or sometimes emarginate; capsule more heavily pubescent at base than elsewhere----- 42. *E. STICTOSPORA*.
28. Seeds not punctately pitted or mottled, obtuse at base, not sharply acute at apex; styles bifid; pubescence of the capsule either uniform, or more abundant on the angles (29).
29. Glands without appendages; seeds smooth; leaves entire; plant usually glabrous or, if not, then the pubescence short, straight, and spreading--- 40. *E. MICROMERA*.
29. Glands appendiculate; seeds variously ridged; leaves often serrulate; plants always somewhat covered with long and weak, crisped or appressed hairs (30).
30. Seeds with sharp transverse ridges; capsules with crisped spreading hairs confined mainly to the external angles.
44. *E. CHAMAESYCE*.
30. Seeds with rounded transverse ridges; capsules evenly strigose----- 43. *E. SUPINA*.
19. Ovary and capsule glabrous (31).
31. Leaves linear, symmetric; herbage glabrous; plants annual, mostly erect (32).
32. Capsules sharply 3-angled, 1.3 to 1.4 mm. long; staminate flowers 5 to 12 per cyathium; involucre 0.5 to 1 mm. in diameter; delicate plants with capillary ultimate branchlets (33).
33. Seeds smooth; involucre 0.5 to 0.7 mm. in diameter; appendages usually longer than the glands; ultimate branchlets about 0.1 mm. in diameter; longest leaves usually shorter than 1 cm.
33. *E. GRACILLIMA*.
33. Seeds transversely wrinkled or ridged; involucre 0.9 to 1 mm. in diameter; appendages not longer than the glands; ultimate branchlets 0.15 to 0.25 mm. in diameter; longest leaves rarely as short as 1 cm----- 34. *E. REVOLUTA*.
32. Capsules roundly 3-lobed to bluntly 3-angled, 2 to 2.5 mm. long; staminate flowers numerous; involucre 1.4 to 2 mm. in diameter; plants coarser (34).
34. Leaves entire, less than 3 cm. long; appendages narrow, never reddish; seeds smooth, ovoid-triangular----- 20. *E. PARRYI*.
34. Leaves sharply but remotely serrulate, up to 6 cm. long; appendages often reddish in age, 1 to 2.8 mm. long; seeds with 2 (or 3) low transverse ridges, the dorsal and lateral angles slightly winged----- 21. *E. FLORIDA*.

31. Leaves rarely linear, inequilateral at base; herbage sometimes pubescent; plants annual or perennial, often prostrate (35).
35. Capsules more than 3 mm. long (36).
36. Capsules about 4 mm. long; seeds nearly flat on the inner face, rounded on the outer; leaves entire, up to 1 cm. long.
18. *E. PLATYSPERMA.*
36. Capsules 3.1 to 3.3 mm. long; seeds quadrangular; leaves serrulate at least at the apex, 1 to 4 cm. long--- 22. *E. TRACHYSPERMA.*
35. Capsules shorter than 3 mm. (37).
37. Stipules united into a glabrous, membranaceous scale; nodes often rooting; leaves entire; herbage glabrous; seeds smooth (38).
38. Plant perennial, common; staminate flowers 12 or more.
27. *E. ALBOMARGINATA.*
38. Plant annual, rare; staminate flowers 5 to 10.-- 28 *E. SERPENS.*
37. Stipules not united into a glabrous, membranaceous scale; nodes not rooting; leaves sometimes serrulate; herbage sometimes pubescent; seeds often wrinkled or ridged (39).
39. Capsules 2 mm. long or longer (40).
40. Leaves (the longer ones) considerably more than 15 mm. long.
25. *E. HYSSOPIFOLIA.*
40. Leaves not more than 15 mm. long, mostly shorter (41).
41. Plants pilose; leaves serrulate----- 45. *E. SERRULA.*
41. Plants entirely glabrous; leaves entire (42).
42. Seeds ovoid or obscurely angled; glands circular or nearly so, the appendages absent: *Var. arenicola.*
19. *E. OCELLATA.*
42. Seeds quadrangular; glands transversely oblong, the appendages present----- 29. *E. FENDLERI.*
39. Capsules shorter than 2 mm. (43).
43. Cyathia in dense terminal glomerules, a few also sometimes solitary in the upper axils; plant perennial but flowering the first year----- 23. *E. CAPITELLATA.*
43. Cyathia solitary in the axils and at the tips of the branches (44).
44. Seeds with definite regular transverse ridges, these usually passing through the angles (45).
45. Plants erect; leaves mostly 15 mm. or longer; seeds with shallow concave depressions separated by low narrow ridges----- 25. *E. HYSSOPIFOLIA.*
45. Plants mostly prostrate; leaves rarely up to 15 mm. long; seeds with rounded transverse ridges as wide as or wider than the valleys between (46).
46. Seeds radially ovate; capsule widest below the middle; herbage always glabrous-- 38. *E. GLYPTOSPERMA.*
46. Seeds radially oblong-ovate to oblong; capsule widest at the middle; herbage (at least the stems) often pubescent----- 39. *E. ABRAMSIANA.*
44. Seeds smooth to faintly or even strongly wrinkled but never with definite transverse ridges (47).
47. Leaves always entire; stems wingless (48).
48. Plant perennial but flowering the first year; glands transversely elongate, the appendages present but often narrow----- 30. *E. POLYCARPA.*
48. Plant annual; glands circular or nearly so, the appendages absent----- 40. *E. MICROMERA.*
47. Leaves mostly serrulate, if nearly entire then the stems more or less winged (49).
49. Herbage more or less pubescent; leaves often wider below the middle and tapering to the apex; seeds reticulately wrinkled to nearly smooth, the testa dark gray under the whitish outer coat.
26. *E. VERMICULATA.*
49. Herbage wholly glabrous; leaves widest at or above the middle; seeds more or less wrinkled but never reticulately so, the testa tan to brown under the whitish outer coat----- 37. *E. SERPYLLIFOLIA.*

1. Euphorbia radians Benth., Pl. Hartw. 8. 1839.

Poinsettia radians (Benth.) Klotzsch and Garcke, Monatsber. Preuss. Akad. Wiss. Phys.-Math. Kl. 1859: 253. 1859.

Huachuca Mountains (Cochise County), Rosemont and south of the Santa Rita Mountains (Pima County). Western Texas to southern Arizona and Mexico.

2. Euphorbia eriantha Benth., Bot. Voy. Sulph. 51. 1844.

Poinsettia eriantha (Benth.) Rose and Standl., Contrib. U. S. Natl. Herbarium 16: 13. 1912.

Graham, Maricopa, Pinal, Pima, and Yuma Counties. 300 to 3,700 feet, dry hot slopes and canyons. Texas to southeastern California and northern Mexico.

3. Euphorbia dentata Michx., Fl. Bor. Amer. 2: 211. 1803.

Poinsettia dentata (Michx.) Klotzsch and Garcke, Monatsber. Preuss. Akad. Wiss. Phys.-Math. Kl. 1859: 253. 1859.

Euphorbia dentata var. *rigida* Engelm. in Torr., U. S. and Mex. Bound. Bot. 190. 1859.

Greenlee, Cochise, Santa Cruz, and Pima Counties, 3,000 to 8,000 feet. Eastern United States to Utah, southern Arizona, and Mexico.

The var. *cuphosperma* Engelm. has been collected in southern Apache, Cochise, Santa Cruz, and Pima Counties, type from Cochise County (Wright in 1851). It differs from the species in having sharply quadrangular seeds, strigose capsules, and shallowly toothed to entire often lanceolate to linear leaves, whereas the typical form has ovoid seeds, glabrous capsules, and generally coarsely toothed, mostly ovate-lanceolate to obovate-cuneate leaves. The var. *gracillima* Millsp. is unworthy of recognition. It is intermediate between var. *cuphosperma* and the species. The type came from Bowie.

4. Euphorbia heterophylla L., Sp. Pl. 453. 1753.

Poinsettia heterophylla Klotzsch and Garcke, Monatsber. Preuss. Akad. Wiss. Phys.-Math. Kl. 1859: 253. 1859.

Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,200 feet. Southeastern United States to southern Arizona, south to tropical America.

Painted spurge. The plants referred here differ in the angled seeds from the plants to which the name is usually applied. The Arizona plants may represent another, perhaps undescribed, species but decision must await a careful revision of a group of plastic tropical species. The floral leaves are often partly colored pink or red.

5. Euphorbia dictyosperma Fisch. and Meyer, Index Sem. Hort. Petrop. 2: 37. 1836.

Euphorbia arkansana Engelm. and Gray, Boston Jour. Nat. Hist. 5: 261. 1845.

Euphorbia arkansana var. *missouriensis* Norton, North Amer. Euphorbia sect. Tithymalus 19. 1899.

Euphorbia arkansana var. *atrosemina* Norton, ibid. p. 21.

Tithymalus missouriensis (Norton) Small, Fl. Southeast. U. S. 721, 1334. 1903.

Tithymalus dictyospermus Heller, Muhlenbergia 1: 56. 1904.

Yavapai, Gila, Pinal, and Pima Counties, 1,300 to 5,000 feet. Widely distributed in the United States and northern Mexico.

Doubtfully distinct from the South American *Euphorbia spathulata* Lam.

6. **Euphorbia alta** Norton, North Amer. Euphorbia sect. Tithymalus 24. 1899.

Tithymalus altus (Norton) Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 145. 1913.

White Mountains (Apache County), Huachuca and Chiricahua Mountains (Cochise County), Santa Catalina and Santa Rita Mountains (Pima County), up to 8,000 feet. New Mexico, Arizona, and Mexico.

7. **Euphorbia chamaesula** Boiss., Cent. Euphorb. 38. 1860.

Euphorbia esulaeformis S. Schauer var.? *subdentata* Engelm. in Torr., U. S. and Mex. Bound. Bot. 192. 1859.

Euphorbia chamaesula Boiss. var. *subdentata* (Engelm.) Norton, North Amer. Euphorbia sect. Tithymalus 47. 1899.

Tithymalus chamaesula Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 145. 1913.

Apache, Navajo, and Coconino Counties to Cochise and Pima Counties, 5,500 to 8,700 feet. New Mexico, Arizona, and Mexico.

8. **Euphorbia brachycera** Engelm. in Torr., U. S. and Mex. Bound. Bot. 192. 1859.

Tithymalus brachycerus Small, Fl. Southeast. U. S. ed. 2, 1349, 1375. 1913.

Chiricahua, Mule, and Huachuca Mountains (Cochise County). Texas to southeastern Arizona and Chihuahua.

9. **Euphorbia odontadenia** Boiss. in DC., Prodr. 15²: 148. 1862.

Segi Canyon (Navajo County). Otherwise known from the region of El Paso, Tex.

An uncertain entity closely allied to *E. incisa*.

10. **Euphorbia incisa** Engelm. in Ives, Colo. River Rpt. 4: 27. 1860.

Euphorbia schizoloba Engelm., Amer. Acad. Arts and Sci. Proc. 5: 173. 1861.

Tithymalus schizolobus Norton in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 343. 1925.

Coconino, Mohave, Gila, Maricopa, and Pinal Counties, 3,000 to 7,000 feet, type from Railroad Pass, Cerbat Mountains, Mohave County (*Newberry* in 1858). Nevada, Arizona, and California.

The var. *mollis* (Norton) L. C. Wheeler (*E. schizoloba* var. *mollis* Norton, *E. yaquiana* Tidestrom), occurs in Yavapai, Graham, Gila, Cochise, and Pima Counties, ascending to 9,200 feet, type from the Santa Catalina Mountains (*Pringle* in 1881). It is distinguished from the species in being pubescent throughout and usually more robust, intergrading with *E. palmeri* var. *subpubens* and with *E. robusta*.

11. **Euphorbia palmeri** Engelm. in S. Wats., Bot. Calif. 2: 75. 1880.

Tithymalus palmeri Abrams, Fl. Los Angeles 216. 1917.

Euphorbia palmeri var. *pepfolia* Norton, North Amer. Euphorbia sect. Tithymalus 41. 1899.

Williams, Flagstaff, and San Francisco Peaks (Coconino County). Utah and northern Arizona to California.

The var. *subpubens* (Engelm.) L. C. Wheeler (*E. subpubens* Engelm., *Tithymalus subpubens* Norton), has a wider range in Arizona than the typical form, occurring in the mountains of Coconino, Yavapai, Gila, and Pima Counties, type from Prescott (*Palmer* 112 in 1876). It differs from the species mainly in being pubescent. The specimens from Gila and Pima Counties are not typical.

12. *Euphorbia lurida* Engelm. in Ives, Colo. River Rpt. 4: 26. 1860.

Euphorbia lurida var. *pringlei* Norton, North Amer. Euphorbia sect. Tithymalus 39. 1899.

Tithymalus luridus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 145. 1913.

Tithymalus luridus pringlei Norton in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 343. 1925.

Apache, Coconino, Yavapai, Greenlee, Graham, and Cochise Counties, 3,500 to 7,000 feet. Southern Utah, New Mexico, and Arizona.

13. *Euphorbia robusta* (Engelm.) Small in Britton and Brown, Illus. Fl. 2: 381. 1897.

Euphorbia montana Engelm. var. *robusta* Engelm. in Torr. U. S. and Mex. Bound. Bot. 192. 1859.

Euphorbia montana Engelm., *ibid.* Not Raf., 1817.

Tithymalus robustus Small in Rydb., Colo. Agr. Expt. Sta. Bul. 100: 224. 1906.

Tithymalus montanus Small, *ibid.*

Tithymalus philorus Cockerell, Muhlenbergia 4: 56. 1908.

Camp Grant (Graham County), Mazatzal Mountains (Gila County), 4,800 to 5,500 feet. South Dakota, Montana, and Utah to New Mexico and Arizona.

14. *Euphorbia marginata* Pursh, Fl. Amer. Sept. 2: 607. 1814.

Dichrophyllum marginatum (Pursh) Klotzsch and Gareke, Abhandl. Preuss. Akad. Wiss. Phys.-Math. Kl. 1859: 44. 1860.

Gila Valley (Graham? County), Fort Huachuca (Cochise County). Montana south to southern Mexico, widely introduced east of the Mississippi River.

Snow-on-the-mountain. Three different collectors found this in Arizona before 1900, but no recent collections seem to have been made.

15. *Euphorbia plummerae* S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 195. 1883.

Known, in Arizona, only from the type collection from Tanner Canyon, Huachuca Mountains, Cochise County (*Lemmon* 2874). Southeastern Arizona, Chihuahua, and Sonora.

16. *Euphorbia bilobata* Engelm. in Torr., U. S. and Mex. Bound. Bot. 190. 1859.

Zygophyllidium bilobatum Standl., Contrib. U. S. Natl. Herbarium 13: 199, 227. 1910.

Yavapai, Greenlee, Cochise, and Santa Cruz Counties, 3,600 to 6,000 feet. Western Texas to Arizona.

17. *Euphorbia exstipulata* Engelm. in Torr., U. S. and Mex. Bound. Bot. 189. 1859.

Zygophyllidium exstipulatum Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 146. 1913.

Coconino, Mohave, Cochise, and Pima Counties, 4,200 to 5,900 feet. New Mexico, Arizona, and northern Mexico.

- *18. *Euphorbia platysperma* Engelm. ex S. Wats., Bot. Calif. 2: 482. 1880.

Euphorbia eremica Jepson, Man. Fl. Pl. Calif. 600. 1925.

An extremely rare species known only from the type, collected by Edward Palmer in 1869 "near the mouth of the Colorado River, Arizona," and from a single collection by Jepson in the Colorado Desert, California. The plant may not occur in Arizona but should be sought in the Yuma region.

19. *Euphorbia ocellata* Dur. and Hilg., Acad. Nat. Sci. Phila. Jour. ser. 2, 3: 46. 1855.

Virgin River, Mohave County, about 1,500 feet (*Purpus* 6187).

The Arizona plant is var. *arenicola* (Parish) Jepson (*E. arenicola* Parish), which ranges from Utah to southeastern California.

20. *Euphorbia parryi* Engelm., Amer. Nat. 9: 350. 1875.

Euphorbia flagelliformis Engelm. in T. S. Brandeg., U. S. Geol. Geog. Survey Terr. Bul. 2: 243. 1876.

Chamaesyce flagelliformis Rydb., Colo. Expt. Sta. Bul. 100: 223. 1906.

Chamaesyce parryi Rydb., Torrey Bot. Club Bul. 40: 53. 1913.

Apache County to northern Mohave County, south to Graham and Cochise Counties, 1,600 to 5,500 feet, sandy soil. Colorado and western Texas to California and Chihuahua.

21. *Euphorbia florida* Engelm. in Torr., U. S. and Mex. Bound. Bot. 189. 1859.

Chamaesyce florida Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 409. 1916.

Yavapai, Graham, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,000 feet, type from west of the Chiricahua Mountains, Cochise County (*Wright* in 1851). Arizona and north-western Mexico.

22. *Euphorbia trachysperma* Engelm. in Torr., U. S. and Mex. Bound. Bot. 189. 1859.

Chamaesyce trachysperma Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 412. 1916.

Maricopa (Pinal County), San Pedro River valley (Cochise County), Tucson (Pima County), near La Paz (Yuma County), very rare, 300 to 4,000 feet, type from along the San Pedro River (*Wright* 1832). Southern Arizona and Sonora.

23. *Euphorbia capitellata* Engelm. in Torr., U. S. and Mex. Bound. Bot. 188. 1859.

Euphorbia pycnanthema Engelm., *ibid.*

Euphorbia rusbyi Greene, Calif. Acad. Sci. Bul. 2: 57. 1886.

Chamaesyce capitellata Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 408. 1916.

Chamaesyce pycnanthema Millsp., *ibid.* p. 411.

Chamaesyce rusbyi Millsp., *ibid.*

Throughout the State except the lower western desert and north-eastern portion, 1,500 to 5,000 feet, type of *E. capitellata* from San Bernardino, Cochise County (*Wright* in 1851), type of *E. rusbyi* from northern Arizona (*Rusby* in 1883). Western Texas to Arizona and northern Mexico.

24. *Euphorbia hirta* L., Sp. Pl. 454. 1753.

Euphorbia pilulifera L., var. *discolor* Engelm. in Torr., U. S. and Mex. Bound. Bot. 188. 1859.

Euphorbia pilulifera L., *sensu* many authors.

Chamaesyce hirta (L.) Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 303. 1909.

Cochise, Santa Cruz, and Pima Counties, 3,200 to 4,900 feet. Florida, Texas, and southern Arizona, southward to Argentina.

25. *Euphorbia hyssopifolia* L., Syst. Nat. ed. 10, 2: 1048. 1759.

Euphorbia jonesii Millsp., Pittonia 2: 89. 1890.

Chamaesyce hyssopifolia Small, N. Y. Bot. Gard. Bul. 3: 429. 1905.

Chamaesyce jonesii Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 410. 1916.

Yavapai, Graham, Gila, and eastern Maricopa Counties, where infrequent, Santa Cruz, Cochise, and eastern Pima Counties, where common, 1,200 to 6,000 feet, type of *E. jonesii* from Bowie, Cochise County (*Jones* 4247). Southern Florida, western Texas to Arizona, south to South America.

26. *Euphorbia vermiculata* Raf., Amer. Month. Mag. 2: 119. 1817, and *op. cit.* 206. 1818.

Chamaesyce vermiculata House, N. Y. State Museum Bul. 233-234: 8. 1922.

Mountains of Apache, Navajo, Gila, and Cochise Counties, about 6,000 feet. Nova Scotia to Pennsylvania and west to Michigan, probably introduced in British Columbia, New Mexico, and Arizona.

Chamaesyce rothrockii Millsp., type from Crittenden, Santa Cruz County (*Rothrock* 672), is intermediate between *E. vermiculata* and *E. maculata* L., as are some of the collections included above. No true *E. maculata* has been seen from Arizona.

27. *Euphorbia albomarginata* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2^d: 174. 1855.

Chamaesyce albomarginata Small, Fl. Southeast. U. S. 710, 1333. 1903.

Throughout the State except the extreme northern, northeastern, and southwestern portions, 1,000 to 6,000 feet, often common on clay and loam flats. Oklahoma to California and northern Mexico.

28. Euphorbia serpens H. B. K., Nov. Gen. et Sp. 2: 52. 1817.

Chamaesyce serpens Small, Fl. Southeast. U. S. 709, 1333. 1903.

Santa Cruz River at La Noria, Santa Cruz County, about 4,900 feet (Mearns 1192). Ontario and Montana, south to South America.

29. Euphorbia fendleri Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2²: 175. 1855.

Chamaesyce fendleri Small, Fl. Southeast. U. S. 710, 1333. 1903.

Apache County to Mohave and Yavapai Counties, also at Dragoon (Cochise County), 4,000 to 7,000 feet. Nebraska to Texas, west to California.

The var. *chaetocalyx* Boiss. (*Chamaesyce chaetocalyx* Woot. and Standl.) occurs in most of the range of the species in Arizona, intergrading with the typical form in Navajo and Coconino Counties.

30. Euphorbia polycarpa Benth., Bot. Voy. Sulph. 50. 1844.

Chamaesyce polycarpa (Benth.) Millsp. in Parish, Cat. Pl. Salton Sink 6. 1913.

Mohave, southern Yavapai, Maricopa, Pima, and Yuma Counties, 600 to 2,800 feet, sandy or gravelly plains and mesas. Nevada to Sonora, California, and Baja California.

A pubescent variant, var. *hirtella* Boiss. (*Chamaesyce tonsita* Millsp.) occurs in Mohave and Yuma Counties, intergrading with the species, which is glabrous.

31. Euphorbia melanadenia Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 135. 1857.

Euphorbia polycarpa var. *vestita* S. Wats., Bot. Calif. 2: 73. 1880.

Chamaesyce melanadenia Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 410. 1916.

In the entire southwestern half of the State, eastward to Gila County, 500 to 4,900 feet, common on dry sunny foothills, often among shrubs. Arizona, southern California, Sonora, and Baja California.

The plants are generally erect or ascending, but on open flats, particularly in disturbed soil, they may be nearly prostrate.

32. Euphorbia pediculifera Engelm. in Torr., U. S. and Mex. Bound. Bot. 186. 1859.

Chamaesyce pediculifera Rose and Standl., Contrib. U. S. Natl. Herbarium 16: 12. 1912.

Euphorbia vermiformis M. E. Jones, Contrib. West. Bot. 16: 23. 1930.

Southern Yavapai, Maricopa, Pinal, Cochise, Santa Cruz, Pima, and Yuma Counties, 500 to 4,000 feet. Arizona, southeastern California, and northwestern Mexico.

Specimens from the deserts at low altitude often simulate *Euphorbia melanadenia* in pubescence and leaf size, but the ovoid-oblong seeds, encircled by 4 or 5 ridges, of *E. pediculifera* are readily distinguishable

from the quadrangular and smooth, or nearly smooth, seeds of *E. melanadenia*.

- 33. *Euphorbia gracillima*** S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 438. 1886.

Chamaesyce gracillima (S. Wats.) Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 409. 1916.

Tucson Mountains, San Solano, and Sells (Pima County), 2,000 to 2,500 feet. Southern Arizona to Sinaloa.

- 34. *Euphorbia revoluta*** Engelm. in Torr., U. S. and Mex. Bound. Bot. 186. 1859.

Chamaesyce revoluta Small, Fl. Southeast. U.S. 711, 1333. 1903.

Coconino, Mohave, Yavapai, Gila, Cochise, Santa Cruz, and Pima Counties, 3,200 to 5,900 feet. Colorado to Arizona and Chihuahua.

- 35. *Euphorbia arizonica*** Engelm. in Torr., U. S. and Mex. Bound. Bot. 186. 1859.

Euphorbia versicolor Greene, Bot. Gaz. 6: 184. 1881.

Chamaesyce arizonica Arthur, Torrey 11: 260. 1911.

Chamaesyce versicolor Norton, Contrib. U. S. Natl. Herbarium 25: 345. 1925.

Grand Canyon (Coconino County), Yucca (Mohave County), and in Greenlee, Graham, Gila, Maricopa, Santa Cruz, Pima, and Yuma Counties, 1,000 to 4,200 feet, type from Arizona (*Schott* in 1856). Texas to southeastern California and northern Mexico.

- 36. *Euphorbia setiloba*** Engelm. ex Torr., U. S. Rpt. Expl. Miss. Pacif. 5: 364. 1857.

Chamaesyce setiloba Millsp. in Parish, Cat. Pl. Salton Sink 6. 1913.

Greenlee and Cochise Counties to Mohave and Yuma Counties, 1,000 to 5,000 feet. Western Texas to California and northwestern Mexico.

- 37. *Euphorbia serpyllifolia*** Pers., Syn. Pl. 2: 14. 1806.

Chamaesyce serpyllifolia Small, Fl. Southeast. U. S. 712, 1333. 1903.

Chamaesyce rugulosa (Engelm.) Rydb., Torrey Bot. Club Bul. 33: 145. 1906.

Chamaesyce neomexicana (Greene) Standl., Contrib. U. S. Natl. Herbarium 13: 199, 227. 1910.

Apache County to Mohave and Yavapai Counties, southeastward to Cochise and Santa Cruz Counties, 3,000 to 7,200 feet. Widely distributed in western North America, from Alberta to Mexico.

- 38. *Euphorbia glyptosperma*** Engelm. in Torr., U. S. and Mex. Bound. Bot. 187. 1859.

Chamaesyce glyptosperma Small, Fl. Southeast. U. S. 712, 1333. 1903.

Apache County to eastern Coconino County (House Rock), 5,000 to 7,500 feet. New Brunswick to British Columbia, south to Texas and northeastern Arizona.

39. **Euphorbia abramsiana** L. C. Wheeler, South. Calif. Acad. Sci. Bul. 33: 109. 1934.

Yavapai, Maricopa, Pinal, Pima, and Yuma Counties, 140 to 3,000 feet. Arizona, southeastern California, and northwestern Mexico.

40. **Euphorbia micromera** Boiss. ex Engelm., Amer. Acad. Arts and Sci. Proc. 5: 171. 1861.

Euphorbia pseudoserpyllifolia Millsp., Pittonia 2: 87. 1890.

Chamaesyce micromera Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 144. 1913.

Chamaesyce pseudoserpyllifolia Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 411. 1916.

Navajo County to Cochise and Pima Counties, 500 to 5,000 feet, type from near the San Pedro River, Cochise County (*Wright* in 1851). Western Texas to Utah, southeastern California, and northern Mexico.

41. **Euphorbia indivisa** (Engelm.) Tidestrom, Biol. Soc. Wash. Proc. 48: 41. 1935.

Euphorbia dioeca H. B. K. var.? *indivisa* Engelm. in Torr., U. S. and Mex. Bound. Bot. 187. 1859.

Chamaesyce indivisa Millsp., Field Museum Nat. Hist. Bot. Ser. 2: 387. 1914.

Near Prescott (Yavapai County), to Cochise, Santa Cruz, and Pima Counties, 2,600 to 5,000 feet. Western Texas to Arizona and northern Mexico.

42. **Euphorbia stictospora** Engelm. in Torr., U. S. and Mex. Bound. Bot. 187. 1859.

Chamaesyce stictospora Small, Fl. Southeast. U. S. 714, 1334. 1903.

Mountains of Cochise, Santa Cruz, and Pima Counties, 3,600 to 5,500 feet. South Dakota and Wyoming to Arizona, Durango, and Zacatecas.

43. **Euphorbia supina** Raf., Amer. Month. Mag. 2: 119. 1817.

Euphorbia maculata of authors. Not of L.

Near Metcalf (Greenlee County), Devil's Canyon (Gila County), Tucson (Pima County). Eastern United States to North Dakota and Texas, introduced here and there farther west.

44. **Euphorbia chamaesyce** L., Sp. Pl. 455. 1753.

Euphorbia prostrata Ait., Hort. Kew 2: 139. 1789.

Chamaesyce prostrata Small, Fl. Southeast. U. S. 713, 1333. 1903.

Eight miles west of Florence (Pinal County), Santa Cruz River at La Noria (Santa Cruz County), Tucson (Pima County), 1,500 to 4,500 feet. South Carolina and Florida to southern Arizona, southward into tropical America.

45. *Euphorbia serrula* Engelm. in Torr., U. S. and Mex. Bound. Bot. 188. 1859.

Chamaesyce serrula Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 144. 1913.

Peach Springs (Mohave County), Tucson (Pima County), and at several localities in Cochise County, 2,400 to 5,000 feet. Western Texas to Arizona and northern Mexico.

65. CALLITRICHACEAE. WATER-STARWORT FAMILY

1. CALLITRICHE. WATER-STARWORT

Aquatic plants with slender stems and small opposite entire leaves, these often crowded at the ends of the stems; flowers minute, axillary, perfect or unisexual, without a perianth, subtended by 2 saccate bracts; stamen and pistil 1; fruit at maturity separating into 4 nutlets, these 1-seeded.

1. *Callitriche palustris* L., Sp. Pl. 969. 1753.

Chuska Mountains (Apache County), Kaibab Plateau (Coconino County), Young to Payson (Gila County), Tucson (Pima County), in streams and ponds. Widely distributed in the Northern Hemisphere.

66. BUXACEAE. BOX FAMILY

1. SIMMONDSIA. JOJOBA, DEERNUT

An evergreen, dichotomously branched shrub; leaves opposite, simple, entire, thick, leathery; flowers unisexual (perhaps always dioecious), apetalous, in dense axillary clusters, small, yellowish; stamens 10 to 12; fruit an acornlike capsule, usually with only 1 large seed.

Also known as goatnut, wild-hazel, coffeebush, and quinine-plant. It is a rather handsome shrub, seldom more than 2 m. (6.5 feet) high in Arizona, and is the best browse plant within its range. The "nuts" are rich in an edible oil (chemically, a liquid wax). This reputedly has medicinal virtues and is used in small quantities in the manufacture of hair oil. In early days the Indians and white settlers made a substitute for coffee from the fruits. The "nuts" may be eaten raw or parched but are too bitter with tannin in their natural state to please the white man's palate.

1. *Simmondsia chinensis* (Link) Schneid., Handb. Laubholz. 2: 141. 1907.

Burus chinensis Link, Enum. Pl. 2: 386. 1822.

Simmondsia californica Nutt., London Jour. Bot. 3: 401. 1844.

Greenlee County to southern Yavapai County, south to Cochise, Pima, and Yuma Counties, 1,000 to 4,300 feet, common, often abundant, dry slopes and along washes, December to July. Southern Arizona, southern California, Sonora, and Baja California.

67. ANACARDIACEAE. CASHEW FAMILY

1. RHUS.⁸⁰ SUMAC

Shrubs, the sap usually acrid and resinous, sometimes poisonous; leaves alternate, either simple and entire, or 3-foliolate, or pinnate; flowers regular, perfect or unisexual, mostly 5-merous, small, greenish, yellowish, or whitish, in axillary or terminal panicles, with a ring-shaped or cup-shaped disk around the ovary; fruit a small 1-seeded drupe.

All of the Arizona species are ornamental. The fruits, except in poison-ivy (*R. radicans*), are thin-fleshed, sweet, pleasantly acid, and can be used to make a refreshing beverage. They are an important food of birds and other wild animals. From the latex of an Asiatic species, *R. verniciflua*, the fine lacquer of China and Japan is manufactured.

Key to the species

1. Fruits yellowish white when mature, shiny, glabrous or nearly so, never glandular-pubescent; plant finely pubescent or glabrate; stems erect, ascending, or climbing by aerial rootlets; leaves deciduous, 3-foliolate, the midlobe long-stalked; leaflets up to 10 cm. long, oblong-lanceolate to ovate, usually coarsely few-toothed; inflorescences loose, paniculate, appearing after the leaves; petals greenish white-----1. *R. RADICANS*.
1. Fruits red when mature, glandular-pubescent (2).
 2. Leaves simple, evergreen, leathery, entire or very nearly so (3).
 3. Blades of the leaves broadly ovate, acute or short-acuminate, often conduplicate, bright green above; petioles usually more than 1 cm. long-----2. *R. OVATA*.
 3. Blades broadly oblong or oval, obtuse or acutish, flat, dark green above with conspicuous whitish veins; petioles usually less than 1 cm. long.
 3. *R. KEARNEYI*.
 2. Leaves compound, sometimes reduced to a single leaflet in *R. trilobata* (4).
 4. Leaflets not more than 3, coarsely crenate, the midlobe sessile or nearly so, often cleft; leaves deciduous, not leathery; inflorescences dense, spike-like, appearing before the leaves (except in one form); petals yellow.
 4. *R. TRILOBATA*.
 4. Leaflets more than 3 or, if only 3, then the leaves evergreen and leathery (5).
 5. Flowers very numerous, in naked terminal inflorescences; stems below the inflorescence, and the leaves, glabrous or glabrate; leaves deciduous, the leaflets seldom fewer than 11, whitish beneath, oblong-lanceolate, conspicuously serrate, 4 to 10 cm. long.
 5. *R. GLABRA*.
 5. Flowers not very numerous, often in axillary as well as terminal inflorescences; leaflets 9 or fewer, paler but not whitish beneath, entire (6).
 6. Leaves evergreen, the rachis not winged; leaflets 3 to 5, coriaceous, somewhat shiny above, glabrate, petiolulate, 2 to 6 cm. long, 1 to 3 cm. wide, acute or short-acuminate at apex; flowers appearing after the leaves-----6. *R. CHORIOPHYLLA*.
 6. Leaves deciduous, the rachis winged; leaflets 5 to 9, not coriaceous or shiny, pilose, sessile, less than 2 cm. long, 2 to 6 mm. wide, rounded to acutish at apex; flowers appearing before the leaves.
 7. *R. MICROPHYLLA*.

1. *Rhus radicans* L., Sp. Pl. 266. 1753.

Toxicodendron radicans Kuntze, Rev. Gen. Pl. 1: 153. 1891.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 8,000 feet, common in rich soil of ravines and canyons, April to September. Throughout most of North America.

⁸⁰ Reference: BARKLEY, F. A. A MONOGRAPHIC STUDY OF RHUS AND ITS IMMEDIATE ALLIES IN NORTH AND CENTRAL AMERICA. Mo. Bot. Gard. Ann. 24: 265-498. 1937.

E. L. Greene published *Toricodendron arizonicum*, *T. laetevirens*, and *T. pumilum*, based on Arizona types, but these are probably only individual variations. A form with seeds constricted at the side, *Toricodendron divaricatum* Greene (*T. radicans* var. *divaricatum* Barkley), was collected near Bisbee, Cochise County (Goodding 46).

Poison-ivy, poison-oak. A variable, often climbing plant, containing a nearly nonvolatile oil, urushiol, that causes painful swelling and eruption of the skin with many persons. The milky juice is poisonous when taken internally.

2. *Rhus ovata* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 358. 1885.

Hualpai Mountain (Mohave County) to Gila and eastern Maricopa Counties, 3,000 to 5,000 feet, slopes and mesas, common in chaparral, April. Central Arizona, southern California, and Baja California.

Sugarbush, sometimes called mountain-laurel in Arizona. A handsome shrub, cultivated as an ornamental in California, with bright green, somewhat shiny, leathery, entire leaves, deep-red flower buds, and cream-colored flowers. The shrubs reach a height of at least 4.5 m. (15 feet). The old bark is very shaggy.

3. *Rhus kearneyi* Barkley, Mo. Bot. Gard. Ann. 24: 363. 1937.

Tinajas Altas, southern Yuma County (Goldman 2311, Kearney and Harrison 6573, the type collection), dry cliffs. Known only from this locality.

4. *Rhus trilobata* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 219. 1838.

Throughout the State, 2,500 to 7,500 feet, very common on slopes and in canyons, often in chaparral, March to June (August). Saskatchewan to Washington, south to Mexico.

Squawbush, skunkbush, etc. A polymorphic species with aromatic foliage, yellow flowers, and bright red fruits. In addition to the typical form, the most distinct forms in Arizona are: (1) var. *pilosissima* Engler (*Rhus emoryi* Wootton), with velvety villous herbage and fruits, common in the central and southern parts of the State, usually flowering in March; (2) var. *simplicifolia* (Greene) Munz and Sloane, with leaves reduced to a single leaflet or the lateral leaflets very small, Apache County to eastern Mohave County; and (3) var. *racemulosa* (Greene) Munz and Sloane, with exceptionally long pedicels and flowering in late summer, after the leaves have matured, whereas the other forms usually flower in advance of the leaves. This last form is confined to the mountains of Greenlee, Cochise, and Pima Counties, 5,000 to 6,000 feet. Several other segregate species were published by Greene, based on Arizona types, but these probably represent mere individual variations.

The plants are browsed. The Indians used the pliable stems in basketry and ate the berries, also using them as a mordant in dyes.

5. *Rhus glabra* L., Sp. Pl. 265. 1753.

Rhus cismontana Greene, Wash. Acad. Sci. Proc. 8: 189. 1906.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,000 to 7,000 feet, common in rich soil, often forming thickets, ascending to the yellow pine belt, June and July. Canada to Florida, New Mexico, Arizona, and Chihuahua.

Scarlet sumac. In the fall the leaves turn bright red, giving a brilliant touch of color to the forest. The acidulous fruits are official in the United States Pharmacopoeia, having astringent and refrigerant properties. Greene published also *R. albida*, *R. elegantula*, and *R. calophylla*,¹ based upon Arizona types, but these appear to be mere forms of *R. glabra*.

6. *Rhus choriophylla* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 146. 1913.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, rocky slopes (often limestone), sometimes growing with *Cupressus arizonica* and *Juniperus pachyphloea*, August to September. Southern New Mexico, southeastern Arizona, and Sonora.

Very close to *R. virens* Lindh., differing chiefly in the usually larger, glabrate leaflets and in the more frequent occurrence of axillary inflorescences. This shrub attains a height of about 2 m. (7 feet).

7. *Rhus microphylla* Engelm. in A. Gray, Pl. Wright. 1: 31. 1852.

Rhoetidium microphyllum Greene, Leaflets 1: 143. 1905.

Greenlee, Cochise, and eastern Pima Counties, 4,000 to 6,000 feet, dry mesas and slopes, March and April. Western Texas to southeastern Arizona and northern Mexico.

A much-branched shrub, up to 1.8 m. (6 feet) high.

68. CELASTRACEAE. BITTERSWEET FAMILY

Plants of diverse habit, more or less woody; leaves simple, alternate or opposite, sometimes reduced to scales; flowers small, regular, usually perfect; calyx lobes and petals 4 to 6; stamens as many or twice as many as the petals, inserted on or below the margin of a basal disk, this rudimentary or wanting in *Canotia*.

Key to the genera

1. Leaves reduced to small deciduous scales; seeds with a thin terminal wing; plant a large shrub or small tree----- 4. CANOTIA.
1. Leaves with well-developed blades; seeds without a terminal wing (2).
 2. Plant a creeping undershrub; leaves mostly opposite; flowers reddish brown. 1. PACHYSTIMA.
 2. Plants intricately branched shrubs; leaves alternate; petals whitish (3).
 3. Herbage scabrous, yellowish; leaves persistent, the blades very thick, with cartilaginous margins, elliptic to nearly orbicular; flowers in panicles, these mostly terminal; stamens commonly 5; capsules symmetric, short-cylindric, rounded and abruptly apiculate at apex. 2. MORTONIA.
 3. Herbage not scabrous, glabrous or puberulent, pale green, somewhat glaucous; leaves deciduous, the blades not very thick, elliptic or oblanceolate; flowers axillary, scattered along the branchlets, often solitary; stamens often more than 5; capsules asymmetric, ovoid, pointed at apex----- 3. FORSELLESIA.

1. PACHYSTIMA. BOXLEAF

Undershrub with creeping stems, glabrous or nearly so; leaves mostly opposite, thickish, evergreen, somewhat shiny above, the margins serrate or serrulate; flowers minute, axillary, solitary or in very few-flowered clusters; fruit a 2-celled, finally dehiscent capsule.

The name of the genus is often spelled *Pachistima*.

1. *Pachystima myrsinites* (Pursh) Raf., Sylv. Tellur. 42. 1838.

Ilex? *myrsinites* Pursh, Fl. Amer. Sept. 119. 1814.

Apache County to Coconino County, south to Graham and Gila Counties, 7,200 to 9,000 feet, coniferous forests, May to July. Canada to New Mexico, Arizona, and California.

Myrtle boxleaf, mountain-lover, Oregon-boxwood. A low and inconspicuous ground cover in the mountains. Relished by deer but not much eaten by domestic livestock.

2. MORTONIA

Plant a yellowish, scurfy-scabrous shrub up to 1.8 m. (6 feet) high, with many stiff, nearly erect, very leafy branches; leaves alternate, small, leathery, commonly elliptic; flowers small, whitish, in narrow panicles.

1. *Mortonia scabrella* A. Gray, Pl. Wright. 2: 28. 1853.

Southern Gila, Cochise, and Pima Counties, 3,000 to 5,500 feet, dry plains, mesas, and slopes, often on limestone, March to September. Western Texas to southern Arizona and northern Mexico.

The var. *utahensis* Coville (*M. utahensis* A. Nels.), has been collected in Havasu Canyon, Coconino County (*Whiting* in 1940) and near Horse Spring, northern Mohave County (*Jones* 5069j). It differs from the typical form in little but the larger leaves (up to 14 mm. long) but has a different distribution, southwestern Utah to southeastern California.

3. FORSELLESIA

A straggling, weakly spiny, glabrous or puberulent shrub with green bark, seldom more than 0.5 m. (1.5 feet) high; leaves alternate, short-petioled, the blades entire; flowers axillary, solitary or in small clusters, the petals whitish.

1. *Forsellesia nevadensis* (A. Gray) Greene, Erythea 1: 206. 1893.

Glossopetalon nevadense A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 73. 1876.

Coconino County and eastern Mohave County, especially in and near the Grand Canyon, 3,500 to 6,500 feet, dry rocky slopes, often on limestone, May and June. Idaho, south to northern Arizona and eastern California.

Grazed by sheep and deer.

4. CANOTIA

A large shrub or small tree, with numerous rigid, mostly spine-tipped, suberect, rushlike branches and yellowish green bark; leaves reduced to small deciduous scales; flowers in small axillary clusters, inconspicuous, without a disk or this rudimentary; ovary superior; fruit a somewhat woody 5-valved capsule, each valve splitting above into 2 long slender points.

An anomalous plant in this family.

1. *Canotia holacantha* Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 68. 1856.

Havasu Canyon (Coconino County) and Mohave County to Cochise, Pinal, Maricopa, and Yuma Counties (probably also Santa Cruz

and Pima Counties), 2,500 to 4,500 feet, dry slopes and mesas, common and in many places abundant, May to August. Arizona and northern Sonora.

Sometimes known locally as "paloverde," a name properly belonging to *Parkinsonia* and *Cercidium*. This striking and peculiar plant is a characteristic feature of the landscape in large areas of southern and western Arizona. The trees attain a height of at least 4.5 m. (15 feet). The living branches burn readily, as if resinous (pl. 17).

69. ACERACEAE. MAPLE FAMILY

1. ACER. MAPLE

Trees or large shrubs; leaves opposite, simple or palmately or pinnately compound; flowers small, perfect or unisexual, in cymose or racemose, mostly axillary inflorescences; petals present or absent; stamens 4 to 12, borne on a ring-shaped disk, or the disk sometimes obsolete; fruit a pair of laterally winged samaras, these united at base.

All of the maples are ornamental, but the genus is of minor importance in Arizona. In autumn the leaves change color and give great beauty to the mountain scenery. It is reported that maple sugar is sometimes made from the sap of *A. grandidentatum*. The plants are browsed by livestock and deer.

Key to the species

1. Leaves pinnately compound, 3- to 5-foliolate, the terminal leaflet long-stalked..... 1. *A. NEGUNDO*.
1. Leaves simple or palmately trifoliolate, the terminal leaflet sessile or short-stalked (2).
 2. Leaf blades thin, glabrous, with numerous acute teeth; inflorescence long-stalked..... 2. *A. GLABRUM*.
 2. Leaf blades thickish, usually persistently pubescent beneath, with few obtuse teeth; inflorescence nearly sessile..... 3. *A. GRANDIDENTATUM*.

1. *Acer negundo* L., Sp. Pl. 1056. 1753.

Apache County to Mohave County, south to Cochise and Pima Counties, 5,000 to 8,000 feet, common along streams, April. Throughout most of the United States.

Boxelder. A rapid-growing tree, reaching a height of 15 m. (50 feet) and a trunk diameter of 0.8 m. (2.5 feet). It is often planted in dooryards and along streets, but is short lived and subject to damage by windstorms. The trunk is short, the crown broad, rounded, and dense, the bark pale grayish brown, and the wood soft and light-colored. The species is represented in Arizona by var. *interius* (Britton) Sarg., which differs from the typical eastern form of *A. negundo* in its somewhat thicker, commonly more pubescent leaves. There is intergradation, however, and the form described as var. *arizonicum* Sarg. (type from the Santa Catalina Mountains, Rehder 463) approaches the eastern form in its thin, very sparingly pubescent leaves.

2. *Acer glabrum* Torr., Ann. Lyc. N. Y. 2: 172. 1828.

Coconino County to Cochise County, 7,200 to 9,000 feet, rich soil of coniferous forests, May to June. South Dakota to Alaska, south to New Mexico, Arizona, and California.



Canotia holacantha in the Hareuvar Mountains, Yuma County, altitude 2,500 feet. A leafless tree about 15 feet high. The bladdery calyces of *Salazaria mexicana*, a common desert shrub, show in the foreground.



Dwarf maple. A shrub or small tree with smooth gray bark, up to 6 m. (20 feet) high and 30 cm. (1 foot) in diameter of trunk. Occupying the same area in Arizona and about equally common are the typical form, with leaf blades merely lobed, and var. *neomexicanum* (Greene) Kearney and Peebles (*A. neomexicanum* Greene), with some or all of the leaves 3-parted.

3. *Acer grandidentatum* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 247. 1838.

Grand Canyon and Oak Creek Canyon (Coconino County), Hualpai Mountain (Mohave County), south to the mountains of Greenlee, Cochise, and Pima Counties, 4,700 to 7,000 feet, mostly with coniferous trees, April. Montana and Idaho to western Texas, New Mexico, and Arizona.

Bigtooth maple. Tree up to 15 m. (50 feet) high and 30 cm. (1 foot) in diameter, with smooth gray or brownish bark. The wood makes excellent fuel. The var. *brachypterum* (Woot. and Standl.) E. J. Palmer (*A. brachypterum* Woot. and Standl.), with smaller fruits and shorter, few-toothed or nearly entire leaf lobes, is found chiefly in the southeastern part of the State, but also near Prescott, Yavapai County.

70. SAPINDACEAE. SOAPBERRY FAMILY

Small trees or shrubs; leaves pinnate or simple; inflorescences terminal or lateral; flowers mostly unisexual, small, with or without petals; stamens commonly 8; fruits various.

Key to the genera

1. Leaves abruptly pinnate with numerous leaflets, not viscid; flowers in large terminal panicles; fruit a 1-seeded berry..... 1. *SAPINDUS*.
1. Leaves simple, viscid when young; flowers in small lateral clusters; fruit a capsule, dry, winged..... 2. *DODONAEA*.

1. *SAPINDUS*. SOAPBERRY

A small tree or large shrub; leaves pinnate with numerous lanceolate or oblong-lanceolate leaflets; flowers small, whitish, in broad many-flowered panicles, with 5 petals and a basal disk; fruits with amber-colored translucent pulp.

1. *Sapindus drummondii* Hook. and Arn., Bot. Beechey Voy. 281. 1840.

Southern Coconino County and southeastern Mohave County to Cochise, Santa Cruz, and Pima Counties, 2,400 to 4,500 (6,000?) feet, along streams, May to August. Kansas and Louisiana to southern Arizona and Mexico.

Western soapberry. Perhaps not specifically distinct from *S. saponaria* L. The tree attains a height in Arizona of 6 m. (20 feet), perhaps more. The fruits, which often hang on the trees long after ripening, have been used by the natives of the southwestern United States and Mexico for washing clothes. They are poisonous, containing a high percentage of saponin, and cause dermatitis in some persons. "This is not considered safe browse for cattle and they seldom touch it" (Mrs. Collom, ms.).

2. DODONAEA. HOPBUSH

Shrub, with viscid foliage; leaves simple, short-petioled, the blades narrow, entire, linear to oblanceolate; flowers yellowish, in small lateral corymbs, apetalous; fruits very conspicuous, dry, with 2 to 4 broad wings.

Sometimes called switchsorrel. The glutinous leaves and the bark have been used to treat various diseases. The attractive winged fruits have been used as a substitute for hops. In Arizona a shrub up to 3.5 m. (12 feet) high. The plant appears to be unpalatable to livestock and tends to increase on overstocked ranges. It is doubtless harmful, as it contains saponin and is used in some countries as a fish poison.

1. *Dodonaea viscosa* Jacq., Enum. Pl. Carib. 19. 1760.

Southern Yavapai County to Cochise and Pima Counties, 2,000 to 4,000 feet, fairly common on dry rocky slopes and in canyons, often on limestone, frequently with *Simmondsia* and *Fouquieria*, February to October. Widely distributed in the warmer parts of the world.

Arizona possesses only the narrow-leaved form, var. *angustifolia* (L. f.) Benth. (*D. arizonica* A. Nels.).

71. RHAMNACEAE. BUCKTHORN FAMILY

Shrubs or small trees; leaves simple; flowers small, perfect or unisexual, regular or nearly so, 4- or 5-merous, with or without petals, with a disk in the calyx throat on which the stamens often are borne; ovary 2- or 3-celled, superior or partly inferior.

Most of these plants are browsed by domestic animals and deer.

Key to the genera

1. Fruits drupelike, with a single stone, this 1- or 2-celled; leaves alternate or fascicled; branches rigid, often spiny; ovary superior----- 1. *CONDALIA*.
1. Fruits capsular or drupelike, with 2 to 4 separate or nearly separate stones (2).
 2. Ovary superior (free from the calyx); fruit drupelike, more or less fleshy, the cells indehiscent (3).
 3. Flowers sessile, in small panicles terminating the branchlets; petals present; style 3-lobed----- 2. *SAGERETIA*.
 3. Flowers pedicellate, axillary, solitary or in small clusters; petals sometimes absent; style 2-lobed----- 3. *RHAMNUS*.
 2. Ovary partly inferior (adnate below to the calyx); fruit capsulelike, dry at maturity, the cells dehiscent (4).
 4. Calyx lobes petaloid; petals white, bluish, or lavender pink, long-clawed, hooded, often spreading away from the stamens---- 4. *CEANOTHUS*.
 4. Calyx lobes not petaloid; petals greenish or yellowish, short-clawed, standing close to the stamens----- 5. *COLUBRINA*.

1. *CONDALIA*

Shrubs or small trees with rigid, usually spiny branches; leaves alternate or fascicled, pinnately veined, often conspicuously so; flowers axillary, in small fascicles or solitary; petals present or absent; ovary superior; fruit a drupe with one stone.

Key to the species

1. Leaves elliptic to ovate, commonly at least 5 mm. wide, entire or dentate, the veins (except the midvein) slender and rather inconspicuous; petals present; fruit globose or nearly so, not beaked, at maturity dark blue with a bloom, 6 to 8 mm. in diameter; spines numerous, stout, divaricate or slightly decurved----- 1. *C. LYCIOIDES*.

1. Leaves spatulate or obovate; petals none; fruit ovoid, ellipsoid, or somewhat obovoid, often beaked with the persistent style, at maturity black without bloom, less than 5 mm. in diameter (2).
2. Fruits nearly sessile; branchlets stout, very rigid, spiny throughout, relatively short; leaf blades oblanceolate or obovate, 4 to 6 mm. wide, with relatively slender and widely spaced, inconspicuous lateral veins.

2. *C. MEXICANA*.

2. Fruits distinctly pedicelled; branchlets slender, moderately rigid, spiny toward the apex, relatively long; leaf blades spatulate, with broad conspicuous lateral veins, these occupying much of the surface (3).

3. Shrub usually not more than 2 m. high, very dense, the branches ascending, often crooked; leaves very numerous, crowded, 3 to 10 (commonly about 5) mm. long including the petiole, 1 to 2 (rarely 3) mm. wide, with veins occupying nearly the whole of the lower surface; bark of the branchlets commonly dark gray; pedicels commonly shorter than the fruit.

3. *C. SPATHULATA*.

3. Shrub up to 5 m. high, comparatively open, the branches divaricate, nearly straight; leaves relatively few, not crowded, 7 to 12 mm. long, 2 to 5 mm. wide, with veins more widely spaced; bark of the branchlets light gray or brown; pedicels nearly as long as to longer than the fruit.

4. *C. GLOBOSA*.

1. ***Condalia lycioides*** (A. Gray) Weberb. in Engler and Prantl, Pflanzenfam. 3⁵: 404. 1895.

Zizyphus lycioides A. Gray, Boston Jour. Nat. Hist. 6: 168. 1850.

Coconino and Mohave Counties to Greenlee, Cochise, Pima, and Yuma Counties, 5,000 feet or lower (usually not above 3,000 feet), common on dry plains, mesas, and slopes, often forming thickets, May to September. Western Texas to southeastern California and northern Mexico.

Lotebush. The typical form, with glabrous or glabrate leaves, is rare in Arizona, but has been collected near Douglas and San Bernardino, Cochise County (*Peebles* 11694, 11703). The common form, var. *canescens* (A. Gray) Trelease, has the leaves permanently canescent. The plants reach a height of 2.5 m. (8 feet) but are usually smaller. They are not or seldom browsed. Birds relish the insipid, dark-blue fruits and find refuge in the impenetrable growth. The Pima Indians treated sore eyes with a decoction of the roots, which also have been used as a substitute for soap.

2. ***Condalia mexicana*** Schlecht., Linnaea 15: 471. 1841.

Cochise and Pima Counties, 3,000 to 4,500 feet, dry slopes and canyons, usually with other large shrubs, July to September. Southern Arizona and Mexico.

Mexican bluewood. The plants reach a height of 3 m. (10 feet).

3. ***Condalia spathulata*** A. Gray, Pl. Wright. 1: 32. 1852.

Southwestern Gila County and eastern Pinal County to Cochise and Pima Counties, 3,500 to 4,500 feet, common on dry mesas and "bajadas," July to September. Western Texas to south-central Arizona and northeastern Mexico.

Squawbush. Shrub up to 3 m. (10 feet high) but usually 1.5 to 2 m. The stones of the black fruits have a soapy taste and are only slightly bitter.

4. ***Condalia globosa*** Johnston, Calif. Acad. Sci. Proc. ser. 4, 12: 1086. 1924.

Western Pima and southern Yuma Counties, 2,000 feet or lower, common on dry sandy plains and along washes, March. South-

western Arizona, southeastern California (?), northwestern Sonora, and Baja California.

Represented in Arizona by var. *pubescens* Johnston. A large shrub or small tree, reaching a height of 4.5, occasionally 6 m. (15 to 20 feet), and a trunk diameter of 0.6 m. (2 feet). The fruits have exceedingly bitter stones. The ranges of *C. globosa* and the nearly related *C. spathulata* apparently do not overlap in Arizona, the former not having been collected east of the Ajo Mountains, and the latter not west of the Baboquivari Mountains.

2. SAGERETIA

A straggling shrub with slender, somewhat spiny, divaricate branches; leaves nearly opposite, bright green, shining; flowers in glomerules, these forming open leafy panicles; petals present, whitish; ovary superior; fruit a somewhat fleshy drupe with 3 stones.

1. *Sageretia wrightii* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 358. 1885.

Greenlee County to eastern Maricopa, Cochise, and Pima Counties, 3,500 to 5,200 feet, in canyons among rocks, March and September. Western Texas, southern Arizona, and Mexico.

3. RHAMNUS.⁵¹ BUCKTHORN

Shrubs or small trees, not spiny; leaves opposite; flowers perfect or unisexual, greenish, axillary, in small fascicles or solitary, with or without petals; calyx free from the ovary; fruit a drupe with 2 to 4 stones.

All of the Arizona species are ornamental. The laxative drug cascara is obtained from the bark of *R. purshiana*, a species of the Pacific Coast States. *R. crocea* is an alternate host of the crown rust disease of oats. The plants, especially the more or less evergreen forms, are of some value as browse in winter, and the fruits are eaten by wild pigeons and other birds.

Key to the species

1. Bud scales present; flowers in fascicles without a common peduncle, commonly 4-merous; style exerted, cleft to about the middle; leaves evergreen, the blades with spinose-dentate margins, broadly ovate or suborbicular, not more than 3 cm. long, commonly truncate or emarginate (rarely acute) at apex, glabrate or permanently short-pilose and often bronzed beneath; fruits bright red at maturity..... 1. *R. CROCEA*.
1. Bud scales none; flowers in pedunculate cymes, commonly 5-merous; style not exerted, the stigma 2- or 3-lobed; leaves deciduous, the blades with serrulate or nearly entire margins; fruits black or nearly so at maturity (2).
 2. Leaf blades evergreen, thickish, whitish-tomentose beneath, oblong-lanceolate to broadly elliptic, commonly less than 3 cm. wide; fruits usually 2-seeded..... 2. *R. CALIFORNICA*.
 2. Leaf blades deciduous, thin, green on both faces, sparsely to copiously pubescent beneath but not tomentose, broadly elliptic to ovate-oblong, commonly more than 3 cm. wide; fruits usually 3-seeded.
 3. *R. BETULAEFOLIA*.

⁵¹ Reference: WOLF, C. B. THE NORTH AMERICAN SPECIES OF RHAMNUS. Monog. Rancho Santa Ana Bot. Gard. Bot. Ser. 1: 1-136. 1938.

1. **Rhamnus crocea** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 261. 1838.

Southern Coconino County and Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 3,000 to 6,800 feet, common in chaparral and in open coniferous forest, March to May (rarely October). Arizona, California, and Baja California.

Redberry buckthorn. A handsome shrub, with bright-green hollylike leaves and bright-red fruits, attaining a height of 4 m. (13 feet) in California, but perhaps never so large in Arizona. The Arizona form is the hollyleaf buckthorn, var. *ilicifolia* (Kellogg) Greene (*R. ilicifolia* Kellogg). It is browsed by deer and bighorns. The Apache Indians ate the fruits with meat.

2. **Rhamnus californica** Esch., Acad. Imp. Sci. St. Pétersb. Mém. 10: 285. 1823.

Southern Coconino County and Hualpai Mountain (Mohave County), to Cochise and Pima Counties, 3,500 to 6,500 feet, common in chaparral and open coniferous forests, May and June. New Mexico and Arizona to southern Oregon, California, and Baja California.

California buckthorn, coffeeberry, pigeonberry. Sometimes attaining a height of 5.5 m. (18 feet), but usually smaller. The Arizona form is var. *ursina* (Greene) Wolf (*R. ursina* Greene). *R. blumeri* Greene (type from the Chiricahua Mountains, *Blumer* 1290, in part) is thought by Wolf to be a hybrid between this variety and *R. betulae-folia* Greene.

3. **Rhamnus betulae-folia** Greene, Pittonia 3: 16. 1896.

Southern Apache County to Cochise County, 5,500 to 7,500 feet, mostly along streams in the live oak and yellow pine belts, May and June. New Mexico, eastern Arizona, and northern Mexico.

Birchleaf buckthorn. Usually a smaller shrub than *R. californica*, reaching a height of 2.5 m. (8 feet). The typical form is limited in Arizona to the southeastern part. A form occurring in the northern part of the State is var. *obovata* Kearney and Peebles, the type of which was collected on Navajo Mountain, Coconino County (*Peebles* and *Smith* 13930). It is found also on the north rim of the Grand Canyon (*Eastwood* 6001, *Eastwood* and *Howell* 989). This variety extends into southern Utah and Nevada and is well separated, geographically, from the main area of *R. betulae-folia*.

4. CEANOTHUS

Much-branched shrubs with commonly rigid or spinescent branches; leaves alternate or opposite, the blades entire or dentate, conspicuously veined; flowers perfect, with hooded, long-clawed petals, in cymose panicles; calyx adnate to the lower part of the ovary; fruit a 3-celled capsule.

These plants afford good browse for cattle, sheep, and especially for deer. They are esteemed as honey plants. It is reported that an infusion of the bark of *C. integerrimus*, and perhaps other species occurring in Arizona, has been employed as a tonic and that the flowers form a lather in water. Many species of this genus are cultivated as ornamentals, and are often known as wild-lilac. The seeds are discharged with considerable force when the capsules open.

Key to the species

1. Leaves opposite, the blades pinnately veined with several broad veins, not more than 2.5 cm. long, thick, pilose or tomentulose at least on the lower surface when young; stipules thick, commonly persistent (at least the lower portion); inflorescences small, not or but little surpassing the leaves.
 1. C. GREGGII.
1. Leaves alternate, the blades palmately 3-nerved; stipules thin, usually soon deciduous except for the thickened basal scar (2).
 2. Inflorescences terminal, elongate-thyrsoïd, 5 to 15 cm. long, very many-flowered, naked or nearly so, greatly surpassing the leaves; twigs not rigid, glabrous or obscurely puberulent; leaf blades (the larger ones) 3 to 6 cm. long, glabrous or sparsely pilose on the veins beneath, bright green above, somewhat paler beneath, broadly elliptic or ovate, the margins entire or very nearly so.----- 2. C. INTEGERRIMUS.
 2. Inflorescences mostly axillary, cymose or subracemose, not more than 4 cm. long, relatively few-flowered, commonly leafy; twigs rigid, copiously pubescent or puberulent; leaf blades commonly less than 3 cm. long (3).
 3. Plant unarmed; leaf blades thin, mostly suborbicular, broadly rounded at apex, commonly rounded or subcordate at base, not more than 1½ times as long as wide, with commonly denticulate or serrulate margins, not whitish beneath, puberulent then glabrate, the veins not prominent beneath.----- 3. C. MARTINI.
 3. Plant usually spiny; leaf blades thickish, narrowly to broadly elliptic (rarely suborbicular), narrowed and obtuse or acute at apex, often narrowed at base, usually at least twice as long as wide, with entire or nearly entire margins, permanently pubescent, whitish and sericeous tomentose beneath, the veins usually prominent beneath.----- 4. C. FENDLERI.

1. *Ceanothus greggii* A. Gray, Pl. Wright. 2: 28. 1853.

Mohave County to Cochise and Pima Counties, 3,000 to 5,300 feet, very common in chaparral, March to April (occasionally September). Western Texas to southern California and northern Mexico.

The plants are seldom more than 1.5 m. (5 feet) high, with petals commonly whitish but frequently bluish or pinkish. Arizona specimens vary greatly in pubescence and in the shape of the leaf blades. The latter are commonly relatively short and broad (var. *orbicularis* Kelso), but specimens from Fort Apache, the Chiricahua Mountains, and Rosemont (Pima County) have narrowly elliptic or oblanceolate, permanently pubescent leaves. The blades are commonly entire or sparingly denticulate, but specimens with some of the leaves spinose-dentate, thus approaching *C. perplexans* Trel., have been collected at Hackberry (Mohave County) and near Fort Verde (Yavapai County). It is suggested in a recent publication⁸² that the Arizona specimens may not belong to *C. greggii*, but partly to *C. vestitus* Greene and partly to *C. cuneatus* (Hook.) Nutt., or some related form.]

2. *Ceanothus integerrimus* Hook. and Arn., Bot. Beechey Voy. 329. 1840.

Ceanothus myrianthus Greene, Leaflets 1: 67. 1904.

Ceanothus mogollonicus Greene, *ibid.*

Southern Coconino County to Cochise and Pima Counties, 3,500 to 6,700 feet, chaparral and open coniferous forest, preferring shade, May to October, type of *C. myrianthus* from near Fort Huachuca (Palmer in 1890). New Mexico and Arizona to Oregon and California.

⁸² HOWELL, JOHN THOMAS. STUDIES IN CEANOTHUS III. Leaflets West. Bot. 2: 228-240. 1940. (See pp. 228-229, 234.)

Deerbrush. Rated in California as one of the most valuable browse plants for livestock. Although widely distributed in Arizona, it is nowhere abundant in this State. It is the handsomest species, with large bright-green leaves and feathery panicles of whitish flowers. The shrubs reach a height of about 2.5 m. (8 feet) but are usually smaller.

3. *Ceanothus martini* M. E. Jones, Contrib. West. Bot. 8: 41. 1898.

Coconino County, Big Springs, Kaibab Plateau (*Eggleston* 10210), Grand Canyon below the north rim (*Goodding* in 1935), about 7,500 feet, June. Utah, Nevada, and northern Arizona.

4. *Ceanothus fendleri* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 29. 1849.

Throughout the State except the extremely desert portions, 5,000 to 10,000 feet, very common in pine forests, tending to form low thickets, April to October. South Dakota to New Mexico and Arizona.

Buckbrush. Its great abundance gives this plant outstanding importance as browse for livestock and deer. It is more spinescent than the other Arizona species, seldom more than 1 m. (3 feet) tall and at high altitudes often less than 0.5 m. About equally abundant and widely distributed are: (1) The more typical form, with leaf blades thin, sparsely pubescent or glabrate above, and not very prominently veined; and (2) var. *venosus* Trel., with leaf blades thicker, permanently sericeous above, and very prominently veined. The two forms intergrade freely.

5. COLUBRINA

A shrub with divaricate, subspinescent branches; leaves alternate, petioled, the blades entire or denticulate, oval or obovate, pinnately few-veined; flowers axillary, solitary or in small fascicles, inconspicuous, greenish or yellowish; petals present, hooded, short-clawed; calyx adnate to the lower part of the ovary; fruit a 3-celled drupelike capsule.

1. *Colubrina californica* Johnston, Calif. Acad. Sci. Proc. ser. 4, 12: 1085. 1924.

Eastern Maricopa County, Pinal County, and southern Yuma County, 3,000 feet or lower, dry slopes and in washes, June to August. Southwestern Arizona, southeastern California, and Baja California.

In favorable situations the plants are 3 m. (10 feet) high but are usually smaller. The Arizona specimens have smaller fruits than those from the type locality in Baja California.

72. VITACEAE. GRAPE FAMILY

Stems woody, climbing or trailing, with prominent nodes and usually with tendrils; leaves alternate, simple or compound, with long petioles dilated at base; flowers small, greenish, perfect or unisexual, in cymose panicles, 4- or 5-merous, often with a disk; stamens opposite the petals; fruit berrylike; seeds bony.

The cultivated grapes are the only economically very important members of this family.

Key to the genera

1. Leaves simple, often shallowly lobed; petals partly united and connivent at anthesis..... 1. VITIS.
1. Leaves compound or very deeply lobed; petals separate and spreading at anthesis (2).
 2. Leaves digitately 5- to 7-foliolate, relatively thin, deciduous; flowers 5-merous..... 2. PARTHENO-CISSUS.
 2. Leaves deeply 3-lobed to 3-foliolate, thick, persistent; flowers 4-merous.
 3. CISSUS.

1. VITIS. GRAPE

Stems climbing or trailing; leaves large, with rounded, cordate, often shallowly lobed blades, persistently pubescent or glabrate; flowers rarely perfect; petals more or less coherent at apex until they fall; berries globose or nearly so, juicy, few-seeded.

1. *Vitis arizonica* Engelm., Amer. Nat. 2: 321. 1868.

Coconino County and Hualpai Mountain (Mohave County), to Greenlee, Cochise, and Pima Counties, 2,000 to 7,000 feet, common along streams and in canyons, often climbing on trees, April to July. Western Texas to southern Utah, Arizona, and northern Mexico.

Canyon grape. The berries are of good quality for jelly and grape-juice and are much eaten by birds. They are also eaten, both fresh and dried, by the Indians. The vines are useful in checking soil erosion along creeks. The leaves when chewed allay thirst. In addition to the typical form, with permanently more or less pubescent leaves, a glabrate form, var. *glabra* Munson, occurs throughout the range of the species in Arizona. Specimens with leaves more deeply and irregularly toothed than is usual, collected in Chevelon Canyon, Navajo or Coconino County (*Zuck* in 1896), and near Flagstaff (*Munson* and *Hopkins* in 1889), may be *V. treleasei* Munson but do not appear to be specifically distinct from *V. arizonica*. An exceptionally pubescent form was collected near Lake Mead, Mohave County (*Clover* 4294).

2. PARTHENO-CISSUS. VIRGINIA-CREEPER

Stems mostly trailing; tendrils often expanded at apex into disks that adhere to bark or other surfaces; leaves large, digitately compound, the leaflets 5 to 7, deciduous; flowers 5-merous, the petals spreading at anthesis; berries thin-fleshed; seeds 1 to 4.

1. *Parthenocissus vitacea* (Knerr) A. S. Hitchc., Spring Fl. Manhattan 26. 1894.

Parthenocissus quinquefolia (L.) Planch. var. *vitacea* Knerr, Bot. Gaz. 18: 71. 1893.

Apache County to Coconino County, south to Cochise and Pima Counties, 4,000 to 7,000 feet, May to September. Ohio to Wyoming, New Mexico, and Arizona.

Very similar to the Virginia-creeper (*P. quinquefolia*) of the eastern United States, which is often cultivated as an ornamental climbing plant. The handsome foliage is beautifully colored in autumn.

3. CISSUS

Stems trailing or clambering, from large tubers; leaves digitately 3-foliolate or deeply 3-lobed, somewhat fleshy, persistent; flower parts

in 4's, the petals spreading at anthesis; ovary 2-celled; berries 1- to 4-seeded.

1. *Cissus trifoliata* L., Syst. Nat. ed. 10, 2: 897. 1759.

Santa Cruz and Pima Counties, 3,000 to 5,000 feet, not common, usually among rocks clambering over bushes, July and August. Southern Arizona, Mexico, and widely distributed in tropical America.

The plant has a rank, disagreeable odor suggesting that of jimsonweed (*Datura*). The tubers are reputed poisonous, and contact with the plant causes dermatitis in susceptible persons.

73. TILIACEAE. LINDEN FAMILY

1. CORCHORUS

Plants herbaceous (in Arizona); leaves alternate, simple, with serrate blades; flowers perfect, regular, solitary or few on short peduncles opposite the leaves; petals 4 or 5, yellow; stamens numerous; ovary superior, 2- to 5-celled; capsule long and slender, 2-valved.

Two Old World species furnish the important fiber jute.

1. *Corchorus hirtus* L., Sp. Pl. ed. 2, 747. 1762.

Apparently the only record for Arizona is a collection from "sandy plains near the Mexican boundary" (Pringle in 1884), August. Southern Arizona, Mexico, and widely distributed in tropical America.

Pringle's specimens are small, with stems only about 6 cm. long. They probably belong to var. *glabellus* Gray.

74. MALVACEAE. MALLOW FAMILY

Plants herbaceous or shrubby, with more or less mucilaginous juice, usually pubescent with stellate or forked hairs; leaves simple, alternate, petioled, stipulate; flowers regular, perfect; calyx often subtended by a calyxlike involucre; petals 5, hypogynous, convolute in the bud, asymmetric, more or less united at base to the staminal column; stamens numerous, monadelphous; anthers 1-celled, reniform; pollen grains large, spiny; carpels 3 or more, 1-celled; style usually several-branched; fruit a loculicidal capsule, or, in most of the genera, the mature carpels separating from one another and from the receptacle; seeds often pubescent.

This family is notable as the one to which the cotton plants (*Gossypium* spp.) belong. Cotton is an important crop in Arizona and a peculiar form (*Gossypium hopi* Lewton), distantly related to upland cotton (*G. hirsutum* L.), was cultivated by the Hopi Indians from prehistoric until very recent times. There is, however, no record of its growing wild anywhere in the State. The garden vegetable okra (*Hibiscus esculentus*) also belongs to the Malvaceae. Many plants of this family have showy flowers, and numerous species of *Hibiscus*, *Malva*, etc., are cultivated as ornamentals. The marsh-mallow (*Althaea officinalis* L.), a European plant with thick mucilaginous roots, is used in making the well-known confection, also medicinally.

Key to the genera

1. Fruit a loculicidal capsule; carpels 3 to 5, not separating at maturity from one another or from the axis; flowers mostly solitary and axillary; ovules and seeds several in each carpel (2).
2. Style branches 5, elongate, finally spreading; stigmas capitate; calyx 5-lobed; seeds reniform; petals yellow or purple; plants suffruticose or herbaceous above the caudex..... 10. *HIBISCUS*.
2. Style not branched, clavate and ribbed toward the apex; calyx entire or shallowly dentate; seeds angulate-obovoid; petals white; plant a shrub. 11. *GOSSYPIUM*.
1. Fruit of several or many carpels, these at maturity usually separating from one another and from the axis, but sometimes connate and sometimes remaining, for a time, attached to the axis by a threadlike prolongation of the midrib of the carpel (3).
3. Style branches filiform, longitudinally and introrsely stigmatic; carpels reniform or subreniform, indehiscent, mucous, 1-ovulate; petals mauve or white; plants herbaceous (4).
4. Stamens in one whorl at the apex of the column; involucrel present, the bractlets narrowly linear; petals not more than 15 mm. long; plants annual; leaf blades crenate, often shallowly cleft, with broad, rounded lobes..... 5. *MALVA*.
4. Stamens more or less united into fascicles, these in 2 whorls, 1 apical and 1 just below the apex of the column; involucrel none; plants perennial; leaf blades, at least the upper ones, palmately parted or divided, with narrow lobes..... 6. *SIDALCEA*.
3. Style branches terminating in a capitate or truncate stigma (5).
5. Carpels sharply differentiated into a more or less reticulate indehiscent basal portion and a smooth dehiscent apical portion, the 2 portions separated by a pronounced ventral notch, or the upper portion expanded and winglike (6).
6. Apical portion of the carpel much wider than the basal portion, thin-walled, winglike, mucous, the notch indistinct or none; involucrel none; petals yellow or pink; plants shrubby..... 2. *HORSFORDIA*.
6. Apical portion of the carpel not or not much wider than the basal portion, not winglike, the 2 portions separated by a (usually deep) notch; involucrel usually present; petals bright red, orange, or mauve; plants herbaceous or suffruticose..... 3. *SPHAERALCEA*.
5. Carpels not sharply differentiated into a reticulate basal and a smooth apical portion or, if so (in species of *Sida*), then the portions not separated by a distinct notch and the apical portion not expanded and winglike; petals never bright red (7).
7. Ovules, and usually the seeds, 2 or more in each carpel; carpels dehiscent to the base or nearly so, not reticulate (8).
8. Involucrel none; carpels without long simple hairs, or, if these present, then the petals orange yellow; column antheriferous only at and near the apex..... 1. *ABUTILON*.
8. Involucrel of 3 narrow bractlets; carpels hirsute with long simple hairs, also stellate-canescenscent; column antheriferous to far below the apex; petals pink..... 4. *ILIAMNA*.
7. Ovule solitary; carpels indehiscent, or dehiscent not nearly to the base (9).
9. Involucrel present; ovule ascending; carpels indehiscent. 7. *MALVASTRUM*.
9. Involucrel usually none or, if present, then the plant more or less lepidote and the petals ochroleucous; ovule pendulous or resupinate-horizontal (10).
10. Lateral walls of the carpels persistent, firm, intact until maturity; carpels mucous to aristate at apex, not umbonate or spurred on the back, indehiscent or apically dehiscent; plants mostly perennial..... 8. *SIDA*.
10. Lateral walls of the carpels fragile, breaking up before maturity or, if more persistent, then very thin and becoming more or less lacerate; carpels mucous at apex, often umbonate, angled, or spurred on the back; plants annual..... 9. *ANODA*.

1. ABUTILON. INDIAN-MALLOW

Plants herbaceous, suffrutescent or shrubby, canescent or tomentose with short stellate hairs, or hirsute with longer simple hairs; leaf blades crenate or dentate, not or obscurely lobed; flowers solitary in the axils, or in leafy panicles; corolla usually orange or yellow; fruit truncate-cylindric or nearly globose, the carpels with smooth sides, dehiscent nearly to the base when mature; ovules 2 or more in each carpel.

Key to the species

1. Carpels conspicuously inflated, mucicous, with thin membranaceous walls, hispid with rather long simple hairs; fruit globose----- 1. *A. CRISPUM*.
1. Carpels not conspicuously inflated, with chartaceous or coriaceous walls, not hispid or, if so, then mucronate to aristate; fruit not globose (2).
 2. Plant annual, tall; carpels usually more than 10, with long, divergent awns----- 2. *A. THEOPHRASTI*.
 2. Plant perennial; carpels seldom more than 10 (3).
 3. Carpels seldom more than 5 (4).
 4. Pubescence of the leaves sparsely strigose or substrigose, the hairs long, rather stiff, mostly simple; stems glabrate or hirsute with very long, simple, spreading or reflexed hairs; carpels aristate, the awns 2 to 3 mm. long, hispid----- 3. *A. THURBERI*.
 4. Pubescence fine or minute, the hairs mostly stellate; carpels mucicous to short-cuspidate (5).
 5. Stems woody well above the caudex; herbage finely and densely puberulent; leaf blades considerably longer than wide, gradually acuminate; petals white or pink, with a dark crimson spot at base----- 4. *A. PRINGLEI*.
 5. Stems not woody above the caudex or only near the base; pubescence coarser or more sparse; leaf blades little if any longer than wide, abruptly acuminate; petals not spotted (6).
 6. Leaf blades thickish, usually densely soft-canescenscent or tomentulose on both faces, the larger ones usually 4 cm. long or longer; flowers usually numerous, in leafy panicles; petals orange yellow, 6 to 10 mm. long; carpels mucicous or nearly so.
 5. *A. INCANUM*.
 6. Leaf blades thin, less pubescent, dark green above, the larger ones about 3 cm. long or shorter; flowers few, scattered, mostly solitary and axillary; petals pink or red, 4 to 6 mm. long; carpels mucronate or short-cuspidate----- 6. *A. PARVULUM*.
 3. Carpels mostly 7 or more (7).
 7. Stems more or less woody above the caudex; leaf blades not more and usually less than 10 cm. long, the basal sinus open; carpels cuspidate (8).
 8. Leaves very shallowly cordate, the sinus usually much less than 1 cm. deep; petals light orange yellow, little surpassing the calyx; stems, leaves, calyx, and carpels stellate-canescenscent or tomentulose.
 7. *A. CALIFORNICUM*.
 8. Leaves more deeply cordate, the sinus usually 1 to 2 cm. deep; petals rich orange, about twice as long as the calyx; calyx and carpels (and usually the stems) villous; leaf blades velvety-tomentose.
 8. *A. PALMERI*.
 7. Stems herbaceous above the caudex, stout, tall, usually 90 cm. long, or longer; leaf blades usually 10 cm. long or longer, very deeply cordate, the sinus often closed and 1.5 to 3 cm. deep on the lower leaves; flowers in long, nearly naked, terminal panicles; petals light orange or yellow, much surpassing the calyx; calyx and carpels stellate-canescenscent (9).
 9. Stems and petioles sparsely to copiously hirsute with long, spreading or reflexed hairs; carpels mucronate or cuspidate-- 9. *A. SONORAE*.
 9. Stems and petioles glabrous or puberulent; carpels mucicous or nearly so----- 10. *A. REVENTUM*.

1. *Abutilon crispum* (L.) Sweet, Hort. Brit. 53. 1827.*Sida crispata* L., Sp. Pl. 685. 1753.*Gayoides crispum* Small, Fl. Southeast. U. S. 764. 1903.

Pinal, Maricopa, and Pima Counties, 3,000 feet or lower, common on dry slopes, flowering almost throughout the year. Florida, southern Arizona, and southward into tropical America.

Leaf blades ovate, cordate, often prominently reticulate-veined beneath; pedicels filiform, often deflexed at the joint; petals pale orange yellow, 7 to 9 mm. long.

2. *Abutilon theophrasti* Medik., Malvenfam. 28. 1787.*Abutilon aricennae* Gaertn., Fruct. et Sem. 2: 251. 1791.

Near Glendale, Maricopa County, in a cotton field (*Kearney* 5986), probably nowhere established in Arizona. Common in the eastern United States; naturalized from Asia.

Leaf blades large, cordate, velvety-pubescent; carpels much surpassing the calyx, villous.

3. *Abutilon thurberi* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 307. 1855.

Near mouths of canyons on the western slope of the Baboquivari Mountains (Pima County), in partial shade, about 3,500 feet (*Gilman* B35, *Peebles* 8987, 9060), August to October. Southern Arizona and northern Sonora.

Calyx and carpels long-hirsute. Stems from creeping rootstocks.

4. *Abutilon pringlei* Hochr., Conserv. et Jard. Bot. Genève Ann. 6: 14. 1902.

Yavapai, Pinal, Maricopa, and Pima Counties, 2,000 to 4,000 feet, common on dry slopes, April to October, type from the Tucson Mountains, Pima County (*Pringle* in 1884). Southern Arizona and northern Sonora.

5. *Abutilon incanum* (Link) Sweet, Hort. Brit. 53. 1827.*Sida incana* Link, Enum. Pl. 2: 204. 1822.*Abutilon texense* Torr. and Gray, Fl. North Amer. 1: 231. 1838.

Mohave, Yavapai, Pinal, Cochise, Pima, and Yuma Counties, 1,000 to 4,000 feet, common on dry slopes, April to October. Central Texas to southern Arizona and Mexico.

Fibers extracted from the stems are reported to be used in Mexico for making rope.

6. *Abutilon parvulum* A. Gray, Pl. Wright. 1: 21. 1852.

Navajo County to Mohave County, southward to Cochise and Pima Counties, 3,500 to 5,000 feet, rather common on dry plains and slopes, sometimes with scrub oak, May to October. Colorado and Texas to Arizona, California, and northern Mexico.

7. *Abutilon californicum* Benth., Bot. Voy. Sulph. 8. 1844.*Abutilon lemmoni* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 357. 1885.

Yavapai, Graham, Pinal, Maricopa, and Pima Counties, 1,800 to 4,000 feet, frequent on dry, rocky slopes, March to September. Southern Arizona and Mexico.

A shrub, up to 2 m. high, the leaves varying greatly in size according to the moisture supply. The flowers open in the evening, according to C. G. Pringle, who collected the type of *A. lemmoni* in the Santa Catalina Mountains.

8. **Abutilon palmeri** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 289. 1870.

Abutilon parishii S. Wats., *ibid.* 20: 357. 1885.

Along Salt River (eastern Maricopa County), Santa Catalina Mountains and Bates Well to Quitobaquito (Pima County), 1,100 to 3,000 (?) feet, dry rocky slopes, April and May, type of *A. parishii* from the Santa Catalina Mountains (*Pringle* in 1884). Southern Arizona, Sonora, and Baja California.

9. **Abutilon sonorae** A. Gray, Pl. Wright. 2: 23. 1853.

Pinal, Santa Cruz, and Pima Counties, 3,000 to 4,000 feet, not infrequent in rich soil near streams, August to October, type (*Wright* 899) collected "on the Sonoita," probably in southwestern Cochise County. Southern Arizona and Mexico.

10. **Abutilon reventum** S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 418. 1886.

Santa Catalina and Baboquivari Mountains (Pima County), 3,000 to 4,000 feet, rich soil near streams, April to September. Southern Arizona and Mexico.

Plant very similar in appearance to *A. sonorae*. Petals bright yellow, not orange as in most of the species.

2. HORSFORDIA

Plants shrubby, densely stellate-canescens or tomentose, the pubescence yellowish; leaf blades denticulate or crenulate, thick, truncate or subcordate at base; flowers axillary, solitary or in few-flowered clusters, often assembled in leafy panicles; carpels 8 to 12, the winged apical portion green, bluish, or purplish, often slightly erose, promptly dehiscent.

Key to the species

1. Leaf blades ovate-lanceolate; petals yellow, about 8 mm. long.

1. Leaf blades ovate, usually broadly so; petals pink, 10 to 15 mm. long.

2. *H. ALATA*.

1. **Horsfordia newberryi** (S. Wats.) A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 297. 1887.

Abutilon newberryi S. Wats., *ibid.* 11: 125. 1876.

Pinal, Maricopa, Pima, and Yuma Counties, 1,500 to 2,000 feet, dry, rocky hillsides, March to October, type from the Purple Hills. Yuma County (*Newberry* in 1858). Southern Arizona, southeastern California, Sonora, and Baja California.

Stems commonly 1 to 2 m. high.

2. *Horsfordia alata* (S. Wats.) A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 297. 1887.

Sida alata S. Wats., ibid. 20: 356. 1885.

Tule Well and Gila Mountains (southern Yuma County), 500 to 1,000 feet, sandy washes, March to October. Southwestern Arizona, southeastern California, Sonora, and Baja California.

The stems reach a height of 3 m. and a diameter at base of 5 cm. The petals turn blue in drying.

3. SPHAERALCEA.⁸³ GLOBEMALLOW

Plants stellate-pubescent; leaf blades shallowly dentate to pedately dissected; inflorescences racemose or paniculate; calyx nearly always 3-bracteolate; corolla usually red (grenadine); fruit hemispheric to truncate-conic; carpels often remaining attached to the axis after maturity by a threadlike extension of the dorsal nerve; ovules and seeds 1 to 3 in each carpel.

Several of the species flower in spring and again after summer rains. They are known locally in Arizona as sore-eye-poppy, doubtless a translation of the Mexican name mal-de-ojos. The Pima Indian name of these plants signifies "a cure for sore eyes." The Hopi Indians are reported to employ certain species as a remedy for disorders of the bowels, and to use the mucilaginous stems, under the name of "kopona," as a substitute for chewing gum. The plants are browsed to some extent by sheep and goats. One species in southern Arizona is a host of the fungus, *Phymatotrichum omnivorum*, that causes the destructive root rot of cotton and other cultivated plants. Many of the species are difficult to identify, especially in the absence of mature fruit.

Key to the species

1. Annual or biennial; petals orange; leaf blades shallowly lobed; carpels very thin-walled, the reticulate basal part forming two-thirds or more of the carpel and conspicuously wider than the unreticulate apical part (2).
2. Plant densely yellowish canescent, appearing scurfy; leaf blades thick and firm, crenulate; carpels rather deeply notched---- 1. *S. ORCUTII*.
2. Plant grayish pubescent, usually rather sparsely and loosely so; leaf blades thin and soft, coarsely crenate; carpels shallowly notched. 2. *S. COULTERI*.
1. Perennial; petals usually red (grenadine), sometimes pink or white (3).
3. Carpels with thick, coriaceous walls, the reticulate part forming two-thirds or more of the carpel, conspicuously wider than the unreticulate part; leaf blades, at least the lower ones, 3-parted or divided (4).
4. Stems, leaves, and calyx silvery-lepidote; upper leaf blades entire, linear to narrowly oblanceolate; carpels 7 to 9----- 15. *S. LEPTOPHYLLA*.
4. Stems, leaves, and calyx canescent or more coarsely pubescent; all of the leaf blades deeply cleft, parted, or divided; carpels 10 to 14. 16. *S. COCCINEA*.
3. Carpels with thinner, scarious to chartaceous walls, the reticulate part forming less than two-thirds of the carpel, not conspicuously wider than the unreticulate part (5).
5. Walls of the carpels very thin, scarious, the reticulate part with very small, transparent areolas (6).
6. Inflorescence narrow, many-flowered, thyrsoïd-glomerate. 3. *S. EMORYI*.

⁸³ Reference: KEARNEY, THOMAS H. THE NORTH AMERICAN SPECIES OF SPHAERALCEA SUBGENUS EUSPHAERALCEA. Calif. Univ. Pubs. Bot. 19: 1-128. 1935.

6. Inflorescence an open, relatively few-flowered panicle. 5. *S. LAXA*.
5. Walls of the carpels thicker, chartaceous, the reticulate part with coarser, often opaque areolas (7).
7. Reticulate part of the carpel usually rugose or muricate on the back, the reticulations prominent and coarse (8).
8. Fruit hemispheric or nearly so; carpels usually muticous or mucronulate, about two-thirds as wide as high; plant often suffrutescent; leaf blades semiobicular, shallowly lobed; inflorescence usually an open panicle----- 4. *S. AMBIGUA*.
8. Fruit truncate-conic; carpels usually cuspidate, less than two-thirds as wide as high; plant not suffrutescent; leaf blades considerably longer than wide; inflorescence racemiform or narrowly thyrsoid (9).
9. Inflorescence a long, many-flowered thyrs with usually more than 3 flowers to the node; caudex well developed; stems erect or nearly so, seldom less than 60 cm. long; pedicels usually persistent----- 3. *S. EMORYI*.
9. Inflorescence racemiform or subthyrsoid with 1 to 3 flowers to the node; caudex usually poorly developed; stems often originating as root shoots, commonly decumbent at base, not more than 50 cm. long; pedicels detaching promptly at maturity of the fruit----- 11. *S. SUBHASTATA*.
7. Reticulate part of the carpel smooth or nearly so on the back, the reticulations less prominent and finer (10).
10. Inflorescence relatively few-flowered, not thyrsoid-glomerate; carpels about half as wide as high (11).
11. Calyx not conspicuously more pubescent than the stems and leaves, these commonly densely whitish canescent or tomentose; inflorescence an open, long-branched panicle; carpels usually acutish, cuspidate, and rather prominently reticulate with semitransparent areolas----- 5. *S. LAXA*.
11. Calyx conspicuously more pubescent than the stems and leaves, these usually green and glabrate; inflorescence typically narrow and short-branched; carpels mostly very obtuse, muticous or mucronate, and rather faintly reticulate with opaque areolas. 6. *S. RUSBYI*.
10. Inflorescence many-flowered, thyrsoid-glomerate, or, if few-flowered and racemiform, then the carpels much more than half as wide as high (12).
12. Fruit hemispheric or nearly so; carpels three-fifths to fully as wide as high (13).
13. Leaf blades not pedate, shallowly lobed near the middle with broad, rounded lobes, broadly deltoid or subobicular, more or less cordate, thickish, the veins prominent beneath. 12. *S. PARVIFOLIA*.
13. Leaf blades pedately cleft, parted, or divided (14).
14. Inflorescence a narrow, interrupted, many-flowered thyrs; leaf blades with a midlobe 10 to 20 mm. wide. 13. *S. GROSSULARIAEFOLIA*.
14. Inflorescence racemiform or subthyrsoid, few-flowered; leaf blades with midlobe not more than 5 mm. wide. 14. *S. DIGITATA*.
12. Fruit truncate-conic; carpels half to three-fifths as wide as high (15).
15. Blades about equally long and wide, shallowly lobed, usually cordate; pubescence grayish or whitish-- 12. *S. PARVIFOLIA*.
15. Blades much longer than wide or, if not much longer, then either pedate, or cuneate at base, or the pubescence yellowish (16).
16. Blades pedately cleft or parted----- 7. *S. WRIGHTII*.
16. Blades not pedate (17).
17. Blades merely angulate or toothed near the base, linear-lanceolate or oblong-lanceolate, not more than one-third as wide as long; pubescence grayish. 10. *S. ANGUSTIFOLIA*.

17. Blades more or less distinctly lobed, ovate or oblong-ovate, more than one-third as wide as long (18).

18. Pubescence yellowish, scurfy; blades shallowly lobed, the lateral lobes usually broad and rounded; petals 10 to 17 mm. long; column 6 to 8 mm. long; hairs of the stem very short, many-rayed.

8. *S. INCANA.*

18. Pubescence grayish or whitish; blades often deeply cleft, the lateral lobes triangular and acutish; petals 8 to 13 mm. long; column 4 to 6 mm. long; or, if the petals and the column longer, then the hairs of the stem relatively long and few-rayed.----- 9. *S. FENDLERI.*

1. *Sphaeralcea orcuttii* Rose, Contrib. U. S. Natl. Herbarium 1: 289. 1893.

Southern Yuma County, 500 feet or lower, abundant, roadsides and fields, usually in sandy soil, March to May. Southwestern Arizona, southeastern California, Sonora, and Baja California.

Plant annual or biennial, with tall wandlike stem and very numerous small flowers.

2. *Sphaeralcea coulteri* (S. Wats.) A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 291. 1887.

Malvastrum coulteri S. Wats., ibid. 11: 125. 1876.

Pinal, Maricopa, Pima, and Yuma Counties, 2,500 feet or lower, roadsides, fields, and mesas, abundant, usually in sandy soil, February to May. Southwestern Arizona, southeastern California, Sonora, and Sinaloa.

3. *Sphaeralcea emoryi* Torr. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 23. 1849.

Mohave, Pinal, Maricopa, Pima, and Yuma Counties, 2,500 feet or lower, roadsides and fields, flowering mostly in spring, type from near the mouth of the Gila River (*Emory* in 1846). Western and southern Arizona, southern Nevada, southeastern California, and northern Baja California.

A highly variable species, intergrading or perhaps hybridizing frequently with *S. ambigua*. The corolla is normally red (grenadine), but plants with a pink or lavender corolla are frequent. The more common form, especially in Maricopa, Pinal, and Pima Counties, is var. *variabilis* (Cockerell) Kearney (*S. variabilis* Cockerell), with leaf blades distinctly lobed or parted, whereas in typical *S. emoryi* they are merely angulate or, at most, indistinctly lobed. A narrow-leaved form, var. *nevadensis* Kearney, has been collected at Silver Lake, Navajo County (*Griffiths* 2698). A form with very delicate, thin-walled carpels, var. *arida* (Rose) Kearney (*S. arida* Rose), is to be looked for along the Colorado River, in Yuma County.

4. *Sphaeralcea ambigua* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 292. 1887.

Mohave, Gila, Pinal, Maricopa, Pima, and Yuma Counties, 3,000 feet or lower, dry rocky slopes and edges of sandy washes, February to May. Southwestern Utah to southern California, Sonora, and northern Baja California.

Desertmallow, apricot-mallow. This is the most xerophytic of the species of *Sphaeralcea* occurring in Arizona. The stems become woody below and are often very numerous, 100 or more from a single

root. It is one of the largest-flowered species, the petals attaining a length of 3 cm. The inflorescence is typically an open, long-branched panicle, but plants with a narrower, more thyrsoid inflorescence are not infrequent. A variant, of local occurrence throughout most of the range in Arizona, is var. *rosacea* (Munz and Johnston) Kearney (*S. rosacea* Munz and Johnston), distinguished by a mauve- rather than apricot- or grenadine-colored corolla.

5. *Sphaeralcea laxa* Woot. and Standl., Torrey Bot. Club Bul. 36: 108. 1909.

Navajo and Coconino Counties (local), southward to Cochise and Pima Counties, 2,000 to 6,000 feet, usually on limestone soils, in the open, May to October. Western Texas to Arizona and northeastern Sonora.

On "caliche" soils near Tucson this is the most abundant species of the genus. It varies from shade forms with thin, bright green, shallowly lobed leaf blades, to forms with thick, whitish tomentose, often deeply dissected blades. The open, relatively few-flowered inflorescence and dark-purple anthers are distinctive.

6. *Sphaeralcea rusbyi* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 293. 1887.

Coconino, Yavapai, Graham, Gila, Pinal, and Maricopa Counties, 2,600 to 6,000 feet, well-drained slopes, often in openings in yellow pine forests, April to September, type from Prescott, Yavapai County (*Rusby* 537). Southern Utah to central Arizona, southeastern California.

In its typical form, this species is distinguished from its nearest relative, *S. lara*, by its sparse pubescence of long-rayed hairs and usually narrow inflorescence. A luxuriant, highly variable form, with usually less deeply pedate leaf blades, larger flowers, and often more copious and shorter pubescence, is var. *gilensis* Kearney. This often occurs at somewhat lower elevations and is especially abundant in the Pinal Mountain region and along the Gila River east of Florence.

7. *Sphaeralcea wrightii* A. Gray, Pl. Wright. 2: 21. 1853.

Camp Grant, Graham County (*E. Palmer* 19, etc.), Douglas and Sulphur Springs Valley, Cochise County (*Carlson* in 1915, *Price* in 1894), apparently rare. Western Texas to southeastern Arizona and Chihuahua.

None of the Arizona specimens are typical, having less distinctly pedate leaves than the type of the species.

8. *Sphaeralcea incana* Torr. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 23. 1849.

Apache, Navajo, and Coconino Counties, 4,000 to 6,000 feet, sandy or gravelly mesas and slopes, summer and autumn. Western Texas to northeastern Arizona and Chihuahua.

The tall, wandlike stems and very numerous flowers make this a conspicuous plant, distinguished from its nearest relative, *S. fendleri*, by the yellowish-green color of the foliage. It is characteristically a plant of the open, whereas *S. fendleri* commonly inhabits forests or thickets. The more frequent form in Arizona is var. *cuneata* Kearney, with narrower leaf blades that are cuneate, not subcordate or truncate at base.

9. *Sphaeralcea fendleri* A. Gray, Pl. Wright. 1: 21. 1852.

Sphaeralcea leiocarpa Woot. and Standl., Torrey Bot. Club
Bul. 36: 107. 1909.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 8,000 feet, commonly in yellow pine forests, sometimes among live oaks at lower elevations, summer and autumn. Southern Colorado to western Texas, Arizona, and northern Mexico.

This is the characteristic species of the yellow pine zone. It is highly variable in leaf shape and in the reticulation of the carpels, which often is scarcely perceptible (*S. leiocarpa*). There are two well-marked variants in Arizona: var. *albescens* Kearney, with very short, velvety-white pubescence, growing in thickets along Sonoita Creek in Santa Cruz County; and var. *venusta* Kearney, with larger flowers than in the typical form and petals commonly mauve, rather than grenadine, in color, also characterized by usually longer hairs of the stems and leaves. This showy form is rather frequent in rich soil, usually along streams, in the live oak belt and at the lower edge of the yellow pine belt in the mountains of Graham, Cochise, Santa Cruz, and Pima Counties.

10. *Sphaeralcea angustifolia* (Cav.) G. Don, Hist. Dichl. Pl. 1: 465. 1831.

Malva angustifolia Cav., Diss. 1: 64. 1786.

Navajo and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 7,000 feet, roadsides and edges of cultivated fields, May to October. Western Kansas and Colorado to western Texas, Arizona, and Mexico.

The species is represented in Arizona by var. *cuspidata* A. Gray (*S. cuspidata* Britton), distinguished from the typical form of the species by its usually denser pubescence, narrower leaf blades with more pronounced basal teeth, grenadine or grenadine-pink petals, and less connate, narrower, mucronate or cuspidate carpels. A form with broader and more distinctly lobed leaf blades, in the vicinity of Tucson, approaches var. *lobata* (Wooton) Kearney (*S. lobata* Wooton).

11. *Sphaeralcea subhastata* Coult., Contrib. U. S. Natl. Herbarium 1: 32. 1890.

Apache County to Mohave County, south to Cochise and Pima Counties, common on treeless plains and mesas, usually in heavy, relatively impermeable soils, May to October. Western Texas to Arizona and northern Mexico.

A highly variable species, characterized by low growth (stems less than 50 cm. long) and racemose or, in one variety, subthyrsoid, relatively few-flowered inflorescences. Approximately typical specimens have been collected only in Cochise County. The varieties chiefly represented in Arizona are: var. *connata* Kearney, distinguished especially by having the carpels connate and separating from the axis in a ring, inhabiting the northern counties, 5,000 to 7,000 feet; var. *pumila* (Woot. and Standl.) Kearney (*S. pumila* Woot. and Standl.) in the same region, and also in Graham and Cochise Counties, characterized by the deeply dissected, sometimes almost divided leaf blades; and var. *thyrsoides* Kearney, in Pima County, 2,000 to 3,000 feet, with

taller stems, more deeply dissected leaf blades, and a less simple inflorescence than in typical *S. subhastata*.

12. **Sphaeralcea parvifolia** A. Nels., Biol. Soc. Wash. Proc. 17: 94. 1904.

Sphaeralcea arizonica Heller ex Rydb., Torrey Bot. Club Bul. 40: 59. 1913.

Apache County to Mohave County, south to Yavapai and Gila Counties, mostly 4,000 to 7,000 feet, dry slopes and mesas, usually in the open, May to October, type of *S. arizonica* from Flagstaff (*MacDougal* 120). Western Colorado to New Mexico, Arizona, and eastern California.

An extremely abundant plant in north-central and northern Arizona, the roadsides often being colored red with its flowers. This species superficially resembles *S. incana* but is distinguished by the whitish or grayish (not yellowish) color of the stems and leaves, less virgate inflorescence, smaller, more rounded leaf blades, flatter fruit, and less cuspidate carpels. From forms of *S. ambigua* with contracted inflorescence, *S. parvifolia* is distinguishable by its more numerous and smaller flowers, fruit equaling or surpassing the calyx, and less galeate and less prominently reticulate carpels.

13. **Sphaeralcea grossulariaefolia** (Hook. and Arn.) Rydb., Torrey Bot. Club Bul. 40: 58. 1913.

Sida grossulariaefolia Hook. and Arn., Bot. Beechey Voy. 326. 1840.

Apache County to Mohave, Yavapai, Gila, and Pinal Counties, 3,000 to 6,000 feet, mesas and slopes, often among junipers and pin-yons, occasionally descending along streams to lower elevations, May to October. Idaho and Washington to New Mexico, Arizona, and California.

This species is represented in Arizona only by var. *pedata* (Torr.) Kearney (*S. pedata* Torr.), which differs from the typical form in its higher, narrower, more pointed carpels, which are often mucronate or cuspidate, and 2-seeded. It closely resembles forms of *S. rusbyi* but may usually be distinguished by its finer and denser pubescence and shorter carpels. At the southern limit of its range in Arizona, specimens suggesting hybridization with *S. rusbyi* have been collected.

14. **Sphaeralcea digitata** (Greene) Rydb., Torrey Bot. Club Bul. 40: 58. 1913.

Malvastrum digitatum Greene, Leaflets 1: 154. 1905.

Apache County to eastern Coconino County, 4,000 to 7,000 feet, well-drained slopes, often among junipers or pines. Western Texas to southern Utah, northern Arizona, and northern Chihuahua.

15. **Sphaeralcea leptophylla** (A. Gray) Rydb., Torrey Bot. Club Bul. 40: 59. 1913.

Malvastrum leptophyllum A. Gray, Pl. Wright. 1: 17. 1852.

Apache County to eastern Coconino County, 4,000 to 6,000 feet, dry, rocky hills and mesas, in shallow soils. Southwestern Colorado, southern Utah, New Mexico, northeastern Arizona, and Chihuahua.

The silvery-lepidote pubescence and the very narrow, simple or

3-divided, otherwise entire leaf blades, distinguish this from all other species of the genus.

16. *Sphaeralcea coccinea* (Pursh) Rydb., Torrey Bot. Club Bul. 40: 58. 1913.

Cristaria coccinea Pursh, Fl. Amer. Sept. 453. 1814.

Malvastrum coccineum A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 21. 1849.

Apache County to Coconino County, 5,000 to 8,000 feet, dry plains and mesas, often associated with grasses, sometimes among pinyons and junipers, summer and autumn. Saskatchewan and Alberta, south to Texas, New Mexico, and northeastern Arizona.

This widely distributed species is represented in Arizona by: (1) Approximately the typical form with relatively broad leaf lobes of nearly equal length; (2) var. *dissecta* (Nutt.) Kearney, with more narrowly lobed leaf blades and denser pubescence; (3) var. *elata* (Baker) Kearney, with a more elongate midlobe and with the smooth, dehiscent portion of the carpels relatively larger. Specimens with distinctly cuspidate carpels, referred doubtfully to the last variety, may be hybrids with *S. subhastata*.

4. ILIAMNA. WILD-HOLLYHOCK

Plant herbaceous above the caudex; herbage sparsely stellate-pubescent; stems tall, leafy; leaf blades rather shallowly 3- to 7-cleft, with broad, triangular lobes; flowers in long, interrupted, thyrsoid panicles; involucre of 3 narrow, persistent bractlets; corolla pink or white; column stellate-hirsute below; carpels not reticulate, dehiscent to the base or nearly so, remaining attached to the axis by threads; ovules and seeds usually 3.

1. *Iliamna grandiflora* (Rydb.) Wiggins, Dudley Herbarium Contrib., Stanford Univ. 1: 223. 1936.

Sphaeralcea grandiflora Rydb., Torrey Bot. Club Bul. 31: 565. 1904.

Phymosia grandiflora Rydb., Torrey Bot. Club Bul. 40: 60. 1913.

South Canyon, Kaibab Plateau, Coconino County, in damp places (*P. Mead* in 1929), flowering in summer. Southwestern Colorado, northern New Mexico, and northern Arizona.

A handsome and showy plant with petals 2 to 3 cm. long and large, maplelike leaves.

5. MALVA. MALLOW, CHEESEWEED

Plants annual or biennial, sparsely pubescent or glabrate; leaf blades orbicular or reniform; flowers small, axillary, solitary or in small cymules, short-pedicel; petals white or pink; style branches filiform, introrsely papillate; fruit depressed, disklike, the carpels numerous, compressed, reniform, indehiscent.

The plants are reported to be boiled and eaten by the Indians in times of scarcity. Both species are natives of the Old World, extensively naturalized in the United States.

Key to the species

1. Petals not more than 6 mm. long, the claws glabrous; carpels sharply and radiately rugose on the sides, reticulate on the back. 1. *M. PARVIFLORA*.
1. Petals 10 to 15 mm. long, the claws bearded; carpels smooth or nearly so. 2. *M. NEGLECTA*.

1. *Malva parviflora* L., Amoen. Acad. 3: 416. 1756.

Coconino, Pinal, Maricopa, Cochise, and Pima Counties, a common field weed, March to September.

2. *Malva neglecta* Wallr., Syll. Ratisb. 1: 140. 1824.

Malva rotundifolia of authors. Not L.

Coconino, Yavapai, and Gila Counties.

6. SIDALCEA

Plants perennial, herbaceous above the caudex, sparsely pubescent; leaf blades palmately lobed or cleft, the lower ones orbicular or nearly so, sometimes merely crenate; flowers showy, short-pedicelled, in terminal, bracted racemes; involucrel none; petals 1.5 to 2.5 cm. long; style branches filiform, introrsely papillate; carpels few, indehiscent, smooth or reticulate on the sides.

1. *Sidalcea neomexicana* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 23. 1849.

Apache County to Coconino and Yavapai Counties, also in the Huachuca Mountains, Cochise County (*Lemmon* 2646), 5,000 to 9,000 feet, frequent in wet meadows and along streams, June to September. Wyoming and Idaho to northern Mexico and California.

A handsome plant, with stems up to about 1 m. long and large, commonly mauve-colored flowers. Reported to be sometimes used as greens by the Indians.

7. MALVASTRUM

Plants annual or perennial, herbaceous or shrubby, sparsely to densely stellate-pubescent, or hispid; leaf blades ovate to orbicular, crenate or palmately cleft; flowers axillary, or in terminal, bracted inflorescences; calyx subtended by an involucrel of narrow bractlets; petals yellow or purple; carpels few, compressed or somewhat turgid, rugose on the sides, sometimes tuberculate on the back, indehiscent.

Key to the species

1. Plant shrubby; leaf blades ovate, crenate-dentate, sparsely to densely stellate-canescenscent; petals orange yellow; carpels rather thick, with coriaceous walls, radiately rugose on the sides, with 2 conical processes or cusps on the back. 1. *M. BICUSPIDATUM*.
1. Plants herbaceous, annual; leaf blades orbicular or nearly so; petals purple or nearly white; carpels thin-walled, not appendaged on the back (2).
2. Leaf blades merely coarsely crenate; stems and petioles hispid with long, mostly simple hairs; petals 15 to 20 mm. long, conspicuously spotted at base, lilac or mauve drying violet-purple; carpels many more than 15, thin, flat, black at maturity, reticulate near the edges. 2. *M. ROTUNDIFOLIUM*.
2. Leaf blades palmately cleft, with rounded lobes; pubescence mostly stellate; petals not more than 6 mm. long, not spotted, lavender or whitish; carpels not more than 15, somewhat turgid, not becoming black, transversely rugose----- 3. *M. EXILE*.

1. *Malvastrum bicuspidatum* (S. Wats.) Rose, Contrib. U. S. Natl. Herbarium 12: 286. 1909.

Malvastrum tricuspdatum var. *biscuspdatum* S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 417. 1886.

Pinal and Pima Counties, 4,000 to 5,000 feet, occasional on rocky slopes, April to October. Southern Arizona and Mexico.

Closely related to the South American *M. scabrum* (Cav.) A. Gray and *M. scoparium* (L'Her.) A. Gray. The Arizona plant was referred by Gray to the latter species.

2. *Malvastrum rotundifolium* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 333. 1868.

Eremalche rotundifolia Greene, Leaflets 1: 208. 1906.

Yuma and Mohave Counties, 100 to 1,500 feet, not infrequent in dry, sandy soil, often in washes, March to April. Western Arizona, southern California, and southern Nevada.

A showy plant when in flower.

3. *Malvastrum exile* A. Gray in Ives, Colo. Riv. Rpt. 8. 1860.

Eremalche exilis Greene, Leaflets 1: 208. 1906.

Mohave, Pinal, Maricopa, Pima, and Yuma Counties, up to 3,500 feet, common at roadsides and in fields, February to May, type from Pyramid Canyon, Mohave County (*Newberry* in 1858). Southwestern Utah to southern Arizona and California.

Reported to be used as food by the Pima Indians, in times of scarcity. The plant affords considerable grazing in southern Arizona, in early spring.

8. SIDA

Plants mostly perennial, herbaceous or suffrutescent, more or less pubescent with forked, stellate, or scalelike hairs; flowers axillary, solitary or in small cymules, these sometimes assembled in terminal leafy panicles; involucre usually none; carpels indehiscent or dehiscent only part way from the apex, more or less rugose and often reticulate on the sides.

Key to the species

1. Calyx greatly enlarged in fruit, papery, veiny, the segments appearing cordate at base; taproot long, tuberlike, often fusiform; stems and leaves hispid (usually sparsely so) with long, mostly few-rayed hairs; petals not or scarcely surpassing the calyx ----- 1. *S. HASTATA*.
1. Calyx not or but slightly enlarged in fruit, not papery or veiny, the segments not appearing cordate; taproot sometimes stout but not tuberlike or fusiform; stems and leaves puberulent, canescent, or lepidote (if long hairs also present, these simple, not stiff); petals considerably surpassing the calyx (2).
2. Flowering stems from elongate rootstocks, decumbent or prostrate; plants conspicuously whitish stellate-canescenscent or lepidote; leaf blades very oblique at base; petals 10 to 20 mm. long, white or ochroleucous when fresh, often fading pink; peduncles axillary, mostly 1-flowered, commonly decurved or sigmoid after anthesis; carpels reticulate on the sides, muticous or nearly so (3).
3. Stems and leaves densely whitish canescent with short, stellate hairs; leaf blades broadly deltoid or suborbicular, wider than long, rounded at apex, rather regularly dentate; involucre of 1 to 3 subulate bractlets, usually persistent until or after anthesis; petals ochroleucous when fresh; carpels indehiscent ----- 2. *S. HEDERACEA*.

3. Stems and leaves sparsely to densely silvery-lepidote with scalelike hairs; leaf blades triangular-lanceolate to triangular-ovate, longer than wide, acutish to acuminate at apex; involucrel none; petals white when fresh; carpels dehiscent at apex..... 3. *S. LEPIDOTA*.
2. Flowering stems not from rootstocks; plants not conspicuously whitish canescent or lepidote; leaf blades not or scarcely oblique at base; petals orange yellow when fresh; carpels more or less dehiscent at apex, rugose or reticulate on the sides (4).
4. Stems decumbent or prostrate, these and the petioles sparingly hirsute with long, spreading, very slender, simple hairs, also finely stellate-canescenscent or puberulent, and with short, glandular hairs; flowers axillary, solitary, on long, slender peduncles; calyx usually both long-hirsute and puberulent..... 4. *S. DIFFUSA*.
4. Stems erect or ascending or, if somewhat decumbent, then the flowers clustered at the ends of the stems and branches; stems, petioles, and pedicels finely stellate-canescenscent or puberulent, without long simple hairs; calyx not hirsute (5).
5. Plant perennial, without a definite axis, the stems diffuse, several or numerous from a woody root; leaf blades linear or narrowly oblong (the lowest sometimes ovate), serrate; petals fading pink; carpels mucicous or short-mucronate, rugulose only at the edges, scarcely differentiated apically and basally..... 5. *S. NEOMEXICANA*.
5. Plant normally with a definite axis, this and the branches erect or nearly so, virgate; leaf blades narrowly lanceolate to ovate, crenate or crenate-dentate; petals not fading pink; carpels with a smooth dehiscent apical portion sharply differentiated from the reticulate indehiscent basal portion (6).
6. Taproot slender, not woody; plant annual, herbaceous; leaf blades narrowly lanceolate, not more than 8 mm. wide, acuminate at apex, finely crenate-dentate flowers mostly in small clusters in the upper axils and at the ends of the main stem and branches; peduncles usually less than 1 cm. long; carpels commonly bicuspidate or biaristate, the basal portion rugose-tuberculate.
6. *S. ANGUSTIFOLIA*.
6. Taproot thick, woody; plant perennial, often suffrutescent; leaf blades ovate or oblong-ovate, mostly 10 to 20 mm. wide, obtuse or acutish at apex, coarsely crenate; flowers solitary, axillary (by reduction of the upper leaves the inflorescence sometimes appearing as an elongate, terminal raceme); peduncles 1 to 3 cm. long; carpels bimucronate, the basal portion coarsely reticulate.
7. *S. TRAGIAEFOLIA*.

1. *Sida hastata* St. Hil., Fl. Bras. Mer. 1: 190. 1827.

Sida physocalyx A. Gray, Boston Jour. Nat. Hist. 6: 163. 1850.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, rather frequent in rich soil in canyons, also at Beaver Creek, Yavapai County (*Purpus* 57), March to October. Texas to Arizona and northern Mexico.

Readily distinguished from all other species of *Sida* in Arizona by the inflated, strongly 5-angled calyx and the large, tuberlike root.

2. *Sida hederacea* (Dougl.) Torr. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 23. 1849.

Malva hederacea Dougl. ex Hook., Fl. Bor. Amer. 1: 107. 1830.

Disella hederacea Greene, Leaflets 1: 209. 1906.

Apache County to Coconino, Pinal, and Yuma Counties, 1,000 to 5,000 feet, moist, often saline soil, usually near streams, May to October. Oklahoma and Texas to Washington, California, Arizona, and Mexico.

The fruits are extensively parasitized by insects and the seeds seldom mature. Known, in New Mexico, as "meloncilla." Often a troublesome weed on heavy soils.

3. *Sida lepidota* A. Gray, Pl. Wright. 1: 18. 1852.

Disella lepidota Greene, Leaflets 1: 209. 1906.

Mohave, Yavapai, Pinal, Maricopa, Cochise, and Pima Counties, 1,000 to 6,000 feet, roadsides, March to October. Western Texas and southern Colorado to Arizona and Mexico.

The typical form, with triangular-ovate, dentate, not or barely hastate leaf blades, has been collected at Deer Spring (*Rothrock* 188) and in the Chiricahua Mountains (*Blumer* 1689). The var. *sagittae-folia* A. Gray (*Disella sagittae-folia* Greene) is much more common in Arizona. It has lanceolate or oblong-lanceolate, asymmetrically hastate or subsagittate leaf blades, with 1 to 3 pairs of teeth near the base, the margins otherwise entire or nearly so.

4. *Sida diffusa* H. B. K., Nov. Gen. et Sp. 5: 257. 1822.

Greenlee, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,500 feet, common on plains and mesas in dry sandy soils, April to October. Western Texas to Arizona and Mexico.

Perhaps not specifically distinct from *S. procumbens* Swartz, a widely distributed plant of tropical and subtropical America.

5. *Sida neomexicana* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 296. 1887.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, plains in the open and in partially shaded canyons, September to October. Western Texas to southern Arizona and Mexico.

6. *Sida angustifolia* Lam., Encycl. 1: 4. 1783.

Sida spinosa L. var. *angustifolia* Griseb., Fl. Brit. West Indies. 74. 1859.

Nogales, Santa Cruz County (*Peebles* et al. 4712), Santa Rita Mountains, Pima County (*Wooton* in 1911 and 1913), about 4,000 feet, dry, sandy plains. Southern and western Texas to southern Arizona and tropical America.

Identification of the Arizona plant as Lamarck's species is perhaps questionable. Mexican specimens are mostly perennial.

7. *Sida tragiaefolia* A. Gray, Boston Jour. Nat. Hist. 6: 164. 1850.

Pima County, at Tucson (*G. A. Wilcox* in 1905) and in the Santa Catalina Mountains, 2,500 to 3,500 feet, dry, rocky slopes (*Pringle* in 1884, *Peebles* et al. 1428, etc.), late summer and autumn. Western Texas, southern Arizona, and northeastern Mexico.

9. ANODA⁸⁴

Plants sparsely hirsute to densely puberulent or tomentose; leaf blades, especially the upper ones, often hastate at base; involucrel none; fruit depressed, hemispheric or disklike; carpels usually umbonate or spurred on the back, with fragile lateral walls, these usually breaking up before maturity, the inner layer forming a saclike envelope of the

⁸⁴ Reference: HOCHREUTNER, B. P. G. MONOGRAPHIA GENERIS ANODAE. Conserv. et Jard. Bot. Genève Ann. 20: 29-68. 1916.

seed or becoming closely adherent to the seed coat, the dorsal wall more persistent.

Key to the species

1. Fruit a flattened disk of radiating carpels, these conspicuously long-hirsute or hispid, with an elongate dorsal spur; calyx spreading in fruit (2).
2. Petals purple; stems and petioles sparsely hirsute with long, mostly simple, spreading or retrorse hairs, often also puberulent, sometimes glabrate; carpels 9 to 20, hispid, not reticulate on the back; leaf blades truncate or short-cuneate at base..... 1. *A. CRISTATA*.
2. Petals orange yellow, purplish at base; stems and petioles densely puberulent or short-pilose, a few long, simple hairs often also present, the pubescence slightly viscid; carpels 10 to 12, hirsute, strongly reticulate on the back with black veins; leaf blades (the lower ones) cordate or subcordate at base..... 2. *A. WRIGHTII*.
1. Fruit hemispheric or somewhat lower, but not flat and disklake; carpels puberulent to short-hirsute, rounded, umbonate, angled, or short-spurred on the back (3).
3. Inner layer of the carpel wall separating from the outer at maturity as a reticulate, loose, saclike envelope of the seed; lower leaves with broadly cordate-angulate or shallowly lobed blades (4).
4. Upper leaves mostly with elongate, hastate blades; petals orange yellow; carpels prominently angled or short-spurred on the back..... 3. *A. CRENATIFLORA*.
4. Upper leaves with narrowly 3- to 5-lobed blades; petals purple; carpels rounded on the back..... 4. *A. RETICULATA*.
3. Inner layer not separating or, if so, then becoming closely adherent to the seed and arilliform; carpels more or less umbonate or gibbous on the back; stems tall, wandlike; inflorescence elongate, often nearly leafless above; pubescence often somewhat viscid (5).
5. Petals about 12 mm. long, more than twice as long as the calyx, orange yellow, often fading pink or purplish; plant velvety short-pubescent, also villous (at least on the lower part of the main stem), with long, spreading or retrorse, simple hairs; leaf blades broadly ovate (up to 10 cm. wide), abruptly long-acuminate at apex, deeply cordate at base, crenate-dentate; lateral walls of the carpel persistent but fragile and becoming more or less torn..... 5. *A. ABUTILOIDES*.
5. Petals not more than 6 mm. long, not more than twice as long as the calyx; plant puberulent or glabrate; upper leaves with narrow, elongate, usually hastate blades; lateral walls of the carpels breaking up before maturity (6).
6. Carpels 8 or 9, strongly several-nerved on the back; petals purple..... 6. *A. THURBERI*.
6. Carpels 5 to 7, 1-nerved on the back; petals orange yellow, often fading pink or purplish..... 7. *A. PENTASCHISTA*.

1. ***Anoda cristata*** (L.) Schlecht., *Linnaea* 11: 210. 1837.

Sida cristata L., Sp. Pl. 685. 1753.

?*Anoda lavaterioides* Medik., *Malvenfam.* 19. 1787.

Graham, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, common in moist meadows and along streams, August to October. Western Texas to southern Arizona, southward to South America.

Highly variable in size of plant and shape of the leaf blades, these being usually narrowly to broadly triangular in outline and coarsely crenate, often hastate, the basal ones sometimes digitately several-lobed. The form with lobed leaves is var. *digitata* (A. Gray) Hochr., which intergrades freely with forms having less dissected leaves.

2. ***Anoda wrightii*** A. Gray, Pl. Wright. 2: 22. 1853.

Cave Creek, Chiricahua Mountains, Cochise County, about 5,000 feet, rich soil in pine forests, September (*Harrison* and *Kearney* 6179). Southwestern New Mexico, southeastern Arizona, and Mexico.

3. *Anoda crenatiflora* Ortega, Hort. Matr. Dec. 96. 1798.

Tumacacori Mission, Santa Cruz County, about 3,000 feet, in thickets (*Harrison* 8146), August and September. Southern Arizona and Mexico.

4. *Anoda reticulata* S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 368. 1882.

Santa Catalina Mountains, Pima County (*Pringle* in 1881, the type collection), Sycamore Canyon near Ruby, Santa Cruz County (*Kearney* and *Peebles* 14453). Known only from southern Arizona.

5. *Anoda abutiloides* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 300. 1887.

Pima County, Santa Catalina Mountains (*Pringle* in 1882, the type collection), Baboquivari Mountains (*Peebles* et al. 387, etc.), 3,500 to 5,000 feet, rich soil in canyons, May to October. Apparently known only from southern Arizona but doubtless also in Sonora.

This plant bears a marked resemblance to *Abutilon sonorae* in its large, deeply cordate, long-pointed, velvety-pubescent leaf blades. In structure of the carpels it forms a link with the genus *Sida*, the lateral walls, although fragile, being more persistent than in any other species of *Anoda*.

6. *Anoda thurberi* A. Gray, Amer. Acad. Arts and Sci. Proc. 22: 299. 1886.

Cochise County, at Paradise, Chiricahua Mountains, on limestone, 5,500 feet (*Blumer* 1730), and near Fort Huachuca, on a sandy plain, about 5,000 feet (*Peebles* et al. 3381), September and October. Southern New Mexico, southeastern Arizona, and northern Mexico.

7. *Anoda pentaschista* A. Gray, Pl. Wright. 2: 22. 1853.

Sidanoda pentaschista Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 427. 1915.

Maricopa, Pinal, Cochise, and Pima Counties, 1,000 to 3,500 feet, roadsides and fields, June to September. Western Texas to southern Arizona and Mexico.

10. HIBISCUS. ROSEMALLOW

Plants perennial, often shrubby; leaf blades merely crenate or dentate, or pedately cleft; flowers axillary, solitary, the petals 2 cm. long or longer; involucre usually present; fruit a loculicidal capsule, the carpels 5; seeds several in each carpel, long-hairy.

Key to the species

1. Petals lavender; bractlets less than half as long as the calyx, often fugacious; stems densely grayish canescent or tomentose with short, stellate hairs; plant suffrutescent or shrubby..... 1. *H. DENUDATUS*.
1. Petals yellow, with a large red basal spot; bractlets nearly equaling to longer than the calyx, persistent; stems strigose or hispid with long, simple or forked hairs (2).
 2. Stems distinctly woody above the caudex, homogeneously strigose with forked hairs; pedicels usually disarticulating at maturity of the fruit; seeds completely covered with long hairs..... 2. *H. COULTERI*.
 2. Stems scarcely woody above the caudex, finely pubescent in 1 or 2 lines, also hispid with long, simple or forked hairs; pedicels not disarticulating; seeds naked or nearly so in the center..... 3. *H. BISEPTUS*.

1. **Hibiscus denudatus** Benth., Bot. Voy. Sulph. 7. 1844.

Pinal, Maricopa, Cochise, Pima, and Yuma Counties, March to October. Western Texas to southern California and northern Mexico.

Two rather well-marked forms occur in Arizona: (1) The typical form of the species, a shrub reaching a height of 1 m., with the involucl commonly little-developed, growing in sandy washes, 1,500 feet or lower, in Pinal, Maricopa, and Yuma Counties; (2) var. *involutellatus* Gray (*H. involucellatus* Woot. and Standl.), an under-shrub, commonly not more than 0.5 m. high, with a better developed and more persistent involucl, the prevailing form on shallow "caliche" soils in Cochise and Pima Counties, 2,000 to 4,000 feet.

2. **Hibiscus coulteri** Harv. ex A. Gray, Pl. Wright. 1: 23. 1852.

Pinal, Maricopa, Pima, and Yuma Counties, 1,500 to 3,500 feet, rather common on rocky slopes and sides of canyons, flowering throughout the year. Western Texas to southern Arizona and Mexico.

A straggling shrub, the stems up to 1.2 m. long.

3. **Hibiscus biseptus** S. Wats., Amer. Acad. Arts and Sci. Proc. 21: 418. 1886.

Pinal, Maricopa, and Pima Counties, 3,000 to 4,500 feet, not infrequent on rocky slopes of canyons, April to October. Southern Arizona and northern Mexico.

Arizona specimens differ from the typical form of the species in having the fine pubescence in only 1 line and the longer hairs mostly forked.

11. GOSSYPIUM. COTTON

Plant shrubby; branchlets and petioles quadrangular; leaf blades pedately 3- to 5-parted, with lanceolate or lance-elliptic, attenuate-acuminate lobes; extrafloral nectaries present on the leaf blades and at apex of the peduncles; flowers mostly solitary and axillary, borne on short branches; involucl present, persistent; petals white or whitish, 2 to 3 cm. long; fruit a 3- or 4-celled loculicidal capsule; seeds turbinate-angulate, rather sparsely villous.

1. **Gossypium thurberi** Todaro, Prodr. Monog. Gen. Gossyp. 7. 1878.

Thurberia thespesioides A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 308. 1855.

Ingenhouzia triloba of authors. Not DC.

Gila, Pinal, Maricopa, Cochise, and Pima Counties, reported also as occurring in the Bradshaw Mountains (Yavapai County), 2,500 to 4,500 (rarely 7,000) feet, rather common on rocky slopes and sides of canyons, late summer and autumn. Southern Arizona and northern Mexico.

A handsome shrub, known in Sonora as "algodoncillo" (little cotton), reaching a height of 4.2 m. (14 feet). Petals normally spotless, but plants with faint crimson basal spots are not rare. The plant is interesting because a subspecies of the cotton boll weevil breeds in the capsules. The form of this insect of which *G. thurberi* is the normal host also occasionally attacks nearby cultivated cotton, consequently the United States Department of Agriculture is endeavoring to eradicate the plant where it grows near areas of cotton cultivation.

75. STERCULIACEAE. CACAO FAMILY

Plants herbaceous to treelike, the pubescence wholly or partly of forked or stellate hairs; leaves alternate, simple; flowers perfect, regular or nearly so; calyx usually 5-lobed; petals normally 5, or none, free or united with the stamen tube; fertile stamens 5, the filaments more or less united below, with staminodia sometimes also present; fruit a 1- to 5-celled capsule.

The most important plant of this family is *Theobroma cacao*, a native of tropical America, from the seeds of which cocoa and chocolate are obtained.

Key to the genera

1. Sepals large, bright yellow; petals none; plant a large shrub or small tree. 1. FREMONTODENDRON.
1. Sepals relatively small and inconspicuous; petals present; plants small shrubs or herbs (2).
2. Petals reddish or purplish, with broad hooded blades abruptly contracted into slender claws; stamens 10, the 5 fertile ones alternating with staminodia, the anthers 3-celled; stigma capitate, larger than the style. 4. AYENIA.
2. Petals orange, with flat, spatulate or obovate blades tapering gradually into relatively broad claws; stamens 5, all fertile, the anthers 2-celled; stigma minute, not or scarcely larger than the style (3).
3. Flowers solitary in the leaf axils, on elongate peduncles; calyx tube not strongly ribbed; petals 6 to 8 mm. long; anthers hispidulous; styles 5, not contorted; fruit much larger than the calyx, 5-celled, bladder-like; seeds several in each cell.----- 2. HERMANNIA.
3. Flowers numerous, sessile, in dense glomerules aggregated into small panicles; calyx tube strongly 10-ribbed, turbinate; petals about 4 mm. long; anthers glabrous; style 1, somewhat contorted; fruit enclosed in the calyx, 1-celled, not inflated; seed solitary.--- 3. WALTHERIA.

1. FREMONTODENDRON. FREMONTIA

A large evergreen shrub or small tree; leaf blades thickish, usually palmately lobed, truncate or subcordate at base, the lower surface whitish or yellowish, scurfy-tomentose with minute stellate hairs; flowers solitary, extra-axillary, showy; sepals large, bright yellow, each with a hairy gland at base; petals none; capsule 4- or 5-celled.

1. *Fremontodendron californicum* (Torr.) Coville, Contrib. U. S. Natl. Herbarium 4: 74. 1893.

Fremontia californica Torr., Pl. Frémont. 5. 1853.

Gila County, near Payson and in the Mazatzal Mountains (*Collom* 1101), and at the junction of Rock and Pinto Creeks (*Copple* and *Cooperider* in 1926), Pinal County, Cliff Dweller Canyon (*Sizer* S-49), reported to occur also in the Bradshaw Mountains (Yavapai County), rare and local, 3,700 to 6,000 feet, on dry usually north slopes in canyons, May. Central Arizona, California, and Baja California.

A handsome plant when in flower, frequently planted in California as an ornamental, also known as flannelbush and California slippery elm. The bark is said to have the same properties as that of the true slippery elm (*Ulmus fulva* Michx.) and to be used for the same purpose, i. e., to relieve irritation of the throat. Cattle browse this plant.

2. HERMANNIA

Plant herbaceous or slightly woody at base, loosely pubescent or glabrate; flowers small, axillary; calyx 5-cleft, the lobes longer than

the tube; anthers about 2.5 mm. long; styles sparsely hispidulous; capsule with stout teeth along the edges of the valves.

1. **Hermannia pauciflora** S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 368. 1882.

Pima County, Santa Catalina Mountains (*Pringle* in 1881, the type collection, *Lemmon* 3069), Tucson Mountains, on dry gravelly slopes (*Pringle* in 1884), April. Southern Arizona and Sonora.

3. WALTHERIA

Plant herbaceous or suffrutescent, tomentose or canescent; flowers in dense axillary clusters; calyx 5-toothed, the teeth shorter than the tube; petals pale yellow, fading reddish; anthers about 1 mm. long; style bearded; capsule pubescent.

1. **Waltheria americana** L., Sp. Pl. 673. 1753.

Waltheria detonsa A. Gray, Pl. Wright. 2: 24. 1853.

Cochise (?) County and Baboquivari Mountains (Pima County), about 4,000 feet (doubtless elsewhere), canyons, September, type of *W. detonsa* from southern Arizona (*Wright* 904). Southern Arizona, Mexico, and widely distributed in tropical America.

4. AYENIA

Herbs or undershrubs, resembling some Euphorbiaceae; flowers inconspicuous; petals with the claw much longer than the blade; staminodia appearing as teeth or lobes at the margin of the expanded apex of the staminal column; capsule 5-celled, conspicuously warty.

Key to the species

1. Plant a small, intricately branched shrub; staminal column short, wholly funnel-form; staminodia large, fleshy, crenate; blades of the petals deltoid-reniform, not adnate to the summit of the column, not appendaged dorsally; ovary and fruit very short-stipitate or subsessile; leaf blades ovate, crenate-dentate..... 1. *A. MICROPHYLLA*.
1. Plants suffrutescent, or herbaceous above the woody caudex; staminal column slender, elongate, abruptly expanded into the funnelform apical portion; staminodia small, toothlike; blades of the petals not reniform, adnate to the summit of the column, bearing a hornlike dorsal appendage; ovary and fruit distinctly stipitate..... 2. *A. PUSILLA*.

1. **Ayenia microphylla** A. Gray, Pl. Wright. 1: 24. 1852.

Near Vail and in the Tucson Mountains (Pima County), Table Top Mountain (Pinal County), 2,000 to 3,000 feet, dry rocky slopes and mesas, spring and late summer. Western Texas, southern Arizona, and northern Mexico.

A small shrub, less than 0.5 m. high.

2. **Ayenia pusilla** L., Syst. Nat. ed. 10, 1247. 1759.

Gila and Yavapai Counties, south to Santa Cruz and Pima Counties, 2,000 to 4,000 feet, dry hot rocky slopes, March to October. Southern Florida, southern Texas, southern Arizona, southeastern California, and widely distributed in tropical and subtropical America.

There is much variation in the leaf blades, which vary from narrowly lanceolate or oblong-lanceolate to ovate, with crenate-dentate to serrate margins.

76. HYPERICACEAE. ST. JOHNSWORT FAMILY

1. HYPERICUM. ST. JOHNSWORT

The Arizona species perennial, glabrous herbs; leaves opposite, simple, sessile, entire, glandular-punctate; flowers perfect, regular, the sepals and petals 4 or 5, the petals yellow or salmon color; stamens numerous, usually in 3 to 5 clusters with the filaments united below; ovary 3-celled or with 3 placentas; capsule dehiscent, many-seeded.

The common St. Johnswort (*H. perforatum* L.), a European plant extensively naturalized in the United States, contains a photosensitizing principle that causes blistering and loss of hair in white-skinned horses, cattle, and sheep if exposed to strong sunlight after eating the plant. It is not known whether the native species have this effect.

Key to the species

1. Stems erect from creeping rootstocks, 20 to 70 cm. long; leaf blades 10 to 35 mm. long, black-dotted along the margin; flowers several or numerous, in leafy terminal panicles; petals yellow, 7 to 14 mm. long.

1. *H. FORMOSUM.*

1. Stems procumbent, often forming mats, rooting at the lower nodes, 3 to 25 cm. long; leaf blades 4 to 12 mm. long, not black-dotted; flowers few in terminal cymes, sometimes solitary, occasionally axillary; petals salmon-colored, 2 to 4 mm. long.

2. *H. ANAGALLOIDES.*

1. **Hypericum formosum** H. B. K., Nov. Gen. et Sp. 5: 196. 1821.

Apache County to Coconino County, south to Cochise and Pima Counties, 7,000 to 9,000 feet, moist soil in coniferous forests, July to September. Wyoming to Arizona, southern California, and Mexico.

2. **Hypericum anagalloides** Cham. and Schlecht., Linnaea 3: 127. 1828.

Kaibab Plateau, Coconino County (Grand Canyon Herb. 956). Montana to British Columbia, northern Arizona, and southern California.

77. ELATINACEAE. WATERWORT FAMILY

1. ELATINE.⁸⁵ WATERWORT

Plants herbaceous, annual, semiaquatic, glabrous; stems slender, rooting at the nodes, seldom more than 5 cm. long; leaves opposite, simple, entire; flowers axillary, minute, commonly 2-merous; fruit a dehiscent capsule, with several to many seeds.

1. **Elatine triandra** Schkuhr, Bot. Handb. 1: 345. 1791.

Grows in Arizona on the muddy margins of ponds, 5,000 feet or higher. Widely distributed in the Northern Hemisphere.

There occur in Arizona both the typical form of the species (var. *genuina* Fassett), with leaves linear to spatulate, often emarginate, and seeds with more than 15 transverse rows of pits; and var. *brachysperma* (A. Gray) Fassett (*E. brachysperma* A. Gray), with leaves linear or narrowly oblong, seeds with not more than 15 rows of pits. The typical form has been collected on the San Francisco Peaks (*MacDougal* 273), in southern Coconino County (*Peebles* 14410), and in the Pinaleno Mountains, Graham County (*Shreve* 5219). The var.

⁸⁵ Reference: FASSETT, NORMAN C. ELATINE AND OTHER AQUATICS. *Rhodora* 41: 367-376. 1939.



Ocotillo (*Fouquieria splendens*) near Salome, Yuma County, altitude 1,600 feet.
The scarlet flowers are very showy.



brachysperma has been collected near the San Francisco Peaks (*Lemon* 3313) and between Young and Payson, Gila County, growing with *Callitriche*, flowering in May (*Peebles* and *Smith* 13295).

78. TAMARICACEAE. TAMARIX FAMILY

1. TAMARIX

Large shrubs or small trees with slender branches, these covered when young by the small, imbricate, scalelike leaves; flowers in slender spikes terminating the branchlets, perfect, regular, small, 4- or 5-merous; petals and stamens borne on a fleshy disk; fruit a 3- to 5-valved capsule; seeds many, usually with a tuft of hairs at one end.

1. *Tamarix gallica* L., Sp. Pl. 270. 1753.

Abundant along streams in most parts of the State at altitudes not above 5,000 feet, often forming extensive thickets, March to August. Naturalized from Europe.

French tamarix. A handsome plant with deep pink to nearly white flowers, from which much honey is obtained in Arizona. In some places the plant is looked upon with favor as a control for too rapid soil erosion. It is seldom browsed by livestock but is used by cattle as a hiding place in the river bottoms. It can be grown on saline soils.

Athel (*T. aphylla*) is an evergreen tree from northern Africa frequently planted in Arizona for windbreaks and shade but almost never occurring spontaneously. The wood is brittle and weak, fragrant when burning. The trees grow rapidly but are objectionable on account of the expense of removal, which often is necessitated by danger of the heavy limbs falling, and the fact that other plants cannot be grown to best advantage in the dense shade and against the severe competition of the shallow feeding roots.

79. FOUQUIERIACEAE. OCOTILLO FAMILY

1. FOUQUIERIA. OCOTILLO

A large thorny shrub with numerous long whiplike unbranched stems; petioles of the short-lived primary leaves becoming thorns, bearing in their axils the fascicles of secondary leaves; flowers perfect, regular, in dense terminal panicles, showy, bright red; corolla tubular, 5-lobed; fruit an incompletely 3-celled capsule; seeds flat, winged, the wing disintegrating into hairlike filaments.

1. *Fouquieria splendens* Engelm. in Wisliz., Mem. North. Mex. 98. 1848.

Southern Apache County and western Mohave County to Greenlee, Cochise, Santa Cruz, Pima, and Yuma Counties, 5,000 feet or lower (exceptionally 6,500 feet in the Chiricahua Mountains), very common on dry mesas and slopes, April to May, rarely late summer. Western Texas to southeastern California and northern Mexico.

Sometimes called "slimwood" and "coach-whip." It is one of the oddest and most conspicuous of Arizona plants and is very attractive in flower (pl. 18). The ocotillo drops its leaves as soon as the soil dries, but as quickly refoliates after a good rain, except in winter when temperatures are low. Cuttings root readily, and it is not uncommon to see living fences or hedges of this plant. The straight, thorny stems are set in the ground thickly to build coyote-proof runs and

corrals for fowl and also are utilized by the Indians for constructing crude huts and outhouses. The Coahuila Indians of southern California are said to eat the flowers and capsules. It is reported that belt dressing of good quality is manufactured from the wax that coats the stems. The Apache Indians relieve fatigue by bathing in a decoction of the roots and also apply the powdered root to painful swellings (Collom ms.).

80. COCHLOSPERMACEAE. COCHLOSPERMUM FAMILY

1. AMOREUXIA

Plants herbaceous, with short flowering stems from a large tuberlike root; leaves long-petioled, the blades palmately lobed or parted with more or less wedge-shaped lobes; flowers few in a terminal raceme, large and somewhat irregular, the petals of unequal width and the numerous stamens in 2 sets, those of one side of the flower with longer incurved filaments; petals orange, all but the lowest one bearing 1 or 2 large red spots; anthers opening by terminal pores, the upper anthers yellow and on shorter filaments than the purple lower anthers; capsule large, with a thick outer wall and a thin inner wall, these separating at maturity.

The flowers are beautiful and the capsules are curious on account of the hyaline endocarp, through which the seeds may be seen as through a window after the exocarp falls away or is removed. The fruits are said to be used as food in Sonora and Chihuahua, and the roots were roasted and eaten by the Indians of southern Arizona. They are reported to taste like carrots or parsnips.

Key to the species

1. Stems and petioles puberulent; leaf blades glabrous; capsule broadly ovoid, less than 4 cm. long, short-acuminate, puberulent; seeds reniform, the outer coat close, hirsutulous; cotyledons oblong, at least twice as long as wide. ----- 1. *A. PALMATIFIDA*.
1. Stems and petioles short-pilose; leaf blades pilose on the veins beneath; capsule ellipsoid, 4 to 7 cm. long, long-acuminate, copiously short-pilose; seeds globose, the outer coat loose, pilose; cotyledons nearly orbicular. ----- 2. *A. GONZALEZII*.

1. ***Amoreuxia palmatifida*** Moç. and Sessé ex DC., Prodr. 2: 638. 1825.

Cochise, Santa Cruz, and Pima Counties, near the Mexican boundary, 4,000 to 5,500 feet, rocky slopes and mesas, July and August. Southern Arizona and Mexico.

2. ***Amoreuxia gonzalezii*** Sprague and Riley, Kew Roy. Bot. Gard. Bul. Misc. Inform. 1922: 102. 1922.

Santa Rita Mountains, Pima County (Wootton in 1914). Southern Arizona and northwestern Mexico.

81. KOEBERLINIACEAE. JUNCO FAMILY

1. KOEBERLINIA. JUNCO

Intricately branched, very thorny shrubs with green bark; leaves reduced to small scales; inflorescences lateral, few-flowered, umbellike or short-racemose; flowers perfect, regular; petals 4, somewhat hooded;

stamens 8, the filaments thickened at the middle; ovary 2-celled, stipitate; fruit a globular berry with 2 to 4 seeds.

Sometimes called "crown-of-thorns," "crucifixion-thorn," and "corona-de-Cristo." This very strongly armed plant repels livestock and no doubt assists in controlling soil erosion. Wherever abundant it is considered a range pest. It tends to form thickets.

1. *Koeberlinia spinosa* Zucc., Flora 15²: Beibl. 73. 1832.

Cochise County to the vicinity of Tucson (Pima County), 2,400 to 4,500 feet, hillsides and mesas, May and June. Western Texas to southeastern Arizona and northern Mexico.

The distribution in Arizona, as given in the preceding paragraph, is that of the typical form. The var. *tenuispina* Kearney and Peebles occurs farther west, in western Maricopa and southern Yuma Counties, also in northwestern Sonora. Normally it differs from the typical form in having longer and more slender branches, bluish-green rather than yellowish-green bark, longer and relatively narrower sepals, and longer petals and filaments. It flowers in March, hence earlier than the typical form, prefers sandier soil, and grows at lower elevations, 2,000 feet or lower. The plant is usually more open and taller, reaching a height of 4.5 m. (15 feet), whereas the typical form seldom exceeds 1.8 m. (6 feet) in height. Further study may show this variant to be a distinct species, but there is considerable variation and some overlapping with typical *K. spinosa* in most of the characters.

82. VIOLACEAE. VIOLET FAMILY

Plants herbaceous, annual or perennial; leaves simple, with stipules, alternate or all basal; flowers 5-merous, irregular, the lower petal concave, saccate, or spurred; filaments very short or none; fruit a 3-valved capsule.

Two favorite garden plants, the pansy (*Viola tricolor* L.), and the sweet violet (*V. odorata* L.) belong to this family. Both are natives of the Old World. Many North American species of *Viola* have beautiful flowers.

Key to the genera

1. Sepals not auriculate at base; lower petal concave or slightly saccate at base, constricted at the middle; plants caulescent, the stems leafy; flowers axillary, solitary or in small clusters..... 1. HYBANTHUS.
1. Sepals dilated or auriculate at base; lower petal produced at base into a spur or deep sac, not noticeably constricted at the middle; plants caulescent or acaulescent; flowers solitary, on long, 2-bracted peduncles..... 2. VIOLA.

1. HYBANTHUS

Plants annual or perennial; stems leafy; leaf blades linear to rhombic-lanceolate; flowers axillary, solitary or few in a cluster, inconspicuous, greenish or purplish.

Key to the species

1. Plant perennial; stems numerous from a slightly woody caudex, decumbent, ascending, or erect, not more (usually much less) than 35 cm. long; herbage dull green, puberulent or glabrous; leaves sessile or subsessile, linear, lanceolate, or oblanceolate (the lowest ones sometimes obovate), not more than 6 mm. wide, usually entire, acute or acutish at apex; flowers solitary; pedicels commonly decurved; corolla 3 to 4 mm. long, the longest petal much less than twice as long as the others, with a cucullate blade.

1. H. VERTICILLATUS.

1. Plant annual; stem solitary, erect, up to 50 cm. long, often loosely pilose above, the pubescence in lines; herbage bright green; leaves distinctly petioled, the blades rhombic-lanceolate, up to 20 mm. wide, serrulate, acuminate at apex; flowers solitary or in few-flowered clusters; pedicels usually not decurved; corolla 6 to 9 mm. long, the lower petal at least twice as long as the others, with a flat blade.----- 2. *H. ATTENUATUS*.

1. ***Hybanthus verticillatus*** (Ortega) A. Nels. in Coult., New Man. Rocky Mount. 323. 1909.

Viola verticillata Ortega, Hort. Matr. Dec. 50. 1797.

Calceolaria verticillata Kuntze, Rev. Gen. Pl. 1: 41. 1891.

Gila and Yavapai Counties to Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,500 feet, dry open plains and mesas, May to September. Kansas and Colorado to Arizona and Mexico.

2. ***Hybanthus attenuatus*** (Humb. and Bonpl.) G. K. Schulze, Notizbl. Bot. Gart. u. Mus. Berlin 12: 114. 1934.

Iomidium attenuatum Humb. and Bonpl. in Roem. and Schult., Syst. Veg. 5: 402. 1819.

Mule Mountains (Cochise County), Santa Rita and Baboquivari Mountains (Pima County), about 4,000 feet, rich soil in canyons, August to September. Southern Arizona to Central America.

2. VIOLA. VIOLET

Plants perennial, with rootstocks, caulescent or acaulescent; leaf blades lanceolate to round-reniform, entire or dentate; flowers on long 2-bracted peduncles, all or some of them large and showy, the corolla violet, yellow, or whitish, the lower petal spurred or deeply saccate at base; inconspicuous cleistogamous flowers also often present; stamens closely surrounding the ovary.

Key to the species

1. Plants strictly acaulescent, the leaves and scapes from rather stout, horizontal to erect rootstocks; herbage glabrous or sparsely pubescent; corolla normally violet, the spur short and stout (2).
 2. Leaf blades round-reniform, crenate----- 1. *V. NEPHROPHYLLA*.
 2. Leaf blades pedately parted or divided with narrow divisions.----- 2. *V. PEDATIFIDA*.
1. Plants caulescent or soon becoming so (3).
 3. Corolla yellow, often tinged with brown or purple; plants subacaulescent when young; herbage pubescent or puberulent; blades of the upper leaves lanceolate or rhombic-lanceolate (4).
 4. Capsules glabrous or glabrate; leaf blades entire or sparingly denticulate, upper petals usually yellow on the back----- 3. *V. NUTTALLII*.
 4. Capsules puberulent; leaf blades, at least the basal ones, conspicuously dentate; petals (at least the 2 upper ones) brown on the back.----- 4. *V. VENOSA*.
 3. Corolla blue or white, sometimes with a yellow eye (5).
 5. Spur cylindrical, one-third as long as to nearly equaling the blade of the petal; corolla blue; plant subacaulescent at first; flowering stems from creeping rootstocks, numerous, diffuse, commonly not more than 10 cm. long; leaf blades ovate to suborbicular, short-cuneate to subcordate at base, crenulate, puberulent or nearly glabrous--- 5. *V. ADUNCA*.
 5. Spur saccate, much less than one-third as long as the blade of the petal; petals white, purple veined, and usually tinged with purple on the back; plant strongly caulescent; flowering stems from short thick rootstocks, few, erect or ascending, commonly 20 to 30 cm. long; leaf blades triangular-ovate to suborbicular, deeply cordate at base, crenate, puberulent on both faces or glabrous beneath.----- 6. *V. CANADENSIS*.

1. *Viola nephrophylla* Greene, *Pittonia* 3: 144. 1896.

Coconino County to Cochise and Pima Counties, 5,000 to 9,200 feet, rich soil of coniferous forests, April to June. Canada to New Mexico, Arizona, and California.

Represented in Arizona chiefly by var. *arizonica* (Greene) Kearney and Peebles (*V. arizonica* Greene), characterized by sparsely pubescent or at least ciliate leaf blades, these glabrous in the typical form. The type of *V. arizonica* was collected near Fort Verde, Yavapai County (Mearns in 1888).

2. *Viola pedatifida* G. Don, *Hist. Dichl. Pl.* 1: 320. 1831.

Mogollon Escarpment, Coconino(?) County (Mearns 44), along a stream in pine forest, May. Wisconsin to Saskatchewan, south to Oklahoma, New Mexico, and Arizona.

Larkspur violet. The presence of this plant in a pine forest in central Arizona is remarkable. The species belongs mainly to the plains and prairies east of the Rocky Mountains.

3. *Viola nuttallii* Pursh, *Fl. Amer. Sept.* 174. 1814.

White Mountains (Apache County), Pagumpa Springs (Mohave County), Ash Fork (Yavapai County); also reported from Fort Verde (Yavapai County), 5,000 feet or higher, April and May. Manitoba to Missouri and central Arizona.

4. *Viola venosa* (S. Wats.) Rydb., *N. Y. Bot. Gard. Mem.* 1: 262. 1900.

Viola nuttallii var. *venosa* S. Wats. in King, *Geol. Expl.* 40th Par. 5: 35. 1871.

A collection on North Peak, Mazatzal Mountains, Gila County, 6,000 feet (Collom 48), has been identified by Baker and Clausen (m.s.) as "a very luxuriant form, nearest to subsp. *atriplicifolia* (Greene) Baker and Clausen." Montana to Washington, south to Colorado, Arizona, and California.

5. *Viola adunca* J. E. Smith, *Rees's Cycl.* 37: no. 63. 1817.

Near Flagstaff, Coconino County (MacDougal 132), Santa Catalina Mountains, Pima County (Peebles and Harrison 2223), about 7,500 feet, yellow pine forest, June to July. Canada to New Mexico, Arizona, and California.

6. *Viola canadensis* L., *Sp. Pl.* 936. 1753.

Viola muriculata Greene, *Pittonia* 5: 28. 1902.

Apache County to Coconino County, south to Cochise and Pima Counties, 6,000 to 9,000 feet, rich moist soil of coniferous forests, April to August, type of *V. muriculata* from the San Francisco Peaks (Greene in 1889). Canada, southward in the mountains to South Carolina, New Mexico, and Arizona.

V. muriculata is a more pubescent form with leaves puberulent on both faces, often slightly scabrous above, and stems also usually puberulent. It intergrades completely with typical *V. canadensis*. Specimens collected at base of the San Francisco Peaks and on the Mogollon Escarpment (Mearns 19, 94) were described as *V. canadensis* var. *scariosa* Porter, characterized as having exceptionally large, scarios stipules.

83. PASSIFLORACEAE. PASSIONFLOWER FAMILY

1. PASSIFLORA.⁸⁶ PASSIONFLOWER

Plants herbaceous or suffrutescent, the stems trailing or climbing, with tendrils opposite the leaves, these alternate, deeply lobed; flowers perfect, regular, normally 5-merous, on 1-flowered axillary peduncles, these often in pairs; petals rarely wanting; calyx throat bearing a conspicuous fringed crown; filaments united below into a tube enveloping the stipitate ovary; fruit a fleshy berry with numerous seeds.

The Arizona passionflowers are relatively inconspicuous, but some of the species of this chiefly tropical genus are highly prized cultivated ornamentals with very handsome large flowers. Two species, *P. quadrangularis*, the granadilla, and *P. edulis*, are cultivated for their fruits, the latter especially in Australia. The fruits are eaten directly or are used for flavoring ices, etc., and for making fruit sirup.

Key to the species

1. Leaves deeply 2-lobed, the lobes ascending, the margin entire; stipules narrowly linear or setaceous; seeds transversely sulcate; plant glabrous.
 1. *P. MEXICANA*.
1. Leaves 3- to 5-lobed, the lateral lobes divaricate, the margin dentate, denticulate, or sinuate; stipules semiovate or pinnatisect; seeds reticulate; plant pubescent nearly throughout (2).
 2. Petioles biglandular near the apex; bracts setaceous; stipules semiovate; corona 1-ranked; ovary glabrous; stem and leaves hispidulous.
 2. *P. BRYONIOIDES*.
 2. Petioles glandless; bracts deeply pinnatisect, with filiform divisions; stipules pinnatisect; corona in several ranks; ovary pilose; stem and leaves grayish-villous----- 3. *P. FOETIDA*.

1. ***Passiflora mexicana*** Juss., Paris Mus. Hist. Nat. Ann. 6: 108. 1805.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, usually along streams, sometimes on dry mesas, July and August. Southern Arizona and Mexico.

2. ***Passiflora bryonioides*** H. B. K., Nov. Gen. et Sp. 2: 140. 1817.

Near Ruby, Santa Cruz County (*Harrison* 5644, *Goodding* in 1936), about 4,000 feet, August and September. Southern Arizona and Mexico. Petals white, the crown purple.

3. ***Passiflora foetida*** L., Sp. Pl. 959. 1753.

Canyons on west side of the Baboquivari Mountains (Pima County), about 4,000 feet, thicket, August and September. Almost throughout tropical and subtropical America.

Represented in Arizona by var. *arizonica* Killip, known only from Arizona and Sonora, type from the Baboquivari Mountains (*Harrison* 4774). The plant has a rank disagreeable odor. The flowers are apparently vespertine, and have a lilac-colored corona.

84. LOASACEAE. LOASA FAMILY

Plants annual or perennial, herbaceous or suffrutescent; herbage rough-pubescent, the hairs often barbed, sometimes stinging; stems

⁸⁶ Reference: KILLIP, ELLSWORTH P. THE AMERICAN SPECIES OF PASSIFLORACEAE. Field Museum Nat. Hist. Bot. Ser. 19: 1-613. 1938.

The key to the Arizona species was contributed by Mr. Killip.

mostly brittle and with pale exfoliating bark; leaves alternate, simple but often deeply pinnatifid; flowers perfect, regular or nearly so, in terminal inflorescences or some of them solitary in the forks of the branches; calyx tube completely adnate to the ovary, only the 5 lobes or teeth free; petals yellow or yellowish, inserted on the calyx throat; stamens few to many; fruit a 1-celled capsule, indehiscent or tardily and irregularly dehiscent; seeds 1 to many.

This family is remarkable for the diversity and peculiar structure of the hairs.

Key to the genera

- 1. Ovary of 1 carpel, 1-celled, containing a single pendulous ovule; stamens 5 or fewer (2).
 - 2. Filaments very short, linear; anthers large, 2-celled, the connective produced into a hyaline spoon-shaped body longer than the anther cells.
 - 1. CEVALLIA.
 - 2. Filaments elongate, filiform; anthers small, 4-celled, the connective not conspicuously produced----- 2. PETALONYX.
- 1. Ovary of more than one carpel, each carpel containing several to many ovules borne on parietal placentas; stamens 10 or more (3).
 - 3. Carpels usually 3; placentas narrow or flat, not projecting far into the cavity of the ovary; ovules in 1 or 2 rows on the placenta; leaf blades not cordate at base----- 3. MENTZELIA.
 - 3. Carpels commonly 5; placentas thick, more or less circular in cross section, projecting far into the cavity of the ovary and connected with the ovary wall by a thin plate; ovules in several rows on the placenta; leaf blades subcordate at base, round-ovate, crenate-dentate, rather thick.
 - 4. EUCNIDE.

1. CEVALLIA

Plant herbaceous, perennial, canescent, also hispid with stinging hairs; leaf blades sinuate-pinnatifid; flowers small, in dense narrow-bracted heads; calyx tube short, the calyx lobes and the petals similar and seemingly in one series, long, narrow, erect, plumose with white hairs.

1. *Cevallia sinuata* Lag., Var. Cienc. 21: 35. 1805.

Greenlee County to Cochise County, 4,000 to 5,000 feet, dry mesas and slopes, August to November. Western Texas to southeastern Arizona and northern Mexico.

A noteworthy plant because of the stinging hairs and the peculiar structure of the flowers.

2. PETALONYX. SANDPAPER-PLANT

Plants woody, at least at base, the herbage scabrous; leaf blades entire or dentate; flowers small, in short broad-bracted spikes, the petals whitish or pale yellow.

Key to the species

- 1. Leaves broad at base, sessile, not shiny, lanceolate to ovate, often few-toothed; plant somewhat woody at base; herbage gray, very scabrous, densely hispidulous with retrorse hairs; floral bracts triangular-ovate, denticulate toward the base; petals 4 to 6 mm. long----- 1. P. THURBERI.
- 1. Leaves narrowed at base or short-petioled; plants woody well above the base (2).
 - 2. Leaves sessile or nearly so, lance-oblong, 3 to 6 mm. wide, entire, green, muricate-scabrous, not shiny; inflorescences subcapitate in flower, elongate in fruit; floral bracts ovate-cordate, entire, obtuse, densely soft-pubescent; petals 4 to 5 mm. long----- 2. P. LINEARIS.

2. Leaves short-petioled, ovate to lanceolate, commonly more than 6 mm. wide, denticulate or dentate, somewhat shiny; inflorescences densely paniculate; floral bracts ovate or lanceolate, not cordate, often denticulate, more or less acuminate, rough-pubescent; petals 7 to 10 mm. long (3).
3. Petals 7 to 8 mm. long; leaf blades ovate, few-dentate, usually coarsely so, rounded, truncate, or short-cuneate at base; stems herbaceous above.

3. *P. NITIDUS.*

3. Petals about 10 mm. long, white, the claws strongly coherent; leaf blades lanceolate to ovate, finely crenate, cuneate at base; stems almost wholly woody-----

4. *P. PARRYI.*

1. ***Petalonyx thurberi*** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 319. 1855.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, up to 5,000 feet but usually much lower, common in sandy soil, often in dry stream beds, May to October, type from the Gila River valley (*Thurber*). Arizona, Nevada, southeastern California, and northwestern Mexico.

2. ***Petalonyx linearis*** Greene, Calif. Acad. Sci. Proc. 4: 188. 1885.

Yuma County near Laguna Dam on the Colorado River (*Jones* in 1906, *Harrison* and *Peebles* 5060) and at Tinajas Altas (*Goodding* in 1938), March. Southwestern Arizona, southeastern California, and Baja California.

3. ***Petalonyx nitidus*** S. Wats., Amer. Nat. 7: 300. 1873.

Yucca, Mohave County, 1,800 feet (*Jones* 4483), May. Western Arizona, southern Utah and Nevada, and southeastern California.

4. ***Petalonyx parryi*** A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 72. 1874.

Northern Arizona (*Palmer* in 1877), Mokiak Pass, Mohave County, 3,000 feet (*Cottam* et al. 4410), northern Mohave County (*Peebles* and *Parker* 14752), dry washes, etc., May. Southern Utah and Nevada, and northern Arizona.

A rounded shrub about 3 feet high.

3. MENTZELIA.⁸⁷ BLAZING-STAR, STICKLEAF

Plants annual or perennial, herbaceous or suffrutescent; herbage scabrous, without stinging hairs; flowers in terminal cymose inflorescences, or some of them solitary in the forks of the branches, small or large, cream-colored, yellow, or orange; stamens usually numerous, the outer ones often petallike.

As one of the common names implies, fragments of the leaves and stems stick readily to clothing and to the hair of animals. Many of the species are handsome in flower.

Key to the species

1. Outer filaments cleft at the dilated apex, the anther borne on a slender prolongation of the filament between the 2 subulate or triangular-lanceolate teeth or lobes; petals ochroleucous, 2 to 4 cm. long; flowers closely subtended by deeply lacinate bracts; stems stout, white or whitish, seldom more than 30 cm. long, branching at or near the base: Section *Bicuspidaria* (2).

⁸⁷ Reference: DARLINGTON, JOSEPHINE. A MONOGRAPH OF THE GENUS MENTZELIA. Mo. Bot. Gard. Ann. 21: 103-226. 1934.

2. Bracts at anthesis concealing the calyx tube, mostly broadly ovate, the lower portion of different texture from the upper, scarious or thinly membranous, whitish, the teeth usually more than 8 and shorter than the width of the undivided central portion of the bract.
 1. *M. INVOLUCRATA.*
2. Bracts at anthesis not concealing the calyx tube, lanceolate, green and of uniform texture throughout, the teeth 6 to 8, at least as long as the width of the undivided central portion of the bract. 2. *M. TRICUSPIS.*
1. Outer filaments not cleft at apex; petals yellow or orange, often fading whitish; flowers not bracteate or, if loosely so, then the bracts not deeply lacinate, often entire (3).
3. Stems not conspicuously whitish, these and the capsules hispid with stout, glochidiate hairs 0.5 to 1.0 mm. long; leaf blades thin, deep green, irregularly dentate and often hastately lobed near the base; petals orange yellow, 6 to 10 mm. long; capsules elongate, clavate or narrowly obconic: Section *Eumentzelia* (4).
4. Petioles of the lower leaves more than half as long as the blade; blades broadly ovate, less than twice as long as wide; filaments of the outer stamens petaloid-dilated toward the apex. 3. *M. ASPERA.*
4. Petioles less than half as long as the blade; blades lanceolate to ovate, often much more than twice as long as wide; filaments not dilated.
 4. *M. ASPERULA.*
3. Stems becoming conspicuously whitish, scabrous-puberulent, short-pilose, or glabrate; leaf blades thickish, light green or yellowish green, not hastate; petals yellow (5).
5. Capsules clavate or narrowly obconic, more than 5 times as long as wide; seeds pendulous, thick, faceted, not winged; hairs not glochidiate, the longer ones very slender; plants annual; outer filaments not or scarcely dilated; leaf blades mostly pinnatifid: Section *Trachyphytum* or *Acrolasia* (6).
6. Seeds appearing smooth at low magnification, grooved on the angles.
 5. *M. AFFINIS.*
6. Seeds evidently muriculate at low magnification, not grooved or but slightly so on one of the angles; blades of the leaves deeply pinnatifid, or the upper ones few-toothed or entire (7).
7. Petals 8 mm. long or longer. 6. *M. NITENS.*
7. Petals less than 8 mm. long. 7. *M. ALBICAULIS.*
5. Capsules turbinate or broadly obconic, not more than 3 times as long as wide; seeds horizontal, thinly lenticular, winged; glochidiate hairs usually present, at least on the calyx; plants biennial or perennial; outer filaments more or less dilated: Section *Bartonia* or *Nuttallia* (8).
8. Petals pale yellow when fresh, 15 to 20 mm. long; stems up to 1.5 m. long, stout, strict, not branched below; leaf blades sinuate-dentate, the lower ones up to 20 cm. long; capsules 20 to 30 mm. long, commonly about 3 times as long as wide, acutish at base.
 8. *M. RUSBYI.*
8. Petals bright yellow when fresh (9).
9. Leaf blades all or mostly pinnatifid; stems usually tall, 50 cm. long or longer; petals 10 to 20 mm. long; capsules 10 to 20 mm. long, 1.5 to 3 (commonly about 2) times as long as wide, acutish to rounded at base. 9. *M. PUMILA.*
9. Leaf blades sinuate-dentate or nearly entire; stems low, less than 50 cm. long, usually branched from the base; capsules about 10 mm. long, less than twice as long as wide, rounded at base (10).
10. Stems herbaceous, slender, becoming smooth; leaf blades lanceolate or narrowly oblong; petals up to 15 mm. long. 10. *M. INTEGR.*
10. Stems suffrutescent, stout, scabrous-pubescent; leaf blades ovate or oblong-ovate; petals not more than 10 mm. long.
 11. *M. PUBERULA.*

1. *Mentzelia involucrata* S. Wats., Amer. Acad. Arts and Sci. Proc. 20: 367. 1885.

Western Maricopa, western Pinal, and Yuma Counties, 2,200 feet or lower, dry sandy soil, March and April. Southwestern Arizona, southeastern California, and northwestern Sonora.

This and the following species are very similar, short-stemmed, with large pale yellow or cream-colored flowers.

2. *Mentzelia tricuspis* A. Gray, Amer. Nat. 9: 271. 1875.

Western Mohave County, 2,000 feet or lower, dry sandy soil, April. Southern Utah to western Arizona and southeastern California.

3. *Mentzelia aspera* L., Sp. Pl. 516. 1753.

Santa Cruz and Pima Counties, about 4,000 feet, thickets, August. Widely distributed in tropical and subtropical America.

4. *Mentzelia asperula* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 148. 1913.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, slopes and mesas, usually among shrubs, sometimes on limestone, August and September. Western Texas to southern Arizona and northern Mexico.

5. *Mentzelia affinis* Greene, Pittonia 2: 103. 1890.

Canyon Lake (Maricopa County), near Tucson (Pima County), 1,500 to 2,500 feet, March to June. Southern Arizona and California.

Arizona specimens have smaller petals than most of those from California and are scarcely distinguishable from *M. albicaulis* except by the seed character.

6. *Mentzelia nitens* Greene, Fl. Francisc. 234. 1891.

Mohave, southern Yavapai, Maricopa, Pinal, Pima, and Yuma Counties, 3,000 feet or lower, February to May. Southern Utah, Arizona, and southeastern California.

Differs from *M. albicaulis* chiefly in its larger flowers and is connected with it by var. *jonesii* (Urban and Gilg) J. Darlington, a relatively small-flowered form with petals not more than 12 mm. long and the upper leaves mostly entire or few-toothed. This variety occurs in Arizona throughout the range of *M. nitens* and intergrades completely with the typical form. Resembling var. *jonesii*, but with slenderer stems and narrower leaves, is var. *leptocaulis* J. Darlington, known only from the type collection on Williams River (*Palmer* 157).

7. *Mentzelia albicaulis* Dougl. ex Hook., Fl. Bor. Amer. 1: 222. 1834.

Acrolasia albicaulis Rydb., Torrey Bot. Club Bul. 30: 277. 1903.

Throughout the State, 7,000 feet or lower, very common in sandy soil on plains and along washes, March to August. Wyoming to Washington, south to New Mexico, Arizona, and California.

Coextensive in range in Arizona with the typical form, and almost equally abundant, is var. *veatchiana* (Kellogg) Urban and Gilg (*M. veatchiana* Kellogg, *M. gracilentia* var. *veatchiana* Jepson) which has petals 4 to 6 mm. long, whereas in typical *M. albicaulis* they are not more than 4 mm. long. This form seems scarcely distinguishable from *M. albicaulis* var. *gracilis* J. Darlington. Parched meal made from the seeds of *M. albicaulis* was eaten by the Arizona Indians.

8. *Mentzelia rusbyi* Woot., Torrey Bot. Club Bul. 25: 261. 1898.

Nuttallia rusbyi Cockerell, Amer. Ent. Soc. Trans. 32: 300.
1906.

Coconino County, 6,000 to 8,500 feet, mostly in yellow pine forests, July to September. Wyoming to New Mexico and northern Arizona.

Plant coarser, more robust, and larger leaved than in any other of the Arizona species.

9. *Mentzelia pumila* (Nutt.) Torr. and Gray, Fl. North Amer. 1: 535. 1840.

Bartonia pumila Nutt., Gen. Pl. 1: 299. 1818.

Apache County to Mohave County, south to Cochise, Pima, and Yuma Counties, 3,600 to 8,000 feet, May to August. Wyoming and Utah to western Texas, Arizona, California, and northern Mexico.

Blazing-star. The distribution in Arizona given in the preceding paragraph is that of the typical form, and of the scarcely distinguishable var. *procera* (Woot. and Standl.) J. Darlington, characterized by acute or acuminate petals, and broad outer filaments. Much more common and abundant in Arizona is var. *multiflora* (Nutt.) Urban and Gilg (*M. multiflora* Gray), with more obtuse petals (these often appearing acute in dried specimens) and narrower outer filaments. This variety occurs throughout the State at altitudes of 100 to 7,000 feet, preferring sandy soil, especially abundant in dry stream beds and along roads. All forms of *M. pumila* have freely branched stems and rather large flowers with petals bright yellow when fresh and 1 to 2 cm. long.

10. *Mentzelia integra* (M. E. Jones) Tidestrom, Contrib. U. S. Natl. Herbarium 25: 362. 1925.

Mentzelia multiflora var. *integra* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 689. 1895.

Nuttallia integra Rydb., Torrey Bot. Club Bul. 40: 61. 1913.

Kaibab Trail, Grand Canyon, Coconino County (*Clover* 4151), Virgin River, Mohave County (*Purpus* 6192). Southern Utah and northern Arizona.

It is doubtful that this form is more than a variety of *M. pumila*.

11. *Mentzelia puberula* J. Darlington, Mo. Bot. Gard. Ann. 21: 177. 1934.

Gila Mountains (Yuma County), 500 to 1,000 feet, dry rocky slopes, March, and flowering occasionally after summer rains. Southwestern Arizona and southeastern California.

An undershrub, not more than 0.5 m. high.

4. EUCNIDE. ROCKNETTLE

Plant herbaceous, hispid with stinging hairs; leaf blades broadly ovate, subcordate, few-toothed; flowers few in terminal cymes, the petals pale yellow or cream-colored, about 5 cm. long; filaments of the stamens all alike, none of them petaloid.

1. *Eucnide urens* Parry, Amer. Nat. 9: 144. 1875.

Along the Colorado River, from above Boulder Dam (Mohave County) to Ehrenberg (northern Yuma County), 300 to 1,500 feet, dry rocky slopes and in canyons, April and May, type from the Colorado River valley (*Bigelow*). Southern Utah and Nevada to western Arizona and southeastern California.

Plant remarkable for the large size of the flowers and the stinging hairs.

85. CACTACEAE.⁸⁸ CACTUS FAMILY

The Arizona species fleshy-stemmed, perennial, mostly spiny and xerophytic plants with mucilaginous or rarely milky juice, characterized by complex cushionlike organs (areoles) from which spines, branches, or flowers arise; stems of 1 or more joints, these flattened, cylindrical, or globose, often tuberculate or ribbed; leaves wanting or rudimentary; flowers perfect, mostly regular and solitary; perianth segments several to many, more or less united at base, inserted on a hypanthium; stamens indefinitely numerous, inserted within the hypanthium tube; ovary inferior, 1-celled, the ovules parietal, numerous; style 1; stigma lobes several; fruit several- to many-seeded, fleshy or dry, indehiscent or dehiscent, spiny, scaly, or smooth.

The cactus family is characteristic of the desert regions of Arizona, where the plants are abundant and conspicuous. The cactus most outstanding in scenic appeal is the gigantic sahuaro, the largest succulent in the United States.

Key to the genera

- | | |
|---|------------------|
| 1. Areoles furnished with glochids (barbed bristles); spines barbed or scabrous. | 5. OPUNTIA. |
| 1. Areoles not furnished with glochids; spines not barbed or scabrous (2). | |
| 2. Flowers borne in the axil of the tubercle or at base of the groove, at some distance from the spiniferous areole; tubercles distinct, disposed in spiral rows..... | 4. MAMMILLARIA. |
| 2. Flowers borne at apex of the tubercle, contiguous with or actually on the spiniferous areole; tubercles coalesced to form vertical or spiral ribs, except in one section of <i>Echinocactus</i> (3). | |
| 3. Flowers nocturnal, borne on the spiniferous areoles; stems greatly elongate, many times longer than thick; plant more or less branched above the base..... | 1. CEREUS. |
| 3. Flowers diurnal, not borne on the spiniferous areoles; stems not greatly elongate; plant caespitose or simple (4). | |
| 4. Hypanthium spiny; flowers lateral..... | 2. ECHINOCEREUS. |
| 4. Hypanthium devoid of spines, commonly scaly; flowers terminal. | 3. ECHINOCACTUS. |

1. CEREUS

Plants large or small; stems greatly elongate, more or less branched above the base of the plant; spines not hooked; flowers funnelliform or salverform, borne on the mature spiniferous areoles, nocturnal, lasting less than 24 hours; scales of the hypanthium usually entire, acute, rather persistent; ovary or fruit more or less spiny, the latter a berry; seeds usually tessellate and shining.

⁸⁸ Reference: BRITTON, N. L., and ROSE, J. N. THE CACTACEAE. Carnegie Inst. Wash. Pub. 248. 1919-23.

The synonyms given by Britton and Rose are not repeated in treating the Arizona species except to indicate a different opinion. The segregate genera employed by Britton and Rose and many of other modern authorities have not been adopted herein, although such names are indicated in the synonymy for the convenience of readers who are accustomed to that nomenclature.

The authors are greatly indebted to A. R. Leding for much helpful advice and material from New Mexico, and to A. A. Nichol for the use of his splendid maps showing distribution of cacti in Arizona.

Key to the species

1. Stems not more than 3 cm. in diameter, densely puberulent; spines less than 10 mm. long; flowers salverform, white; plant rarely 2 m. high; root tuberous; fruit red (2).
2. Branches 1.5 to 3 cm. thick, strongly angled with 3 to 6 prominent ribs; root large, carrot-shaped; flowers 12 to 20 cm. long; fruit 12 to 15 cm. long; seeds 3.5 mm. long, tessellate and rugose, dull -- 1. *C. GREGGII*.
2. Branches 5 to 8 mm. thick, not angled, deeply striate; ribs 6 to 9, low, broad, flattened; roots clustered; flowers 7 to 15 cm. long --- 2. *C. DIGUETII*.
1. Stems very stout, glabrous; spines more than 10 mm. long; flowers funnellform; plant arborescent, 4 to 17 m. high; roots not tuberous (3).
3. Plant with a massive stem more than 30 cm. thick, this usually continuous, often unbranched but usually bearing smaller variously curved lateral branches; ribs 12 to 24, 5 to 10 cm. apart; flowers white, 10 to 12 cm. long, borne in crownlike clusters at the ends of branches; fruit ovoid, 6 to 9 cm. long, naked or sparsely spiny; seeds tessellate.
 3. *C. GIGANTEUS*.
3. Plant with several to many stems, these of approximately equal size, less than 20 cm. thick, mainly produced from base of the plant; flowers pink (4).
4. Spines similar all along the stem; ribs 12 to 17, 2 to 4 cm. apart; flowers 6 to 7.5 cm. long; fruit globose, 5 to 7.5 cm. in diameter, densely spiny; seeds tessellate or reticulate and obscurely pitted -- 4. *C. THURBERI*.
4. Spines twisted and conspicuously longer on the upper (floriferous) part of the stem; ribs 5 to 7 in number, 6 to 10 cm. apart; flowers 3 to 4 cm. long, often 2 or more at an areole; fruit globose, 2 to 3 cm. in diameter, unarmed; seeds tessellate, at least toward the base -- 5. *C. SCHOTTII*.

1. *Cereus greggii* Engelm. in Wisliz., Mem. North. Mex. 102. 1848.

Peniocereus greggii Britt. and Rose, Contrib. U. S. Natl. Herbarium 12: 428. 1909.

Southern Mohave County to Graham, Cochise, Pima, and Yuma Counties, commonly at low altitudes with *Larrea*, June and July. Western Texas, southern New Mexico, Arizona, and northern Mexico.

Nightblooming cereus, reina-de-la-noche. The beautiful, white, heavily fragrant flowers last only 1 night. The root sometimes is enormous but ordinarily weighs from 5 to 15 pounds. It is reported that the Indians formerly utilized the root for food.

*2. *Cereus diguetii* Weber, Paris Mus. Hist. Nat. Bul. 1: 319. 1895.

A living specimen was collected in 1939 by J. Whitman Evans in the vicinity of Sonoita, Sonora, a few miles south of the international boundary. According to Evans the flowers are nocturnal and white, as described for *C. diguetii*, a species regarded by Britt. and Rose as synonymous with *C. striatus* T. S. Brandeg. (*Wilcoxia striata* Britt. and Rose). Flowers of the latter are believed to be diurnal and purple. A. A. Nichol has observed plants very similar to Evans' specimen in western Pima County along the Mexican boundary.

3. *Cereus giganteus* Engelm. in Emory, Mil. Recon. 159. 1848.

Carnegiea gigantea Britt. and Rose, N. Y. Bot. Gard. Jour. 9: 188. 1908.

Yavapai and Mohave Counties to Graham, Pima, and Yuma Counties, up to 3,500 or exceptionally 4,500 feet, warm situations in well-drained soil, common, flowering May and June, type from along the Gila River, southern Arizona. Arizona, Sonora, and very locally in southeastern California.

Sahuaro, saguaro, giant cactus. Designated Arizona's State flower, this massive succulent is the largest cactus in the State,

occasionally attaining a height of more than 50 feet and developing as many as 50 "arms." Large individuals are believed to be from 150 to 200 years of age. The flowers are nocturnal, opening between 9 and 12 o'clock at night. They open slowly, full expansion requiring about 2 or 3 hours; and persist in full flowering stage until late the following afternoon when they begin to close and wither. The large and beautiful white flowers are not fragrant but have an odor like that of ripe melon (see frontispiece).

The sahuaro (pl. 19) has contributed substantially toward the subsistence of the Pima and Papago Indians, furnishing materials for food and shelter. The great capacity for storing water, combined with slow rate of growth, enables the plant to fruit annually more or less irrespective of drought. The fruit, or pitahaya of the early Spaniards, matures in June and July. The watermelon-red pulp is eaten fresh or stored, and in the form of sirup and preserves. At the annual harvest an intoxicating beverage is prepared by allowing the juice to ferment. The Papagos make a sort of butter from the seeds. The white-wing dove, a favorite game bird of Arizona sportsmen, feeds largely on the seeds of the sahuaro during the fruiting season.

4. *Cereus thurberi* Engelm., Amer. Jour. Sci. ser. 2, 17: 234. 1854.

Lemaireocereus thurberi Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 2: 97. 1920.

Southern Pinal, southern Maricopa, and western Pima Counties, up to about 3,000 feet, May to July. Arizona, Sonora, and Baja California.

Organpipe cactus (pl. 20). The flowers open shortly after sunset and close the following day. The inner perianth segments are pale pink in the center, white along the margin and toward the base. The large, globose, extremely spiny fruits are highly esteemed by the Papago Indians. The old name, pitahaya dulce, denotes the sweetness of the pulp. A large area in the desert south of Ajo, Pima County, has been set aside as a national monument for the preservation of the organpipe cactus and the sinita.

5. *Cereus schottii* Engelm., Amer. Acad. Arts and Sci. Proc. 3: 288. 1856.

Lophocereus schottii Britt. and Rose, Contrib. U. S. Natl. Herbarium 12: 427. 1909.

Western Pima County, 1,000 to 2,000 feet, April to August. Arizona, Sonora, and Baja California.

Sinita. The odorless pink flowers open soon after sunset and wither the following morning (pl. 21).

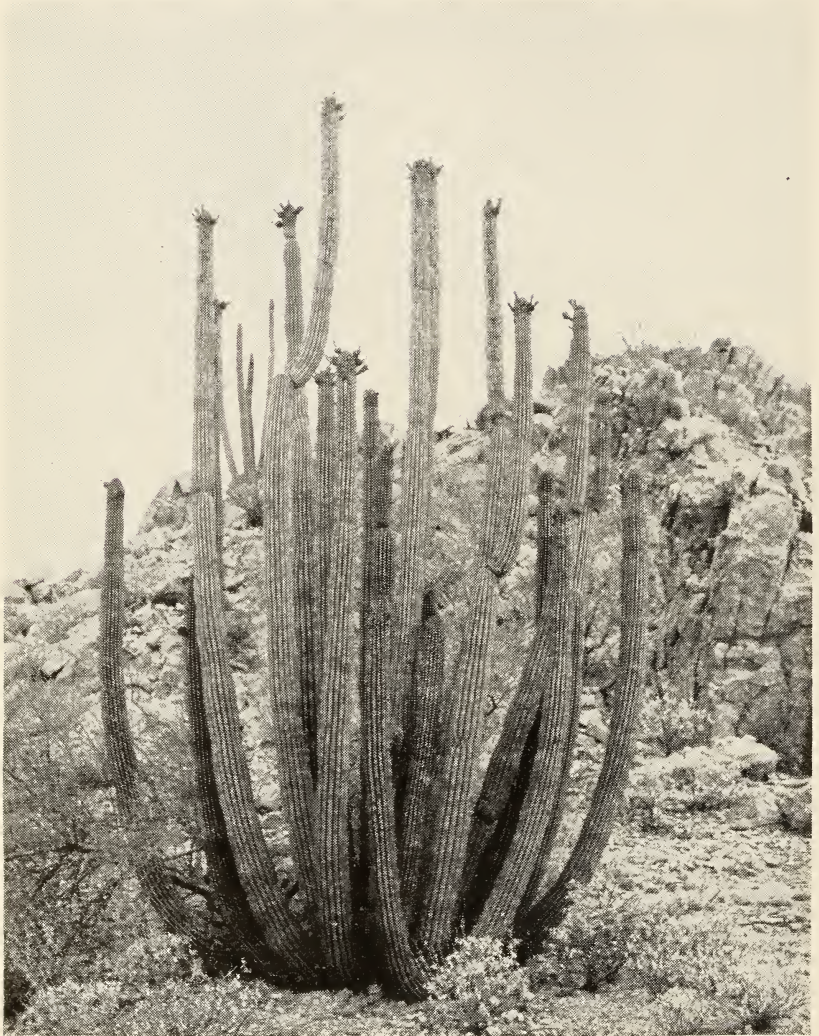
Cereus alamosensis Coult. (*Rathbunia alamosensis* Britt. and Rose), which is known in Sonora, Sinaloa, and Tepic, has been dubiously reported from western Pima County. This species has weak, usually reclining stems, and scarlet flowers.

2. ECHINOCEREUS. HEDGEHOG CACTUS, STRAWBERRY CACTUS

Plant small, rarely 0.5 m. high, cespitose or simple; stems 1-jointed, cylindrical or ovoid, erect or strongly ascending; spines not hooked; flowers funnellform or subcampanulate, arising from a rupture of the epidermis immediately above mature lateral spiniferous areoles, diurnal, lasting several days; hypanthium scales small, acute, entire,



Sahuaro (*Cereus giganteus*) in Pinal County, altitude 1,600 feet. A very old individual. The holes in the stems are bird nests originally excavated by woodpeckers.



Organpipe cactus (*Cereus thurberi*) in the Puerto Blanco Mountains, Pima County altitude 1,700 feet. Two open flowers and many maturing fruits are shown.

rather persistent; fruit spiny with large and readily detachable spine clusters, thin-fleshed, juicy, edible; seeds black, tuberculate, the tubercles more or less confluent.

Key to the species

1. Flowers scarlet or crimson (2).
 2. Plant with few stems, these stout, 20 to 50 cm. long; central spines 3 or 4, stout, straight, subulate, often angled, ashy gray or darkened.
 1. *E. POLYACANTHUS*.
 2. Plant strongly proliferous; stems seldom more than 20 cm. long (3).
 3. Stems seldom more than 50; spines straight or nearly so, never flexuous, not or scarcely angled, often clear yellow; central spines 1 to 4, acicular.
 2. *E. COCCINEUS*.
 3. Stems often very numerous (500 or more) in large hemispheric mounds; spines curved or even flexuous, angled, ashy gray; central spine solitary.
 3. *E. MOJAVENSIS*.
1. Flowers purple (4).
 4. Areoles narrowly elliptic; radial spines closely appressed and pectinate, not more than 12 mm. long, red or pink----- 4. *E. RIGIDISSIMUS*.
 4. Areoles oblong to circular; radial spines not pectinate; central spines never wanting (5).
 5. Central spines 2 to 6 or more, all well developed, more or less curved or twisted, the lower ones deflexed, commonly flattened and angled toward the base; stems stout, up to 50 cm. long; ribs 11 to 18.
 6. *E. ENGELMANNII*.
 5. Central spines solitary, terete, often accompanied by shorter superposed accessory centrals (6).
 6. Central spine curved toward the base, deflexed; spines translucent, straw colored, monochromatic; accessory centrals 1 to 4, or wanting; stems stout, up to 50 cm. long; ribs 13 to 16----- 5. *E. LEDINGII*.
 6. Central spine not curved near the base; spines commonly opaque (7).
 7. Ribs 12 to 22, usually 14 to 17; principal central spine porrect or deflexed, reddish, white, or rarely straw-colored and translucent; 1 or 2 accessory centrals on at least some of the areoles.
 7. *E. BOYCE-THOMPSONI*.
 7. Ribs 8 to 13, usually not more than 10; central spines dark brown or ashy gray (8).
 8. Central spine curved and, except in age, strongly ascending, flexible, 2.5 to 4.5 cm. long; accessory centrals wanting; radials straight or curved; stem rarely more than 15 cm. long, flaccid.
 8. *E. FENDLERI*.
 8. Central spine straight, porrect; accessory centrals usually present on some of the areoles; stem rarely less than 15 cm. long, firm (9).
 9. Spines 1 to 2.5 cm. long, stout, rigid; stems 1 to 5 in number, 8 to 25 cm. long----- 9. *E. RECTISPINUS*.
 9. Spines 2.5 to 6 cm. long, flexible; stems as many as 15, 25 to 45 cm. long----- 10. *E. ROBUSTUS*.

1. *Echinocereus polyacanthus* Engelm. in Wisliz., Mem. North. Mex. 104. 1848.

Echinocereus arizonicus Orcutt, Cactography 3: 3. 1926.

Graham, Pinal, Cochise, and Pima Counties, mountains, 4,000 to 6,000 feet, April and May. New Mexico, Arizona, and Mexico.

The flowers are usually larger than those of the 2 following species, attaining a length of 6 or 7 cm. *E. polyacanthus* (pl. 22) is understood by the writers to embrace a variety of forms, including *E. arizonicus*, which has short wool in the axils of the hypanthium scales. The type locality of *E. arizonicus* is the Pinal Mountains, Pinal County.

A. A. Nichol has verbally reported having collected living plants of *E. triglochidiatus* Engelm. near Fort Defiance, Apache County, in 1935. This species, which occurs in Colorado, Utah, western Texas, and New Mexico, has scarlet

flowers, few strongly angled deep-green stems with 5 to 8 ribs, and spines 3 to 8 in number, spreading, frequently all radial.

2. *Echinocereus coccineus* Engelm. in Wisliz., Mem. North. Mex. 94. 1848.

Eastern half of the State, mountains, 4,000 to 9,000 feet, common, May to July. Colorado, Utah, New Mexico, and Arizona.

3. *Echinocereus mojavensis* (Engelm. and Bigel.) Rümpler in Först., Handb. Cact. ed. 2, 803. 1886.

Cereus mojavensis Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 281. 1856.

Navajo, Coconino, and Mohave Counties, 4,000 to 6,000 feet. Southern Utah and northern Arizona to southeastern California.

4. *Echinocereus rigidissimus* (Engelm.) Rose, Contrib. U. S. Natl. Herbarium 12: 293. 1909.

Cereus pectinatus var. *rigidissimus* Engelm., Amer. Acad. Arts and Sci. Proc. 3: 279. 1856.

Cochise, Pima, and Santa Cruz Counties, 4,000 to 6,000 feet, rocky situations, June to August. Arizona and northern Sonora.

Rainbow cactus. Central spines are wanting in *E. rigidissimus*. Plants having 2 to 7 (usually 4 or 5) central spines have been collected several times in southern Cochise County (Perilla Mountains, Harlan in 1939). This form may be referable to *E. pectinatus* (Scheid.) Engelm., although that rare species is known to occur only in Mexico far from the boundary.

Echinocereus dasyacanthus Engelm. has been reported from Arizona, but the writers have not seen any Arizona material. This species has central spines and large, lemon-yellow flowers.

5. *Echinocereus ledingii* Peebles, Cactus and Succulent Jour. 8: 35. 1936.

Pinaleno Mountains, Graham County, the type locality, 4,500 to 6,000 feet, May. Known only from Arizona.

Specimens have been collected only from the type locality, but the species is reported by Nichol as occurring also in mountain ranges in Cochise and Pima Counties.

6. *Echinocereus engelmannii* (Parry) Rümpler in Först., Handb. Cact. ed. 2, 805. 1886.

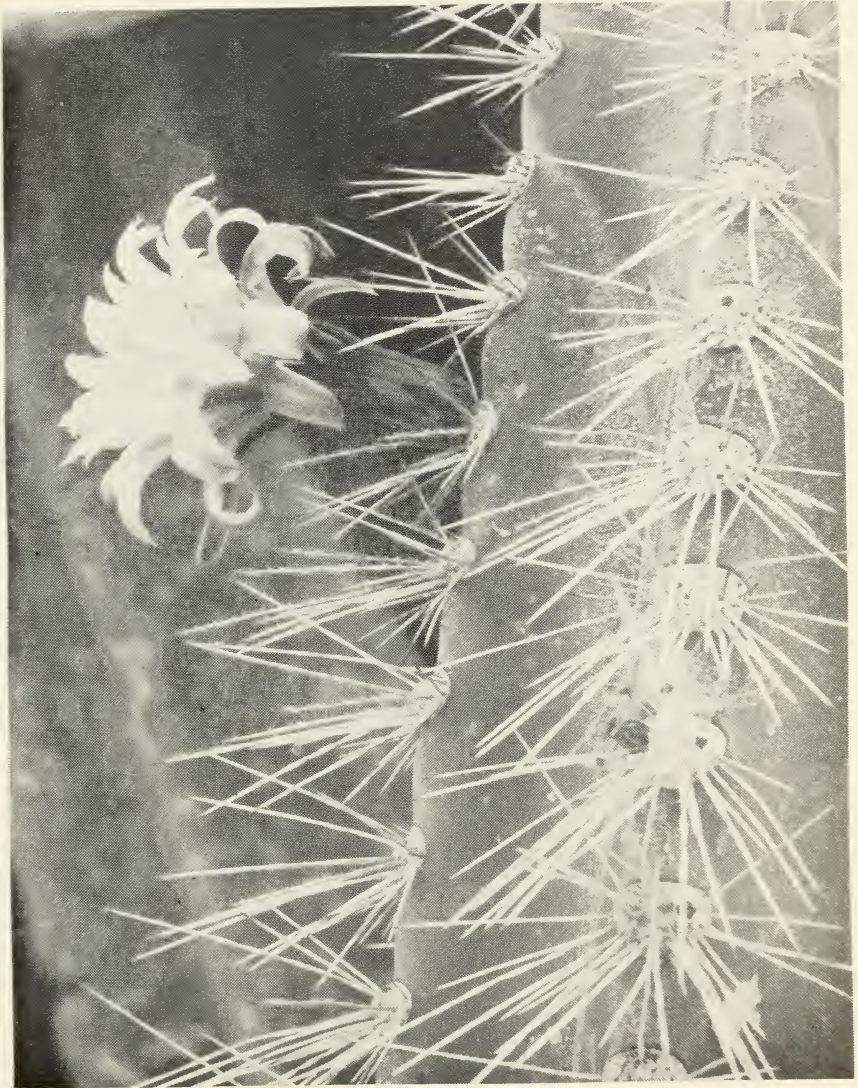
Cereus engelmannii Parry ex Engelm., Amer. Jour. Sci. ser. 2, 14: 338. 1852.

Coconino and Mohave Counties to Pima and Yuma Counties, up to 5,000 feet, common, February to May. Southern Utah to Sonora and Baja California.

A common and variable species. Ordinarily spines of more than one color occur at the same areole, and they may be white, brown, black, or yellow, opaque or rarely translucent.

7. *Echinocereus boyce-thompsoni* Orcutt, Cactography 3: 4. 1926.
(Reprinted in Amer. Jour. Bot. 25: 677. 1938.)

Coconino, Yavapai, Gila, Graham, and Pinal Counties, 2,000 to 5,000 feet, April and May. Known only from Arizona.



Sinita (*Cereus schottii*). The pink flowers open in the evening. Note the twisted spines. Photographed at Sacaton on a cultivated plant at 9 a. m., April 25.

- 3. Stems several to many; ribs 13 to 21, narrow and acute, partially obscured by the spines; flowers yellow (4).
- 4. Seeds tessellate; spines glabrate----- 2. E. XERANTHEMOIDES.
- 4. Seeds papillose; spines densely puberulent---- 3. E. POLYCEPHALUS.
- 2. Hypanthium and fruit glabrous, the scales orbicular-ovate, obtuse, finely ciliate; spines densely puberulent; stem normally solitary, 0.5 to 3 m. high; seeds reticulate and also somewhat tuberculate; flowers mainly yellow, but the perianth segments usually with a differently colored central stripe (5).
- 5. Central spines usually brown or gray and hooked; stem thick, barrellike, the circumference approximating the length; inner perianth segments with a broad purplish central stripe (6).
- 6. Bristlelike spines wanting; spines variable, often not hooked, not rarely as thick as wide----- 4. E. COVILLEI.
- 6. Bristlelike spines borne on the margin of the areole; spines hooked, flattened----- 5. E. WISLIZENI.
- 5. Central spines pink, red, or rarely straw-colored; stem of mature plants thinner, not barrellike; bristlelike spines normally borne on the margins of the areoles; inner perianth segments with a narrow reddish central stripe, or entirely yellow (7).
- 7. Central spines commonly deflexed or ascending, usually not much twisted, rarely hooked----- 6. E. LECONTEI.
- 7. Central spines porrect, commonly twisted and hooked.----- 7. E. ACANTHODES.
- 1. Fruit thin-walled, dry, dehiscent by longitudinal fissure or rarely by a basal orifice, persisting only a few weeks; plant small, rarely 50 cm. high; stem solitary; spines not annulate, nearly always glabrous; seeds prevalingly papillose or tuberculate (8).
- 8. Ribs obsolete, the distinct tubercles arranged in spiral rows; spines not hooked (9).
- 9. Central spines terete, rigid, straight, at first nearly black; perianth segments conspicuously fringed; hypanthium scales fringed; lower tubercles spiniferous; flowers yellowish----- 12. E. SILERI.
- 9. Central spines strongly flattened and grooved, flexible, curved-ascending, chartaceous, ashy white; perianth segments entire; hypanthium scales entire or very sparsely lacerate-toothed; lower tubercles unarmed; flowers white; seeds tessellate----- 13. E. PAPHYRACANTHUS.
- 8. Ribs evident; hypanthium scales broad, erose or ciliate, in fruit chartaceous (10).
- 10. One or more of the lower central spines strongly hooked, the upper central erect, not hooked, often whitened, subulate, and strongly flattened; flowers greenish yellow or magenta----- 11. E. WHIPPLEI.
- 10. None of the spines hooked or flattened, all uniformly pink or red (11).
- 11. Central spines 4 to 9, all alike, straight or slightly curved; flowers yellow or magenta----- 8. E. JOHNSONI.
- 11. Central spines 1 to 4 (if more than 1, then dissimilar), straight; flowers pink (12).
- 12. Central spines 1 or 2, rarely several, the upper one long and erect, the lower porrect and commonly much shorter.----- 9. E. ERECTOCENTRUS.
- 12. Central spines about 4, one very short and porrect, the upper ones appressed and otherwise like the radials-- 10. E. INTERTEXTUS.

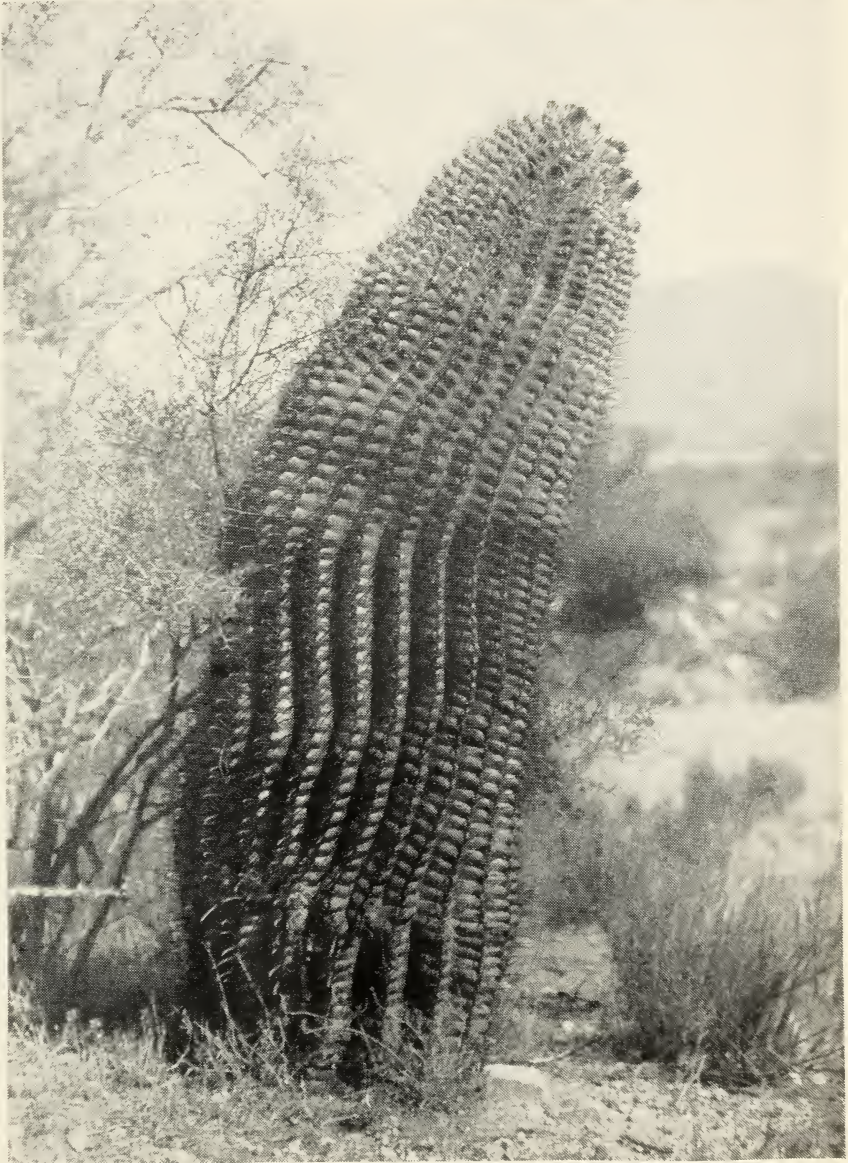
1. *Echinocactus horizontalonius* Lemaire, Cact. Gen. Nov. Sp. 19. 1839.

Silver Bell, Pima County, 2,600 feet, May and June. Western Texas, southern New Mexico, Arizona, and Mexico.

2. *Echinocactus xeranthemoides* (Engelm.) Rydb., Fl. Rocky Mount. 579. 1917.

Echinocactus polycephalus var. *xeranthemoides* Engelm. ex Coult., Contrib. U. S. Natl. Herbarium 3: 358. 1896.

Coconino and Mohave Counties. Southern Utah and Arizona.



Barrel cactus or bisnaga (*Echinocactus wislizeni*), in Pima County, altitude 3,500 feet. The stem, which is more than 6 feet high, is inclined toward the south.

3. **Echinocactus polycephalus** Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 276. 1856.

Mohave and Yuma Counties, desert regions at low altitudes, flowering February and March. Arizona, southern California, and northwestern Sonora.

In this species, and in *E. xeranthemoides*, the plant is normally many-stemmed, forming mounds.

4. **Echinocactus covillei** (Britt. and Rose) Berger, Kakteenkunde. 238. 1929.

Ferocactus covillei Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 132. 1922.

Pinal, Maricopa, and Pima Counties, 1,500 to 4,500 feet, June to August. Arizona and northern Sonora.

5. **Echinocactus wislizeni** Engelm. in Wisliz., Mem. North. Mex. 96. 1848.

Ferocactus wislizeni Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 127. 1922.

? *Echinocactus emoryi* Engelm. in Emory, Mil. Recon. 157. 1848.

Greenlee and Cochise Counties to Maricopa and Pima Counties, up to at least 4,500 feet, July to September. Western Texas, southern New Mexico, Arizona, and northern Mexico.

This species (pl. 23) and the preceding are the 2 largest barrel cacti in Arizona. A specimen 11 feet high has been called to the authors' attention by Frank A. Thackery.

6. **Echinocactus lecontei** Engelm., Amer. Acad. Arts and Sci. Proc. 3: 274. 1856.

Ferocactus lecontei Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 129. 1922.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, up to 3,500 feet, April and May. Southern Utah to Baja California, Arizona, and Sonora.

This species appears to intergrade with, or simulate, *E. acanthodes*.

7. **Echinocactus acanthodes** Lemaire, Cact. Gen. Nov. Sp. 106. 1839.

Ferocactus acanthodes Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 129. 1922.

Ferocactus rostrii Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 146. 1922.

Echinocactus hertrichii Weinberg, Desert Plant Life 1: 40. 1929.

Yuma County, up to 3,000 feet, April to June. Southern Nevada to Arizona and Baja California.

8. **Echinocactus johnsoni** Parry ex Engelm. in King, Geol. Expl. 40th Par. 5: 117. 1871.

Ferocactus johnsoni Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 141. 1922.

Mohave and Yuma Counties, up to 3,000 feet, April. Southwestern Utah to California, and Arizona.

Beehive cactus. The flowers are magenta in the typical form. The form bearing greenish-yellow flowers (var. *lutescens* Parish) is more common in Arizona.

9. **Echinocactus erectocentrus** Coult., Contrib. U. S. Natl. Herbarium 3: 376. 1896.

Echinomastus erectocentrus Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 148. 1922.

Pinal, Cochise, and Pima Counties, 3,500 to 4,500 feet, March and April, type from Cochise County. Known only from Arizona.

An atypical form with the lower central spine exceptionally long and stout and the upper central not strictly erect was collected near Florence, Pinal County (*Lindsay* in 1939).

10. **Echinocactus intertextus** Engelm., Amer. Acad. Arts and Sci. Proc. 3: 277. 1856.

Echinomastus intertextus Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 149. 1922.

Sonoita, Santa Cruz County (*Peebles* and *Loomis* SF 186). Southwestern Texas to Arizona, and northern Mexico.

11. **Echinocactus whipplei** Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 271. 1856.

Sclerocactus whipplei Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 213. 1922.

Apache County to Mohave County, 4,900 to 7,200 feet, June, type from Navajo County. Southwestern Colorado, southern Utah, and Arizona.

Large specimens 20 to 25 cm. high differ from descriptions in having as many as 7 central spines and the upper central shorter than the lower ones, much like the radials and not broadly subulate.

Echinocactus polyancistrus Engelm. and Bigel., of Utah, Nevada, and California, has been reported from Mohave County. According to descriptions, it has a glabrous style and upper central spine 6 to 13 cm. long. In *E. whipplei* the style is puberulent and the upper central spine is 2 to 6 cm. long.

12. **Echinocactus sileri** Engelm. ex Coult., Contrib. U. S. Natl. Herbarium 3: 376. 1896.

Utahia sileri Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 215. 1922.

Type from Cottonwood Springs and Pipe Springs, "southern Utah" (*Siler* in 1883).

Pipe Springs is located in northern Mohave County, and in all probability the type specimen was collected in Arizona. In specimens from Pipe Springs (*Lindsay* in 1939, *Peebles* and *Parker* 14692) the tubercles are distinct, although in large plants they are crowded together toward the base of the stem in riblike rows. The spines are exceedingly persistent, and toward the base of old plants become whitened, shreddy, and greatly weathered.

13. *Echinocactus papyracanthus* Engelm., Acad. Sci. St. Louis Trans. 2: 198. 1863.

Mammillaria papyracantha Engelm. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 49. 1849.

Toumeyia papyracantha Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 3: 91. 1922.

Near Showlow, Navajo County, about 6,500 feet (*Bumstead* in 1935), May. Northern New Mexico and Arizona.

4. MAMMILLARIA. FISHHOOK CACTUS, PINCUSHION CACTUS

Small or low plants with short, solitary to numerous, turbinate or hemispheric to cylindric, 1-jointed stems, these furnished with crossing spiral rows of distinct teatlike tubercles; spines straight or hooked; flowers borne in the axils of the tubercles or on the tubercles at the base of a groove, funnellform, diurnal, lasting several days; hypanthium scales usually ciliate, not extending to the ovary; fruit a smooth berry; seeds usually pitted.

Key to the species

1. Tubercles grooved from apex to middle or base; flowers borne at apex of the stem, or laterally in *M. recurvata* (2).
2. Spines yellow, the centrals more or less curved or even hooked; flowers yellow; berry green; seeds red or reddish brown, delicately reticulate or tessellate, shining (3).
 3. Tubercles short, crowded; central spines 1 to 2 cm. long, curved-reflexed; radials shorter, appressed; stems several to many, obscured by spines, 10 to 20 cm. thick, broadly cylindric, the apex depressed; flowers borne well below the summit of the stem; berry about 8 mm. long; seeds 1.5 mm. long ----- 1. *M. RECURVATA*.
 3. Tubercles 15 to 30 mm. long, often with large glands in the grooves, widely spaced except toward the base of the stem; central spines 30 to 40 mm. long, stout, usually curved; stem not obscured by spines; fruit 4 to 6 cm. long, slender; seeds 3.5 mm. long (4).
 4. Central spines 1 to 4, curved but rarely hooked; stem usually solitary.
 2. *M. ENGELMANNII*.
 4. Central spines 1 or rarely 2, stout, usually hooked; stems 1 to many.
 3. *M. ROBUSTISPINA*.
2. Spines dark brown, whitish, or brown-tipped, straight; seeds red, pitted, 1 to 2.5 mm. long (5).
 5. Flowers 2.5 to 3.5 cm. long, yellowish or pink; stems solitary or few, ovoid or cylindric ----- 4. *M. CHLORANTHA*.
 5. Flowers 3.5 to 5.5 cm. long, pink; stems solitary, few, or numerous in congested mounds, globose to ovoid (6).
 6. Inner perianth segments oblanceolate, pale pink; central spines white with dark brown tips ----- 5. *M. AGGREGATA*.
 6. Inner perianth segments lanceolate or linear-oblanceolate, darker pink; central spines mostly dark brown ----- 6. *M. ARIZONICA*.
1. Tubercles without a groove or shortly and indistinctly grooved at apex; flowers borne below the apex of the stem, or subvertical in *M. wilcoxii* (7).
 7. Juice milky; stem turbinate or hemispheric; spines not hooked; seeds small, red, translucent, vertically rugose, the deep depressions (pits) elongate and about as wide as the ridges (8).
 8. Outer perianth segments erose or fimbriate; flowers greenish yellow; radial spines 9 to 15 ----- 13. *M. MACDOUGALII*.
 8. Outer perianth segments entire, somewhat crispate; flowers pink; radial spines about 20 ----- 14. *M. HEYDERI*.

- 7. Juice clear; stem cylindric, ovoid, or hemispheric; some of the spines hooked (rarely so in *M. oliviae*); seeds black or dark brown, commonly opaque, when pitted the depressions circular or somewhat angled but not elongate (9).
- 9. Central spines rarely hooked, usually straight and short; stem ovoid to cylindric; berry clavate, scarlet, 20 to 25 mm. long; seeds black, pitted. 11. *M. OLIVIAE*.
- 9. Central spines hooked (10).
- 10. Seeds coarsely rugose and finely reticulate, dark brown, 2 mm. long, the hilum greatly enlarged, corky, light brown; stem ovoid to cylindric; berry obovoid-clavate, scarlet, 10 to 20 mm. long; central spines 1 to 4 at an areole, 1 or all hooked. 7. *M. TETRANCISTRA*.
- 10. Seeds smaller, pitted, the hilum not enlarged (11).
- 11. Spines yellow; stem hemispheric; berry obovoid, scarlet or red, 5 to 7 mm. long. 8. *M. MAINAE*.
- 11. Spines not yellow, in various combinations of white and dark reddish brown (12).
- 12. Plants colonizing freely; stem flaccid, rarely more than 12 cm. long and 3 cm. in diameter; berry obovoid to clavate, scarlet, 7 to 13 mm. long. 9. *M. FASCICULATA*.
- 12. Plant solitary; stem rarely less than 5 cm. in diameter (13).
- 13. Berry scarlet, clavate, 12 to 25 mm. long; stem ovoid to cylindric, firm; perianth segments spreading, pink with white margin; spines glabrous. 10. *M. MICROCARPA*.
- 13. Berry green or purplish, ovoid to subglobose, 10 to 15 mm. in diameter, borne at or near the apex of the stem; perianth segments erect with spreading tips, pink, straw-colored, or greenish white; stem hemispheric to cylindric, flaccid; spines glabrous or pubescent. 12. *M. WILCOXII*.

1. *Mammillaria recurvata* Engelm., Acad. Sci. St. Louis Trans. 2: 202. 1863.

Coryphantha recurvata Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 27. 1923.

Pajarito Mountains, Santa Cruz County, about 4,500 feet, July. Arizona and Sonora.

A single plant may have as many as 50 stout stems.

2. *Mammillaria engelmannii* Cory, Rhodora 38: 405. 1936.

Echinocactus muehlenpfordtii Poselger, Allg. Gartenztg. 21: 102. 1853. (Not *Mammillaria muehlenpfordtii* Först. 1847.)

Coryphantha muehlenpfordtii Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 28. 1923.

Paradise to San Simon, Cochise County, about 4,000 feet (*Loomis* and *Peebles* S. F. 200), July. Western Texas, southern New Mexico, Arizona, and northern Mexico.

The stem is large for the genus, occasionally attaining a height of about 30 cm.

3. *Mammillaria robustispina* Schott ex Engelm., Amer. Acad. Arts and Sci. Proc. 3: 265. 1856.

Coryphantha robustispina Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 33. 1923.

Cochise, Pima, and Santa Cruz Counties, 2,500 to 6,000 feet, July. Arizona and northern Sonora.

4. **Mammillaria chlorantha** Engelm. in Rothr., U. S. Geol. and Geog. Survey Rpt. 6: 127. 1878.

Coryphantha chlorantha Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 43. 1923.

Reported from Mohave County. Southwestern Utah and southeastern California.

In *M. chlorantha* the central spines are 6 to 9 in number, 25 mm. long, and the flowers yellowish or greenish yellow. *M. deserti* Engelm., which has fewer central spines and the perianth segments purplish tipped, also has been reported from Mohave County. *M. alversonii* (Coult.) Zeissold, a pink-flowered species with 12 to 14 central spines, occurs in southern California.

5. **Mammillaria aggregata** Engelm. in Emory, Mil. Recon. 157. 1848.

Coryphantha aggregata Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 47. 1923.

Southeastern quarter of the State, 3,000 to 7,000 feet, common in rocky situations, May. New Mexico and Arizona.

In Cactaceae of the Ives Exploration, Engelmann treated *M. aggregata* as synonymous with *Echinocereus coccineus* Engelm., but in the sketch on which the original description is based the tubercles are arranged in crossed spirals, indicating that Emory's plant is not an *Echinocereus*.

6. **Mammillaria arizonica** Engelm. in Brewer and Wats., Bot. Calif. 1: 244. 1876.

Coryphantha arizonica Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 45. 1923.

Apache County to Mohave, Gila, and Yavapai Counties, mostly north of the Mogollon Escarpment, common, 5,000 to 8,000 feet, May and June, type from northern Arizona. Southern Utah and Arizona.

Plants grown at low altitude in southern Arizona retain the characteristically narrow, deep-pink perianth segments and dark spines.

7. **Mammillaria tetrancistra** Engelm., Amer. Jour. Sci. ser. 2, 14: 337. 1852.

Phellosperma tetrancistra Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 60. 1923.

Mohave, southern Yavapai, Maricopa, Pinal, Pima, and Yuma Counties, low desert regions. Southwestern Utah, southern Nevada, Arizona, and southern California.

8. **Mammillaria mainae** K. Brandeg., Zoe 5: 31. 1900.

Santa Cruz and Pima Counties, 2,000 to 4,000 feet, July. Arizona and Sonora.

The plants occur on rocky hills but more commonly on plains with ironwood and mesquite.

9. *Mammillaria fasciculata* Engelm. in Emory, Mil. Recon. 157. 1848.

Graham (?), Pinal, and Pima Counties, 1,200 to 3,000 feet, May and June, type from along the Gila River, Graham (?) County. Arizona and Sonora.

This little fishhook cactus has great tolerance for saline soil and seems to show preference for deep soils. Although often abundant, the plants usually grow under shrubbery and are not easily found.

10. *Mammillaria microcarpa* Engelm. in Emory, Mil. Recon. 157. 1848.

Neomammillaria milleri Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 156. 1923.

Western and southern Arizona up to 4,500 feet, common in both heavy and well-drained soil, June and July, type from Pinal County. Southern Utah to western Texas, Arizona, California, and northern Mexico.

A widespread and variable species (pl. 24). *Neomammillaria milleri*, type from near Phoenix, is one of the stout forms.

11. *Mammillaria oliviae* Orcutt, West Amer. Sci. 12: 163. 1902.

Cochise and Pima Counties, 3,500 to 4,500 feet, type from Pima County. Arizona and Sonora.

A neat plant, hoary with a dense covering of short, white, prevailing straight spines.

12. *Mammillaria wilcoxii* Toumey ex Orcutt in Schumann, Gesamtb. Kakteen 545. 1899.

Neomammillaria viridiflora Britt. and Rose, Carnegie Inst. Wash. Pub. 248. 4: 153. 1923.

Hualpai Mountain (Mohave County) and in Pinal, Graham, and Santa Cruz Counties, 2,500 to 5,000 feet or higher, May and June, type locality Arizona. Known only from Arizona.

A variable endemic species not uncommon in the vicinity of Superior, Pinal County, near the type locality of *N. viridiflora*. The original description of *M. wilcoxii* is incomplete and Toumey's plant may never be identified with certainty. We have observed only greenish subglobose berries on plants of this nature, and have no evidence that the species bears scarlet clavate berries as implied by Britton and Rose (ibid. p. 69) in their key to the genus *Neomammillaria*. The Arizona plant is closely related to, or possibly identical with, *M. barbata* Engelm., a rare Mexican species.

13. *Mammillaria macdougallii* Rose in Bailey, Standard Cycl. Hort. 4: 1982. 1916.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, rocky situations, March and April, type from Pima County. Known only from Arizona.

14. *Mammillaria heyderi* Mühlenpfordt, Allg. Gartenztg. 16: 20. 1848.

Bisbee, Cochise County (*Peebles* SF 922), May. Texas, New Mexico, Arizona, and northern Mexico.



Fishhook cactus (*Mammillaria microcarpa*). Photograph of a plant cultivated at Sacaton. The flowers are pink.

5. OPUNTIA ⁵⁹

Shrubs or herbaceous perennials with short-jointed stems; joints flattened or terete, often tuberculate but never ribbed; leaves small, fleshy, subulate, caducous; areoles furnished with glochids (barbed bristles); spines minutely barbed, at least at the tip, not hooked; floriferous and spiniferous areoles combined in one organ; flowers diurnal; hypanthium bearing scales resembling the leaves, the tube short; perianth segments usually broad, entire, spreading; fruit indehiscent, fleshy or dry, glochidiate, often spiny; seeds bony, compressed or angled, pallid.

The flat-jointed kinds (pl. 25) are known as pricklypear, and those with edible fruits particularly as tuna. The vernacular term, cane cactus, is applied to species with cylindrical joints (see pl. 26), and cholla to several of the especially spiny forms of this kind. In the Arizona species the flowers apparently remain fresh only one day. Some opuntias increase rapidly and become pestiferous on range land subjected to prolonged overgrazing. On the other hand, some of the species provide emergency feed. Cattle can feed on opuntias without undue injury, provided the spines are burned or the joints macerated.

The genus presents many taxonomic difficulties, and satisfactory classification of the Arizona species is far from an accomplished fact. Diagnostic characters are often greatly altered by environment. Natural hybrids are not rare.

Key to the species

1. Joints flattened; spines not sheathed (2).
2. Fruit dry; plant small or low, rarely more than 0.5 m. high; areoles 5 to 15 mm. apart; joints inclined to be transversely marked or wrinkled (3).
3. Fruit not spiny (4).
4. Branches erect, 1-jointed; areoles deeply depressed; joints unarmed, densely puberulent----- 1. *O. BASILARIS*.
4. Branches prostrate or low, several-jointed; areoles depressed or level with the surface of the joint; joints unarmed or somewhat spiny, glabrous.----- 2. *O. AUREA*.
3. Fruit spiny; joints inclined to be tuberculate (5).
5. Joints readily detached, not more than 5 cm. long, often ovoid or subglobose, spiny or unarmed; plant very small, low, with 1 to several branches, these 1- to several-jointed; flowers yellow.----- 3. *O. FRAGILIS*.
5. Joints firmly attached, 5 to 20 cm. long (6).
6. Areoles less than 10 mm. apart; spines appressed or strongly deflexed, 1 to 3 cm. long; joints usually suborbicular, spiny on most of the surface; flowers pale yellow----- 4. *O. POLYACANTHA*.
6. Areoles mostly more than 10 mm. apart; spines not appressed, 3 to 15 cm. long; plants of the same species with either yellow or pink flowers (7).
7. Spines bristlelike, obscuring the surface of the joint, those at base of old joints flexuous and up to 20 cm. long----- 6. *O. URSINA*.
7. Spines not bristlelike, often numerous but not obscuring the surface of the joint (8).
8. Spines 4 to 12 cm. long, 4 or more at an areole; joints obovate, 8 to 15 cm. long, not thickened, usually heavily armed over the entire surface----- 5. *O. HYSTRICINA*.

⁵⁹ Reference: BOISSEVAIN, C. H., and DAVIDSON, C. COLORADO CACTI. *Cactus and Succulent Jour.* 12⁴⁻⁷, (sup.) 1940.

8. Spines 2 to 6 cm. long (9).
 9. Spines 4 or more at an areole, slender, acicular; joints 8 to 20 cm. long, elliptic or oblong, armed over the entire surface, usually thickened and even subterete.
7. O. ERINACEA.
 9. Spines 1 to 4 at an areole, stout; joints 5 to 12 cm. long, elliptic to obovate, spiny only on the upper half, often somewhat thickened.----- 8. O. RHODANTHA.
2. Fruit fleshy; flowers yellow (10).
 10. Plant small or low, at most not more than 0.5 m. high; joints rarely more than 15 cm. long, obovate or rarely orbicular, usually lead green, transversely marked or wrinkled, not tuberculate; areoles 15 to 25 mm. apart (11).
 11. Roots definitely tuberous; spines 1 to 3 at an areole, mostly confined to the upper areoles.----- 9. O. PLUMBEA.
 11. Roots not tuberous; spines 1 to several at an areole, often borne well down on the sides of the joint.----- 10. O. RAFINESQUEI.
 10. Plant commonly large, bushy, more than 0.5 m. high; joints mostly more than 20 cm. long, not tuberculate, not transversely marked (12).
 12. Areoles 15 to 30 mm. apart; joints prevailing orbicular, usually 6 to 10 mm. thick (13).
 13. Principal spines deflexed or appressed, yellow, translucent, subsetaceous, 2 to 4 cm. long; joints yellowish green, usually crowded and orbicular, the areoles soon abundantly filled with large glochids.----- 11. O. CHLORTICA.
 13. Principal spines spreading, never appressed, opaque, reddish brown or darker, coarse, 4 to 7 cm. long; joints purple-tinged (14).
 14. Central spines wanting, or few and confined almost entirely to the upper margin; plant of erect bushy habit; joints crowded, orbicular or ovate.----- 12. O. SANTA-RITA.
 14. Central spines never wanting, produced from the sides as well as the margin of the joint; plant of rather open habit; joints not crowded, orbicular or obovate.----- 13. O. MACROCENTRA.
 12. Areoles 30 to 50 mm. apart; joints usually broadest above the middle, seldom less than 10 mm. thick (15).
 15. Joints yellowish green, the spines short and few, or wanting; plant bushy (16).
 16. Joints obovate-oblong, nearly or quite spineless, asymmetric, 25 to 30 cm. long, often purple around the areoles; fruits mostly with a long stipelike base.----- 14. O. LAEVIS.
 16. Joints relatively broader, not entirely spineless; fruit not contracted at base, or shortly so (17).
 17. Joints obovate, spiny on the upper margin and more or less so on the sides, rich yellow green, often purple around the areoles, inclined to be asymmetric, about 30 cm. long; spines at first yellowish, soon whitened, on old joints darkened, deflexed, often curved, mostly less than 2.5 cm. long.
 15. O. GILVESCENS.
 17. Joints orbicular-obovate, usually unarmed except along or near the upper margin, symmetrical, not purple around the areoles, 20 to 25 cm. long; principal spines reddish brown toward the base, in age whitened, 2 to 3 (rarely 4.5) cm. long.
 16. O. FLAVESCENS.
 15. Joints commonly gray green, with more numerous and longer spines, obovate (18).
 18. Branches prostrate or decumbent; joints 15 to 25 cm. long; principal spines not appreciably flattened or angled, straight, spreading, often spirally twisted, 5 to 6 cm. long, reddish brown, variegated, or whitened; center of the flower darkened.
 17. O. PHAEACANTHA.
 18. Branches ascending or erect, or the lowermost prostrate, forming a bushy plant; joints commonly more than 25 cm. long; principal spines stout, more or less angled or flattened, slightly curved, 2 to 4 cm. long, the lower or lowest deflexed and whitened, those at the facial areoles arranged in a characteristic figure somewhat resembling a bird's foot; center of the flowers only slightly darkened.----- 18. O. ENGELMANNII.

1. Joints not flattened (19).
19. Spines sheathed only at the tip, strongly flattened, scabrous; plant low, creeping; joints more or less clavate; base of the fruit contracted (20).
20. Principal spines flattened, but slender and not daggerlike; joints 2.5 to 7 cm. long, narrowly clavate; flowers purple----- 19. *O. PULCHELLA*.
20. Principal spines usually daggerlike, sharply 2-edged; joints broader; flowers yellow (21).
21. Tubercles tending to be confluent in more or less distinct rows; joints subcylindric, narrowed only toward the base, 10 to 20 cm. long, 3 to 4 cm. thick----- 23. *O. WRIGHTIANA*.
21. Tubercles all distinct; joints tapering from near the apex to the base (22).
22. Joints mostly 3 to 7 cm. long----- 20. *O. PARISHII*.
22. Joints mostly more than 7 cm. long (23).
23. Joints very stout, 3 to 5.5 cm. thick, 10 to 20 cm. long; tubercles 25 to 45 mm. long, 8 to 11 mm. wide, 10 to 15 mm. high.
21. *O. STANLYI*.
23. Joints not so stout, 2 to 3.5 cm. thick, 8 to 10 or 15 cm. long; tubercles 10 to 30 mm. long, 5 mm. wide, 5 to 10 mm. high.
22. *O. KUNZEI*.
19. Spines completely invested with a loose, papery sheath, minutely barbed but not scabrous; plant not creeping (except in low forms of *O. whipplei*), bushy or arborescent; joints cylindric (24).
24. Ultimate joints rarely more than 1.5 cm. thick; spines usually fewer than 6 at an areole (25).
25. Joints tessellate with somewhat rhombic tubercles; fruit dry, bristly; joints gray, often purple-tinged----- 24. *O. RAMOSISSIMA*.
25. Joints not tessellate; fruit fleshy (26).
26. Fruit conspicuously tuberculate, 2.5 to 4 cm. long; plant erect, or low and creeping; joints prominently tuberculate; principal spines 1 to 4; flowers greenish yellow----- 35. *O. WHIPPLEI*.
26. Fruit not tuberculate when fully mature (27).
27. Flowers purplish; spines 1 to 6, commonly 4, at an areole; tubercles long, narrow, rather prominent but not crowded; plant an openly branched shrub about 1 m. high without a definite trunk; fruit 2 to 2.5 cm. long, scarlet-tinged.
26. *O. TETRACANTHA*.
27. Flowers yellow (28).
28. Flowers greenish yellow; principal spines 1 to 4 at an areole; joints strongly tuberculate, the tubercles crowded and only about twice as long as wide----- 35. *O. WHIPPLEI*.
28. Flowers bronze yellow; spines usually solitary at the areoles of the ultimate joints; tubercles low, not prominent, not crowded (29).
29. Fruit 2.5 to 4 cm. long, greenish yellow, obovoid or clavate, often proliferous; ultimate joints 7 to 10 mm. in diameter.
25. *O. ARBUSCULA*.
29. Fruit 10 to 18 mm. long, obovoid, scarlet; branches 3 to 5 mm. thick; plant less than 1 m. high, sparingly branched except toward the base----- 27. *O. LEPTOCAULIS*.
24. Ultimate joints more than 1.5 cm. thick; spines 6 to 30 at an areole (30).
30. Fruit not persisting for more than 1 season (31).
31. Fruit fleshy, bristly with numerous setaceous, readily detached spines; joints 3 to 5 cm. thick, clavate, impenetrably armed, readily detached; tubercles nearly as broad as long, somewhat 4-sided; spines and sheaths straw-colored; flowers greenish yellow, the outer segments pink-tinged----- 28. *O. BIGELOVII*.
31. Fruit dry, the spines stout, firmly attached; joints less than 3 cm. thick (32).
32. Ultimate joints mostly less than 10 cm. long; tubercles about twice as long as wide, not strongly compressed except in new growth; plant typically with a well-developed trunk and very dense crown, 1 to 1.5 m. high; flowers greenish yellow.
29. *O. ECHINOCARPA*.
32. Ultimate joints mostly 15 to 30 cm. long; tubercles twice or thrice as long as wide, strongly compressed; trunk rarely well developed (33).

33. Joints rather weakly armed; spines less than 2.5 cm. long, the sheaths not conspicuous; plant 1 to 2 m. high; flowers yellow, red, or rarely purple.----- 30. *O. THORNBERI*.
33. Joints strongly armed; spines numerous, the principal ones more than 2.5 cm. long, conspicuously sheathed; plant 1.5 to 3 (rarely up to 5) m. high----- 31. *O. ACANTHOCARPA*.
30. Fruit persisting for more than 1 season, fleshy; plant 2 to 4 m. high (34).
34. Mature fruit evidently tuberculate, solitary; joints 1.5 to 3 cm. thick; tubercles 6 to 15 mm. long; spines 10 to 15 mm. long; flowers purple, occasionally red or yellow----- 34. *O. SPINOSIOR*.
34. Mature fruit slightly or not at all tuberculate (35).
35. Joints readily detached, impenetrably armed, 3 to 5 cm. thick, pale green; spines and sheaths straw-colored; fruits proliferous, suspended in chainlike clusters; flowers pink :- 32. *O. FULGIDA*.
35. Joints not readily detached, very spiny but not impenetrably armed, about 2.5 cm. thick, elongate, usually purplish; spines dark-colored; fruits solitary or sparingly proliferous; flowers commonly purple, occasionally red or yellow.
33. *O. VERSICOLOR*.

1. *Opuntia basilaris* Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 298. 1856.

Mohave, Yavapai, Maricopa, and Yuma Counties, up to 3,000 feet, March and April, type from Mohave County. Southern Utah to southern California, Arizona, and Sonora.

Beavertail cactus (pl. 25). The typical form is a handsome plant with large, velvety, ash-gray joints and magenta flowers with somewhat crispate perianth segments.

2. *Opuntia aurea* Baxter, Cactus and Succulent Jour. 5: 489. 1933.

Northern Mohave County, type from Pipe Springs, about 5,000 feet, May. Eastern California, southern Nevada, southwestern Utah, and Arizona.

The flowers are either yellow or pink. The fruit has not been seen by the writers, although in the key to species it is assumed to be dry and spineless. An amazing variety of forms was observed at the type locality. The areoles are not always deeply depressed and the joints vary greatly in size, thickness, and color. Plants with spines along the margin and on the upper areoles are not uncommon. *Opuntia rhodantha* occurs at Pipe Springs and it seems probable that some of the variant forms are the result of natural crossing.

3. *Opuntia fragilis* (Nutt.) Haw., Sup. Pl. Succ. 82. 1819.

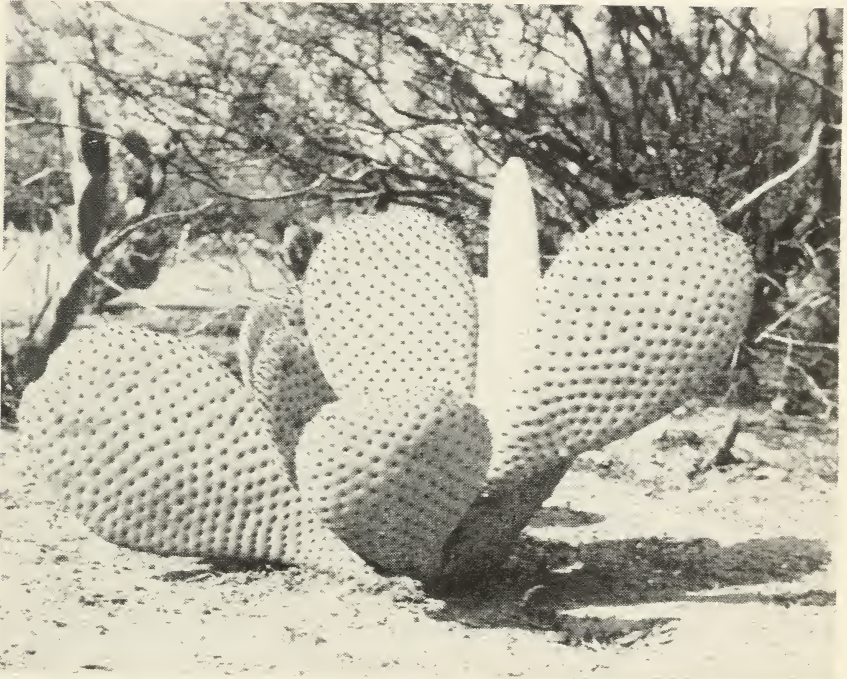
Cactus fragilis Nutt., Gen. Pl. 1: 296. 1818.

Apache County to Coconino County, 6,500 to 7,500 feet, with pines, June. Wisconsin to British Columbia, south to Texas and Arizona.

4. *Opuntia polyacantha* Haw., Sup. Pl. Succ. 82. 1819.

Apache County to Coconino County, 6,000 to 7,200 feet, June. Alberta to North Dakota, Washington, Texas, and Arizona.

A widely ranging and variable species. The var. *trichophora* (Engelm. and Bigel.) Coult., distinguished by long flexuous bristle-like spines at the base of old joints, is not uncommon in the north-eastern part of the State. The typical form appears to be rare in Arizona.



Beavertail cactus (*Opuntia basilaris*). Photograph of a plant cultivated at Sacaton. The largest joint is 11 inches long. Note the depressed areoles.

5. **Opuntia hystricina** Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 299. 1856.

Apache County to Coconino County, 4,500 to 6,500 feet, common, May and June, type from Coconino County. New Mexico and Arizona.

A form found in the vicinity of Navajo Bridge, Coconino County, is characterized by extremely coarse, white spines and rather large joints, but it may not be properly referable to *O. hystricina*.

On sandy soil between Chinle and Ganado, Apache County, *O. hystricina* has become pestiferous in its great abundance. In that locality the yellow and pink color phases are equally represented.

6. **Opuntia ursina** Weber in Bois, Dict. Hort. 189. 1899.

Near Littlefield, Mohave County, 2,700 feet (*Pebbles* SF 1007). Southern Nevada, Arizona, and southeastern California.

7. **Opuntia erinacea** Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 301. 1856.

Northern Apache County and Mohave County, 3,000 to 5,200 feet, May and June. Southern Utah and Nevada, Arizona, and eastern California.

8. **Opuntia rhodantha** Schumann, Gesamtb. Kakteen 735. 1899.

Apache County to Mohave County, 4,500 to 7,200 feet, common, May and June. Western Nebraska, Colorado, Utah, and Arizona.

The flowers are prevailingly, possibly always, pink or apricot pink.

9. **Opuntia plumbea** Rose, Smithsn. Inst. Misc. Collect. 50: 524. 1908.

Opuntia delicata Rose, Contrib. U. S. Natl. Herbarium 13: 310. 1911.

Opuntia loomisii Peebles, Cactus and Succulent Jour. 9: 109. 1938.

Apache County to Mohave, Yavapai, Cochise, and Santa Cruz Counties, 4,000 to 7,500 feet, common in juniper and pine forests, May and June, type from Gila County, types of *O. delicata* and *O. loomisii* from Santa Cruz and Yavapai Counties, respectively. New Mexico and Arizona.

The flowers are yellow when fresh, but in the afternoon often change to shades of red or orange.

10. **Opuntia rafinesquei** Engelm., Amer. Acad. Arts and Sci. Proc. 3: 295. 1856.

Opuntia cymochila Engelm. and Bigel. in Engelm., *ibid.* 3: 144. 1856.

Opuntia stenochila Engelm. and Bigel. in Engelm., *ibid.*

Apache County to northern Mohave County, not common, 5,000 to 7,000 feet, May and June. Wisconsin to Texas, New Mexico, and Arizona.

11. **Opuntia chlorotica** Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 291. 1856.

Throughout most of the State, except in the northeastern quarter, common, 2,000 to 6,000 feet, flowering in spring, type from Mohave

County. Southern Utah to Baja California, New Mexico, Arizona, and Sonora.

Pancake-pear, silverdollar cactus.

12. *Opuntia santa-rita* (Griffiths and Hare) Rose, Smithsn. Inst. Misc. Collect. 52: 195. 1908.

Opuntia chlorotica var. *santa-rita* Griffiths and Hare, N. Mex. Agr. Expt. Sta. Bul. 60: 64. 1906.

Cochise, Pima, and Santa Cruz Counties, 2,000 to 4,000 feet, flowering in spring, type from the Celero Mountains. Arizona and probably Sonora.

Santa-rita cactus. The combination of bright-yellow flowers and purple joints is very attractive, and the plant is often grown for ornament. *O. santa-rita* is closely related to *O. gosseliniana* Weber. Specimen plants on the campus of the University of Arizona that seem to belong to the latter species were collected by A. A. Nichol in western Pima County. This species of Sonora and Baja California has the erect habit of *O. santa-rita*, but the joints are well armed on the sides. In Nichol's specimens, the principal spines are long and brown, and the secondary spines, when present, are strongly deflexed or appressed.

13. *Opuntia macrocentra* Engelm., Amer. Acad. Arts and Sci. Proc. 3: 292. 1856.

Greenlee County to Gila, Cochise, and Pima Counties, 2,000 to 5,000 feet, April and May. Western Texas, southern New Mexico, Arizona, and northern Mexico.

14. *Opuntia laevis* Coult., Contrib. U. S. Natl. Herbarium 3: 419. 1896.

Gila, Pinal, Cochise, and Pima Counties, 2,500 to 4,500 feet, infrequent, April and May, type from Pima County. Known only from Arizona.

Spineless cactus. The plant sometimes attains a height of 3 or 4 m. in protected and otherwise favorable situations.

15. *Opuntia gilvescens* Griffiths, Mo. Bot. Gard. Ann. Rpt. 20: 87. 1909.

Pima and Santa Cruz Counties, 3,500 to 4,500 feet, infrequent in arroyos and on detrital slopes, type from Pima County. Known only from Arizona.

This species is closely related to *O. laevis* Coult.

16. *Opuntia flavescens* Peebles, Cactus and Succulent Jour. 9: 67. 1937.

Pima County, 2,500 to 3,500 feet, April and May, type from near Sells. Known only from Arizona.

Closely related to *O. phaeacantha* Engelm., but the plant is larger and of bushy habit. In southeastern Arizona plants with the general character of *O. flavescens* but with more numerous and longer spines are not infrequently encountered. They should, perhaps, be referred to *O. flavescens* rather than to *O. phaeacantha*.

17. *Opuntia phaeacantha* Engelm. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 52. 1849.

Opuntia tortispina Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 293. 1856.

Throughout most of the State, 1,200 to 7,500 feet, common, April to June. Colorado, Utah, and Arizona to Texas and northern Mexico.

O. procumbens Engelm. and Bigel. and *O. angustata* Engelm. and Bigel., both known only from Arizona, probably are merely infrequent variants of *O. phaeacantha*. The twisted spines ascribed to *O. tortispina* Engelm. and Bigel. are not of diagnostic importance. The writers assume that Boissevain and Davidson (see footnote 89, p. 607) are correct in referring to *O. rafinesquei* Engelm., the plant regarded by Britton and Rose as *O. tortispina*.

The writers have seen no local material of *O. tenuispina* Engelm., although the species is reported from Arizona. Specimens from southern New Mexico, supplied by A. R. Leding, do not appear to be very closely related to *O. phaeacantha*. The joints are rather small, exceedingly spiny, and transversely wrinkled, and the fruits are not more than 3 cm. long.

18. *Opuntia engelmannii* Salm-Dyck ex Engelm., Boston Jour. Nat. Hist. 6: 207. 1850.

Opuntia discata Griffiths, Mo. Bot. Gard. Ann. Rpt. 19: 266. 1908.

? *Opuntia canada* Griffiths, ibid. 20: 90. 1909.

Throughout the southern part of the State, common or abundant, 1,000 to 6,500 feet or somewhat higher, April to June. Texas to Arizona, and Mexico.

In Arizona the plants are somewhat variable but usually recognizable, 0.5 to 1.5 m. high, the joints obovate, 20 to 35 cm. long. A very robust form, often mistaken for the form described by Griffiths as *O. discata* but apparently undescribed, is common in the southeastern counties. The plant is often 2 m. high and 3 m. in diameter. The joints are orbicular or slightly rhombic, 30 to 45 cm. long. The type plants of *O. discata* and *O. canada* were found in Pima County. *O. engelmannii* has become a pest on some cattle ranges but has potential value as feed in times of drought.

- *19. *Opuntia pulchella* Engelm., Acad. Sci. St. Louis Trans. 2: 201. 1863.

Corynopuntia pulchella Knuth in Back. and Knuth, Kaktus-ABC 115. 1935.

Reported from Arizona and to be looked for in northern Mohave County. Nevada.

20. *Opuntia parishii* Orcutt, West Amer. Sci. 10: 81. 1896.

Corynopuntia parishii Knuth in Back. and Knuth, Kaktus-ABC 115. 1935.

Thirty-five miles north of Hackberry, Mohave County (*Evans* in 1935). Nevada, Arizona, and southern California.

Opuntia clavata Engelm. is reported from Apache and Navajo Counties. White spines distinguish this New Mexican species from *O. parishii*.

21. *Opuntia stanlyi* Engelm. in Emory, Mil. Recon. 158. 1848.

Corynopuntia stanlyi Knuth in Back. and Knuth, Kaktus-ABC 114. 1935.

Greenlee, Graham, Gila, and Pinal Counties, common, 2,000 to 5,000 feet, June. Southwestern New Mexico and Arizona.

22. *Opuntia kunzei* Rose, Smithsn. Inst. Misc. Collect. 50: 505. 1908.

Pinal and Pima Counties, 1,300 to 2,000 feet, June, type from Pima County. Known only from Arizona.

23. *Opuntia wrightiana* (Baxter) Peebles, Desert Plant Life 9: 43. 1937.

Grusonia wrightiana Baxter, California Cactus 58. 1935.

Western Pima County and Yuma County, 500 to 2,000 feet, May and June, type from Yuma County. Arizona, southeastern California, and Sonora.

Closely related to *Opuntia kunzei*, but the joints are larger, differently shaped, and even more heavily armed. The distinguishing characters are not well marked in plants found in extreme western Pima County.

24. *Opuntia ramosissima* Engelm., Amer. Jour. Sci. ser. 2, 14: 339. 1852.

Cylindropuntia ramosissima Knuth in Back. and Knuth, Kaktus-ABC 122. 1935.

Mohave, Maricopa, and Yuma Counties, 500 to 2,000 feet, May to September. Southwestern Utah and Nevada to Sonora and California.

25. *Opuntia arbuscula* Engelm., Amer. Acad. Arts and Sci. Proc. 3: 309. 1856.

Cylindropuntia arbuscula Knuth in Back. and Knuth, Kaktus-ABC 123. 1935.

Maricopa, Pinal, Pima, and Yuma Counties, 1,000 to 3,000 feet, May and June, type from Pinal County. Arizona and Sonora.

Pencil cholla (pl. 26). Typically an arborescent shrub with compactly branched crown and well-developed trunk, but not infrequently the plant is less than 1 m. high and openly branched. The Papago Indians utilized the young joints of the pencil cholla and similar species as a boiled vegetable, but probably only in times of want.

The obscure tubercles and large fruits of *Opuntia vivipara* Rose, which is known only from a few plants in the vicinity of Tucson, Pima County, indicate relationship with *O. arbuscula*. On the other hand, *O. vivipara* resembles *O. tetracantha* in having 1 to 4 spines at an areole, these only 2 to 4 cm. long, and purplish flowers.

26. *Opuntia tetracantha* Toumey, Gard. and Forest 9: 432. 1896.

Cylindropuntia tetracantha Knuth in Back. and Knuth, Kaktus-ABC 124. 1935.

Cochise, Pinal, and Pima Counties, infrequent, May, type from Pima County. Known only from Arizona.



Pencil cholla (*Opuntia arbuscula*), in Pinal County, altitude 1,000 feet. The plant is 4½ feet high and represents the typical form with a densely branched crown and a definite trunk.

27. *Opuntia leptocaulis* DC., Paris Mus. Hist. Nat. Mém. 17: 118. 1828.

Cylindropuntia leptocaulis Knuth in Back. and Knuth, Kaktus-ABC 122. 1935.

Southern Arizona, 1,000 to 5,000 feet, May and June. Texas, New Mexico, Arizona, and Mexico.

Common and variable, especially in respect to development of the spines, but the small scarlet fruits, very slender stems, and small size of the plant mark the species well.

28. *Opuntia bigelovii* Engelm., Amer. Acad. Arts and Sci. Proc. 3: 307. 1856.

Cylindropuntia bigelovii Knuth in Back. and Knuth, Kaktus-ABC 125. 1935.

Western and southern Arizona, up to 3,000 feet, common on talus slopes, February to May, type from Mohave County. Southwestern Utah and southern Nevada to Sonora and Baja California.

Jumping cholla, teddybear cactus. The plants occur in abundance on warm slopes of desert mountains. The combination of barbed spines and densely armed, very easily detached joints has earned profound respect for this formidable cholla.

29. *Opuntia echinocarpa* Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 305. 1856.

Cylindropuntia echinocarpa Knuth in Back. and Knuth, Kaktus-ABC 124. 1935.

Mohave and Yuma Counties, up to 3,000 feet, April, type from Mohave County. Southwestern Utah and southern Nevada to Arizona and Baja California.

30. *Opuntia thornberi* Thornber and Bonker, Fantastic Clan 133. 1932.

Southern Yavapai County to Graham and Pima Counties, 1,500 to 3,500 feet, foothills and detrital slopes, April and May, type from southern Arizona. Known only from Arizona.

31. *Opuntia acanthocarpa* Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 308. 1856.

Cylindropuntia acanthocarpa Knuth in Back. and Knuth, Kaktus-ABC 124. 1935.

Mohave, Yavapai, Maricopa, Pinal, Pima, and Yuma Counties, common, 500 to 3,500 feet, flowering in spring, type from Mohave County. Southwestern Utah and southern Nevada to Sonora and southern California.

The typical form is a robust plant of open habit, commonly 2 to 3 m. high, with the younger branches ascending at acute angles and the joints at least 2.5 cm. thick. In var. *ramosa* Peebles the plant is bushy, 1 or 2 m. high, with joints less than 2.5 cm. thick and the flowers red, yellow, or variegated. The Pima Indians use the flower buds of var. *ramosa* for food. The product, which is prepared by a steaming process, keeps well and is eaten as needed, usually in combination with pinole or saltbush greens.

32. *Opuntia fulgida* Engelm., Amer. Acad. Arts and Sci. Proc. 3: 306. 1856.

Cylindropuntia fulgida Knuth in Back. and Knuth, Kaktus-ABC 126. 1935.

Southern Arizona, up to 4,000 feet, common, June to August. Arizona to Sinaloa.

Cholla. The var. *mammillata* (Schott) Coult., which is distinguished by less densely armed joints, occurs with the typical form but often replaces the latter at the higher elevations. Cattle relish the fruits of both forms and will eat the viciously armed joints if the spines are scorched. In fact, a few cattle acquire a taste for this cholla and actually eat the spiny joints as they occur in nature. The reticulate stems are used in the manufacture of small articles of furniture, such as picture frames and lampstands.

33. *Opuntia versicolor* Engelm. ex Coult., Contrib. U. S. Natl. Herbarium 3: 452. 1896.

Cylindropuntia versicolor Knuth in Back. and Knuth, Kaktus-ABC 125. 1935.

Pinal and Pima Counties, 1,200 to 4,000 feet, common, May, type from Pima County. Arizona and northern Mexico.

Deerhorn or staghorn cholla.

34. *Opuntia spinosior* (Engelm. and Bigel.) Toumey, Bot. Gaz. 25: 119. 1898.

Opuntia whipplei var. *spinosior* Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 307. 1856.

Cylindropuntia spinosior Knuth in Back. and Knuth, Kaktus-ABC 126. 1935.

Yavapai County to Greenlee, Cochise, and Pima Counties, 1,200 to 5,000 feet, occasionally higher, common, May and June, type from southern Arizona. Western New Mexico, Arizona, and northern Mexico.

An apparent hybrid between *O. spinosior* and *O. fulgida* is rather abundant in the bed of the Gila River between Florence and Casa Blanca, Pinal County. The hybrid plants propagate freely by means of fallen joints.

35. *Opuntia whipplei* Engelm. and Bigel. in Engelm., Amer. Acad. Arts and Sci. Proc. 3: 307. 1856.

Cylindropuntia whipplei Knuth in Back. and Knuth, Kaktus-ABC 124. 1935.

Apache County to Mohave, Yavapai, and Gila Counties, 3,500 to 6,500 feet, common, June and July. Southwestern Colorado, southern Utah, western New Mexico, and Arizona.

The var. *nodis* Peebles, characterized by nontuberculate, shallowly umbilicate fruits, is known only from the type collection on Hualpai Mountain, Mohave County, 4,200 feet (*Kearney and Peebles* SF 883). The fruits of *O. whipplei* are utilized by the Hopi Indians for food and for seasoning food.

86. ELAEAGNACEAE. OLEASTER FAMILY

Shrubs or small trees, scurfy-pubescent with stellate hairs; leaves alternate or opposite, simple, the blades entire; flowers small, apetalous, regular, perfect or unisexual, axillary, solitary or in small clusters; calyx 4-cleft or 4-parted; ovary technically superior but the perianth tube becoming fleshy and closely investing the achene, the whole structure simulating a drupe.

Key to the genera

1. Leaves alternate; flowers perfect or polygamous; stamens 4- 1. ELAEAGNUS.
 1. Leaves opposite; flowers dioecious; stamens normally 8- 2. SHEPHERDIA.

1. ELAEAGNUS. OLEASTER

A shrub or small tree, up to about 7.5 m. (25 feet) high, often thorny; leaf blades lanceolate or oblong-lanceolate, bright green above, closely silvery-lepidote beneath; flowers pale yellow, very fragrant; fruit oval, yellow, silvery-lepidote.

1. *Elaeagnus angustifolia* L., Sp. Pl. 121. 1753.

Oak Creek Canyon, southern Coconino County, 5,500 feet (*Kearney* and *Peebles* 12208), an escape from cultivation, apparently nowhere naturalized in Arizona.

Russian-olive, native of the Old World, often cultivated as an ornamental in the United States.

2. SHEPHERDIA. BUFFALOBERRY

Shrubs; leaves persistent or deciduous; flowers dioecious; stamens alternating with as many teeth of a fleshy disk; fruits globose or ellipsoid.

Key to the species

1. Leaves persistent, the blades thick, rounded-oval, ovate, or nearly orbicular, often subcordate at base, not more than 3 cm. long, silvery-lepidote above, densely yellowish or whitish lepidote-tomentose beneath; fruits almost globose, scurfy----- 1. *S. ROTUNDIFOLIA*.
 1. Leaves deciduous, the blades thin, not subcordate at base, up to 5 cm. long; fruit more or less elongate, not scurfy (2).
 2. Plant somewhat thorny, 1 to 6 m. high; leaf blades oblong, cuneate at base, copiously to densely silvery-lepidote on both faces; fruits ovoid-ellipsoid, usually scarlet, edible----- 2. *S. ARGENTEA*.
 2. Plant not thorny, 1 to 2 m. high; leaf blades elliptic-oblong to ovate, usually rounded at base, sparsely lepidote to nearly glabrous above, silvery- and rusty-lepidote beneath; fruits ellipsoid, yellowish red, unpalatable.----- 3. *S. CANADENSIS*.

1. *Shepherdia rotundifolia* Parry, Amer. Nat. 9: 350. 1875.

Lepargyrea rotundifolia Greene, Pittonia 2: 122. 1890.

Navajo, Coconino, and eastern Mohave Counties, 5,000 to 7,000 feet, May and June. Southern Utah and northern Arizona.

Roundleaf buffaloberry. An evergreen shrub commonly about 1 m. high, with silvery leaves and a compact habit of growth, common and even abundant in certain areas and pretty well distributed throughout northeastern Arizona, apparently preferring steep slopes (sides of mesas and badly gullied areas). The ripe fruit contains a sweet, watery, pale yellow juice.

2. *Shepherdia argentea (Pursh) Nutt., Gen. Pl. 2: 241. 1818.*Hippophae argentea* Pursh, Fl. Amer. Sept. 115. 1814.*Lepargyrea argentea* Greene, Pittonia 2: 122. 1890.

The writers have seen no specimens from Arizona, but the plant has been collected in northwestern New Mexico, near the border. Canada to Kansas, New Mexico, and California.

Silver buffaloberry.

3. *Shepherdia canadensis* (L.) Nutt., Gen. Pl. 2: 241. 1818.*Hippophae canadensis* L., Sp. Pl. 1024. 1753.*Lepargyrea canadensis* Greene, Pittonia 2: 122. 1890.

White Mountains, Apache County at Twelve Mile Creek, head of the Little Colorado River, and Marsh Lake, about 9,000 feet (*Coville* 1130, *Goodding* 1155, *Goldman* 2466). Newfoundland to Alaska, south to New York, New Mexico, Arizona, and Oregon.

Russet buffaloberry.

87. LYTHRACEAE. LOOSESTRIFE FAMILY

Plants (Arizona species) herbaceous, annual or perennial; leaves simple, entire, opposite or alternate, without stipules; flowers perfect, regular or irregular, axillary or in terminal racemes or spikes; calyx tube enclosing but free from the ovary; petals and stamens borne on the throat of the calyx; fruit a 1- to 4-celled capsule; seeds numerous.

Key to the genera

1. Calyx broad, campanulate or turbinate in flower, hemispheric to globose in fruit, not prominently ribbed; petals usually inconspicuous, sometimes wanting; leaves opposite; flowers axillary, solitary or in small short-stalked glomerules (2).
 2. Capsules regularly dehiscent longitudinally; leaves attenuate at base, short-petioled or sessile..... 1. *ROOTALA*.
 2. Capsules bursting irregularly; leaves some or all of them auriculate-clasping at base..... 2. *AMMANNIA*.
1. Calyx narrow, cylindrical, tubular, or subclavate, with several longitudinal ribs; petals usually conspicuous, normally rose purple (3).
 3. Plant perennial; herbage glabrous or obscurely puberulent; leaves mostly alternate, sessile or subsessile; flowers nearly regular; calyx almost symmetric, narrowly cylindrical or subclavate in fruit..... 3. *LYTHRUM*.
 3. Plant annual; herbage glandular-hispid; leaves mostly opposite, petioled; flowers irregular, the upper petals larger than the others; calyx oblique, turgid in fruit, hispid..... 4. *CUPHEA*.

1. *ROOTALA*

Small annual herbs, glabrous or nearly so; leaves opposite, narrow; flowers regular or nearly so, axillary, mostly solitary, small; bractlets longer than (often twice as long as) the calyx, this short and broad, with appendages often 3 times as long as the lobes; petals 4 and about 1 mm. long, or wanting; ovary ellipsoid; valves of the capsule minutely transverse-striate.

1. *Rotala dentifera (A. Gray) Koehne, Bot. Jahrb. 1: 161. 1880.*Ammannia dentifera* A. Gray, Pl. Wright, 2: 55. 1853.

The writers have seen no specimens from Arizona, but the type was collected near Santa Cruz, Sonora, a few miles south of the inter-

national boundary, at "margins of pools and mountain streams" (Wright 1063). Apparently known only from Sonora.

R. ramosior (L.) Koehne is also to be looked for in Arizona. It differs from *R. dentifera* in having the bractlets seldom surpassing the calyx, the appendages of the calyx one-half as long as to slightly longer than the lobes, and the ovary globose-ovoid.

2. AMMANNIA

Annual herbs, differing from *Rotala* chiefly by the characters given in the key to genera, and in the plants being usually larger, with the flowers in few-flowered axillary cymes.

Key to the species

1. Capsules equaling or somewhat surpassing the calyx lobes; flowers distinctly pedicelled, the pedicels often elongate..... 1. *A. auriculata*.
 1. Capsules not equaling the calyx lobes; flowers sessile or subsessile, the pedicels rarely up to 4 mm. long..... 2. *A. coccinea*.

*1. ***Ammannia auriculata*** Willd., Hort. Berol. 1: 7. 1806.

Ammannia wrightii A. Gray, Pl. Wright. 2: 55. 1853.

Not known definitely to occur in Arizona but was collected near Santa Cruz, Sonora, and along the San Pedro River (in Arizona?) (Wright 1062, type collection of *A. wrightii*), growing with *Rotala dentifera*. Missouri to Texas, Arizona (?), and southward.

According to Koehne⁹⁰ all American specimens of *A. auriculata* belong to var. *arenaria* (H. B. K.) Koehne.

2. ***Ammannia coccinea*** Rottb., Pl. Hort. Havn. Descr. 7. 1773.

Maricopa, Cochise, Pima, and Yuma Counties, 4,000 feet or lower, infrequent in wet soil or shallow water, late summer and autumn. New Jersey to Washington, south to Florida, Arizona, and California; South America.

3. LYTHRUM. LOOSESTRIFE

Plant herbaceous or nearly so, perennial, stoloniferous; stems erect, very leafy, with exfoliating bark; leaves alternate or nearly opposite, sessile, the blades of the stem leaves linear-lanceolate, those of the basal shoots oblong or somewhat oblanceolate; flowers mostly solitary in the axils, short-pedicelled, forming slender leafy spikes, the petals normally rose purple.

1. ***Lythrum californicum*** Torr. and Gray, Fl. North Amer. 1: 482. 1840.

Lythrum alatum Pursh var. *linearifolium* A. Gray, Boston Jour. Nat. Hist. 6: 188. 1850.

Lythrum linearifolium Small, Fl. Southeast. U. S. 828. 1903.

Gila and Yavapai Counties to Cochise, Santa Cruz, and Pima Counties, 1,300 to 5,500 feet, frequent in wet soil along streams and in bogs, June to August. Texas to southern Nevada, Arizona, California, and Mexico.

4. CUPHEA

Plant annual; stems erect, leafy, usually branched; leaves slender-petioled, the blades broadly lanceolate to ovate, thin; flowers axillary,

⁹⁰ KOEHNE, E. LYTHRACEAE. Pflanzenreich IV. 216: 1-326. 1903. (See p. 46.)

also in terminal leafy racemes or narrow panicles; petals 6; stamens 10 to 12.

Several exotic species are cultivated as ornamentals, the best-known one being *C. ignea*, the cigarflower, with a scarlet, black-and-white-tipped calyx.

1. *Cuphea wrightii* A. Gray, Pl. Wright. 2: 56. 1853.

Parsonsia wrightii Kearney, N. Y. Acad. Sci. Trans. 14: 37. 1894.

Cochise, Santa Cruz, and Pima Counties, 4,500 to 6,000 feet, rich soil of canyons, etc., August to September. Southern Arizona to Panama.

A form with small very narrow petals, these grayish with very short hairs, is var. *nematopetala* Bacigalupi. This was based on a collection near Bowie, Cochise County (*Jones* in 1884), and was collected by *Jones* also in the Huachuca Mountains.

88. ONAGRACEAE. EVENING-PRIMROSE FAMILY

Contributed by PHILIP A. MUNZ

Herbs or rarely shrubs, with simple, alternate or opposite leaves; stipules none; flowers perfect, axillary or in terminal racemes, the parts mostly in 2's or in 4's; hypanthium adnate to the ovary and usually prolonged beyond it; sepals 4 (sometimes 2 or 5); petals 4 (sometimes 2 or 5), inserted at summit of the hypanthium; stamens as many or twice as many as the petals, borne at the summit of the hypanthium; ovary inferior, 4- (sometimes 2- or 5-) celled; style 1; stigma 4-lobed, capitate, or discoid; fruit a capsule, rarely nutlike.

This family is notable for the beauty of the flowers in many of the genera. Numerous species of *Fuchsia*, *Zauschneria*, *Clarkia*, *Godetia*, and *Oenothera* are highly prized as cultivated ornamentals. The evening-primroses with large white flowers (*Oenothera deltoides*, etc.) are among the handsomest of the desert plants, and in favorable springs make a glorious display, often growing in great profusion with sandverbena (*Abronia*).

Key to the genera

1. Sepals persistent, divided down to the ovary (2).
 2. Sepals 5; petals 5, about 1 cm. long----- 1. JUSSIAEA.
 2. Sepals 4; petals 4 and minute, or lacking----- 2. LUDWIGIA.
1. Sepals deciduous after flowering (3).
 3. Flowers 2-merous; fruit indehiscent, obovoid, usually with hooked hairs. 10. CIRCAEA.
 3. Flowers 4-merous (4).
 4. Seeds with tufts of hairs (coma) at one end (5).
 5. Hypanthium 2 to 3 cm. long, funnellform, with a transverse row of scales within about midway of its length; flowers scarlet. 3. ZAUSCHNERIA.
 5. Hypanthium less than 1 cm. long, without scales within, sometimes lacking; flowers not scarlet----- 4. EPILOBIUM.
 4. Seeds without coma (6).
 6. Fruit nutlike, indehiscent----- 9. GAURA.
 6. Fruit a capsule, dehiscent (7).
 7. Ovary 2-celled; hypanthium not prolonged beyond the ovary; flowers minute; stems with capillary branches----- 8. GAYOPHYTUM.
 7. Ovary 4-celled; hypanthium prolonged beyond the ovary (8).
 8. Anthers usually versatile, attached near the middle; petals yellow or white, rarely red except on aging----- 7. OENOTHERA.

8. Anthers innate, attached near the base, erect; petals white or pink (9).
 9. Petals distinctly clawed, the claw at least one-fourth as long as the blade----- 5. CLARKIA.
 9. Petals not or scarcely clawed, the claw not more than one-tenth as long as the blade----- 6. GODETIA.

1. JUSSIAEA

Plants perennial, herbaceous, aquatic; leaves alternate; flowers 5-merous, solitary in the leaf axils; ovary 5-celled, many-ovuled; capsule cylindric-clavate.

1. *Jussiaea repens* L., Sp. Pl. 388. 1753.

Known in Arizona from a single collection in shallow water, Papago Park near Tempe, Maricopa County (*McLellan* and *Stitt* 671), May to October.

Yellow-waterweed. The species is represented in Arizona by var. *peploides* (H. B. K.) Griseb. (*J. californica* (S. Wats.) Jepson), which ranges from Oregon to South America.

2. LUDWIGIA. SEEDBOX

Plants perennial, herbaceous, inhabiting marshes and wet places; leaves opposite (in the Arizona species); flowers 4-merous; petals often lacking; stamens 4; ovary flattened at the broad apex; capsule short, 4-valved.

1. *Ludwigia palustris* (L.) Ell., Bot. S. C. and Ga. 1: 211. 1821.

Isnardia palustris L., Sp. Pl. 120. 1753.

Banks of "El Riato" (probably Rillito Creek), south side of the Santa Catalina Mountains (*J. G. Lemmon* 176), reported also by Shreve from the same mountains. Nova Scotia to California, southern Arizona, and Guatemala.

Marshpurslane. Characterized by longitudinal green bands on the fruit and by the 4 persistent sepals. The form that occurs in Arizona is var. *americana* (DC.) Fern. and Griscom.

3. ZAUSCHNERIA. HUMMINGBIRD-TRUMPET

Plants perennial, herbaceous, somewhat woody at base and with shredding bark; leaves sessile or nearly so, more or less fascicled, elliptic to elliptic-lanceolate, somewhat coriaceous, usually denticulate, pallid, more or less villous; flowers mostly 3 to 4 cm. long, scarlet, horizontal, fuchsialike.

1. *Zauschneria latifolia* (Hook.) Greene, Pittonia 1: 25. 1887.

Zauschneria californica Presl var. *latifolia* Hook., Curtis's Bot. Mag. 76: pl. 4493. 1850.

Greenlee and Gila Counties southward to the Mexican border, westward to the Ajo Mountains (Pima County), damp places on rocky slopes and in canyons, 3,500 to 7,000 feet, August to December.

The Arizona form is var. *arizonica* (Davidson) Hilend (*Z. arizonica* Davidson), the type of which was collected at Metcalf, Greenlee County (*Davidson* 365), and which occurs in southwestern New Mexico, southern Arizona, and northern Sonora.

4. EPILOBIUM.⁹¹ WILLOW-WEED

Plants annual or perennial, herbaceous; leaves nearly or quite sessile; flowers axillary or in terminal racemes or panicles; hypanthium either short or not prolonged beyond the ovary; sepals 4; petals 4, usually notched, white, pink, or purplish; stamens 8, the alternate ones shorter; capsule elongate, subcylindric to clavate, 4-celled, loculicidal.

Key to the species

1. Hypanthium not prolonged beyond the ovary; flowers large; petals 8 to 18 mm. long, entire, spreading----- 1. *E. ANGUSTIFOLIUM*.
1. Hypanthium prolonged beyond the ovary; flowers smaller; petals 2 to 6 mm. long, notched, ascending (2).
 2. Plants annual, of dry situations; stems with an exfoliating epidermis (3).
 3. Stems glabrous except in the upper parts, usually more than 30 cm. long; leaves usually alternate, with fascicles in the axils; hypanthium 1 to 3 mm. long----- 2. *E. PANICULATUM*.
 3. Stems puberulent throughout, less than 30 cm. long; leaves mostly opposite, without fascicles; hypanthium scarcely 1 mm. long.
 3. *E. MINUTUM*.
 2. Plants usually perennial, mostly of moist situations; epidermis of the stems not exfoliating (4).
 4. Rootstocks bearing turions, i. e., globose or ovoid winter buds with fleshy overlapping scales (5).
 5. Leaves lanceolate, appressed-erect, sharply denticulate.
 4. *E. HALLEANUM*.
 5. Leaves lance-ovate to ovate, spreading, subtire to denticulate.
 5. *E. SAXIMONTANUM*.
 4. Rootstocks not bearing turions (6).
 6. Plants caespitose, 1 to 2 dm. high, from a matted base; stems simple above----- 6. *E. HORNEMANNII*.
 6. Plants 1- to few-stemmed, 3 to 6 dm. high; stems branched above (7).
 7. Inflorescence glandular-pubescent----- 7. *E. ADENOCAULON*.
 7. Inflorescence whitish-pubescent, not glandular. 8. *E. CALIFORNICUM*.

1. *Epilobium angustifolium* L., Sp. Pl. 347. 1753.

Chamaenerion angustifolium Scop., Fl. Carn. ed. 2, 1: 271. 1772.

Kaibab Plateau and San Francisco Peaks (Coconino County), to the mountains of Greenlee and Graham Counties, 7,000 to 11,000 feet, damp places, July to August. Widely distributed in the Northern Hemisphere.

Fireweed, blooming-sally. The large rose to almost lilac flowers, strongly perennial habit, and elongate capsules opening to expose masses of dingy coma are characteristic.

2. *Epilobium paniculatum* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 490. 1840.

A polymorphous species of wide distribution in the western United States, occurring in Arizona in the following forms: (1) f. *adenocladon* Hausskn., with capsules and pedicels glandular-puberulent and petals rose to lilac, 5 to 7 mm. long, Coconino, Yavapai, and Gila Counties, dry, open and disturbed places, 5,000 to 8,500 feet, August to October; (2) f. *subulatum* Hausskn., with capsules and pedicels glabrous and petals as in the preceding, Coconino and Yavapai Counties; (3) f. *tracyi* (Rydb.) St. John, with petals white, 2 to 3 mm. long, and capsule subglabrous, Kaibab Plateau, at Nagle Ranch, 7,600 feet (*Jones* 6054i), and Jacobs Lake, 8,050 feet (*Kearney* and *Peebles* 13662).

⁹¹ Reference: TRELEASE, WM. THE SPECIES OF EPILOBIUM OCCURRING NORTH OF MEXICO. Mo. Bot. Gard. Ann. Rpt. 2: 69-117. 1891.

3. *Epilobium minutum* Lindl. in Hook., Fl. Bor. Amer. 1: 207. 1834.

Gila County, between Young and Payson, 5,300 feet (*Pebbles and Smith* 13273), between Miami and Superior (*Arce and Ruth Nelson* 1905). May. Montana to British Columbia, south to Arizona and central California.

4. *Epilobium halleanum* Hausskn., Monog. Epilob. 261. 1884.

Epilobium drummondii Hausskn., *ibid.* 271.

Kaibab Plateau, Grand Canyon, Flagstaff (Coconino County), Hannigan Meadow (Greenlee County). 8,500 to 10,000 feet, damp places, July and August. Colorado to British Columbia and Arizona.

5. *Epilobium saximontanum* Hausskn., Oesterr. Bot. Ztschr. 29: 119. 1879.

Epilobium oratifolium Rydb., Torrey Bot. Club Bul. 31: 567. 1904.

Lukachukai Mountains (Apache County), San Francisco Peaks, etc. (Coconino County), Pinaleno Mountains (Graham County), 8,000 to 11,500 feet, moist places, July and August. Colorado to Alberta and Arizona.

6. *Epilobium hornemannii* Reichenb., Icon. Bot. Pl. Crit. 2: 73. 1824.

San Francisco Peaks, Coconino County, 9,400 to above 10,000 feet (*Leiberg* 5720, *Collom* 955). Arctic America to Arizona and California; Europe.

7. *Epilobium adenocaulon* Hausskn., Oesterr. Bot. Ztschr. 29: 119. 1879.

Epilobium glandulosum var. *adenocaulon* Fernald, Rhodora 20: 35. 1918.

Epilobium novomexicanum Hausskn., Monog. Epilob. 260. 1884.

Widely distributed in Arizona, 4,000 to 9,500 feet, moist places, June to September. Eastern United States to British Columbia, Arizona, and Mexico.

Occasional specimens with narrow, petioled leaves, very slender stems, and an exceedingly close, appressed pubescence in the upper parts, may be referred to the uncertain var. *perplexans* Trelease.

8. *Epilobium californicum* Hausskn., Monog. Epilob. 260. 1884.

Epilobium fendleri Hausskn., *ibid.* 261.

Widely distributed in Arizona, 5,000 to 8,250 feet, moist places, June to October. Washington to New Mexico, Arizona, and Baja California.

Intergrades freely with *E. adenocaulon* and is perhaps only a variety of it.

5. CLARKIA⁹²

Plant annual, herbaceous; leaves few, subopposite, lance-ovate to elliptic; inflorescence spicate; buds nodding; flowers rose purple; capsules 1 to 3 cm. long, 2 to 4 mm. thick, on short pedicels; seeds densely cellular-pubescent.

⁹² Reference: MUNZ, P. A., and HITCHCOCK, C. LEO. A STUDY OF THE GENUS CLARKIA, WITH SPECIAL REFERENCE TO ITS RELATIONSHIP TO GODETIA. Torrey Bot. Club Bul. 56: 181-197. 1929.

1. *Clarkia rhomboidea* Dougl. ex Hook., Fl. Bor. Amer. 1: 214. 1834.

Gila and Pima Counties, 3,000 to 6,000 feet, rather dry and often disturbed places, May and June. South Dakota to Washington, Arizona, and Baja California.

The rose-purple petals may or may not be dotted.

6. GODETIA⁹³

Plants annual, herbaceous; leaves linear to spatulate, the lower ones usually deciduous, the secondary ones borne in fascicles; hypanthium with an inner ring of hairs; seeds with a fimbriate upper margin.

Key to the species

1. Buds erect; hypanthium with the inner ring of hairs about one-third way from the base; petals lavender to purple; sepals usually distinct in anthesis; capsule 2 to 3 mm. thick.----- 1. *G. QUADRIVULNERA*.
1. Buds nodding; hypanthium with the inner ring of hairs near the summit; petals whitish; sepals united in anthesis; capsule 1 to 1.5 mm. thick.----- 2. *G. EPILOBIOIDES*.

1. *Godetia quadrivulnera* (Dougl.) Spach, Hist. Nat. Vég. 4: 389. 1835.

Oenothera quadrivulnera Dougl. ex Lindl., Bot. Reg. 13: pl. 1119. 1828.

Gila County, Pinal Mountains (*Harrison* 1897), and Mazatzal Mountains (*Mrs. Collom*), Pima County, Tucson (*Thorner* 2530), April to May. Washington to Arizona and Baja California.

2. *Godetia epilobioides* (Nutt.) S. Wats. in Brewer and Wats., Bot. Calif. 1: 231. 1876.

Oenothera epilobioides Nutt. ex Torr. and Gray, Fl. North Amer. 1: 511. 1840.

Pinal, Maricopa, and Pima Counties, 1,500 to 3,000 feet, damp and disturbed places, March to May. Southern Arizona to central California and Baja California.

7. OENOTHERA.⁹⁴ EVENING-PRIMROSE, SUNDROPS

Plants herbaceous; leaves alternate or basal; flowers yellow or white, rarely red except in age, when commonly so; hypanthium deciduous after flowering; sepals and petals 4; stamens 8, equal or unequal; capsule straight, curved, or coiled, membranous or woody, 4-celled, 4-valved, dehiscent; seeds many, naked.

⁹³ Reference: HITCHCOCK, C. LEO. REVISION OF NORTH AMERICAN SPECIES OF GODETIA. Bot. Gaz. 89: 321-361. 1930.

⁹⁴ References: MUNZ, PHILIP A. STUDIES IN ONAGRACEAE—1. A REVISION OF THE SUBGENUS CHYLISMA OF THE GENUS OENOTHERA. Amer. Jour. Bot. 15: 223-240. 1928.
 2. REVISION OF THE NORTH AMERICAN SPECIES OF SUBGENUS SPHAEROSTIGMA. Bot. Gaz. 85: 233-270. 1928.
 3. A REVISION OF THE SUBGENERA TARAXIA AND EULOBUS. Amer. Jour. Bot. 16: 246-257. 1929.
 4. A REVISION OF THE SUBGENERA SALPINGIA AND CALYLOPHIS. Amer. Jour. Bot. 16: 702-715. 1929.
 5. THE NORTH AMERICAN SPECIES OF THE SUBGENERA LAVAUXIA AND MEGAPTERIUM. Amer. Jour. Bot. 17: 358-370. 1930.
 6. THE SUBGENUS ANOGR. Amer. Jour. Bot. 18: 309-327. 1931.
 7. THE SUBGENUS PACHYLOPHIS. Amer. Jour. Bot. 18: 728-738. 1931.
 8. THE SUBGENUS HARTMANNIA. Amer. Jour. Bot. 19: 755-765. 1932.
 9. THE SUBGENUS RAIMANNIA. Amer. Jour. Bot. 22: 645-663. 1935.

Key to the species

1. Stigma with 4 linear lobes; flowers mostly vespertine (2).
2. Capsule sharply 4-angled or -winged, at least in the upper part, rather short for its thickness; plants perennial (3).
3. Flowers white to red; capsule club-shaped, the lower part narrow and sterile, the upper part thicker, ribbed or winged; seeds in more than 2 rows in each cell: Subgenus *Hartmannia* (4).
4. Buds nodding; lower sterile part of the capsule cylindric and sessile; petals white to pink, 2.5 to 4 cm. long----- 14. *O. SPECIOSA*.
4. Buds erect; lower sterile part of the capsule tapering toward the base; petals 0.5 to 1.5 cm. long (5).
5. Petals rose, 5 to 10 mm. long; hypanthium 4 to 8 mm. long.
 15. *O. ROSEA*.
 5. Petals white to pink, 10 to 15 mm. long; hypanthium 10 to 20 mm. long----- 16. *O. KUNTHIANA*.
3. Flowers yellow; capsule body proper ovoid or prismatic (6).
6. Seeds in 1 row in each cell, with corky tubercles; capsule broadly winged throughout its length; hypanthium 5 to 15 cm. long; petals 3 to 5 cm. long: Subgenus *Megapterium*--- 19. *O. BRACHYCARPA*.
6. Seeds in 2 rows in each cell, granular, with a winglike margin around the obtuse summit; capsule winged most widely in the upper half: Subgenus *Lavauxia* (7).
7. Tube of the hypanthium 4 to 8 cm. long; sepals and petals 1 to 2 cm. long; wings of the capsule 2 to 5 mm. wide--- 17. *O. FLAVA*.
7. Tube of the hypanthium 12 to 18 cm. long; sepals and petals 3 to 4 cm. long; wings of the capsule 1 to 2 mm. wide.
 18. *O. TARAXACOIDES*.
2. Capsule terete or round-angled, elongate, not winged (8).
8. Seeds sharply angled, in 2 rows in each cell of the capsule; capsule somewhat cylindric or fusiform, gradually tapering upward; flowers yellow, opening in the evening: Subgenus *Euoenothea* or *Onagra* (9).
9. Petals 10 to 14 mm. long, not very red in age; free tube of the hypanthium 2 to 4 cm. long----- 3. *O. PROCERA*.
9. Petals 25 to 40 mm. long, reddish or purplish in age (10).
10. Free tube of the hypanthium 3 to 5 cm. long; leaves usually distinctly denticulate----- 1. *O. HOOKERI*.
10. Free tube of the hypanthium 8 to 12 cm. long; leaves often almost entire----- 2. *O. LONGISSIMA*.
8. Seeds not sharply angled (11).
11. Plants tufted or almost acaulescent; seeds with a deep furrow along the raphe; capsule cylindric or lance-ovoid, thick-walled, usually ridged, often tuberculate: Subgenus *Pachylophis* (12).
12. Flowers white, aging pink; plant perennial; sepals 25 to 35 mm. long; anthers 10 to 14 mm. long----- 12. *O. CAESPITOSA*.
12. Flowers yellow, aging red; plant annual; sepals 15 to 28 mm. long; anthers 5 to 10 mm. long----- 13. *O. PRIMIVERIS*.
11. Plants definitely caulescent; seeds not with a deep raphe groove (13).
13. Capsule membranous, slightly enlarged in the upper part; seeds in 2 rows in each cell, with shallow pits in regular rows: Subgenus *Raimannia* (14).
14. Flowers yellow; buds erect; petals 5 to 15 mm. long.
 4. *O. LACINIATA*.
14. Flowers white; buds nodding (15).
15. Plant perennial from slender underground rootstocks; hypanthium with conspicuous white hairs in the throat; petals 7 to 11 mm. long; capsule 8 to 20 mm. long.
 5. *O. CORONIFOLIA*.
15. Plant annual or winter annual; hypanthium not long-hairy in the throat; petals 15 to 40 mm. long; capsule 20 to 40 mm. long----- 6. *O. ALBICAULIS*.
13. Capsule woody, cylindric, slightly narrowed toward the apex; seeds in 1 row in each cell, not pitted; flowers white: Subgenus *Anogra* (16).
16. Plant a coarse spring or winter annual; basal leaf blades rhombic, 2 to 8 cm. long; capsules woody, 2 to 7 cm. long, with exfoliating epidermis; buds often shaggy----- 7. *O. DELTOIDES*.

16. Plants perennial or biennial; basal leaf blades smaller and narrower; capsules not woody (17).
17. Upper portion of the plant conspicuously pilose with long spreading hairs; hypanthium 3 to 5 cm. long; sepals 2 to 3 cm. long; capsules quite erect, 2 to 3 cm. long.
8. O. NEOMEXICANA.
17. Upper portion of the plant not conspicuously pilose with long spreading hairs or, if so, then also pallid with fine appressed hairs; hypanthium 1.5 to 3.5 cm. long; capsules spreading, deflexed, or coiled (18).
18. Plants essentially glabrous; capsules usually contorted; anthers 5 to 10 mm. long----- 9. O. PALLIDA.
18. Plants canescent to hoary; capsules spreading or curved, sometimes contorted; anthers 3 to 6 mm. long (19).
19. Underground system a running rootstock.
10. O. RUNCINATA.
19. Underground system a taproot----- 11. O. TRICHOCALYX.
1. Stigma capitate, discoid, or 4-toothed; flowers mostly diurnal (20).
20. Hypanthium about 1 mm. long, lined with a lobed, orange disk; stigma capitate; capsules linear, often strongly refracted; seeds with purple dots: Subgenus *Eulobus*----- 20. O. LEPTOCARPA.
20. Hypanthium usually longer, not lined with a disk; seeds not purple dotted (21).
21. Stigma discoid, somewhat shallowly 4-lobed; flowers yellow (22).
22. Tube of the hypanthium 5 to 15 mm. long; stamens of 2 lengths; sepals distinctly keeled especially toward the tip: Subgenus *Calylophis*.
24. O. SERRULATA.
22. Tube of the hypanthium 25 to 50 mm. long; stamens subequal; sepals not keeled: Subgenus *Salpingia* (23).
23. Plants densely strigose, with a peculiar olive-gray-green color, low and densely tufted, 5 to 20 cm. high; leaves typically 5 to 15 mm. long; petals 13 to 22 mm. long; sepals 7 to 8 mm. long, with free tips 1 to 2 mm. long----- 21. O. LAVANDULAEFOLIA.
23. Plants greenish or, if grayish, then with longer leaves, not so densely tufted, often quite woody, 10 to 40 cm. high (24).
24. Stems subglabrous to minutely glandular-pubescent; leaf margins not crisped or wavy----- 22. O. HARTWEGII.
24. Stems conspicuously pubescent or even pilose; leaf margins tending to be crisped or wavy----- 23. O. GREGGII.
21. Stigma capitate; flowers yellow or white (25).
25. Capsule cylindric or tapering toward the tip, sessile or nearly so: Subgenus *Sphaerostigma* (26).
26. Flowers yellow, often drying greenish, borne in the axils of the foliage leaves (27).
27. Cauline leaves linear to lance-linear, 1 to 3 mm. wide; petals 2 to 3 mm. long; capsules not 4-angled----- 29. O. CONTORTA.
27. Cauline leaves broadly lanceolate, 5 to 10 mm. wide; petals 3 to 7 mm. long; mature capsules 4-angled----- 30. O. MICRANTHA.
26. Flowers white, often drying pinkish, borne in terminal spikes (28).
28. Capsules terete, cylindric, linear, not thickened in the lower portion, scarcely if at all coiled, not noticeably attenuate at tip (29).
29. Petals 5 to 7 mm. long, suborbicular; style exceeding the corolla; hypanthium 4 to 6 mm. long; capsules refracted or spreading, occasionally coiled----- 25. O. REFRACTA.
29. Petals 3 mm. long, spatulate; style shorter than the corolla; hypanthium 2.5 to 3 mm. long; capsules divaricately spreading----- 26. O. CHAMAENERIOIDES.
28. Capsules not strictly cylindric, somewhat enlarged at base and attenuate at tip, curved or bent (30).
30. Leaves chiefly basal, subglabrous, lance-ovate to oblanceolate; stems glabrous or nearly so, the epidermis exfoliating promptly; capsule 15 to 25 mm. long-- 27. O. DECORTICANS.
30. Leaves well distributed, glandular-pubescent to glandular-villous, ovate to oblong-ovate; stems glandular-pubescent to glandular-villous, the epidermis exfoliating tardily, if at all; capsule 10 to 15 mm. long----- 28. O. BOOTHII.

25. Capsule cylindric or clavate, distinctly pediceled: Subgenus *Chylismia* (31).
31. Leaves orbicular-cordate, well distributed along the stem, not at all pinnatifid, commonly glandular-pubescent; plants rather coarse; flowers yellow, becoming bright red in age; anthers glabrous; capsules on rather short pedicels, coarse-cylindric.
31. O. CARDIOPHYLLA.
31. Leaves ovate, oblong, or lanceolate, mostly near the base of the plant, commonly pinnatifid (32).
32. Capsules linear, elongate, usually more than 2 cm. long (33).
33. Stems slender, commonly freely branched above; pedicels capillary, 10 to 25 mm. long; capsules linear, 1.5 to 3.5 cm. long; anthers glabrous in some forms; petals 1.5 to 9 mm. long----- 34. O. MULTIJUGA.
33. Stems coarse, commonly branched only near the base; pedicels short, usually 3 to 15 mm. long; capsules linear, widely spreading, 2 to 9 cm. long; anthers hairy (34).
34. Petals bright yellow, 12 to 15 mm. long; stem usually with conspicuous spreading hairs, especially near the base; sepals pilose; capsules 5 to 9 cm. long, 2 to 3 mm. thick; hypanthium with a swelling within on each rib at the upper edge of the pubescent portion--- 32. O. BREVIPES.
34. Petals pale yellow, 8 to 12 mm. long; stem ashy-strigose, often without conspicuous spreading hairs; sepals strigulose to subglabrous; capsules 2 to 5 cm. long, 1 to 2 mm. thick; hypanthium without inner swellings---33. O. PALLIDULA.
32. Capsules somewhat clavate, usually less than 2 cm. long (35).
35. Branches in well-developed plants capillary and arising freely throughout the plant; capsules 3 to 9 mm. long; anthers oblong to linear-oblong, glabrous; style not exceeding the petals; petals 3 to 7 mm. long----- 37. O. PARRYI.
35. Branches in well-developed plants few to several and arising at base of the plant only, not capillary; capsules 10 to 25 mm. long; anthers linear, with scattering white hairs; style exceeding the petals (36).
36. Stems slender; flowers few, not crowded; leaves ovate, subentire; petals usually less than 4 mm. long.
35. O. SCAPOIDEA.
36. Stems somewhat coarse; flowers crowded in close terminal clusters; leaves usually pinnatifid; petals 4 to 7 mm. long----- 36. O. CLAVAEFORMIS.

1. *Oenothera hookeri* Torr. and Gray, Fl. North Amer. 1: 493. 1840.

Onagra hookeri Small, Torrey Bot. Club Bul. 23: 171. 1896.

Two forms occur in Arizona, both growing in damp places. The first, var. *irrigua* (Woot. and Standl.) Gates (*O. irrigua* Woot. and Standl.), characterized by stems 1 to 2 m. tall, the pubescence mostly closely appressed and ashy, the sepals not papillate at base of the hairs, and the sepal tips 4 to 5 mm. long, has been collected in Navajo and Coconino Counties, about 5,000 feet. It ranges from eastern Utah and southwestern Colorado to New Mexico, Arizona, and Chihuahua. The second form, var. *hirsutissima* (A. Gray) Munz (*O. biennis* var. *hirsutissima* A. Gray, *O. hirsutissima* Rydb.) characterized by stems usually less than 1 m. high, with long divergent hairs throughout, the sepals papillose at base of the long hairs, and the sepal tips 2 to 3.5 mm. long, is found from Navajo and Coconino Counties south to Cochise and Pima Counties, 5,000 to 9,500 feet, July to October. It occurs also in New Mexico and Chihuahua. These varieties intergrade with each other and with other forms of *O. hookeri*.

2. *Oenothera longissima* Rydb., Torrey Bot. Club Bul. 40: 65. 1913.*Oenothera clutei* A. Nels., Amer. Bot. 28: 22. 1922.

Coconino and Mohave Counties, 4,000 to 7,000 feet, damp and springy places, July to September. Southern Utah and northern Arizona to eastern California.

Distinguished from *O. hookeri*, its nearest relative, by its remarkably long hypanthium.

3. *Oenothera procera* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 156. 1913.

Oak Creek, Coconino County (*Fulton* 7329), Ryan Ranch, southern Apache County (*Harrison* 4843). Southern Colorado, New Mexico, and Arizona.

Doubtfully distinct from *O. strigosa* Rydb. in its smaller flowers and less shaggy pubescence.

4. *Oenothera laciniata* Hill, Veg. Syst. 12: 64. 1767.

Almost throughout the State except the extreme western part, 1,270 to 9,500 feet, disturbed and fairly damp places, commonly in pine forest, May to October.

Represented in Arizona by var. *pubescens* (Willd.) Munz (*O. pubescens* Willd.), which ranges from Texas to Arizona, south to Ecuador. The flowers open in the evening.

5. *Oenothera coronopifolia* Torr. and Gray, Fl. North Amer. 1: 495. 1840.*Anogra coronopifolia* Britton, Torrey Bot. Club Mem. 5: 234. 1894.

Coconino County (several collections), Peach Springs, Mohave County (*Lemmon* in 1884), Benson, Cochise County (*Lemmon* 43), 6,000 to 8,000 feet, usually in dry sod on plains, June to August. South Dakota to Kansas, Utah, and Arizona.

6. *Oenothera albicaulis* Pursh, Fl. Amer. Sept. 733. 1814.*Anogra albicaulis* Britton, Torrey Bot. Club Mem. 5: 234. 1894.

Widely distributed in Arizona, 2,400 to 7,500 feet, rather dry grassy and disturbed places, March to July. South Dakota and Montana to Chihuahua and Arizona.

7. *Oenothera deltoides* Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 314. 1845.*Oenothera trichocalyx* of authors. Not Nutt.*Key to the varieties*

1. Hairs of the sepals, hypanthium, and upper stems spreading, not closely appressed (2).
2. Petals 2 to 4 cm. long; uppermost leaves usually less deeply divided, rarely pinnatifid; buds with straight hairs 1 to 1.5 mm. long; capsules 2.5 to 7 cm. long, 2 to 3 mm. thick at base..... *O. DELTOIDES* (typical).
2. Petals usually less than 2 cm. long; uppermost leaves deeply sinuate-dentate or pinnatifid, the portion along the midrib only 3 to 4 mm. wide; buds with curly hairs 2 or more mm. long; capsules 1.5 to 3 cm. long, 3 to 5 mm. thick at base..... var. *PIPERI*.
1. Hairs of the sepals, hypanthium, etc., closely appressed, or both appressed and spreading (3).



Evening primrose (*Oenothera deltoides*). Flowers white, photographed in the early morning. A few sandverbenas (*Abronia villosa*) show at the left side of the picture.

3. Sepals with both appressed and scattered spreading hairs, and with a purple spot at the base of each spreading hair; cauline leaves usually deeply and regularly pectinate-pinnatifid; capsules very slender, 1.5 to 2.5 mm. thick at base. ----- var. ARIZONICA.
3. Sepals with appressed hairs only, without purple spots on the buds; leaves subtire to shallowly and coarsely dentate; capsules usually 2.5 to 5 mm. thick at base (4).
4. Sepals with free tips 1 to 2 mm. long; buds usually 4-angled toward the tip ----- var. DECUMBENS.
4. Sepals without free tips; buds not at all 4-angled toward the tip. ----- var. CINERACEA.

(1) The typical form occurs in Mohave and Yuma Counties, below 1,000 feet, sandy open places, February and March, ranging into the deserts of California and Baja California. (2) The var. *piperi* Munz has been collected at Fredonia, Coconino County (*Jones*, in 1929), and ranges from eastern Oregon to eastern California, Nevada, and Arizona. (3) The var. *arizonica* Munz occurs in Pinal, Maricopa, and Pima Counties, 500 to 2,500 feet, February to May, and is known only from Arizona. A collection on Hualpai Mountain, Mohave County, 5,150 feet (*Kearney* and *Peebles* 12668), is also to be referred here. A variant of var. *arizonica* is forma *floccosa* Munz, with the long hairs on the sepals so closely set as to make the buds appear like tufts of wool, known from Phoenix, Tempe, etc., Maricopa County. (4) The var. *decumbens* (S. Wats.) Munz occurs in northern Mohave County, 2,000 feet or lower, March and April, ranging into Utah and Nevada. (5) The var. *cineracea* (Jepson) Munz is found in Yuma County, below 1,000 feet, March and April, ranging into southeastern California and northwestern Sonora.

O. deltoides is probably the species that is reported to be used as a potherb by the Papago Indians (pl. 27).

8. *Oenothera neomexicana* (Small) Munz, Amer. Jour. Bot. 18: 317. 1931.

Anogra neomexicana Small, Torrey Bot. Club Bul. 23: 176. 1896.

Oak Creek Canyon (Coconino County), 5,100 feet, Greenlee and Graham Counties, 8,000 to 9,500 feet, dry open places, July and August. New Mexico and Arizona.

9. *Oenothera pallida* Lindl., Bot. Reg. 14: pl. 1142. 1828.

Anogra pallida Britton, Torrey Bot. Club Mem. 5: 234. 1894, in part.

Apache, Navajo, and Coconino Counties, 3,300 to 7,500 feet, dry open places, June to August. Eastern Washington to New Mexico and Arizona.

In Arizona many plants intergrade with the next species, but to the north it is much more distinct in its more glabrous and less deeply divided leaves.

10. *Oenothera runcinata* (Engelm.) Munz, Amer. Jour. Bot. 18: 323. 1931.

Oenothera albicaulis var. *runcinata* Engelm., Amer. Jour. Sci. ser. 2, 34: 334. 1862.

Anogra runcinata Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 151. 1913.

The typical form, with leaves deeply sinuate-dentate and with much fine, closely appressed pubescence, occurs in Apache, Navajo, Coco-

nino, Yavapai, and Pinal Counties, 4,500 to 7,000 feet, dry plains and hills, May and June, ranging to Texas and Chihuahua. The var. *brevifolia* (Engelm.) Munz, which is quite glabrous and has pinnatifid leaves, has been collected in the Lukachukai Mountains, Apache County (*Goodman and Payson* 2900a), and at Clifton, Greenlee County (*Davidson* 240), ranging into New Mexico, Texas, and Chihuahua. The var. *leucotricha* (Woot. and Standl.) Munz, characterized by being both hirsute and strigulose, apparently is represented by a single collection in this State, on Hualpai Mountain, Mohave County, 4,500 feet (*Kearney and Peebles* 12650), being otherwise known only from central New Mexico.

11. *Oenothera trichocalyx* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 494. 1840.

Known in Arizona only from Beaver Dam Creek, Mohave County (*Maguire* 4886). Wyoming, Colorado, Utah, and northwestern Arizona.

This species, characterized by conspicuously hairy buds and deeply sinuate leaves, is very much like *O. runcinata* var. *leucotricha* in its capsules and pubescence but has a taproot instead of creeping rootstocks.

12. *Oenothera caespitosa* Nutt. ex Fraser, Cat. n. 53. 1813; Sims, Bot. Mag. 39: pl. 1593. 1813.

Pachylophus caespitosa Raimann in Engl. and Prantl, Pflanzenfam. 3⁷: 215. 1893.

The typical glabrous form of the species is not known in Arizona, but 3 varieties are found there: (1) The var. *marginata* (Nutt.) Munz, characterized by being villous-hirsute throughout, usually caulescent, the leaves sinuate-pinnatifid, the capsules pediceled, linear-cylindric, with low tubercles, scarcely ridged, 3 to 4 cm. long, is well distributed throughout the State, 3,000 to 7,500 feet, dry stony slopes, April to August, ranging from Colorado and Arizona to Washington and California. (2) The var. *montana* (Nutt.) Durand, which is acaulescent, nearly glabrous except for the canescent pubescence on the margins and veins of the leaves, the capsules sessile, not tubercled, about 2 cm. long, with sinuate ridges and occasional cross veins, occurs in Apache, Navajo, and Coconino Counties, 4,500 to 6,500 feet, May and June, ranging from Montana and Oregon to New Mexico and Arizona. (3) The var. *australis* (Woot. and Standl.) Munz, characterized by being quite acaulescent, finely cinereous throughout, and with the hypanthium 10 to 18 cm. long, is known from several localities in Cochise County, and is found also in New Mexico.

13. *Oenothera primiveris* A. Gray, Pl. Wright. 2: 58. 1853.

Mohave, Greenlee, Pinal, Maricopa, Cochise, Pima, and Yuma Counties, below 4,500 feet, dry open deserts, March to May. Texas to Nevada and California.

Plant caespitose, with yellow flowers and leaves peculiarly pinnatifid into lanceolate or ovate lobes with rounded teeth or lobes.

14. *Oenothera speciosa* Nutt., Acad. Nat. Sci. Phila. Jour. 2: 119. 1821.

Hartmannia speciosa Small, Torrey Bot. Club Bul. 23: 181. 1896.

Reported from Fort Verde, Yavapai County, by Britton (Trans. N. Y. Acad. Sci. 8: 67. 1889), as having been collected by *Mearns*

(no. 330), and at one time introduced on the campus of the University of Arizona at Tucson (*Thornber* in 1904). Missouri and Kansas to Louisiana, Texas, and northern Mexico.

The large white to rose-colored flowers are very handsome.

15. *Oenothera rosea* Ait., Hort. Kew. 2: 3. 1789.

Hartmannia rosea G. Don in Sweet, Hort. Brit. ed. 3, 236. 1839.

Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 5,500 feet, occasional in river bottoms and canyons, May to July. Texas and southern Arizona to Bolivia.

16. *Oenothera kunthiana* (Spach) Munz, Amer. Jour. Bot. 19: 759. 1932.

Hartmannia kunthiana Spach, Paris Mus. Hist. Nat. Nouv. Ann. 4: 363. 1835.

Fort Huachuca, Cochise County (*Wilcox* in 1892). Western Texas to southeastern Arizona and central Mexico.

17. *Oenothera flava* (A. Nels.) Munz, Amer. Jour. Bot. 17: 361. 1930.

Lavauria flava A. Nels., Torrey Bot. Club Bul. 31: 243. 1904.
Lavauria hamata Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 154. 1913.

Navajo, Coconino, Mohave, Yavapai, and Gila Counties, 5,000 to 9,000 feet, fairly damp flats and meadows, May to September. Canada to New Mexico, California, Arizona, and Mexico.

18. *Oenothera taraxacoides* (Woot. and Standl.) Munz, Amer. Jour. Bot. 17: 362. 1930.

Lavauria taraxacoides Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 155. 1913.

Apache, Navajo, Coconino, and Graham Counties, particularly in the White Mountains, 5,000 to 8,000 feet, sandy soil in pine forests, May to August. Western Texas to Arizona and Chihuahua.

19. *Oenothera brachycarpa* A. Gray, Pl. Wright. 1: 70. 1852.

Lavauria brachycarpa Britton, Torrey Bot. Club Mem. 5: 235. 1894.

Navajo, Coconino, Cochise, and Pima Counties, 4,000 to 6,000 feet, rare on dry slopes and benches, May to July. Idaho to Texas, Arizona, and Chihuahua.

Represented in Arizona by var. *wrightii* (A. Gray) Léveillé (*Oenothera wrightii* A. Gray, *Lavauria wrightii* Small).

20. *Oenothera leptocarpa* Greene, Pittonia 1: 302. 1889.

Eulobus californicus Nutt. ex Torr. and Gray, Fl. North Amer. 1: 515. 1840.

Yavapai, Mohave, Pinal, Maricopa, Pima, and Yuma Counties, below 4,500 feet, dry slopes and plains, February to May. Western Arizona and southern California to Sonora and Baja California.

The cruciferlike aspect of this plant is striking.

21. *Oenothera lavandulaefolia* Torr. and Gray, Fl. North Amer. 1: 501. 1840.

Galpinsia lavandulaefolia Small, Fl. Southeast. U. S. 845, 1335. 1903 (in part).

Ten miles southeast of Tuba, Coconino County, 5,600 feet (*Pebbles* and *Smith* 13363), apparently the only collection in Arizona of the typical form, which ranges from Wyoming to Texas and Arizona.

Hypanthium and calyx strigose-canescens in the typical form. The var. *glandulosa* Munz, with hypanthium and calyx glandular, occurs in Navajo, Coconino, and Mohave Counties, 5,000 to 7,500 feet, dry slopes and flats, May and June, ranging to Nevada, Colorado, and Texas.

22. *Oenothera hartwegii* Benth., Pl. Hartw. 5. 1839.

Galpinsia hartwegii Britton, Torrey Bot. Club Mem. 5: 236. 1894.

The typical form, with leaves 1 to 3 mm. wide, the herbage generally minutely glandular-pubescent throughout, sometimes subglabrous, the hypanthium 5 to 8 mm. wide at top, and the petals 10 to 20 mm. long, occurs in Apache, Navajo, Coconino, Cochise, and Santa Cruz Counties, 4,500 to 7,500 feet, occasional on dry mesas, May to September, ranging from Texas to Arizona and Zacatecas. The var. *fendleri* A. Gray, with leaves 3 to 6 mm. wide, the herbage subglabrous throughout, the hypanthium 10 to 15 mm. wide at top in pressed specimens, and the petals 20 to 25 mm. long, occurs rarely in Navajo and Coconino Counties, ranging from Oklahoma and Texas to Arizona. The var. *toumeyii* (Small) Munz (*Galpinsia toumeyii* Small), with fascicles of small leaves in the main axils, the free tips of the sepals 3 to 10 mm. long, and the petals less rhombic and more rounded than in the other varieties, but intergrading freely with them, is found in the Chiricahua, Huachuca, and Santa Rita Mountains (Cochise and Pima Counties), 5,000 to 9,000 feet, rocky places, June to September, occurring also in New Mexico, Sonora, and Chihuahua.

23. *Oenothera greggii* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 46. 1849.

Galpinsia greggii Small, Torrey Bot. Club Bul. 23: 186. 1896.

This species is represented in Arizona by var. *lampasana* (Buckl.) Munz (*Oenothera lampasana* Buckl., *Galpinsia lampasana* Woot. and Standl.), which occurs from the White Mountains (Apache County) to the mountains of Pinal, Cochise, Santa Cruz, and Pima Counties, 3,800 to 7,000 feet, occasional on limestone hills, April to June, ranging from Oklahoma and Texas to southeastern Arizona.

The characteristic form has spreading hairs, the leaves crinkled-wavy, 5 to 9 mm. wide, the hypanthium 25 to 40 mm. long, and the petals 15 to 30 mm. long. Some Arizona collections with narrower leaves and hairs closely appressed (none spreading) approach var. *pringlei* Munz of northern Mexico.

24. *Oenothera serrulata* Nutt., Gen. Pl. 1: 246. 1818.

Meriolix serrulata Raf., Amer. Month. Mag. 192. 1819.

Apache County at Willow Spring (*Palmer* 481), Navajo County at Forestdale (*Hough* 83) and Fort Apache (*Mrs. Hoyt, Thornber*).

Assiniboia to Texas and eastern Arizona, ranging widely over the plains east of the Rocky Mountains.

25. **Oenothera refracta** S. Wats., Amer. Acad. Arts and Sci. Proc. 17: 373. 1882.

Sphaerostigma refractum Small, Torrey Bot. Club Bul. 23: 192. 1896.

Mohave and Yuma Counties, below 4,000 feet, frequent on open deserts, March to May, type from gravelly hills on the Colorado (*Bigelow*). Southern Utah and western Arizona to California.

26. **Oenothera chamaenerioides** A. Gray, Pl. Wright. 2: 58. 1853.

Sphaerostigma chamaenerioides Small, Torrey Bot. Club Bul. 23: 189. 1896.

Yavapai and Mohave Counties to Greenlee, Santa Cruz, Pima, and Yuma Counties, below 5,500 feet, open deserts, February to May. Texas to Utah, Arizona, and California.

27. **Oenothera decorticans** (Hook. and Arn.) Greene, Fl. Francisc. 217. 1891.

Sphaerostigma decorticans Small, Torrey Bot. Club Bul. 23: 191. 1896.

Mohave, Maricopa, Pima, and Yuma Counties, below 2,500 feet, open deserts, March to May. Utah and Nevada to western Arizona and southeastern California.

The form occurring in Arizona is var. *condensata* Munz.

28. **Oenothera boothii** Dougl. ex Hook., Fl. Bor. Amer. 1: 213. 1834.

Sphaerostigma boothii Walp., Repert. Bot. 2: 77. 1843.

On and near the San Francisco Peaks, Coconino County (*Knowlton* 200, *Leiberg* 5808). Eastern Washington to northern Arizona and California.

29. **Oenothera contorta** Dougl. ex Lehm. in Hook., Fl. Bor. Amer. 1: 214. 1834.

Sphaerostigma contortum Walp., Repert. Bot. 2: 78. 1843.

Fort Huachuca, Cochise County (*Wilcox* in 1892-3).

Represented in Arizona by var. *epilobioides* (Greene) Munz, characterized by almost linear leaves, small yellow flowers, and narrow cylindric capsules. This variety occurs in southern Arizona, California, and Baja California.

30. **Oenothera micrantha** Hornem. ex Spreng., Syst. Veg. 2: 228. 1825.

Sphaerostigma micranthum Walp., Repert. Bot. 2: 77. 1843.

Grand Canyon (Coconino County) and in Yavapai, Mohave, Gila, Pinal, and Maricopa Counties, below 4,500 feet, deserts, March to May.

The form that occurs in Arizona is var. *exfoliata* (A. Nels.) Munz (*Sphaerostigma pallidum* Abrams), which occurs in Arizona and southeastern California.

31. *Oenothera cardiophylla* Torr., U. S. Rpt. Expl. Miss. Pacif. 5: 360. 1856.

Chylismia cardiophylla Small, Torrey Bot. Club Bul. 23: 193. 1896.

The typical form, with hypanthium 5 to 10 mm. long, petals 3 to 8 mm. long, and style 12 to 16 mm. long, occurs in Pinal and Yuma Counties, at low altitudes, desert washes and rocky slopes, February to April, ranging also into the deserts of California and Baja California. The var. *splendens* Munz and Johnston (var. *longituba* Jepson, *Chylismia arenaria* A. Nels.), with hypanthium 20 to 35 mm. long, petals 13 to 25 mm. long, and style 30 to 60 mm. long, is more common than the species in Yuma County, especially in the Gila and Tinajas Altas Mountains, and is found also in adjacent California.

32. *Oenothera brevipes* A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 87. 1857.

Chylismia brevipes Small, Torrey Bot. Club Bul. 23: 194. 1896.

Mohave and Yuma Counties, below 4,500 feet, dry washes and desert plains, March to May. Nevada, western Arizona, and southeastern California.

33. *Oenothera pallidula* Munz, Leaflets West. Bot. 2: 88. 1938.

Oenothera brevipes var. *pallidula* Munz, Amer. Jour. Bot. 15: 229. 1928.

Beaver Dam and Fort Mohave (Mohave County), Sentinel (Maricopa County), Mohawk and Dome (Yuma County) at low altitudes, open deserts, washes, etc., March to May. Utah and Nevada to western Arizona and southeastern California.

Plants from Arizona have hairier stems than those from farther north and west.

34. *Oenothera multijuga* S. Wats., Amer. Nat. 7: 300. 1873.

Chylismia multijuga Small, Torrey Bot. Club Bul. 23: 193. 1896.

The typical form, with petals 7 to 9 mm. long and anthers 2 to 3 mm. long, is found in western Coconino County and in Mohave County, mostly below 2,500 feet, washes and canyons, April to June, ranging into Nevada and southern Utah. The var. *parviflora* (S. Wats.) Munz, with petals 3 to 5 mm. long and shorter, more glabrous anthers, occurs in the lower Grand Canyon, and near Mead Lake (Mohave County), ranging to Death Valley, Calif., and St. George, Utah. The var. *orientalis* Munz, with leaves less basal and less divided and petals 1.5 to 2 mm. long, occurs rarely in Coconino and Mohave Counties, at Cameron, Lees Ferry, and the Grand Canyon, about 4,000 feet, and ranges from western Colorado and eastern Utah to northern Arizona.

35. *Oenothera scapoidea* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 506. 1840.

Chylismia scapoidea Small, Torrey Bot. Club Bul. 23: 193. 1896.

Northeast of Rock Point, Apache County, 5,700 feet (*Peebles* and *Smith* 13529), Capitan, Navajo County, 5,650 feet (*Peebles* and

Fulton 11915), below Black Falls, Little Colorado River, Coconino County (*L. F. Ward* in 1901).

The Arizona form is var. *seorsa* (A. Nels.) Munz, which ranges from Wyoming to Oregon and northern Arizona.

36. *Oenothera claviformis* Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 314. 1845.

Chylismia claviformis Heller, *Muhlenbergia* 2: 105. 1906.

The var. *aurantiaca* (S. Wats.) Munz, with white flowers and strigulose hypanthium and sepals, is found in Mohave, Graham, Gila, Pinal, Maricopa, and Yuma Counties, below 3,000 feet, washes and sandy places, March to April and occasionally in autumn, ranging from southwestern Utah to Arizona and California. The var. *peeblesii* Munz, with white flowers and glandular-puberulent hypanthium, sepals, and ovaries, occurs in Yavapai, Pinal, Maricopa, Cochise, Pima, and Yuma Counties, below 3,500 feet, washes and dry sandy places, March to May, known only from south-central Arizona. The var. *peirsonii* Munz, with spreading-villous stems and yellow flowers, has been collected between Growler Pass and Tule Well, Pima or Yuma County (*Kearney* and *Peebles* 10859), and occurs also in the Colorado Desert of California and in northern Baja California.

37. *Oenothera parryi* S. Wats., *Amer. Nat.* 9: 19, 270. 1875.

Chylismia parryi Small, *Torrey Bot. Club Bul.* 23: 193. 1896.

Extreme northern Coconino and Mohave Counties, at Fredonia (*Jones* in 1929) and north of Wolf Hole (*Peebles* and *Parker* 14760), 3,500 to 4,500 feet, May and June. Southwestern Utah and northwestern Arizona.

Petals bright yellow.

8. GAYOPHYTUM⁹⁵

Annuals with slender stems and filiform branches; leaves alternate, entire; flowers very small; petals white or pink; stamens 8, the alternate ones much reduced and usually sterile.

Key to the species

1. Capsules not torulose, subsessile; plants branched only at base or sparingly above; upper leaves well developed..... 3. *G. RACEMOSUM*.
1. Capsules torulose, pedicelled; plants freely branched above the base, repeatedly dichotomous; upper leaves bractlike (2).
 2. Petals 0.5 mm. long; capsules 2 to 5 mm. long, shorter than the usually deflexed pedicels; plants quite glabrous..... 1. *G. RAMOSISSIMUM*.
 2. Petals 1 to 1.5 mm. long; capsules 5 to 12 mm. long, exceeding the erect or ascending pedicels..... 2. *G. NUTTALLII*.

1. *Gayophytum ramosissimum* Torr. and Gray, *Fl. North Amer.* 1: 513. 1840.

Coconino County, 6,500 to 9,000 feet, open places in pine forests, June to August. Colorado to Washington and northern Arizona.

2. *Gayophytum nuttallii* Torr. and Gray, *Fl. North Amer.* 1: 514. 1840.

Lukachukai Mountains (Apache County) Coconino County, Prescott (Yavapai County) 6,000 to 9,500 feet, open places in pine woods,

⁹⁵ Reference: MUNZ, P. A. STUDIES IN ONAGRACEAE—VIII. THE GENUS GAYOPHYTUM. *Amer. Jour. Bot.* 19: 768-778. 1932.

July and August. South Dakota to Washington, New Mexico, Arizona, and southern California.

3. **Gayophytum racemosum** Torr. and Gray, Fl. North Amer. 1: 514. 1840.

Coconino County, 6,500 to 8,500 feet, open places in pine forests, June to August. Colorado to Washington, northern Arizona, and southern California.

9. GAURA⁹⁶

Annual or perennial herbs, with red to white, rather irregular, 4-merous flowers; stamens declined, all fertile, 8 in number; stigma deeply lobed, with a cuplike indusium at base; fruit woody, small, indehiscent, 1- to 4-seeded.

Key to the species

1. Flowers small, the petals 1.5 to 2 mm. long, the sepals 1.5 to 3 mm. long; anthers oval, 1 mm. long; tall weedy biennial or winter annual, the stem mostly simple below and branched above..... 1. *G. PARVIFLORA*.
1. Flowers larger, the petals 4 to 6 mm. long, the sepals 4 to 8 mm. long; anthers linear-oblong, 2 to 5 mm. long; low perennials, the stem much branched from the base (2).
 2. Body of the fruit ovoid-pyramidal, widest near the narrow base and winged almost throughout, transversely wrinkled on each face; plants 40 to 90 cm. high; basal leaves sinuate-dentate, 4 to 10 cm. long.
 2. *G. GRACILIS*.
 2. Body of the fruit widest at or above the middle, winged only beyond this point, the basal portion terete and thick, not with transverse wrinkles; plants mostly 10 to 40 cm. high; basal leaves subentire, 1.5 to 3.5 cm. long..... 3. *G. COCCINEA*.

1. **Gaura parviflora** Dougl. ex Hook., Fl. Bor. Amer. 1: 208. 1834.

Navajo, Coconino, Yavapai, Greenlee, Cochise, and Pima Counties, 2,000 to 6,000 feet, waste and disturbed places, June to October. Mississippi Valley to Washington and northern Mexico; Argentina.

The typical form has the ovary and capsule glabrous, and the hypanthium minutely puberulent. The f. *glabra* Munz, with the hypanthium also glabrous, has been collected in Arizona at Kirkland, Yavapai County (*Pebbles* et al. 4244), and in Ramsey Canyon, Huachuca Mountains (*Jones* 24941). The var. *lachnocarpa* Weatherby, with the hypanthium, ovaries, and capsules short-pubescent, occurs in Yavapai, Mohave, Gila, Pinal, Maricopa, Pima, and Yuma Counties, mostly below 3,000 feet, March to June.

2. **Gaura gracilis** Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 153. 1913.

Gaura podocarpa Woot. and Standl., *ibid.*

Gaura strigillosa Woot. and Standl., *ibid.* 154.

Gaura brassicea Woot. and Standl., *ibid.* 152.

Nearly throughout the State except the most western counties, especially abundant about Flagstaff and in the mountains of Cochise County, 2,500 to 7,500 feet, canyons, along roadsides, etc., May to October. Western Texas to Arizona and northern Mexico.

The typical form has the hypanthium and calyx strigulose to glabrous. Another form, with the hypanthium and calyx bearing short gland-tipped hairs, f. *glandulosa* (Woot. and Standl.) Munz, has much

⁹⁶ Reference: MUNZ, P. A. STUDIES IN ONAGRACEAE—XI. A REVISION OF THE GENUS GAURA. Torrey Bot. Club Bul. 65: 105-122, 211-228. 1938.

the same range in the State but perhaps grows at somewhat higher altitudes.

3. *Gaura coccinea* Nutt. ex Pursh, Fl. Amer. Sept. 733. 1814.

Key to the varieties

1. Capsules about 10 mm. long, 1.5 to 2 mm. wide; anthers 4 to 5 mm. long. var. ARIZONICA.
1. Capsules 5 to 7 mm. long, 2.5 to 3 mm. wide; anthers 2 to 3 mm. long (2).
2. Stem and leaves glabrous----- var. GLABRA.
2. Stem and leaves more or less pubescent (3).
3. Leaves linear, subentire----- var. PARVIFOLIA.
3. Leaves (at least the lower ones) lanceolate and sinuate-dentate (4).
4. Main leaves mostly plane, oblong, crowded; flowers crowded; inflorescence not peduncled; plant 10 to 30 cm. high. G. COCCINEA (typical).
4. Main leaves mostly waved and crisped, acutish, not crowded; flowers not crowded; inflorescence with a short peduncle; plant 30 to 40 cm. high----- var. EPILOBIOIDES.

Typical *G. coccinea* has been found in most parts of Arizona except the southwestern desert portion, 3,000 to 8,000 feet, rather dry flats and plains, May to September. Southern Canada to Texas, Arizona, and eastern California. The var. *epilobioides* (H. B. K.) Munz has much the same distribution in the State and ranges from Texas to Arizona and Mexico. The var. *parvifolia* (Torr.) Torr. and Gray is known from Apache, Yavapai, Cochise, and Santa Cruz Counties, and ranges from Kansas and Colorado to northern Mexico. The var. *glabra* (Lehm.) Torr. and Gray has the same general range within and outside the State as has the typical form. The var. *arizonica* Munz occurs in Yavapai, Gila, and Pima Counties, 1,800 to 6,000 feet, and ranges into New Mexico and Coahuila.

10. CIRCAEA. ENCHANTERS-NIGHTSHADE

Plants low, delicate, herbaceous, perennial, with short slender rootstocks and small tubers; leaves thin, opposite, petioled; flowers small, racemose; sepals and petals 2; fruit 1-celled, 1-seeded, indehiscent, pear-shaped, bristly with hooked hairs.

1. *Circaea pacifica* Asch. and Mag., Bot. Ztg. 29: 392. 1871.

Greer, Apache County, 8,800 feet (*Eggleston* 17151), Oak Creek, Coconino County (*Fulton* 9673), Pinaleno Mountains, Graham County (*Peebles* et al. 4482), rich soil in shady ravines, June to July. Rocky Mountains to British Columbia, Arizona, and southern California.

Very doubtfully distinct from *C. alpina* L.

89. HALORAGIDACEAE. WATERMILFOIL FAMILY

Plants herbaceous, perennial, aquatic, the stems wholly or partly immersed; leaves commonly in whorls; flowers minute, perfect or unisexual; petals when present usually 4; stamens 1 to 8; ovary inferior, 1- to 4-celled; fruit indehiscent.

Key to the genera

1. Leaves (at least the submersed ones) pinnatifid to capillary-dissected; flowers mostly unisexual; stamens more than 1; ovary 2- to 4-celled.
 1. MYRIOPHYLLUM.
 2. HIPPURIS.
1. Leaves all entire; flowers mostly perfect; stamen 1; ovary 1-celled.

1. MYRIOPHYLLUM. WATERMILFOIL

Submersed leaves (often all of the leaves) pinnately dissected into capillary divisions; flowers axillary or in interrupted terminal spikes, often emersed; petals present or absent; stamens 4 or more; fruit 4-celled, deeply 4-lobed.

Key to the species

1. Leaves all alike, in whorls of 4 to 6, pinnatifid, the segments linear-filiform, not more than 5 mm. long; flowers axillary----- 1. *M. BRASILIENSE*.
 1. Leaves dimorphic, the submersed ones in whorls of 3 or 4, pinnate, the segments capillary, commonly at least 10 mm. long, the emersed (floral) leaves bract-like, entire or merely dentate, not or but slightly surpassing the flowers; flowers in interrupted terminal spikes----- 2. *M. EXALBESCENS*.

1. **Myriophyllum brasiliense** Cambess. in A. St. Hil., Fl. Bras. Merid. 2: 252. 1829.

Myriophyllum proserpinacoides Gill. ex Hook. and Arn. in Hook., Bot. Misc. 3: 313. 1833.

In a pond near Sacaton, Pinal County (*Peebles* 10607), apparently well established, perhaps introduced by migrating wild fowl. Native of South America. Parrotfeather. Commonly grown in aquaria and ponds.

2. **Myriophyllum exalbescens** Fernald, Rhodora 21: 120. 1919.

Myriophyllum spicatum L. var. *exalbescens* Jepson, Man. Fl. Pl. Calif. 691. 1925.

Apache, Navajo, and Coconino Counties, 6,200 to 9,000 feet, ponds and lakes, June. Canada to Florida, northern Arizona, and California.

2. HIPPURIS. MARESTAIL

Stems usually partly emersed, erect, not branched; leaves all simple, entire, in whorls of 6 or more; calyx not lobed, almost completely adnate to the ovary; petals none; style filiform, in a groove formed by the lobes of the single anther.

1. **Hippuris vulgaris** L., Sp. Pl. 4. 1753.

Marsh Lake, White Mountains, Apache County, 9,000 feet (*Goldman* 2450). Widely distributed in the cooler parts of the Northern Hemisphere.

90. ARALIACEAE. GINSENG FAMILY

1. ARALIA

Plants perennial, herbaceous or shrubby; leaves large, compound, with large leaflets; flower small, regular, perfect or unisexual, in umbels, these forming terminal panicles; calyx adnate to the ovary; petals and stamens 5 each, borne on the calyx; fruit berrylike, several-seeded.

The underground parts are more or less spicy-aromatic. The roots of a North American species and an Asiatic species of a related genus, *Panax*, commonly known as ginseng, are highly esteemed for medicinal purposes in China.

Key to the species

1. A shrub, up to 2.5 m. high; leaves mostly simply pinnate, with 5 to 9 leaflets, these crenulate or crenate with obtuse or acutish, often glandular-mucronulate teeth, light or yellowish green, commonly rather thick, persistently and usually copiously puberulent beneath, lance-ovate or oblong-ovate; peduncles and pedicels sparsely puberulent or glabrate. 1. *A. HUMILIS*.
1. A large herb, 1 to 2 m. high; leaves (all except the uppermost) ternate or biternate, the ultimate divisions pinnate with 3 to 5 leaflets, these doubly crenate-serrate with setose-cuspidate teeth, deep green, very thin, puberulent only on the veins beneath when mature, lance-ovate to broadly ovate; peduncles and pedicels copiously puberulent. 2. *A. RACEMOSA*.

1. *Aralia humilis* Cav., Icon. Pl. 4: 7. 1797.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, canyons, August and September. Southern Arizona and Mexico.

The stems reach a height of 3 m. (10 feet) and a diameter at base of 5 cm., and the older bark is rough.

2. *Aralia racemosa* L., Sp. Pl. 273. 1753.

Aralia bicrenata Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 157. 1913.

Aralia arizonica Eastw., Calif. Acad. Sci. Proc. ser. 4, 20: 148. 1931.

Apache and Coconino Counties to Cochise County, 7,300 to 9,500 feet, rich soil of coniferous forests, preferring shade, July and August, type of *A. arizonica* from the Chiricahua Mountains (*Kusche* in 1929). Canada to Georgia, Arizona, and northern Mexico.

American spikenard. The plants reach a height of 2 m. (7 feet). The form occurring in Arizona (*A. bicrenata* Woot. and Standl.) should perhaps be regarded as a variety, having more deeply serrate margins of the leaflets and a more ample inflorescence than in most specimens from the eastern United States. The fruits are eaten by various birds.

91. UMBELLIFERAE. PARSLEY FAMILY

Contributed by MILDRED E. MATHIAS and LINCOLN CONSTANCE

Plants herbaceous, annual or perennial, with commonly hollow stems; leaves alternate or basal, usually compound, with usually sheathing petioles; flowers small, regular, in simple or compound umbels, or the umbels sometimes proliferous or capitate; rays sometimes subtended by bracts forming an involucre; umbellets usually subtended by bractlets forming an involucre; calyx tube wholly adnate to the ovary, the calyx teeth obsolete or small; petals 5, usually with an inflexed tip; stamens 5, inserted on an epigynous disk; ovary inferior, 2-celled, with 1 anatropous ovule in each cell; styles 2, sometimes swollen at base to form a stylopodium; fruit consisting of 2 mericarps united by their faces (commisures), each mericarp with 5 ribs, 1 down the back (dorsal rib), 2 on the edges near the commissure (lateral ribs), and 2 between the dorsal and lateral ribs (intermediate ribs), with oil tubes usually present in the intervals (spaces between the ribs), and on the commissural surface; mericarps 1-seeded, splitting apart at maturity, usually suspended from the summit of a slender prolongation of the axis (carphophore); embryo small, the endosperm cartilaginous.

Among the useful Umbelliferae are garden vegetables, such as carrot, parsnip, celery, and parsley, and condiment plants, such as caraway, fennel, dill, anise, and coriander. On the other hand, some of these plants are very poisonous, notably the waterhemlocks (*Cicuta* spp.) and poisonhemlock (*Conium maculatum*). The latter, an Old World plant, is extensively naturalized in the United States but has not been reported from Arizona.

Key to the genera

1. Inflorescence capitate, not umbellate (2).
 2. Fruit not winged, ribless, variously squamose----- 3. ERYNGIUM.
 2. Fruit winged, not squamose----- 22. CYMOPTERUS.
1. Inflorescence a distinct umbel, more or less spreading, never capitate (3).
 3. Leaves simple; umbels simple or proliferous (4).
 4. Ovary and fruit covered with stellate hairs; foliage more or less stellate-pubescent----- 2. BOWLESIA.
 4. Ovary and fruit glabrous; foliage glabrous (5).
 5. Leaves with a definite ovate to orbicular blade----- 1. HYDROCOTYLE.
 5. Leaves reduced to hollow cylindrical jointed petioles. 15. LILAEOPSIS.
 3. Leaves variously compound; umbels compound or rarely simple by reduction (6).
 6. Ovary and fruit armed with bristles, callous teeth, or papillae (7).
 7. Ovary and fruit linear or linear-oblong, several times longer than wide; oil tubes absent or obscure in mature fruit----- 4. OSMORHIZA.
 7. Ovary and fruit ovate to oblong, not more than twice as long as wide; oil tubes present in mature fruit (8).
 8. Stems and leaves variously hispid; involucre foliaceous; bractlets of the involucre foliaceous, usually pinnately divided; fruit armed with barbed or hooked bristles (9).
 9. Fruit flattened laterally, the bristles hooked, not barbed; stylopodium conic; calyx teeth prominent----- 5. CAUCALIS.
 9. Fruit flattened dorsally, the bristles barbed at tip; stylopodium absent; calyx teeth absent----- 29. DAUCUS.
 8. Stems and leaves glabrous or somewhat roughened, never hispid; involucre mostly absent; bractlets of the involucre linear or filiform and entire, or absent; fruit armed with short bristles, callous teeth, or papillae (10).
 10. Involucre absent; umbels sessile; fruit papillate-- 7. APIASTRUM.
 10. Involucre present; umbels peduncled; fruit not papillate (11).
 11. Fruit covered with short bristles; seed face more or less sulcate.
 9. SPERMOLEPIS.
 11. Fruit covered with callous teeth; seed face plane to somewhat concave----- 10. AMMOSELINUM.
 6. Ovary and fruit not armed, sometimes pubescent (12).
 12. Ribs of the fruit not prominently winged, the ovary and fruit terete in cross section or somewhat flattened laterally (13).
 13. Petals conspicuously unequal; fruit subglobose, not constricted at the commissure----- 6. CORIANDRUM.
 13. Petals equal; fruit orbicular to oblong, more or less constricted at the commissure (14).
 14. Flowers yellow; plants with an aniselike odor. 16. FOENICULUM.
 14. Flowers not yellow; plants without an aniselike odor (15).
 15. Ribs of the fruit corky; plants of marshes or aquatic (16).
 16. Involucre inconspicuous or absent; some or all of the leaves ternate-pinnate----- 11. CICUTA.
 16. Involucre conspicuous; leaves simply pinnate (17).
 17. Ribs of the fruit corky, equal; stylopodium depressed.
 13. Sium.
 17. Ribs filiform, the pericarp forming a continuous corky covering; stylopodium conic----- 14. BERULA.
 15. Ribs of the fruit not corky; plants of dry ground or moist meadows (18).
 18. Ribs narrowly winged; leaflets variously incised.
 18. LIGUSTICUM.

18. Ribs not winged; leaflets entire to lobed (19).
 19. Plants from slender elongate roots; umbels axillary or terminal; calyx lobes inconspicuous----- 8. *APIUM*.
 19. Plants from fascicled tuberous or fusiform roots; umbels terminal; calyx lobes conspicuous---12. *PERIDERIDIA*.
 12. Ribs of the fruit (some or all of them) prominently winged, the fruit more or less flattened dorsally (20).
 20. Plants annual, with an aniselike odor----- 17. *ANETHUM*.
 20. Plants perennial, without an aniselike odor (21).
 21. Plants hirtellous-pubescent only at base of the umbel.
 24. *PSEUDOCYMOPTERUS*.
 21. Plants glabrous or pubescent throughout or (in genus *Conioselinum*) glabrous except in the inflorescence (22).
 22. Plants acaulescent or short-caulescent, relatively low, 1 to 55 cm. high, subscapose (23).
 23. Leaf blades narrowly oblong, the leaflets few and remote; calyx teeth persistent----- 23. *PTERYXIA*.
 23. Leaf blades broader, the leaflets many, crowded but usually distinct; calyx teeth rarely persistent (24).
 24. Lateral ribs winged, the wings thin, the dorsal ribs absent or filiform----- 26. *LOMATIUM*.
 24. Lateral and dorsal ribs winged or, if the dorsal ribs obsolete, then the lateral wings corky (25).
 25. Calyx teeth conspicuous; leaves pinnate or bipinnate.
 19. *OREOXIS*.
 25. Calyx teeth inconspicuous; leaves pinnately decom-
 pound----- 22. *CYMOPTERUS*.
 22. Plants caulescent, mostly tall, 30 to 120 cm. high, the stems more or less leafy (26).
 26. Marginal flowers of the umbel with radially enlarged petals; plant tomentose-pubescent; leaves ternate.
 28. *HERACLEUM*.
 26. Marginal flowers regular; plants glabrous or pubescent, never tomentose; leaves pinnate to ternate-pinnate or decom-
 pound (27).
 27. Lateral wings corky; leaves decom-
 pound, the leaflets narrow, linear-oblong, scabrous-puberulent; stylo-
 podium absent----- 25. *LEPTOTAENIA*.
 27. Lateral wings thin; leaves pinnate to ternate-pinnate, the leaflets broad, lanceolate to ovate, glabrous or puberulent; stylopodium present (28).
 28. Flowers yellow; dorsal ribs filiform, the oil tubes promi-
 nent on the dorsal surface----- 27. *PASTINACA*.
 28. Flowers not yellow; dorsal ribs winged, the oil tubes not prominent on the dorsal surface (29).
 29. Plants glabrous except for the puberulent inflorescence; stems from a cluster of fleshy roots; ovaries and fruit glabrous----- 20. *CONIOSELINUM*.
 29. Plants somewhat pubescent; stems from a taproot; ovaries densely hirsutulous, the fruit occasionally glabrate----- 21. *ANGELICA*.

1. HYDROCOTYLE. WATERPENNYWORT

Plants glabrous, perennial, with slender floating or creeping stems or rootstocks; leaf blades round, peltate or nonpeltate; flowers in a simple axillary umbel or an interrupted spike; calyx teeth minute; corolla white, greenish, or yellow; stylopodium depressed to conspicuously conic; fruit transversely ovate to orbicular, 1 to 3 mm. long, strongly flattened laterally, the ribs slender or obsolete, the oil-bearing cells conspicuous to obsolete, the seed face plane to convex.

Plants of wet ground, or aquatic.

Key to the species

1. Leaves peltate, orbicular, shallowly 8- to 13-lobed; inflorescence an interrupted simple or branched spike, longer than the leaves, the flowers borne in scattered verticils..... 1. *H. VERTICILLATA*.
 1. Leaves not peltate, roundish-reniform, 5- or 6-lobed to about the middle; inflorescence a simple umbel; peduncles shorter than the leaves.
 2. *H. RANUNCULOIDES*.

1. *Hydrocotyle verticillata* Thunb., Diss. Hydroc. 2, 5. 1798.

Hydrocotyle cuneata Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 28. 1900.

Montezuma Well, Yavapai County (*MacDougal* 575, the type of *H. cuneata*), Catalpa, Gila County (*MacDougal* in 1891), San Bernardino Ranch, Cochise County (*Mearns* 829), Sonoita Valley, Santa Cruz County (*Lemmon* 2710). Massachusetts to Florida and the West Indies, west to southern Utah, Arizona, and California.

In the typical form the inflorescence is often bifurcate and the fruit sessile or subsessile. The var. *racemosa* (Sessé and Moç.) Mathias, distinguished from the species by a rarely bifurcate inflorescence and pedicellate fruit with pedicels up to 10 mm. long, has been collected at Beaver Dam, Mohave County (*Jones* 5024), and near Tucson, Pima County (*Pringle* in 1881, *Dewey* in 1891).

2. *Hydrocotyle ranunculoides* L. f., Sup. 177. 1781.

San Pedro River valley, Cochise County (*Toumey* in 1894), Tucson (*Toumey* in 1894). Pennsylvania and Delaware to Florida, west to Washington and Arizona, south to tropical America.

2. BOWLESIA

Plants annual, stellate-pubescent, prostrate or suberect, dichotomously branching; leaf blades suborbicular, palmately 5- to 7-lobed; peduncles axillary, shorter than the leaves; umbels simple, few-flowered; involucre bracts small; calyx teeth prominent; corolla greenish white; stylopodium depressed-conic; fruit broadly ovate, 1 to 1.5 mm. long, stellate-pubescent, turgid, narrowed at the commissure, the ribs and oil tubes obsolete, the seed face plane or convex.

1. *Bowlesia incana* Ruiz and Pavon, Fl. Peruv. Chil. 3: 28. 1802.

Bowlesia septentrionalis Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 31. 1900.

Mohave County to Graham, Pima, and (probably) Yuma Counties, 1,000 to 3,500 feet, common, usually among bushes, spring, type of *B. septentrionalis* from near Tucson (*Zuck*). Southern Texas to Arizona and central California; Peru.

3. ERYNGIUM. ERYNGO, BUTTON-SNAKEROOT

Plants perennial, caulescent, glabrous; stems simple or branched; leaf blades lanceolate to oblanceolate and reticulate-veined, or linear and parallel-veined, entire to pinnatifid; peduncles exceeding the leaves; inflorescence a dense bracteate head; bracts linear to ovate-lanceolate, entire to spinulose-serrate; floral bractlets usually entire; calyx lobes lanceolate to ovate, obtuse or acute; corolla white or blue; stylopodium absent; fruit ovoid, flattened laterally, covered with hyaline scales or tubercles, the ribs obsolete, the oil tubes several, inconspicuous, the seed face plane.

Key to the species

- 1. Leaves elongate, linear, parallel-veined, usually entire.
 - 1. E. SPARGANOPHYLLUM.
- 1. Leaves shorter, lanceolate to oblanceolate, reticulate-veined, crenate to spinose-serrate or pinnatifid (2).
 - 2. Basal leaves obscurely crenate or serrate, not spinose; heads cylindric-ovoid, amethystine----- 2. E. PHYTEUMAE.
 - 2. Basal leaves spinose-serrate or pinnatifid; heads ovoid, not amethystine (3).
 - 3. Plants from a cylindric taproot; lower cauline leaves pinnatifid to bipinnatisect; inflorescence paniculately branched, the heads comate; bracts linear-lanceolate to lanceolate, entire or with 1 or 2 pairs of lateral spines near the middle, yellowish above.
 - 3. E. HETEROPHYLLUM.
 - 3. Plants from a fascicle of fibrous or fleshy roots; lower cauline leaves spinose-serrate; inflorescence successively trifurcate, the heads not comate; bracts broadly lanceolate to oblanceolate, spinose-serrate with 2 or 3 pairs of teeth, silvery-white above----- 4. E. LEMMONI.

1. *Eryngium sparganophyllum* Hemsl. in Hook., Icon. Pl. 26: pl. 2508. 1897.

Agua Caliente ranch near Tucson, 2,900 feet, marshy ground (Shreve in 1908). New Mexico to southern Arizona and Mexico.

2. *Eryngium phyteumae* Delar., Eryng. 51. 1808.

Eryngium discolor S. Wats., Amer. Acad. Arts and Sci. Proc. 18: 193. 1883.

In water, Huachuca Mountains, Cochise County (Lemmon 1714, 2714). Southeastern Arizona and Mexico.

3. *Eryngium heterophyllum* Engelm. in Wisliz., Mem. North. Mex. 106. 1848.

Eryngium wrightii A. Gray, Pl. Wright. 1: 78. 1852.

Cochise and Santa Cruz Counties, 4,000 to 6,500 feet, plains and along watercourses. Texas to southeastern Arizona and Mexico.

Known locally as Mexican-thistle. The flowers are pale blue.

4. *Eryngium lemmoni* Coult. and Rose, Bot. Gaz. 14: 279. 1889.

Cochise County, chiefly in the Chiricahua and Huachuca Mountains, 6,000 to 7,000 feet, type from the Chiricahua Mountains (Lemmon 17). Southeastern Arizona and northern Mexico.

4. OSMORHIZA. SWEETROOT, SWEET-CICELY

Plants perennial, caulescent, glabrous to hirsute; leaves biternate or ternate-pinnate, the leaflets broad, variously toothed or lobed, distinct; peduncles exceeding the leaves; umbels compound; involucre usually absent; calyx teeth obsolete; corolla white to greenish yellow; stylopodium conic; fruit linear to linear-oblong, 10 to 20 mm. long, cylindric or clavate, more or less attenuate at base, slightly compressed laterally or not at all, the ribs inconspicuous, the oil tubes obsolete in mature fruit, the seed face sulcate.

Key to the species

- 1. Involucels of several bractlets----- 1. O. BRACHYPODA.
- 1. Involucels absent (2).
 - 2. Rays and pedicels spreading-ascending; fruit linear-oblong, cylindric.
 - 2. O. NUDA.
 - 2. Rays and pedicels divaricate; fruit clavate----- 3. O. OBTUSA.

1. *Osmorhiza brachypoda* Torr. in Durand, Acad. Nat. Sci. Phila. Jour. ser. 2, 3: 89. 1855.

Mazatzal Mountains, Gila County (*Harrison* 7815, 7830, *Collom* 866). Central Arizona and California.

2. *Osmorhiza nuda* Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 93. 1857.

Osmorhiza divaricata Blankinship, Mont. Agr. Col. Sci. Studies Bot. 1: 91. 1905.

Oak Creek, Coconino or Yavapai County (*Fulton* 9678), Pinaleno Mountains, Graham County (*Peebles* et al. 4483), Santa Catalina Mountains, Pima County, 7,500 feet (*Peebles* et al. 2581). Quebec and New Hampshire to British Columbia, Arizona, and California.

3. *Osmorhiza obtusa* (Coul. and Rose) Fernald, *Rhodora* 4: 154. 1902.

Washingtonia obtusa Coul. and Rose, Contrib. U. S. Natl. Herbarium 7: 64. 1900.

Baldy Peak, Apache County (*Peebles* and *Smith* 12507), San Francisco Peaks (*MacDougal* 397, *Leiberg* 5707, *Toumey* 39), Mormon Lake, Coconino County (*MacDougal* 101), 7,000 to 10,000 feet. Labrador and Newfoundland to the Rocky Mountains, south to northern Arizona.

5. CAUCALIS

Plants annual, caulescent, branching, hispid; leaves pinnately decomposed, the segments short, linear to filiform; peduncles axillary and terminal; umbels compound or occasionally simple by reduction; involucre of foliaceous bracts shorter than the rays; bractlets of the involucre foliaceous, entire or pinnately divided, mostly shorter than the fruits; calyx teeth prominent; corolla white; stylopodium conic; fruit ovate-oblong, 3 to 7 mm. long, laterally compressed, the carpels with 5 filiform bristly prominent ribs and 4 prominent winged secondary ribs bearing hooked bristles, the oil tubes solitary in the intervals, 2 on the commissure, the seed face deeply sulcate.

1. *Caucalis microcarpa* Hook. and Arn., Bot. Beechey Voy. 348. 1840.

Mohave County to Gila, Santa Cruz, and Pima Counties, 3,500 feet or lower. Idaho to British Columbia, south to Arizona and Baja California.

6. CORIANDRUM. CORIANDER

Plants annual, caulescent, glabrous; leaves biternate to ternate-pinnate, the leaflets mostly cuneate, doubly lobed at apex, the upper leaflets linear; peduncles axillary or terminal; umbels compound; involucre absent; bractlets of the involucre few, inconspicuous, lanceolate; calyx teeth acute, unequal; corolla white or roseate, the petals conspicuously unequal; stylopodium conic; fruit subglobose, about 3 mm. long, not constricted at the commissure, the ribs prominent, the oil tubes solitary in the intervals, few on the commissure, the seed face concave.

1. *Coriandrum sativum* L., Sp. Pl. 256. 1753.

Tucson, Pima County (*G. A. Wilcox* in 1905), probably only a chance escape from cultivation. Sparingly naturalized from Europe in various parts of North America.

7. APIASTRUM

Plants annual, slender, glabrous; stems sometimes simple, usually di- or tri-chotomously branching; leaves 2- or 3-ternate, the segments subfiliform to linear; umbels compound, sessile in the axils or opposite the upper leaves; involucre and involucl none; calyx teeth obsolete; corolla white; stylopodium minute and depressed; fruit ovate or cordate, 1 mm. long, papillate-roughened, the ribs inconspicuous, the oil tubes solitary in the intervals, 2 on the commissure, the seed face concave to sulcate.

1. *Apiastrum angustifolium* Nutt. ex Torr. and Gray, Fl. North Amer. 1: 644. 1840.

Santa Rita Range Reserve and Coronado National Forest, Pima County (*Griffiths* 429, 474, 516). Southern Arizona, California, and Baja California.

8. APIUM. CELERY

Plants annual or biennial, glabrous, branched above; leaves pinnate to ternate-pinnately decomposed; umbels compound (or simple by reduction), axillary and terminal, sessile to short-pedunculate; involucre and involucl none; calyx teeth absent or inconspicuous; corolla white; stylopodium short-conic; fruit ovate to suborbicular, 1 to 2 mm. long, laterally compressed, somewhat constricted at the commissure, the ribs obtuse, conspicuous, the oil tubes solitary in the intervals, 2 on the commissure, the seed face more or less plane.

Key to the species

1. Plant annual; leaves pinnately or ternate-pinnately decomposed, the segments linear to filiform.----- 1. *A. LEPTOPHYLLUM*.
 1. Plant biennial; leaves pinnate, the segments ovate to suborbicular or cuneate. 2. *A. GRAVEOLENS*.

1. *Apium leptophyllum* (Pers.) F. Muell. in Benth., Fl. Austral. 3: 372. 1866.

Pimpinella leptophylla Pers., Syn. Pl. 1: 324. 1805.

Apium ammi (L.) Urban, Fl. Bras. 11¹: 341. 1879.

Tempe, Maricopa County, in a lawn (*Stitt* and *McLellan* in 1935). Throughout North America.

2. *Apium graveolens* L., Sp. Pl. 264. 1753.

Havasu Canyon, Coconino County, abundant and apparently naturalized (*Clover* 4418), Maricopa County, at Phoenix (*Dewey* in 1891) and Granite Reef (*Gillespie* 5626), Gila Indian Reservation, Pinal County (*Peebles* 9652), in moist soil.

Common celery, more or less naturalized throughout North America from the Old World.

9. SPERMOLEPIS

Plants annual, caulescent, alternately branching, glabrous; leaves ternately decomposed, the segments filiform; peduncles axillary and terminal, exceeding the leaves; umbels compound; involucre absent; bractlets of the involucl few, filiform, shorter than the pedicels, glabrous or callous-toothed; calyx teeth obsolete; corolla white; stylopodium low-conic; fruit ovoid, 1.5 to 2 mm. long, laterally compressed, covered with short echinate bristles, the oil tubes 1 to 3 in the intervals, 2 on the commissure, the seed face more or less sulcate.

1. *Spermolepis echinata* (Nutt.) Heller, Contrib. Herbarium Franklin and Marshall Col. 1: 73. 1895.

Leptocaulis echinatus Nutt. ex DC., Prodr. 4: 107. 1830.

Maricopa, Pinal, Cochise, and Pima Counties, 1,300 to 5,000 feet. Missouri to Louisiana, west to southern Arizona and Coahuila.

10. AMMOSELINUM

Plants annual, caulescent, branching, more or less roughened; leaves ternate, then bipinnate, the segments linear; peduncles axillary and terminal, up to 4 cm. long, or none; umbels compound; involucre mostly absent; bractlets of the involucre few, linear, acute, somewhat callous-toothed, about equaling the pedicels; calyx teeth obsolete; corolla white; stylopodium low-conic; fruit oblong-ovate, 3 to 5 mm. long, somewhat constricted toward the apex, subcordate at base, laterally compressed, covered with callous teeth, the ribs corky, acute to rounded, the oil tubes 3 in the intervals, 2 on the commissure, the seed face concave.

1. *Ammoselinum giganteum* Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 89. 1900.

Mesas near Phoenix (*Pringle* 28, the type collection), Maricopa, Pinal County (*Dewey* in 1894), Eloy, Pinal County (*Peebles* et al. 6496). Southern Arizona, California, and Coahuila.

11. CICUTA. WATERHEMLOCK

Plants perennial from a vertical or horizontal, short or elongate tuberous base bearing fibrous or fleshy-fibrous roots, caulescent, glabrous; leaves 1- to 3-pinnate, the leaflets linear-lanceolate to ovate-lanceolate, distinct or some of them confluent, remotely to coarsely serrate or incised; peduncles exceeding the leaves; umbels compound; involucre of few bracts or none; bractlets of the involucre several, ovate-lanceolate to linear, acute to acuminate; calyx teeth evident; corolla white or greenish white; stylopodium low-conic; fruit orbicular to oval, 2 to 4 mm. long, slightly compressed laterally, definitely constricted at the commissure, the ribs low, broad and corky, wider than the reddish-brown or homochromous intervals, the oil tubes solitary in the intervals, 2 on the commissure, the seed face concave, plane, or convex.

Plants violently toxic to warm-blooded animals, especially the roots and young growth. No antidote is known, but in human beings the use of emetics has proved effective. Symptoms are vomiting, colicky pains, staggering, unconsciousness, and convulsions. The poisonous principle, cicutoxin, affects the nerve centers. These plants should be eradicated from ranges, as they have caused the loss of much livestock.

1. *Cicuta douglasii* (DC.) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 95. 1900.

? *Sium* (?) *douglasii* DC., Prodr. 4: 125. 1830.

Cicuta occidentalis Greene, Pittonia 2: 7. 1889.

Cicuta grandifolia Greene, Leaflets 2: 24. 1909.

Apache, Greenlee, and Coconino Counties, 6,000 to 9,000 feet, wet ground, type of *C. grandifolia* from Mormon Lake (*Pearson* 140). Montana and Alaska to Arizona, California, and Chihuahua.

12. PERIDERIDIA

Plants perennial from fascicled tuberous or fusiform roots, usually caulescent, glabrous; leaves mostly pinnate or ternate-pinnate, the leaflets filiform to lanceolate; peduncles exceeding the leaves; umbels compound; involucre usually absent; involucl present, the bractlets linear to lanceolate; calyx teeth prominent; corolla white or pink; stylopodium conic; fruit orbicular to oblong, 2 to 4 mm. long, laterally compressed, the ribs inconspicuous, the oil tubes 1 to 5 in the intervals, 2 to 8 on the commissure, the seed face plane to broadly concave.

Key to the species

1. Leaves pinnate to bipinnate; bractlets of the involucl linear-acuminate; fruit orbicular to suborbicular, 2 to 3 mm. long, the oil tubes solitary in the intervals..... 1. *P. GAIRDNERI*.
1. Leaves ternate, rarely biternate, the uppermost entire; bractlets of the involucl narrowly lanceolate; fruit ovoid to oblong, 3 to 4 mm. long, the oil tubes 2 to 4 in the intervals..... 2. *P. PARISHII*.

1. *Perideridia gairdneri* (Hook. and Arn.) Mathias, *Brittonia* 2: 244. 1936.

Atenia gairdneri Hook. and Arn., *Bot. Beechey Voy.* 349. 1840.

Carum gairdneri A. Gray, *Amer. Acad. Arts and Sci. Proc.* 7: 344. 1867.

White Mountains (Apache County), Flagstaff, Mogollon Escarpment, and Bill Williams Mountain (Coconino County), 7,000 feet or higher, moist soil. South Dakota to New Mexico, west to British Columbia and southern California.

Yampa, wild-caraway. The tuberous roots have a pleasant nutty flavor and were used by the Indians as food. The seeds were used as seasoning.

2. *Perideridia parishii* (Coul. and Rose) Nels. and Macbr., *Bot. Gaz.* 61: 33. 1916.

Pimpinella parishii Coul. and Rose, *Bot. Gaz.* 12: 157. 1887.

Eulophus parishii Coul. and Rose, *Rev. North Amer. Umbell.* 112. 1888.

Eulophus parishii var. *rusbyi* Coul. and Rose, *Bot. Gaz.* 14: 281. 1889.

North rim of the Grand Canyon to Oak Creek, Coconino County, 6,500 to 8,000 feet, moist soil in pine woods, July. Northern Arizona, California, and Nevada.

Aletes acaulis (Torr.) Coul. and Rose. Ranges in the Rocky Mountains from Colorado to New Mexico and western Texas. In the herbarium of the University of California there is a specimen of this species bearing the label "Gila River" and collected by Mohr. This is probably an error, since Dr. Mohr collected the same species in Colorado.

13. SIUM. WATERPARSNIP

Plants perennial from fascicled fibrous roots, caulescent, aquatic, glabrous; leaves simply pinnate, the leaflets lanceolate to linear, finely to coarsely serrate or incised, mostly acute; peduncles exceeding the leaves; umbels compound; involucre of 6 to 10 unequal, lanceolate or linear bracts, these reflexed in fruit; involucl of 4 to 8 linear-lanceolate bractlets, these shorter than the flowers; calyx teeth minute; corolla

white; stylopodium depressed; fruit oval to orbicular, 2 to 3 mm. long, laterally compressed, the ribs prominent, corky, the oil tubes solitary in the intervals, 2 to several on the commissure, the seed face plane.

1. *Sium suave* Walt., Fl. Carol. 115. 1788.

Sium cicutaeifolium Gmel., Syst. Nat. 2: 482. 1791.

Near Tuba, Coconino County, in a marsh, 5,050 feet (*Kearney and Peebles* 12857). Widely distributed in North America.

14. BERULA. WATERPARSNIP

Plants perennial from fascicled fibrous roots, caulescent, glabrous, aquatic; leaves simply pinnate, the segments linear to ovate, entire to variously lobed; peduncles axillary and terminal, exceeding the leaves; umbels compound; involucre conspicuous, of 6 to 8 unequal linear or lanceolate bracts; involucre of 4 to 8 conspicuous, lanceolate or linear bractlets; calyx teeth inconspicuous; corolla white; stylopodium depressed-conic; fruit oval to orbicular, 1.5 to 2 mm. long, laterally compressed, emarginate at base, the ribs slender, inconspicuous, scarcely raised above the surface, the oil tubes numerous and somewhat contiguous in the innermost layer of the mericarp immediately surrounding the seed, the seed face plane.

1. *Berula erecta* (Huds.) Coville, Contrib. U. S. Natl. Herbarium 4: 115. 1893.

Sium erectum Huds., Fl. Angl. 103. 1762.

Apache County to Coconino County, south to Cochise and Santa Cruz Counties, 4,000 to 7,000 feet, wet places. Widely distributed in North America; Eurasia.

15. LILAEOPSIS

Plants perennial, glabrous; stems creeping and rooting in the mud; leaves reduced to hollow cylindrical petioles, transversely septate, elongate when growing in water; peduncles shorter than the leaves; umbels simple; involucre of few small bracts; calyx teeth minute; corolla white; stylopodium depressed; fruit subglobose or slightly compressed laterally, 2 to 2.25 mm. long, the lateral ribs very thick and corky, the dorsal ribs filiform, the oil tubes solitary in the intervals, 2 on the commissure, the seed face somewhat convex.

1. *Lilaeopsis recurva* A. W. Hill, Linn. Soc. London Jour. Bot. 47: 535. 1927.

Lilaeopsis schaffneriana Coult. and Rose, Bot. Gaz. 24: 48. 1897 (in part). Not of Schlecht.

Huachuca Mountains, Cochise County (*Lemmon* 2895, etc.), Santa Cruz River valley near Tucson, Pima County (*Pringle* in 1881, the type collection). Known only from southern Arizona.

16. FOENICULUM. FENNEL

Plants perennial, caulescent, branching, glabrous, with a strong odor of anise; stem tall; leaves large, pinnately decomposed, the seg-

ments filiform, glaucous; peduncles axillary and terminal, exceeding the leaves; umbels compound; involucre and involucl none; calyx teeth obsolete; corolla yellow; stylopodium conic; fruit oblong, 3.5 to 4 mm. long, laterally compressed, the ribs slender, acute, the oil tubes solitary in the intervals, 2 on the commissure, the seed face slightly concave.

1. *Foeniculum vulgare* Hill, Brit. Herbal 413. 1756.

Mule Mountains, Cochise County (*Harrison* and *Kearney* 8284). Waste ground in various parts of North America, a common weed in coastal California; naturalized from Europe.

17. ANETHUM. DILL

Plants annual or biennial from slender subfusiform roots, caulescent, branching, glabrous, with a strong odor of anise; leaves quadripinnatisect, the segments filiform, distinct; peduncles axillary and terminal, exceeding the leaves; umbels compound; involucre and involucl mostly absent; calyx teeth obsolete; corolla yellow; stylopodium conic, the margin crenulate; fruit ovate, about 4 mm. long, compressed dorsally, the lateral wings much narrower than the body of the fruit, the dorsal wings obsolete, the oil tubes solitary in the intervals, 2 on the commissure, the seed face plane.

1. *Anethum graveolens* L., Sp. Pl. 263. 1753.

Ditch bank at Sacaton, Pinal County (*King* 1832), only 1 plant seen. The species is found wild sparingly in North America; introduced from Europe.

18. LIGUSTICUM. LOVAGE, CHUCHUPATE

Plants perennial, caulescent, glabrous or puberulent; leaves once or twice ternate, then once or twice pinnate, the leaflets mostly distinct, ovate, more or less incised; peduncles axillary or often verticillate, exceeding the leaves; umbels compound; involucre absent or occasionally of a solitary, deciduous, linear bract; involucl wanting, or of several linear bractlets; calyx teeth small or wanting; corolla white; stylopodium depressed-conic; fruit oblong, 5 to 8 mm. long, glabrous, terete, the lateral and dorsal ribs narrowly winged, the oil tubes 4 to 6 in the intervals, 8 to 10 on the commissure, the seed face concave.

1. *Ligusticum porteri* Coult. and Rose, Rev. North Amer. Umbell. 86. 1888.

Mountains of Apache, Coconino, Graham, and Cochise Counties, 7,000 to 11,300 feet. Wyoming to Arizona and Chihuahua.

A palatable forage plant. The aromatic roots, in the drug trade known as coughroot, are used to treat coughs, colds, etc.

19. OREOXIS⁹⁷

Plants perennial from slender elongate roots, low, acaulescent; leaves oblong, pinnate or bipinnate, the segments short, linear, mostly distinct; peduncles exceeding the leaves; umbels compound; involucre usually absent; involucl of several linear bractlets about equaling

⁹⁷ Reference: MATHIAS, MILDRED E. STUDIES IN THE UMBELLIFERAE III—A MONOGRAPH OF CYMOP-TERUS INCLUDING A CRITICAL STUDY OF RELATED GENERA. Mo. Bot. Gard. Ann. 17: 213-476. 1930.

the flowers; calyx teeth conspicuous; corolla yellow; stylopodium absent; fruit oblong, 3 to 8 mm. long, slightly compressed dorsally, the lateral and dorsal wings broadly linear to subovate in cross section, the oil tubes usually solitary in the intervals, 2 to 4 on the commissure, the seed face plane or slightly concave.

Key to the species

1. Plants more or less puberulent; involucre bractlets usually ciliate; fruit boat-shaped, the wings subovate in cross section----- 1. *O. ALPINA*.
 1. Plants glabrous; involucre bractlets not ciliate; fruit not boat-shaped, the wings broadly linear in cross section----- 2. *O. MACDOUGALI*.

1. **Oreoxis alpina** (A. Gray) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 144. 1900.

Cymopterus alpinus A. Gray, Amer. Jour. Sci. ser. 2, 33: 408. 1862.

Keet Seel, Navajo Indian Reservation (*J. Howell* 69), without locality (*Palmer* in 1869). Wyoming to northern New Mexico and northeastern Arizona, in the mountains.

2. **Oreoxis macdougalii** (Coult. and Rose) Rydb., Torrey Bot. Club Bul. 40: 68. 1913.

Aletes (?) *macdougalii* Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 107. 1900.

Known in Arizona only from the type collection, on Grandview (Berry) Trail, Grand Canyon, 7,000 feet (*MacDougal* 192). Southwestern Colorado, southeastern Utah, and northern Arizona.

20. CONIOSELINUM

Plants perennial from a cluster of fleshy roots, caulescent, glabrous or the inflorescence puberulent; leaves bipinnate or ternate-pinnate, the leaflets ovate to ovate-lanceolate, acute, laciniately toothed or pinnatifid; peduncles exceeding the leaves; umbels compound; involucre mostly absent; involucre wanting, or of 1 to several, more or less elongate, narrow bractlets; calyx teeth obsolete; corolla white; stylopodium low-conic; fruit oval, 3 to 6 mm. long, compressed dorsally, the lateral wings broad, corky, the dorsal ribs slender, winged, the oil tubes 1 or 2 in the intervals, 4 on the commissure, the seed face plane or slightly concave.

Key to the species

1. Leaves ternate-pinnately divided, 10 to 20 cm. long, the upper leaves similar to the lower leaves; leaflets 2 to 6.5 cm. long; bractlets of the involucre linear, elongate; rays 10 to 20----- 1. *C. SCOPULORUM*.
 1. Leaves bi- to ternate-pinnate, 6 to 14 cm. long, the upper leaves with elongate entire leaflets; leaflets 1 to 2.5 cm. long; bractlets of the involucre filiform or wanting; rays 5 to 11----- 2. *C. MEXICANUM*.

1. **Conioselinum scopulorum** (A. Gray) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 151. 1900.

Ligusticum scopulorum A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 347. 1868.

East fork of White River (Navajo ? County), Pinaleno Mountains (Graham County), Chiricahua and Huachuca Mountains (Cochise

County), Santa Rita Mountains (Pima County). Wyoming to New Mexico and Arizona.

2. *Conioselinum mexicanum* Coult. and Rose, Wash. Acad. Sci. Proc. 1: 147. 1900.

Santa Rita Mountains, Pima County (*Kearney* and *Peebles* 10497). Southern Arizona and Chihuahua.

21. ANGELICA

Plants perennial, caulescent, somewhat pubescent; leaves ternate-pinnate or by reduction pinnate, the leaflets lanceolate to ovate, acute, distinct, coarsely to remotely serrate; peduncles exceeding the leaves; umbels compound; involucre and involucrel usually absent; calyx teeth obsolete; corolla white, greenish, or purple; stylopodium low-conic; fruit oblong-oval, 3 to 6 mm. long, densely hirsutulous when young, occasionally glabrate at maturity, compressed dorsally, the lateral wings broad, the dorsal ribs slender, winged, the oil tubes 1 or 2 in the intervals, several on the commissure, the seed face slightly concave.

1. *Angelica pinnata* S. Wats. in King, Geol. Expl. 40th Par. 5: 126. 1871.

Angelica leporina S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 252. 1877.

Without definite locality (*Palmer* 183, in 1877), also collected by Standley in the Tunitcha Mountains, N. Mex., a range which extends into Arizona. Wyoming, Utah, and Nevada to northern Mexico.

22. CYMPTERUS⁹⁸

Plants perennial from long taproots, low, acaulescent or subacaulescent, glabrous or pubescent; leaves 2- to 4-pinnatisect, the segments narrow, short; peduncles shorter than to exceeding the leaves; umbels compound, or globose with the rays fused into a disk; involucre absent or present; bractlets of the involucrel usually conspicuous, usually dimidiate, foliaceous to scarios; calyx teeth inconspicuous; corolla white, yellow, or purple; stylopodium absent; fruit ovate to oblong, 4 to 18 mm. long, more or less compressed dorsally, the lateral wings present, the dorsal wings usually present, the oil tubes small, 1 to 24 in the intervals, 2 to 22 on the commissure, the seed face slightly to deeply concave.

Key to the species

1. Rays of the umbel fused to form a discoid inflorescence; involucrel bractlets scarios and paleaceous----- 1. *C. MEGACEPHALUS*.
1. Rays of the umbel distinct, 0.2 to 9 cm. long; involucrel bractlets not paleaceous (2).
2. Bractlets of the involucrel scarios (3).
3. Bractlets of the involucrel purple or greenish white, conspicuously many-nerved----- 4. *C. MULTINERVATUS*.
3. Bractlets of the involucrel white or whitish, few-nerved (4).
4. Umbels more or less spreading, the mature rays 10 to 50 mm. long; fruit ovate-oblong to oblong, the wings mostly narrower than the body of the fruit----- 2. *C. BULBOSUS*.
4. Umbels densely globose, the mature rays 4 to 10 mm. long; fruit ovate, the wings broader than the body of the fruit. 3. *C. PURPURASCENS*.

⁹⁸ Reference: See footnote 97, p. 649.

2. Bractlets of the involucl rarely scarios, inconspicuous, or foliaceous and conspicuous (5).
5. Bractlets of the involucl inconspicuous, not foliaceous; oil tubes 1 to 8 in the intervals ----- 7. *C. PURPUREUS.*
5. Bractlets of the involucl conspicuous, foliaceous; oil tubes 3 to 17 in the intervals (6).
6. Pseudoscape present; leaf segments usually longer than wide. 5. *C. FENDLERI.*
6. Pseudoscape absent; leaf segments wider than long. 6. *C. NEWBERRYI.*
1. **Cymopterus megacephalus** M. E. Jones, *Zoe* 2: 14. 1891.
Junction of Moenkopi Wash and the Little Colorado River, on mesas in gravel near lower edge of juniper zone (*Jones* in 1890, the type collection), 12 miles south of Cameron, 5,050 feet (*Peebles* 11807), 50 miles south of (Lees?) Ferry (*Jones* in 1890). Known only from these collections in Coconino County, northern Arizona.
2. **Cymopterus bulbosus** A. Nels., *Torrey Bot. Club Bul.* 26: 241. 1899.
Phellopterus utahensis (M. E. Jones) Woot. and Standl., *Contrib. U. S. Natl. Herbarium* 16: 158. 1913, in part.
Apache, Navajo, and Graham Counties, 2,700 to 6,000 feet. Southwestern Wyoming to western Texas and northeastern Arizona.
3. **Cymopterus purpurascens** (A. Gray) M. E. Jones, *Zoe* 4: 277. 1893.
Cymopterus montanus var. *purpurascens* A. Gray in Ives, *Rpt. Colo. River* 15. 1860.
Phellopterus utahensis (M. E. Jones) Woot. and Standl., *Contrib. U. S. Natl. Herbarium* 16: 158. 1913, in part.
Navajo County to eastern Mohave County, 3,500 to 7,000 feet, type from Oraibi (*Newberry* in 1858). Southern Idaho to central Arizona.
4. **Cymopterus multinervatus** (Coul. and Rose) Tidestrom, *Biol. Soc. Wash. Proc.* 48: 41. 1935.
Phellopterus multinervatus Coul. and Rose, *Contrib. U. S. Natl. Herbarium* 7: 169. 1900.
Coconino and Mohave Counties to Cochise, Santa Cruz, and Pima Counties, 3,000 to 7,000 feet, type from Peach Springs, Mohave County (*Lemmon* in 1884). Southern Utah to Texas, northern Mexico, Arizona, and southeastern California.
5. **Cymopterus fendleri** A. Gray, *Amer. Acad. Arts and Sci. Mem.* ser. 2, 4: 56. 1849.
Apache County to Coconino County, 5,000 to 6,000 feet. Utah to Chihuahua and northern Arizona.
6. **Cymopterus newberryi** (S. Wats.) M. E. Jones, *Zoe* 4: 47. 1893.
Peucedanum newberryi S. Wats., *Amer. Nat.* 7: 301. 1873.
Navajo and Coconino Counties, 4,700 to 7,000 feet, usually in sand, type from the "Flax" (Little Colorado) River (*Newberry* in 1858). Southern Utah and northern Arizona.
The sweet roots are eaten by Hopi children in spring.

7. *Cymopterus purpureus* S. Wats., Amer. Nat. 7: 300. 1873.

Aulospermum purpureum (S. Wats.) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 178. 1900.

Apache County to northwestern Mohave County, 4,000 to 6,500 feet. Southwestern Colorado, southern Utah, northwestern New Mexico, and northern Arizona.

Cymopterus jonesii Coult. and Rose (*Aulospermum jonesii* Coult. and Rose), of southwestern Utah, may be found in Arizona.

23. PTERYXIA⁹⁹

Plants perennial from a slender taproot, caulescent, glabrous; leaves few, remote, narrowly oblong, bipinnate, the segments linear, acute, distinct; peduncles exceeding the leaves; umbels compound; involucre absent; bractlets of the involucre inconspicuous, linear; calyx teeth conspicuous, persistent; corolla yellow; stylopodium absent; fruit ovate to ovate-oblong, 4.5 to 7 mm. long, compressed dorsally, the lateral and dorsal wings linear in cross section, the oil tubes 3 to 8 in the intervals, 5 to 15 on the commissure, the seed face somewhat concave.

1. *Pteryxia petraea* (M. E. Jones) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 172. 1900.

Cymopterus petraeus M. E. Jones, Contrib. West. Bot. 8: 32-1898.

Both rims of the Grand Canyon (*Cook and Johnson* 2063, *Eastwood* 5833, *Eastwood and Howell* 1006). Southern Idaho and southeastern Oregon to northern Arizona and California.

24. PSEUDOCYMOPTERUS⁹⁹

Plants perennial with a long slender taproot, acaulescent or caulescent, glabrous or pubescent; leaves pinnate to tripinnate, the segments filiform, linear, or lanceolate, short or elongate; peduncles exceeding the leaves, hirtellous at base of the umbel; umbels compound; involucre mostly absent; bractlets of the involucre usually conspicuous; calyx teeth conspicuous; corolla purple or yellow; stylopodium absent; fruit oblong to ovate-oblong, 3 to 7 mm. long, compressed dorsally or subterete, the lateral wings present, the dorsal wings similar to the laterals or absent through abortion, the wings mostly thin, sublinear in cross section, the oil tubes 1 to 8 in the intervals, 2 to 8 on the commissure, the seed face slightly concave.

Key to the species

1. Stems naked or few-leaved; young fruit glabrous; mature fruit ovate to ovate-oblong, 3 to 7 mm. long, 2 to 4 mm. wide..... 1. *P. MONTANUS*.
 1. Stems mostly many-leaved; young fruit puberulent; mature fruit oblong, 3 to 4 mm. long, 1 to 2 mm. wide..... 2. *P. DAVIDSONI*.

⁹⁹ Reference: See footnote 97, p. 649.

1. **Pseudocymopterus montanus** (A. Gray) Coult. and Rose, Rev. North Amer. Umbell. 74. 1888.

Thaspium (?) *montanum* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 57. 1849.

Peucedanum lemmoni Coult. and Rose, Bot. Gaz. 14: 277. 1889.

Lomatium lemmoni Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 231. 1900.

Pseudocymopterus multifidus Rydb., Torrey Bot. Club Bul. 33: 147. 1906.

Pseudocymopterus purpureus (Coult. and Rose) Rydb., *ibid.*

Pseudocymopterus tenuifolius (A. Gray) Rydb., *ibid.*

Apache County to Coconino County, south to Cochise and Pima Counties, 5,500 to 12,000 feet, common in pine woods. Southern Wyoming to western Utah, south to northern Mexico.

This species is exceedingly variable in vegetative characters, such as leaf division, shape and size of the ultimate segments, and height of growth. These characters are governed to a great extent by the habitat of the individual plant. The flower color sometimes varies on the same plant from yellow, through orange purple, to purple. In some individuals the dorsal wings of the fruit are absent through abortion.

2. **Pseudocymopterus davidsoni** (Coult. and Rose) Mathias, Mo. Bot. Gard. Ann. 17: 316. 1930.

Aletes (?) *davidsoni* Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 107. 1900.

Pseudocymopterus filicinus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 158. 1913.

Greenlee County, among rocks in a moist creek bed near Clifton (*Davidson* in 1900, the type collection), Garfield (*Davidson*), 45 miles north of Clifton, 8,100 feet (*Kearney* and *Peebles* 12240, 12241). Western New Mexico and southeastern Arizona.

25. LEPTOTAENIA

Plants perennial, caulescent, glabrous except for the scabrous-puberulent, rarely glabrate, foliage; leaves large, ternate-pinnately decomposed, the segments linear-oblong, acute or obtuse, distinct; peduncles exceeding the leaves; umbels compound; involucre of few bracts, or absent; involucre of several linear bractlets; calyx teeth usually obsolete; corolla purple, yellow, or greenish; stylopodium absent; fruit oblong-oval, 8 to 16 mm. long, compressed dorsally, the lateral wings broad, corky-thickened, the dorsal ribs obscure or filiform, the oil tubes obscure, the seed face plane.

1. **Leptotaenia dissecta** Nutt. ex Torr. and Gray, Fl. North Amer. 1: 630. 1840.

Mormon Lake, Coconino County (*MacDougal* 58), East Fork of White River, Navajo (?) County (*Harrison* 4847), Mazatzal Mountains, Gila County (*Collom* 147, *Harrison* 7828), 4,000 to 6,000 feet. Colorado to British Columbia, south to Arizona and California.

The species is represented in Arizona by var. *multifida* (Nutt.) Jepson (*L. multifida* Nutt.). The plant is sometimes known as carrot-

leaf and wild-carrot. It is reported that it is palatable to livestock and that the Indians roasted and ate the large roots.

26. LOMATIUM.¹ BISCUITROOT, INDIANROOT

Plants perennial, with moniliform tubers or long taproots, acaulescent or short-caulescent, glabrous or pubescent; leaves ternately or pinnately decomposed, the segments filiform to ovate; peduncles equaling or exceeding the leaves; umbels compound; involucre mostly absent; bractlets of the involucre filiform to obovate, foliaceous to subscariosus, distinct to connate, rarely none; calyx teeth small; corolla greenish white, yellow, or purple; stylopodium absent; fruit ovate to linear, 4.5 to 15 mm. long, compressed dorsally, the lateral wings present, the dorsal ribs absent or filiform, the wings thin, the oil tubes small, 1 to several in the intervals, 2 to several on the commissure, the seed face slightly concave.

Many of the species have edible roots that the Indians ate raw, cooked, or ground into flour. The plants are grazed by livestock.

Key to the species

1. Plant with elongate moniliform tuberous roots; fruit narrowly oblong, 10 to 15 mm. long, 2 to 5 mm. wide, the wings less than half the width of the body; rays and pedicels strict, suberect.....1. L. LEPTOCARPUM.
1. Plants with more or less thickened, elongate taproots, sometimes with very deep-seated tubers; fruit orbicular to broadly oblong, with broader wings; rays and pedicels more spreading (2).
 2. Fruiting pedicels 10 to 17 mm. long; plant glabrous; leaf blades narrowly oblong, 10 to 20 cm. long; fruit oblong..... 5. L. PARRYI.
 2. Fruiting pedicels mostly less than 10 mm. long; plants more or less pubescent; leaf blades broadly oblong to ovate, 5 to 15 cm. long; fruit suborbicular to oblong-obovate (3).
 3. Involucre bractlets with a conspicuous scarious margin, never tomentose or villous; flowers white..... 2. L. NEVADENSE.
 3. Involucre bractlets not conspicuously scarious-margined, more or less tomentose or villous; flowers yellow or purple (4).
 4. Plants more or less villous throughout; petioles shorter than the blades; flowers yellow or purplish-tinged..... 3. L. MACDOUGALI.
 4. Plants hoary-pubescent, never villous; petioles longer than the blades; flowers purple..... 4. L. MOHAVENSE.

1. **Lomatium leptocarpum** (Nutt.) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 213. 1900.

Peucedanum leptocarpum Nutt. ex Torr. and Gray, Fl. North Amer. 1: 626. 1840.

Grand Canyon (*Jones*), abundant under pines in camp grounds on the north rim of the Grand Canyon (*Mathias* 736). Northwestern Colorado to northern Idaho, northern Arizona, and northeastern California.

2. **Lomatium nevadense** (S. Wats.) Coult. and Rose, Contrib. U. S. Natl. Herbarium 7: 220. 1900.

Peucedanum nevadense S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 143. 1876.

Yavapai, Gila, eastern Maricopa, and Pima Counties, 3,000 to 5,000 feet, mesas and rocky slopes. Western Utah to Oregon and

¹ Reference: MATHIAS, MILDRED E. A REVISION OF THE GENUS LOMATIUM. Mo. Bot. Gard. Ann. 25: 225-297. 1938.

eastern California, south to western New Mexico, Arizona, and Sonora.

The distribution in Arizona as given above is that of the typical form, with ovaries and fruit puberulent. The var. *parishii* (Coul. and Rose) Jepson (*Cogswellia orientalis* (Coul. and Rose) M. E. Jones, in part, *C. decipiens* M. E. Jones), is easily distinguished from the species by its glabrous ovaries and fruit. It is the commonest and most widely distributed form of the species in Arizona, ranging from Coconino and Mohave Counties to Greenlee, Maricopa, and Pima Counties, 3,500 to 5,500 feet, type of *C. decipiens* from Hualpai Mountain (Jones in 1903). Another form occurring in Arizona is var. *pseudorientalis* (M. E. Jones) Munz (*Cogswellia nevadensis* var. *pseudorientalis* M. E. Jones), which is similar to var. *parishii* except that the petioles are more prominently scarious-margined, the wings broader than the body of the fruit, and the dorsal ribs evident. This occurs in much of the range of var. *parishii* but is apparently less common, the type from Skull Valley, Yavapai County (Jones in 1903).

3. *Lomatium macdougali* Coul. and Rose, Contrib. U. S. Natl. Herbarium 7: 233. 1900.

Coconino, eastern Mohave, and Yavapai Counties, 4,500 to 8,000 feet, type from Mormon Lake (*MacDougal* 84). Western Wyoming to central Oregon, south to central Arizona.

4. *Lomatium mohavense* Coul. and Rose, Contrib. U. S. Natl. Herbarium 7: 234. 1900.

Peach Springs, Mohave County, 5,000 feet (*Lemmon* in 1884). Deserts of southern California and adjacent Nevada.

5. *Lomatium parryi* (S. Wats.) Macbride, Contrib. Gray Herbarium ser. 2, 56: 35. 1918.

Peucedanum parryi S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 143. 1876.

Cynomarathrum parryi Coul. and Rose, Contrib. U. S. Natl. Herbarium 7: 246. 1900.

South end of Navajo Mountain, Coconino County, 7,500 to 8,400 feet (*Peebles* and *Smith* 13963). Mountains of southeastern Utah to northern Arizona and eastern California.

Other species of this genus that may be found in Arizona are: *Lomatium nuttallii* (A. Gray) Macbride, which has been collected in northwestern New Mexico, *L. latilobum* (Rydb.) Mathias, known from southeastern Utah, and *L. scabrum* (Coul. and Rose) Mathias, known from southwestern Utah.

27. PASTINACA. PARSNIP

Plants perennial from thick taproots, caulescent, branching, glabrous or nearly so; stem stout, fluted; leaves pinnate, the leaflets oblong to ovate, coarsely serrate and pinnately lobed or divided; peduncles axillary and terminal; umbels compound; involucre none or of a few narrow, deciduous bracts; involucre absent; calyx teeth obsolete; corolla yellow; stylopodium depressed-conic; fruit obovate to orbicular, 5 to 6 mm. long, strongly flattened dorsally, the dorsal ribs filiform, the lateral wings narrow, the oil tubes solitary in the intervals, 2 on the commissure, visible on the dorsal surface, shorter than the fruit, the seed face plane.

1. *Pastinaca sativa* L., Sp. Pl. 262. 1753.

Ramsey Canyon, Huachuca Mountains (*Pebbles* et al. 3488). The parsnip has escaped from gardens and established itself widely in North America but has scarcely become naturalized in Arizona.

28. HERACLEUM. COW-PARSNIP

Plant perennial, with fascicled fibrous roots, caulescent, tomentose; stem tall, stout; leaves ternately compound, the leaflets 3, large, ovate to orbicular, sharply serrate and lobed, petiolulate; peduncles axillary and terminal; umbels compound; involucre of narrow, entire, deciduous bracts; bractlets of the involucre small, linear; calyx teeth obsolete; corolla white, the petals obcordate, the marginal ones of the umbel much larger; stylopodium thick, conic; fruit broadly obovate or obcordate, 8 to 12 mm. long, strongly flattened dorsally, more or less pubescent, the dorsal and intermediate ribs filiform, the lateral wings broad, the oil tubes solitary in the intervals, visible on the dorsal surface and extending from the apex to about the middle of the mericarp, 2 on the commissure, the seed face plane.

1. *Heracleum lanatum* Michx., Fl. Bor. Amer. 1: 166. 1803.

Pinaleno Mountains (Graham County), Santa Catalina Mountains (Pima County), McClintock Canyon, Black Mesa (Apache or Navajo County), 7,500 to 9,000 feet. Widely distributed in the United States and Canada.

A coarse plant, reported to be relished by livestock. The young leaves and stems were eaten by the Indians. The root appears to be somewhat stimulant and carminative and has been used in epilepsy. It is reported that the Apache Indians used it medicinally. Contact with the wet foliage is stated to cause dermatitis in susceptible persons.

29. DAUCUS. CARROT

Plant annual, caulescent, variously hispid; leaves 3- to 4-pinnatisect, the leaflets small, linear; peduncles terminal; umbels compound; involucre foliaceous, equaling or exceeding the rays, pinnately decomposed into short linear or lanceolate segments; bractlets of the involucre linear, about equaling the pedicels; calyx teeth obsolete; corolla white; stylopodium none; fruit oblong, 3 to 5 mm. long, somewhat flattened dorsally, the primary ribs slender, bristly, the secondary ribs with a single row of prominent barbed bristles, the oil tubes solitary in the intervals, 2 on the commissure, the seed face plane to concave.

1. *Daucus pusillus* Michx., Fl. Bor. Amer. 1: 164. 1803.

Mohave County to Greenlee, Santa Cruz, Pima, and (doubtless) Yuma Counties, 4,000 feet or lower, spring. South Carolina to Florida, west to Missouri, Arizona, Washington, California, and Mexico.

This humble relative of the cultivated carrot (*D. carota* L.) is known in California as rattlesnake-weed. It is reported that the Navajo Indians ate the roots, both raw and cooked.

92. CORNACEAE. DOGWOOD FAMILY

Small trees or shrubs; leaves opposite, without stipules, the blades entire; flowers perfect or dioecious, regular, small, the parts in 4's or 5's; ovary inferior.

Key to the genera

1. Flowers in catkins, dioecious, apetalous..... 1. GARRYA.
 1. Flowers in flat-topped compound cymes, perfect, with petals.... 2. CORNUS.

1. GARRYA. SILKTASSEL

Large evergreen shrubs, the branchlets quadrangular; leaves opposite, simple, short-petioled, the blades thick, entire or nearly so; flowers of both sexes in loose or dense catkinlike spikes, the staminate ones in clusters of 3, the pistillate flowers solitary in the axils of the bracts; calyx with tube adnate to the ovary, the limb reduced to 4 teeth or lobes in the staminate flowers, obsolete or nearly so in the pistillate flowers; fruit berrylike, dry or juicy.

Sometimes called quinine-bush and coffeeberry-bush. The leaves are bitter, and an alkaloid, garryin, obtained from 1 or 2 species of the genus, is used medicinally. The plants are sometimes browsed by cattle and deer. Both of the Arizona species occur usually in the chaparral association, on dry slopes and in canyons.

Key to the species

1. Inflorescences spiciform, dense (especially the pistillate ones); bracts not leaflike, triangular, strongly connate; fruits ellipsoid-ovoid, acutish at apex, densely whitish sericeous; leaf blades entire or nearly so, when mature copiously grayish-sericeous to glabrate above, densely sericeous-tomentose beneath, the larger ones commonly 5 cm. long or longer.
 1. G. FLAVESCENS.
 1. Inflorescences of both sexes loose; bracts leaflike, not triangular, connate only at base; fruits globose, rounded at apex, when ripe glabrous or very nearly so and dark blue with a slight bloom; leaf blades more or less callous-denticulate, when mature glabrous or pulverulent on both faces (sometimes very sparsely appressed-pubescent beneath with straight hairs), the larger ones commonly less than 5 cm. long..... 2. G. WRIGHTII.

1. *Garrya flavescens* S. Wats., Amer. Nat. 7: 301. 1873.

Garrya mollis Greene, Leaflets 2: 86. 1910.

Coconino, Mohave, Gila, Yavapai, and Yuma Counties, 2,500 to 7,200 feet, January to March, type of *G. mollis* from Oak Creek Canyon, Coconino County (Pearson 339). Southern Utah and Arizona to southern California.

This shrub attains a height of at least 1.8 m. (6 feet). The leaves are sometimes 25 cm. long. The bark is grayish green.

2. *Garrya wrightii* Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 136. 1856.

Coconino County to Greenlee, Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, dry slopes, July and August. Western Texas to Arizona and northern Mexico.

The plant is sometimes 3 m. (10 feet) high.

2. CORNUS. Dogwood

Shrub, with purplish-red young bark; leaves opposite, the blades ovate, entire, finely appressed-pubescent, whitish beneath; flowers small; calyx limb of 4 minute teeth, the tube wholly adnate to the ovary; petals 4, white; fruit a drupe, normally white when mature.

1. *Cornus stolonifera* Michx., Fl. Bor. Amer. 1: 92. 1803.*Cornus instolonea* A. Nels., Bot. Gaz. 53: 224. 1912.

Apache County to Coconino County, south to Cochise and Pima Counties, 6,000 to 9,000 feet, along streams, often with willows and alder, June and July. Canada and Alaska, south to the District of Columbia, New Mexico, Arizona, and California.

Red-osier dogwood, so called because the bark resembles that of some willows. The fruits are very attractive to birds.

93. LENNOACEAE. LENNOA FAMILY

1. AMMOBROMA.² SANDROOT, SANDFOOD

Plant without chlorophyll, a root parasite; stems thick, succulent, subterranean; leaves reduced to scales; flowers regular, perfect, small, very numerous on an expanded receptacle; sepals filiform, plumose-hairy; corolla funnelform, its lobes normally 6 to 9; stamens borne on the corolla.

1. *Ammobroma sonorae* Torr. in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 327. 1854.

Southern Yuma County along the Mexican boundary (*Harrison and Kearney* 8435), below 500 feet, drifting sand, April. Southwestern Arizona, southeastern California, and northwestern Sonora.

One of the most remarkable plants in the Arizona flora. Only the saucer-shaped receptacle is normally seen above ground. This is commonly 3.5 to 12.5 cm. in diameter, about the color of the surrounding sand, and thickly studded with tiny violet-colored flowers, opening in successive circles. The long, succulent underground stems are attached to the roots of various desert shrubs. They were formerly much used as food by a western group of Papago Indians, the "Sand Papagos," who ate them raw, roasted, or ground into meal.

94. ERICACEAE. HEATHER FAMILY

Plants of various habit, herbaceous to treelike, with or without chlorophyll, often evergreen; flowers perfect, regular or nearly so; corolla gamopetalous or the petals nearly separate; stamens free from the corolla or nearly so; anthers mostly opening by terminal pores, commonly awned; style 1; ovary superior or inferior; fruit dry or juicy.

Key to the genera

1. Plants saprophytic, without green-coloring matter, yellowish brown or red; leaves reduced to scales; anthers not beaked; style erect, stout (2).
2. Petals separate; anthers not awned, opening at apex; ovary borne on a deeply toothed disk; seeds not winged but with taillike extensions of the coat..... 1. MONOTROPA.
2. Petals united below; anthers with 2 long dorsal awns, opening lengthwise; disk none; seeds with a hyaline wing much larger than the body. 2. PTEROSPORA.

² Reference: THACKERY, F. A., and GILMAN, M. F. A RARE PARASITIC FOOD PLANT OF THE SOUTHWEST. *Smithsn. Inst. Ann. Rpt.* 1930: 409-416. 1931.

1. Plants autophytic and green, the leaves with well-developed blades, except sometimes in *Pyrola aphylla* (3).
3. Petals separate; plants small, herbaceous or barely suffrutescent; anthers not awned, opening by pores and often tubular-beaked at the apparent apex (4).
4. Filaments greatly dilated above the base; flowers in corymbs (rarely solitary); well-developed leaves borne along the stem.
 3. CHIMAPHILA.
4. Filaments not dilated above the base, glabrous; flowers in racemes, or solitary; well-developed leaves all basal or nearly so (5).
 5. Flowers several; petals converging at anthesis; style often declined; stigma lobes very short; valves of the capsule sparsely arachnoid-pubescent on the edges when opening----- 4. PYROLA.
 5. Flower solitary; petals spreading at anthesis; style straight; stigma lobes elongate, triangular, narrow; valves of the capsule not pubescent on the edges----- 5. MONESES.
3. Petals united, the corolla cylindric-urceolate; plants shrubby or arborescent, usually tall; anthers with 2 dorsal awns, opening by apical pores or slits (6).
6. Ovary wholly inferior; plants small shrubs; leaves thin, deciduous; fruit a more or less juicy berry, crowned by the persistent calyx.
 8. VACCINIUM.
6. Ovary wholly superior; plants mostly large shrubs or arborescent; leaves thick, evergreen; fruit not juicy (7).
7. Fruit berrylike, only slightly fleshy, the surface granular-tessellate, glabrous----- 6. ARBUTUS.
7. Fruit drupelike, dry, the surface not granular, glabrous or glandular-pilose----- 7. ARCTOSTAPHYLOS.

1. MONOTROPA. PINESAP

Plant saprophytic, yellowish brown or red; stems beset with scale-like leaves; flowers soon nodding; calyx of 3 to 5 separate bractlike sepals; anthers more or less reniform; style erect, stout; fruit a dehiscent 4- or 5-celled capsule.

1. *Monotropa hypopitys* L., Sp. Pl. 387. 1753.

Coconino County to Cochise and Pima Counties, 7,000 to 8,500 feet, rich soil in shade of pines, firs, and aspens, July and August. Widely distributed in the Northern Hemisphere.

The only form known to occur in Arizona is var. *latisquama* (Rydb.) Kearney and Peebles (*Hypopitys latisquama* Rydb.), which differs from the form of the eastern United States (var. *americana* DC., *Hypopitys americana* Small) in the pink or red color of the plant, taller and stouter stems up to about 30 cm. long, broader bracts, and more numerous and larger flowers, with petals 10 mm. long or longer. The plant is somewhat fragrant in drying.

2. PTEROSPORA. PINEDROPS

Plant with a superficial resemblance to *Monotropa* but with a more elongate inflorescence, smaller, more numerous, pendulous flowers, and a 5-parted calyx.

1. *Pterospora andromedea* Nutt., Gen. Pl. 1: 269. 1818.

Coconino County to Cochise and Pima Counties, 6,000 to 9,500 feet, coniferous forests, July and August. Canada to Pennsylvania, Arizona, California, and northern Mexico.

3. CHIMAPHILA. PIPSISSEWA

Plants herbaceous or nearly so; stems somewhat leafy; leaves evergreen, thick and leathery, tending to form whorls; inflorescences

corymbose or umbelliform, the flowers nodding; petals pink or whitish, waxlike, spreading.

Key to the species

1. Leaf blades lanceolate or ovate, whitish-mottled along the veins; dilated portion of the filaments conspicuously villous..... 1. *C. MACULATA*.
1. Leaf blades oblanceolate or spatulate, not mottled; dilated portion of the filaments glabrous or merely ciliolate..... 2. *C. UMBELLATA*.

1. *Chimaphila maculata* (L.) Pursh, Fl. Amer. Sept. 300. 1814.

Pyrola maculata L., Sp. Pl. 396. 1753.

Santa Catalina Mountains (Pima County), about 8,000 feet, among rocks in pine forest (*Harrison* and *Kearney* 8100), August. Massachusetts and Ontario, south to Georgia, Arizona, and Mexico.

Represented in Arizona by var. *dasystemma* (Torr.) Kearney and Peebles (*C. dasystemma* Torr.), which differs from most of the eastern specimens of *C. maculata* in its shorter and broader leaf blades, these 2 to 4 cm. long, one-third to two-thirds as wide as long.

2. *Chimaphila umbellata* (L.) Nutt., Gen. Pl. 1: 274. 1818.

Pyrola umbellata L., Sp. Pl. 396. 1753.

Coconino County, Baldy Peak (Apache County), Pinaleno Mountains (Graham County), 6,500 feet or higher, coniferous forest, July. Widely distributed in the Northern Hemisphere.

Represented in Arizona by var. *acuta* (Rydb.) Blake (*C. acuta* Rydb.), which may be distinguished from other forms of *C. umbellata* by its narrowly oblanceolate, acute or acutish, few-toothed leaves, not prominently veined beneath. The type of *C. acuta* Rydb. was collected on the Mogollon Escarpment, head of Tonto Basin (*Mearns* 136).

4. PYROLA

Small herbaceous perennials, more or less scapose; leaves mostly basal or nearly so, evergreen, usually with well-developed blades; flowers several, nodding, in terminal racemes; corolla nearly globose; anthers commonly reversed at anthesis, the basal pore appearing apical.

Key to the species

1. Stamens connivent; style straight, the stigma much wider than the apex of the style, the latter not expanded into a ring or collar; plants with well-developed green leaves; leaf blades oblong-ovate, serrulate; racemes secund; corolla campanulate, with connivent, greenish-white petals; anthers not beaked; style 3 to 4 mm. long..... 1. *P. SECUNDA*.
1. Stamens not connivent, often declined; style bent at base, more or less curved upward toward the apex; stigma narrower than the apex of the style, the latter expanded into a ring or collar (2).
2. Basal leaves, when present, with greatly reduced blades not more than 5 mm. wide; plant almost or quite devoid of chlorophyll; petals greenish brown outside..... 2. *P. APHYLLA*.
2. Basal leaves with well-developed green blades at least 1 cm. wide; petals greenish white (3).
3. Leaf blades more or less whitish-mottled along the veins, ovate or oval, thick, 3 to 8 cm. long, usually longer than the petiole, denticulate to nearly entire; anther cells narrowed or beaklike at the apparent apex. 3. *P. PICTA*.

3. Leaf blades uniformly green above (4).
4. Leaf blades commonly shorter than the petiole, suborbicular, thickish; anther cells narrowed or beaklike at the apparent apex.
 4. P. CHLORANTHA.
4. Leaf blades equaling or longer than the petiole, elliptic or obovate-oval, thin; anther cells not or very slightly narrowed at the apparent apex.
 5. P. ELLIPTICA.

1. *Pyrola secunda* L., Sp. Pl. 396. 1753.

Mountains of Apache, Coconino, Graham, and Pima Counties, 7,200 to 9,500 feet, coniferous forests, July and August. Widely distributed in the Northern Hemisphere. Sidebells pyrola.

2. *Pyrola aphylla* J. E. Smith, Rees's Cycl. 29: No. 7. 1814.

"Northern Arizona," probably near Kanab, Utah (*Mrs. Thompson* in 1872).

This species, mainly of the Pacific Coast States, is represented in Arizona by var. *paucifolia* Howell (var. *foliosa* Andres?) with basal leaves having distinct but very small blades.³

3. *Pyrola picta* J. E. Smith, Rees's Cycl. 29: No. 8. 1814.

Pinaleno Mountains, Graham County, 9,700 feet (*Shreve* 4304, *Thorner* and *Shreve* 8048, in part). Montana to British Columbia, south to New Mexico, Arizona, and California.

4. *Pyrola chlorantha* Swartz, Svenska Vetensk. Akad. Handl. 1810: 190. 1810.

Lukachukai and White Mountains (Apache County) and Kaibab Plateau (Coconino County) to the Chiricahua Mountains (Cochise County) and Santa Catalina Mountains (Pima County), 6,500 to 10,000 feet, coniferous forests, July and August. Canada to the District of Columbia, New Mexico, Arizona, and California; Europe.

5. *Pyrola elliptica* Nutt., Gen. Pl. 1: 273. 1818.

Pinaleno Mountains, Graham County, 8,800 feet (*Shreve* 5257), Santa Catalina Mountains, Pima County, 7,500 feet (*Peebles* et al. 2524), reported also from the Grand Canyon, July. Canada to the District of Columbia, New Mexico, and Arizona. Shinleaf.

5. MONESES

Resembles *Pyrola* except in the characters given in the key to the genera.

1. *Moneses uniflora* (L.) A. Gray, Man. 273. 1848.

Pyrola uniflora L., Sp. Pl. 397. 1753.

San Francisco Peaks (Coconino County), Baldy Peak (Apache County), 10,000 to 11,500 feet, July and August. Widely distributed in the cooler parts of the Northern Hemisphere.

One of the most attractive of the Arizona high mountain plants.

6. ARBUTUS. MADROÑO

Usually a tree, up to 15 m. (50 feet) high, with smooth, thin, exfoliating bark; leaves alternate, thick, evergreen, somewhat shiny

³W. H. Camp (Aphyllous forms in *Pyrola*. *Torrey Bot. Club Bul.* 67: 453-465. 1940) has pointed out recently that several collections, including one by Mearns at Baker Butte, Coconino County, Ariz., comprise both *P. picta* and aphyllous or nearly aphyllous forms, under the same number. He concludes that *P. aphylla* is merely an extreme form of *P. picta* (forma *aphylla* (J. E. Smith) Camp).

above; flowers in terminal racemes or panicles; corolla urn-shaped, white or pink, the lobes short; stamens 10; fruit berrylike, the surface tessellate-warty.

1. *Arbutus arizonica* (A. Gray) Sarg., Gard. and Forest 4: 317. 1891.

Arbutus xalapensis H. B. K. var. *arizonica* A. Gray, Syn. Fl. ed. 2, 2¹: 396. 1886.

Mountains of Graham, Cochise, and Pima Counties, 4,000 to 8,000 feet, often with live oaks, April to September. Southwestern New Mexico, southeastern Arizona, and northern Mexico.

Arizona madroño.

7. ARCTOSTAPHYLOS.⁴ MANZANITA

Shrubs, large or small; leaves mostly alternate, thick, evergreen; flowers in terminal racemes or panicles, much like those of *Arbutus*; fruit globose, several-seeded, the surface (in the Arizona species) smooth or nearly so.

A. pungens and *A. pringlei* are characteristic plants of the chaparral association in Arizona. The wood is very hard and the smooth, mahogany-colored bark is distinctive. The plants are seldom browsed except by goats. Birds, bears, and other animals eat the fruits, and a delicious jelly can be made from the unripe fruits of *A. pungens*. *A. uva-ursi* is employed for treating disorders of the urinary tract, and it is reported that a decoction of the leaves of *A. pungens* has been used locally in Arizona as a remedy for stomach trouble.

Key to the species

1. Plant with creeping, much-branched stems, forming large mats close to the ground; leaf blades spatulate, obtuse or retuse----- 1. *A. UVA-URSI*.
1. Plants large shrubs; stems normally erect or ascending, 1 m. long or longer; leaf blades elliptic, lanceolate, or ovate, exceptionally oblanceolate or obovate (2).
 2. Twigs, leaves, pedicels, and calyx glandular-pilose; ovary (and often the mature fruit) pubescent; bracts commonly more than 3 mm. long, thin, often pink; leaf blades commonly rounded or subcordate at base.
 2. *A. PRINGLEI*.
 2. Twigs and leaves puberulent or subtomentose when young, then glabrate; pedicels, calyx, and ovary glabrous, or the calyx ciliolate; bracts commonly only 2 to 3 mm. long, thickish, firm (3).
 3. Leaf blades pale or bluish green, mostly elliptic or lanceolate, usually acute or acutish and pungent at apex, commonly narrowed or subcuneate at base, seldom more than 1.5 cm. wide; branches of the inflorescence subtomentose, not glandular----- 3. *A. PUNGENS*.
 3. Leaf blades bright green, broadly ovate or suborbicular, usually obtuse or rounded at apex and rounded or truncate at base, commonly 2 to 3 cm. wide; branches of the inflorescence glandular-pubescent.
 4. *A. PATULA*.

1. *Arctostaphylos uva-ursi* (L.) Spreng., Syst. Veg. 2: 287. 1825.

Arbutus uva-ursi L., Sp. Pl. 395. 1753.

Included in the Arizona flora on the doubtful basis of a collection labeled only "Arizona" (*Palmer* in 1869). Widely distributed in the cooler parts of the Northern Hemisphere. Known as bearberry, sandberry, and kinnikinnick.

⁴ References: EASTWOOD, ALICE. A REVISION OF ARCTOSTAPHYLOS. Leaflets West. Bot. 1: 105-127. 1934. ADAMS, J. E. A SYSTEMATIC STUDY OF THE GENUS ARCTOSTAPHYLOS Adams. Elisha Mitchell Sci. Soc. Jour. 56: 1-62. 1940.

2. *Arctostaphylos pringlei* Parry, Calif. Acad. Sci. Bul. 2: 494. 1887.

Southern Coconino County and Hualpai Mountain (Mohave County) to the Pinaleno Mountains (Graham County) and the Rincon and Santa Catalina Mountains (Pima County), 4,000 to 6,500 feet, common on dry slopes, often with cypress, juniper, and pinyon, April to June. Arizona, southern California, and Baja California.

A large shrub, often 2 m. (6 feet) high.

3. *Arctostaphylos pungens* H. B. K., Nov. Gen. et Sp. 3: 278. 1818.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, abundant on dry slopes, often accompanied by *A. pringlei*, March and April. New Mexico, southern Utah, Arizona, southern California, and Mexico.

Pointleaf manzanita. A smaller shrub than *A. pringlei*, with a more pronounced tendency to form dense thickets, these often nearly impenetrable because of the rigid, crooked stems. Exceptionally broad-leaved specimens, e. g., a collection at the Grand Canyon (*Tidestrom* 2350), resemble the next species except in the absence of glandular pubescence.

4. *Arctostaphylos patula* Greene, Pittonia 2: 171. 1891.

Arctostaphylos pungens var. *platyphylla* A. Gray, Syn. Fl. 2^d: 28. 1878.

Arctostaphylos platyphylla Kuntze, Rev. Gen. Pl. 2: 385. 1891.

Navajo Mountain and north rim of the Grand Canyon (Coconino County), 7,000 to 8,500 feet, coniferous forests, May and June. Colorado to northern Arizona and California.

Greenleaf manzanita. In Arizona a low shrub, commonly not more than 1 m. (3 feet) high, thicket-forming, the stems rooting where they touch the soil. Reported to be very resistant to fire. The foliage is brighter green than in the other species.

8. VACCINIUM. BLUEBERRY, WHORTLEBERRY

The Arizona species a low shrub, less than 0.5 m. high; twigs yellowish or tinged with red, acutely angled; leaf blades ovate, oval, oblanceolate, or obovate, distinctly serrulate, rounded to acutish at apex, 1 to 3 cm. long; corolla about 4 mm. long; fruit black purple, not glaucous, up to 8 mm. in diameter, juicy.

1. *Vaccinium oreophilum* Rydb., Torrey Bot. Club Bul. 33: 148. 1906.

White Mountains (Apache County), Pinaleno Mountains (Graham County), Santa Catalina Mountains (Pima County), 9,000 to 11,000 feet, July. Canada to New Mexico and Arizona.

This plant is closely related to *V. membranaceum* Dougl., a common species of the northwestern United States and British Columbia, but is smaller in all its parts. On Baldy Peak above 9,000 feet it is an important element of the ground cover in spruce forests.

95. PRIMULACEAE. PRIMROSE FAMILY

Plants herbaceous, annual or perennial, scapose or with leafy stems; leaves simple, entire or shallowly dentate; inflorescence various;

flowers perfect, regular; corolla gamopetalous but sometimes cleft nearly to the base; stamens inserted separately on the corolla; style and stigma 1; ovary superior or partly inferior, 1-celled.

The family includes some highly ornamental plants, notably several species of *Primula* that are much cultivated under the names primrose and cowslip, and the well known cyclamen.

Key to the genera

1. Ovary partly inferior, its base enveloped by and adnate to the base of the calyx tube..... 3. SAMOLUS.
1. Ovary superior, not adnate to the calyx tube (2).
2. Plants caulescent, the stems leafy; corolla rotate (3).
 3. Flowers numerous, in leafy panicles; corolla yellow; capsule dehiscent longitudinally..... 4. LYSIMACHIA.
 3. Flowers few, solitary, axillary; capsule circumscissile, globose; plants small, annual (4).
 4. Corolla normally red, longer than the calyx; leaves opposite; filaments bearded..... 5. ANAGALLIS.
 4. Corolla whitish, shorter than the calyx; leaves alternate; filaments not bearded..... 6. CENTUNCULUS.
2. Plants acaulescent or nearly so; flowers in umbels or solitary at the apex of the scape; corolla white or purplish pink, often with a differently colored eye (5).
 5. Corolla with entire reflexed lobes and a dark eye, showy; stamens inserted in the throat of the corolla, exerted, the filaments united at least at base, the anthers connivent around the pistil.... 7. DODECATHÉON.
 5. Corolla with erect or spreading lobes; stamens inserted in the tube of the corolla, included, the filaments separate, the anthers not connivent (6).
 6. Plants perennial; flowers relatively large and showy.... 1. PRIMULA.
 6. Plants annual; flowers small and inconspicuous..... 2. ANDROSACE

1. PRIMULA.⁵ PRIMROSE

Plants scapose, often tufted; calyx tube elongate, angled; corolla surpassing the calyx at anthesis, often with obcordate lobes, the limb pink or reddish purple, the throat open, greenish or yellowish; capsule opening apically by valves or teeth.

Key to the species

1. Scapes stout, up to 55 cm. long; leaf blades entire or nearly so; pedicels and calyx copiously to densely glandular-puberulent, not at all mealy; corolla with a limb 2 cm. or more in diameter, the lobes shallowly notched or nearly entire, the tube not or but slightly surpassing the calyx... 1. P. PARRYI.
1. Scapes slender, not more than 25 cm. long; leaf blades denticulate or dentate; pedicels and calyx not glandular-puberulent, more or less white-mealy; corolla with a limb less than 2 cm. in diameter, the lobes distinctly notched, the tube surpassing the calyx (2).
 2. Leaf blades denticulate or dentate, pruinose but not mealy beneath; calyx mealy only at base and near the margins of the lobes... 2. P. RUSBYI.
 2. Leaf blades conspicuously and irregularly dentate, more or less white-mealy beneath, at least when young; calyx mealy over most or all of its surface..... 3. P. SPECULICOLA.

1. *Primula parryi* A. Gray, Amer. Jour. Sci. ser. 2, 34: 257. 1862.

San Francisco Peaks (Coconino County), Baldy Peak (Apache County), 10,000 to 12,000 feet, among rocks, often along brooks, June to August. Montana and Idaho to New Mexico and Arizona.

The plant is showy but rather coarse, and the flowers have an odor of carrion.

⁵ Reference: WILLIAMS, L. O. REVISION OF THE WESTERN PRIMULAS. Amer. Midland Nat. 17: 741-748. 1936.

2. *Primula rusbyi* Greene, Torrey Bot. Club Bul. 8: 122. 1881.

Mountains of Graham, Cochise, and Pima Counties, 7,500 to 10,300 feet, usually on damp mossy ledges, May to July. New Mexico and southeastern Arizona.

3. *Primula specuicola* Rydb., Torrey Bot. Club Bul. 40: 461. 1901.

?*Primula hunnewellii* Fernald, Rhodora 36: 117. 1934.

North rim of the Grand Canyon, flowering June (*Eastwood* and *Howell* 1024, a rather large form with some of the scapes 15 cm. long), type of the doubtfully distinct *P. hunnewellii* also from the Grand Canyon. Southern Utah and northern Arizona.

2. ANDROSACE ⁶

Small tufted plants; flowers inconspicuous, slender-pedicelled, in umbels subtended by an involucre of small, nearly separate bracts; corolla constricted at the throat, white or whitish, not surpassing the calyx at anthesis.

Key to the species

1. Bracts subtending the inflorescences elliptic or ovate and more or less rhombic; plants of low altitudes (below 5,000 feet), flowering in early spring.
 1. *A. OCCIDENTALIS*.
1. Bracts lanceolate or subulate; plants of high altitudes (above 6,000 feet), flowering in summer----- 2. *A. SEPTENTRIONALIS*.

1. *Androsace occidentalis* Pursh, Fl. Amer. Sept. 137. 1814.

Graham, Pinal, Maricopa, Cochise, Santa Cruz, and Pima Counties, 1,200 to 5,000 feet, along streams and on hillsides, February to April. Western Canada to Illinois, Texas, and Arizona.

The var. *arizonica* (A. Gray) St. John (*A. arizonica* A. Gray) with larger, green and foliaceous calyx lobes, these more spreading than in the typical form or even slightly recurved, is found throughout most of the range of the species in Arizona. It often grows with the typical form and intergrades with it.

2. *Androsace septentrionalis* L., Sp. Pl. 142. 1753.

Kaibab Plateau (Coconino County), White Mountains (Apache County), south to the mountains of Cochise and Pima Counties, 7,000 to 12,000 feet, usually in springy places in coniferous forests, May to September. Widely distributed in the cooler parts of the Northern Hemisphere.

Key to the varieties

1. Scapes few, often only 1 strongly developed, this strictly erect; central pedicels straight, erect or nearly so, the outer ones mostly ascending (2).
 2. Pedicels not glandular----- *A. SEPTENTRIONALIS* (typical).
 2. Pedicels bearing dark stipitate glands----- var. *GLANDULOSA*.
1. Scapes several, of nearly equal length; pedicels mostly spreading or ascending-spreading (3).
 3. Plant pale green; scapes 10 to 25 cm. long, about twice as long as the slender, flexuous, wide-spreading, often very numerous pedicels.
 - var. *SUBULIFERA*.

⁶ Reference: ST. JOHN, HAROLD. REVISION OF CERTAIN NORTH AMERICAN SPECIES OF ANDROSACE. Victoria Mus. Mem. 126: 45-55. 1922.

3. Plants dark green or reddish; scapes less than 10 cm. long or, if slightly more than 10 cm. long, then more than twice as long as the pedicels (4).
4. Scapes not more than 3 cm. long; pedicels few, relatively short and stout.
var. SUBUMBELLATA.
4. Scapes 5 cm. long or longer; pedicels numerous (5).
5. Calyx glabrous or nearly so; pedicels sparsely puberulent.
var. DIFFUSA.
5. Calyx copiously to densely puberulent at base of the tube and on the lobes; pedicels usually densely puberulent. var. PUBERULENTA.

The varieties intergrade and are difficult to distinguish. The typical form of the species apparently does not occur in Arizona, but var. *glandulosa* (Woot. and Standl.) St. John (*A. glandulosa* Woot. and Standl.) has been collected several times in the region of Flagstaff and the San Francisco Peaks and in the White Mountains. The var. *subulifera* A. Gray (*A. subulifera* Rydb.) is reported from Prescott, and a form intermediate between var. *subulifera* and var. *glandulosa* from the base of the San Francisco Peaks. The var. *subumbellata* A. Nels. (*A. subumbellata* Small) occurs at higher altitudes than any other form, ascending to 12,000 feet on the San Francisco Peaks. By far the most abundant and widely distributed of the Arizona forms is var. *diffusa* (Small) Knuth (*A. diffusa* Small), which occurs throughout the range of the species in Arizona. The var. *puberulenta* (Rydb.) Knuth (*A. puberulenta* Rydb.) is not known definitely to occur in Arizona, but specimens from the Kaibab Plateau and the vicinity of Flagstaff have been so identified.

3. SAMOLUS. WATERPIMPERNEL

Plants mostly perennial, glabrous or nearly so; stems leafy, at least below; leaf blades broad, entire; flowers small, pedicelled, in loose racemes or panicles, the petals white; capsule globose, opening apically by valves.

Key to the species

1. Leaves crowded near the base of the stem, the blades broadly spatulate; pedicels bractless, ascending, rather stiff; corolla 3 mm. long or longer.
1. *S. EBRACTEATUS*.
1. Leaves scattered along the stem, the blades oval, elliptic, or somewhat obovate; pedicels bearing a small bract, spreading, lax; corolla less than 3 mm. long (2).
2. Stems erect or ascending, bearing several or numerous leaves; blades of the basal leaves commonly oval or elliptic; inflorescences several- to many-flowered; bract borne near the middle of the pedicel; calyx lobes shorter than the tube..... 2. *S. FLORIBUNDUS*.
2. Stems mostly procumbent, stolonlike, bearing few leaves; blades of the basal leaves obovate or spatulate; inflorescences few-flowered; bract borne usually near the base of the pedicel; calyx lobes equaling or longer than the tube..... 3. *S. VAGANS*.

*1. **Samolus ebracteatus** H. B. K., Nov. Gen. et Sp. 2: 223. 1817.

Not known definitely from Arizona but has been collected along the Muddy River, Nevada, near the northwestern border. Florida to Texas, southern Nevada; Mexico, West Indies.

2. **Samolus floribundus** H. B. K., Nov. Gen. et Sp. 2: 224. 1817.

Navajo, Yavapai, Greenlee, Pinal, and Pima Counties, 1,200 to 5,000 feet, wet soil along streams, April to August. Throughout most of North America; South America.

3. **Samolus vagans** Greene, Repert. Spec. Novarum Regni Veg. 7: 196. 1909.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, in sand near springs and brooks, May to October, type from Chiricahua Mountains (*Blumer* 1546). Apparently known only from southeastern Arizona.

4. LYSIMACHIA. LOOSESTRIFE

Plant perennial; stems leafy; leaves opposite or appearing whorled, the petioles conspicuously ciliate, the blades lanceolate or ovate-lanceolate; corolla rotate, yellow; stamens borne on a ring at base of the corolla, the 5 fertile ones alternating with 5 staminodia.

1. **Lysimachia ciliata** L., Sp. Pl. 147. 1753.

Steironema ciliatum Raf., Ann. Gén. Phys. 7: 192. 1820.

Apache, Coconino, and Gila Counties, 6,000 to 7,500 feet, moist rich soil, July and August. Canada to Georgia, New Mexico, Arizona, and Washington.

Represented in Arizona by var. *validula* (Greene) Kearney and Peebles (*Steironema validulum* Greene), which differs from most eastern specimens of *L. ciliata* in its relatively narrow leaf blades, these, at most, obscurely ciliate. The type of *S. validulum* was collected near Flagstaff, Coconino County (*Lemmon* in 1884).

5. ANAGALLIS. PIMPERNEL

Stems low, spreading or procumbent; leaves ovate, sessile; peduncles surpassing the leaves; corolla rotate with scarcely any tube, normally red, the lobes denticulate and bearing stalked glands on the margin.

The flowers quickly close at the approach of storms, hence the English name poormans-weatherglass.

1. **Anagallis arvensis** L., Sp. Pl. 148. 1753.

Sacaton (Pinal County), Tucson (Pima County), probably elsewhere, a weed in lawns, April and later. Widely distributed in North America; naturalized from Europe.

6. CENTUNCULUS. CHAFFWEED

Stems short, tufted, ascending, leafy; flowers small, nearly sessile; corolla with a rotate limb and a short tube, usually persistent at the apex of the capsule.

1. **Centunculus minimus** L., Sp. Pl. 116. 1753.

Graham, Santa Cruz, and Pima Counties, about 4,000 feet, wet soil along streams, apparently rare in Arizona but easily overlooked. Illinois and Minnesota to British Columbia, south to Florida, Texas, and Arizona; Europe.

7. DODECATHEON. SHOOTINGSTAR

Perennial acaulescent herbs, with a short rootstock, glabrous or nearly so; leaves in a basal rosette, petioled; scapes elongate, bearing 1 to many showy flowers in a terminal umbel; calyx and corolla deeply cleft, the lobes narrow; capsule ovoid, dehiscent by valves.

Handsome plants, sometimes cultivated as ornamentals.

Key to the species

1. Leaf blades thin, bright green, ovate or ovate-oblong, not or scarcely more than twice as long as wide, sinuate to coarsely dentate, rounded, truncate, or subcuneate at base, abruptly contracted into petioles often longer than the blades; flowers usually very few, sometimes solitary; corolla lobes white.----- 1. *D. ELLISIAE*.
1. Leaf blades thickish, dull green, oblanceolate, more (often much more) than twice as long as wide, entire or subsinuate, tapering into petioles shorter than the blades; flowers commonly 4 to 6; corolla lobes pink, drying purple (2).
 2. Filaments very short or nearly obsolete, purple; leaf blades up to 10 cm. long.----- 2. *D. RADICATUM*.
 2. Filaments well developed, one-third as long to equaling the anthers, yellow. leaf blades seldom more than 5 cm. long.----- 3. *D. PAUCIFLORUM*;

1. *Dodecatheon ellisiae* Standl., Biol. Soc. Wash. Proc. 26: 195. 1913.

Pinaleno Mountains (Graham County), Santa Catalina Mountains (Pima County), 8,000 to 9,500 feet, rich moist soil in coniferous forests, June to August. New Mexico and southern Arizona.

Resembles *D. dentatum* Hook., but the anthers are pointed and the short caudex is vertical.

2. *Dodecatheon radicans* Greene, Erythea 3: 37. 1895.

Apache, Navajo, and Coconino Counties, 6,200 to 10,000 feet, June to August. South Dakota and Wyoming to New Mexico and Arizona.

3. *Dodecatheon pauciflorum* (Durand) Greene, Pittonia 2: 72. 1890.

Dodecatheon meadia L. var. *pauciflorum* Durand, Pl. Pratten. 95. 1855.

"Northern Arizona" (*Palmer* 298, in 1877). Saskatchewan to British Columbia, south to Colorado, Arizona, and California.

96. PLUMBAGINACEAE. PLUMBAGO FAMILY

1. PLUMBAGO

Plant suffrutescent; leaves alternate, simple, with entire blades; flowers nearly sessile, in panicles of spikelike racemes, perfect, regular; calyx tubular, beset with stipitate glands; corolla gamopetalous, salverform, with a long slender tube; stamens 5, separate, free or nearly free from the corolla; capsule circumscissile near the base.

P. capensis, a South African species with sky-blue flowers, is often cultivated as an ornamental in the warmer parts of the United States. The roots and leaves of *P. scandens* are reported to cause dermatitis in susceptible persons.

1. *Plumbago scandens* L., Sp. Pl. ed. 2, 215. 1762.

Mountains of Pima County, 3,000 to 4,000 feet, in canyons, May to August. Southern Florida, southern Arizona, and widely distributed in tropical America.

Flowers whitish or tinged with blue.

97. SAPOTACEAE. SAPOTE FAMILY

The highly esteemed tropical American fruit sapodilla is produced by *Achras zapota* L., a tree that also yields chicle, from which chewing gum is manufactured.

1. BUMELIA

Large shrub with spiny branches; leaves mostly fascicled on the branchlets, the blades oblanceolate- or obovate-cuneate, rusty-lanate beneath; flowers small, perfect, regular, in axillary fascicles; corolla white, with lobelike appendages in the sinuses; stamens 10, of these 5 sterile and petallike; fruit a drupe, with 1 stone.

1. *Bumelia lanuginosa* (Michx.) Pers., Syn. Pl. 1: 237. 1805.

Sideroxylon lanuginosum Michx., Fl. Bor. Amer. 1: 122. 1803.

Cochise and Pima Counties, 4,000 to 5,300 feet, forming thickets along streams, June. Georgia and Florida to Illinois, Kansas, southern Arizona, and northern Mexico.

The Arizona form is var. *rigida* A. Gray (*B. rigida* Small), which has smaller, more strongly cuneate leaves than in the typical form of the species. In Arizona it is a shrub, ordinarily 2.4 to 3 m. (8 to 10 feet) high. The flowers are very fragrant. Gum exuded from the bark is reported to be used for chewing by children in Texas.

98. OLEACEAE. OLIVE FAMILY

Trees, shrubs, or herbs, of diverse habit; leaves simple or pinnate, alternate or opposite; flowers regular, perfect or unisexual, with or without a corolla; stamens 2 or 4; ovary 2-celled; fruit various.

The best-known members of this family are olive, ash, and lilac.

Key to the genera

1. Leaves pinnately compound or, if unifoliolate, then the blade broad, ovate, oval, or suborbicular; fruit with a conspicuous, mainly terminal, flat wing. 1. FRAXINUS.
1. Leaves simple; fruit not winged (2).
 2. Flowers often unisexual, appearing before the leaves; corolla none or rudimentary; fruit a 1-seeded drupe.----- 2. FORESTIERA.
 2. Flowers perfect, appearing after the leaves; corolla large; fruit a membranaceous, didymous capsule with 2 to 4 seeds in each cell. 3. MENODORA.

1. FRAXINUS.⁷ Ash

Trees or large shrubs; leaves opposite, commonly pinnate, petioled; flowers in racemes or panicles, mostly unisexual, apetalous or with a 4-parted corolla; stamens commonly 2, with large anthers; fruit dry, with a large flat terminal wing, indehiscent; seeds 1 or 2.

Some of the North American ashes are important timber trees, but the species occurring in Arizona do not grow large enough to make the wood valuable. The herbage is of limited value as browse. The Arizona ash (*F. velutina* var. *glabra*) is an exceptionally fine shade tree and is planted extensively in dooryards and along streets in southern Arizona.

Key to the species

1. Twigs evidently quadrangular; wing of the fruit extending nearly or quite to the base of the thin, strongly compressed body; twigs and foliage glabrous or glabrate (rarely decidedly pubescent in *F. lowellii*); corolla none; fruit elliptic or obovate, obtuse or truncate and often retuse at apex (2).

⁷ Reference: REHDER, ALFRED. THE GENUS FRAXINUS IN NEW MEXICO AND ARIZONA. Amer. Acad. Arts and Sci. Proc. 53: 199-212. 1917.

2. Leaves 1- or 3-foliolate, the single or terminal leaflet broadly ovate or orbicular, truncate or short-cuneate at base, commonly obtuse or retuse at apex, the margin entire to crenate; plant commonly a shrub.
 1. *F. ANOMALA*.
2. Leaves 3-, 5-, or 7-foliolate; leaflets elliptic or ovate, the terminal one usually obovate, cuneate at base, the margin crenate-serrate; plant a small tree.
 2. *F. LOWELLII*.
1. Twigs terete or rounded-quadrangular; wing of the fruit subterminal, not extending nearly to the base of the body, except sometimes in *F. macropetala* (3).
 3. Corolla present, 4-parted, white, 10 to 15 mm. long; body of the fruit thin, strongly compressed; leaflets not more than 4 cm. long, lanceolate to broadly ovate, acutish to acuminate or sometimes obtuse or emarginate, the margin entire or nearly so; fruit spatulate-oblong or oblong-lanceolate, the wing obtuse or truncate and often emarginate at apex.
 3. *F. MACROPETALA*.
 3. Corolla none; body of the fruit thick, more or less terete; leaflets commonly 5 or more (4).
 4. Old leaves persistent until the flowers appear; rachis narrowly winged; leaflets not more, usually much less, than 4 cm. long, coriaceous, sessile, oblanceolate, narrowly obovate, or elliptic, obtuse or acutish at apex, inconspicuously crenate or dentate, commonly 5; plant a shrub or small tree, glabrous or nearly so; wing of the fruit narrowly elliptic or oblanceolate, much longer than the thick body.
 4. *F. GREGGII*.
 4. Old leaves deciduous before the flowers appear; rachis not winged; leaflets commonly more than 4 cm. long, lanceolate to ovate, mostly acuminate and serrulate or serrate; plants normally small trees.
 5. *F. VELUTINA*.

1. **Fraxinus anomala** Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 283. 1871.

Apache County to Coconino County, 2,000 to 6,000 feet, especially common in the Grand Canyon, April. Western Colorado and New Mexico to northern Arizona and southeastern California.

Singleleaf ash. A shrub, sometimes 6 m. (20 feet) high.

2. **Fraxinus lowellii** Sarg. ex Rehder, Amer. Acad. Arts and Sci. Proc. 53: 211. 1917.

Southern Coconino County and eastern Mohave County to western Gila and eastern Maricopa Counties (perhaps also in the Santa Rita Mountains, Pima County), 3,200 to 6,500 feet, mostly along streams, March, type from Oak Creek Canyon (*Rehder* 53). Known only from Arizona.

Lowell ash, commonly shrubby, reaching a height of at least 7.5 m. (25 feet).

3. **Fraxinus macropetala** Eastw., Torrey Bot. Club Bul. 30: 494. 1903.

Fraxinus cuspidata Torr. var. *macropetala* Rehder, Amer. Acad. Arts and Sci. Proc. 53: 201. 1917.

Coconino County, chiefly in and near the Grand Canyon, May and June, type from the Grand Canyon (*Wootton* 1102). Known only from Arizona.

Flowering ash, the only species in Arizona having a corolla. The flowers are fragrant. The plant is commonly a large shrub with 1- to 5-foliolate leaves.

4. *Fraxinus greggii* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 63. 1877.

Near Ruby, Santa Cruz County, 4,000 to 5,000 feet, steep rocky slopes (*Goodding* in 1936). Western Texas, southern Arizona, and northern Mexico.

Gregg ash, a handsome shrub or small tree with smooth iron-gray bark and neat foliage. Further study may show the Arizona form to be at least a good variety. The twigs in this form are tomentulose and some of the leaves are 7-foliolate. As compared with specimens of *F. greggii* from Texas and Mexico, the leaflets are broader and more distinctly crenate, the body of the fruit is thinner, longer, more slender and less obtuse, and the wing extends farther toward the base of the fruit.

5. *Fraxinus velutina* Torr. in Emory, Mil. Recon. 149. 1848.

Fraxinus standleyi Rehder, Amer. Acad. Arts and Sci. Proc. 53: 208. 1917.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 2,000 to 7,000 feet, along streams, March and April. Western Texas to southern California and northern Mexico.

Velvet ash, usually a tree, reaching a height of at least 9 m. (30 feet), extremely variable. The typical form, with copiously pubescent herbage and leaflets subsessile or very short-stalked, is less common in Arizona than 2 varieties. These are: (1) var. *toumeyii* (Britton) Rehder (*F. toumeyii* Britton), similar to the typical form in pubescence but with distinctly stalked leaflets; (2) var. *glabra* (Thornber) Rehder (*F. glabra* Thornber), the Arizona ash, with twigs and foliage glabrous or nearly so, the leaflets usually distinctly stalked, often coarsely serrate, occasionally approaching in thickness those of var. *coriacea* (S. Wats.) Rehder. Both varieties occur throughout the range of the species in Arizona.

2. FORESTIERA. ADELIA

Large, much-branched shrubs; leaves simple, opposite or fascicled at the ends of the branchlets; flowers very small, apetalous or nearly so, in lateral clusters; calyx minute or none; fruit an ellipsoid or narrowly ovoid thin-fleshed drupe with a bony seed.

The tough wood of *F. neomexicana* is stated to have been used by the Hopi for making digging sticks.

Key to the species

1. Leaf blades with entire or slightly sinuate, more or less involute margins, lanceolate, oblanceolate, or narrowly oblong, not more (commonly less) than 6 mm. wide, usually 3 or more times as long as wide, commonly pubescent; filaments 3 to 5 mm. long, the anthers dark purple; drupes very asymmetric, ellipsoid or subclavate, about twice as long as thick.
 1. *F. PHILLYREOIDES*.
1. Leaf blades with crenulate or serrulate margins (rarely nearly entire), ovate, obovate, oblanceolate, or rhombic-elliptic, commonly more than 6 mm. wide, usually not more than twice (exceptionally 3 times) as long as wide; filaments usually not more than 3 mm. long, the anthers yellow; drupes symmetric or nearly so, ellipsoid or narrowly ovoid, commonly less than twice as long as thick. ----- 2. *F. NEOMEXICANA*.

1. **Forestiera phillyreoides** (Benth.) Torr., U. S. and Mex. Bound. Bot. 167. 1859.

Piptolepis phillyreoides Benth., Pl. Hartw. 29. 1840.

Forestiera shrevei Standl., Field Mus. Nat. Hist. Bot. Ser. 17: 205. 1937.

Southern Maricopa, Pima, and Yuma Counties, 2,500 to 4,000 feet, dry rocky slopes, often forming thickets, December to March, type of *F. shrevei* from the Ajo Mountains (*Shreve* 6201). Southern Arizona and Mexico.

Reaches a height of at least 2.5 m. (8 feet). What seems to be a form of this species, collected by L. N. Goodding on the summit of the Ajo Mountains, Pima County, has drupes 7.5 to 9.5 mm. long, whereas they do not usually exceed 8 mm. in length in this species.

2. **Forestiera neomexicana** A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 63. 1876.

Carrizo Mountains (Apache County) to Hualpai Mountain (Mohave County), south to southern Apache, Gila, and Yavapai Counties, 4,000 to 7,000 feet, April and May. Colorado and Utah to western Texas, New Mexico, Arizona, and California.

Commonly 1.8 to 2.5 m. (6 to 8 feet) high, varying greatly in leaf shape. The var. *arizonica* Gray (*F. arizonica* Rydb.), which has the twigs and sometimes the leaves copiously and often persistently soft-pilose (these glabrous or obscurely puberulent in the typical form), occurs throughout most of the range of the species in Arizona. The type of var. *arizonica* was collected near Prescott by E. Palmer. This variety seems to connect *F. neomexicana* A. Gray and *F. pubescens* Nutt.

3. MENODORA⁸

Perennial herbs or undershrubs; leaves simple, entire, mostly alternate; flowers showy, the corolla large, gamopetalous, rotate-campanulate, yellow; capsules didymous, thin-walled, circumscissile; seeds commonly 4 in each cell.

The plants are reported to be highly palatable to livestock, in some localities constituting a significant proportion of the total forage.

Key to the species

1. Calyx lobes normally 5 or 6, additional ones, if present, smaller; herbage and calyx glabrous or nearly so; leaves of the inflorescence mostly reduced to small subulate bracts----- 1. *M. SCOPARIA*.
 1. Calyx lobes 7 or more; herbage and calyx usually scabrous-puberulent; leaves of the inflorescence small but commonly foliaceous----- 2. *M. SCABRA*.

1. **Menodora scoparia** Engelm. in A. Gray, Bot. Calif. 1: 471. 1876.

Mohave, Yavapai, Gila, Pinal, Pima, and Yuma Counties, 3,500 to 5,000 feet, dry slopes and mesas, April to July. Arizona, southeastern California, and northern Mexico.

What appears to be an exceptional form of this species, collected in the Ajo Mountains, Pima County (*Goodding* 4392), is a low, dense shrub, woodier than is usual in *M. scoparia*.

⁸ Reference: STEYERMARK, J. A. A REVISION OF THE GENUS MENODORA. Mo. Bot. Gard. Ann. 19: 87-160. 1932.

2. Menodora scabra A. Gray, Amer. Jour. Sci. ser. 2, 14: 44. 1852.

Apache County to Coconino County, south to Pima County, 1,500 to 7,000 feet, dry mesas and slopes, April to August. Western Texas to southern Utah, Arizona, southeastern California, and northern Mexico.

In the southern part of the State, a form with woodier, more branched, longer stems, var. *ramosissima* Steyermark, is commoner than the typical form. The stems are sometimes nearly 1 m. long in this variety. Similar to var. *ramosissima* except in its longer corolla tube is var. *longituba* Steyermark, known only from the type collection in the Mazatzal Mountains (*Smart* 213).

99. LOGANIACEAE. LOGANIA FAMILY

A member of this family, *Strychnos nux-vomica* L., is the source of the powerful drug and poison, strychnine.

1. BUDDLEJA

Shrubs; leaves opposite or whorled; flowers small, in dense axillary clusters, these often forming leafy interrupted spikes; flowers perfect, regular, normally 4-merous; anthers sessile or nearly so; fruit a capsule, dehiscing apically, usually 2-valved.

Several exotic species are cultivated as ornamental plants, the best-known one being *B. davidii*, known as butterflybush and summer-lilac. *B. sessiliflora* is used medicinally in Mexico. The name of the genus is usually spelled *Buddleia*.

Key to the species

1. Herbage and inflorescence usually only moderately tomentose to glabrate; leaves distinctly petioled, the blades rather thin, with veins not or scarcely impressed above and not very prominent beneath, lanceolate to rhombic-ovate, acuminate at apex, usually tapering at base, entire or serrate, commonly at least 5 cm. long and 15 mm. wide; glomerules of flowers usually about 1 cm. in diameter..... 1. *B. SESSILIFLORA*.
1. Herbage and inflorescence densely and conspicuously lanate-tomentose; leaves sessile or nearly so, the blades thick, with veins deeply impressed above and very prominent beneath, linear or narrowly oblong-elliptic, obtuse or acutish at apex, crenate, seldom more than 3 cm. long and 6 mm. wide; glomerules of flowers usually much less than 1 cm. in diameter.
 2. *B. UTAHENSIS*.

1. Buddleja sessiliflora H. B. K., Nov. Gen. et Sp. 2: 345. 1818.

Buddleia pringlei A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 86. 1883.

Valley of the Santa Cruz River and foothills of the Santa Catalina Mountains, Pima County (*Thornber* 7571, 8097), flowering in spring. Southern Arizona and Mexico.

***2. Buddleja utahensis** Coville, Biol. Soc. Wash. Proc. 7: 69. 1892.

The writers have seen no specimens from Arizona, but the plant occurs so near the northwestern border that it is very likely to be found, eventually, within the State.

100. GENTIANACEAE. GENTIAN FAMILY

Plants herbaceous, annual or perennial, mostly glabrous; leaves simple, entire, commonly opposite, sessile; flowers solitary, or in simple

or compound cymes, perfect, regular, the corolla gamopetalous; stamens borne separately on the corolla, alternate with its lobes; style 1 or none; stigmas 1 or 2; ovary superior, 1-celled; fruit a capsule.

Key to the genera

1. Corolla lobes with 1 or 2 conspicuous fringed glands and pits toward the base of each lobe (2).
 2. Corolla not blue, the lobes 4, each with 1 or a pair of large copiously fringed glands and pits..... 3. FRASERA.
 2. Corolla normally blue, the lobes 4 or 5, each with a pair of sparsely fringed nectariferous pits at base..... 4. SWERTIA.
1. Corolla lobes without glands or pits, or these not fringed (3).
 3. Lobes of the corolla each bearing a conspicuous divaricate spur; corolla yellow..... 5. HALENIA.
 3. Lobes of the corolla without spurs; corolla not yellow, but sometimes ochroleucous in genus *Gentiana* (4).
 4. Corolla pink, without folds or fringes, salverform; anthers becoming spirally twisted after anthesis..... 1. CENTAURIUM.
 4. Corolla not pink; anthers not becoming twisted (5).
 5. Stamens inserted in the corolla tube; corolla with folds or plaits between the lobes, or fringed in the throat, or the margins of the lobes fringed or erose-dentate (if otherwise, then the corolla ochroleucous and not more than 1 cm. long); style short and stout, or none; inflorescence narrow and leafy, or the flowers solitary.
 2. GENTIANA.
 5. Stamens inserted in the corolla throat; corolla without folds or fringes, the lobes entire; style elongate; stigma very large, with broad flattened lobes; inflorescence a loose, small-bracted panicle.
 6. EUSTOMA.

1. CENTAURIUM

Plants annual or biennial; stems branched; calyx and the limb of the corolla 4- or 5-parted, the calyx lobes keeled, the corolla salverform; stamens inserted in the throat of the corolla; stigma 2-lobed. The name canchalagua is sometimes used for these plants.

Key to the species

1. Corolla lobes 5, at least 7 mm. long, nearly as long as the tube; stems up to 60 cm. long, slender or stout, with more than 6 pairs of leaves; leaves narrowly lanceolate or oblanceolate to broadly elliptic.
 1. C. CALYCOSUM.
1. Corolla lobes 4 or 5, not more than 5 mm. long; stems seldom more than 30 cm. long, slender, rarely with more than 6 pairs of leaves (2).
 2. Basal leaves not forming a rosette, not conspicuously wider than the stem leaves; plant normally strict, the branches, peduncles, and leaves erect or narrowly ascending; corolla lobes 4 or 5..... 2. C. EXALTATUM.
 2. Basal leaves forming a rosette, conspicuously wider than the stem leaves, plant rather lax, the branches, peduncles, and often the leaves ascending, spreading; corolla lobes normally 5..... 3. C. NUDICAULE.

1. *Centaurium calycosum* (Buckl.) Fernald, *Rhodora* 10: 54. 1908.

Erythraea calycosa Buckl., *Acad. Nat. Sci. Phila. Proc.* 1862: 7. 1863.

Centaurium arizonicum (A. Gray) Heller, *Muhlenbergia* 4: 86. 1908.

Almost throughout the State, 150 to 6,000 feet, moist soil, April to October. Western Texas to southern Utah, Nevada, Arizona, and northern Mexico.

There is much variation, especially in the width of the leaves and of the corolla lobes, but the writers find no satisfactory basis for the distinction of varieties.

- *2. *Centaurium exaltatum* (Griseb.) W. F. Wight, Contrib. U. S. Natl. Herbarium 11: 449. 1906.

Erythraea douglasii A. Gray, Bot. Calif. 1: 480. 1876.

The only specimen seen by the writers that is surely of this species and that may have come from Arizona is one labeled "Southern Utah, northern Arizona, etc." (Palmer in 1877). Nebraska to Washington, Utah, and California.

3. *Centaurium nudicaule* (Engelm.) Robinson, Amer. Acad. Arts and Sci. Proc. 45: 397. 1910.

Erythraea nudicaulis Engelm., Amer. Acad. Arts and Sci. Proc. 17: 222. 1882.

Santa Catalina and Baboquivari Mountains (Pima County), 3,000 to 4,000 feet, along streams, April and May, type from the Santa Catalina Mountains (Pringle in 1881). Southern Arizona and Baja California.

Specimens collected at Willow Spring, southern Apache County (Palmer in 1890), and in northeastern Pinal County (Smith 12994), seem to be intermediate between this species and *C. exaltatum*.

2. GENTIANA. GENTIAN

Plants annual or perennial; stems mostly erect, simple or sparingly branched; flowers terminal or axillary, solitary or in cymose clusters, these often forming narrow leafy panicles; corolla cylindric, funnel-form, or salverform, usually with folds, these often extended into teeth or fringed appendages between the lobes; stamens attached to the tube of the corolla; stigmas 2, or the stigma 2-lobed.

The medicinal use of gentian root is of great antiquity, but the drug is very mild and probably only a stimulant of gastric secretions. Many of the species are very beautiful in flower.

Key to the species

1. Flowers terminal and solitary; plant annual; stems not more than 12 cm. long; corolla 9 to 15 mm. long, the lobes entire or nearly so; alpine plants (2).
2. Leaves appressed to the stem, these and the calyx lobes with conspicuous white scarious margins; flower nearly sessile, or the peduncle not more than 1 cm. long; corolla salverform with a long, slender tube and spreading lobes, whitish or greenish purple, with broad, emarginate folds in the sinuses..... 1. G. FREMONTII.
2. Leaves not appressed or scarious-margined; flower borne on a peduncle 2 to 8 cm. long; corolla nearly cylindric, the tube about as wide as the throat, the lobes erect, pale blue (sometimes ochroleucous?) without folds in the sinuses, fringed in the throat..... 2. G. MONANTHA.
1. Flowers clustered or, if terminal and solitary, then the corolla more than 20 mm. long (3).
3. Corolla folded in the sinuses, the terminal portion of the folds free and bifid or irregularly dentate or laciniate; plant perennial; leaves thickish; corolla usually violet (4).
4. Flowers solitary or few (not more than 5), terminal and subterminal; corolla campanulate-funnel-form, 30 to 40 mm. long, rich violet with a green band externally between each pair of folds extending nearly to the apex, the folds 2-cleft at apex and nearly equaling the lobes.
 3. G. PARRYI.

4. Flowers usually several or numerous in a more or less elongate inflorescence, some of them usually axillary well below the apex of the stem; corolla narrowly funneiform or subcylindric (5).
5. Calyx irregular, spathaceous, cleft on one or both sides, toothless or with 1 or 2 subulate teeth much less than one-third as long as the tube.
 4. *G. FORWOODII.*
5. Calyx nearly regular, not spathaceous, with 5 well-developed teeth at least one-third as long as the tube; corolla nearly closed in anthesis (6).
 6. Inflorescence relatively short and dense, seldom constituting more than one-third of the length of the stem, not conspicuously leafy-bracted, the floral leaves erect or narrowly ascending, not surpassing the flowers; stem leaves (excluding the basal and floral ones) with lanceolate blades not more than 5 times as long as wide; calyx lobes oblong-lanceolate, equaling or somewhat longer than the tube; corolla 25 to 35 mm. long, the lobes acutish to acuminate.----- 5. *G. AFFINIS.*
 6. Inflorescence elongate and rather loose below, usually constituting more than one-third (sometimes one-half) of the length of the stem, conspicuously leafy-bracted, the floral leaves spreading and much surpassing the flowers; stem leaves with lance-linear blades 7 or more times as long as wide; calyx lobes subulate, from much shorter to longer than the tube; corolla 20 to 25 mm. long, the lobes obtuse and apiculate.----- 6. *G. BIGELOVII.*
3. Corolla without folds in the sinuses (7).
 7. Lobes of the corolla with erose or fimbriate margins; flowers usually 4-merous, solitary or not more than 3; corolla 25 mm. long or longer, not fimbriate internally (8).
 8. Plant perennial; flowers solitary, sessile or very nearly so, closely invested by the bractlike uppermost pair of leaves, occasionally also with 1 or 2 closely contiguous axillary flowers on short, bractless peduncles; corolla lobes long-fimbriate from below the apex nearly to the base; filaments bearded below; stems not more than 15 cm. long.----- 7. *G. BARBELLATA.*
 8. Plant annual; flowers solitary, on naked peduncles at least 2 cm. long (usually much longer); margins of the corolla lobes erose and fimbriate at and near the apex; filaments naked (9).
 9. Stems from base to the uppermost leaves not more than 25 cm. long, seldom with more than 3 pairs of leaves; peduncle up to 15 cm. long but usually much shorter; calyx lobes shorter to somewhat longer than the tube; corolla 25 to 45 (rarely 50) mm. long.
 8. *G. THERMALIS.*
 9. Stems to the uppermost leaves 20 to 50 cm. long, often with 4 or more pairs of leaves; peduncle 10 to 20 cm. long; calyx lobes much longer than the tube; corolla 45 to 60 mm. long. 9. *G. GRANDIS.*
7. Lobes of the corolla with entire or nearly entire margins; flowers usually 5-merous, numerous, in terminal and lateral clusters; corolla not more than 25 mm. long, fimbriate internally (except in *G. microcalyx*); plant annual or biennial; stems quadrangular, the angles often narrowly winged (10).
 10. Calyx without a distinct tube, parted or cleft very nearly to the base, the lobes strikingly dissimilar, 2 of them foliaceous, about one-third longer and at least twice as wide as the others; corolla pale blue or ochroleucous.----- 10. *G. HETEROSEPALA.*
 10. Calyx with a distinct but short tube, the lobes unequal in length and width but not strikingly dissimilar (11).
 11. Corolla 20 to 25 mm. long, ochroleucous; calyx lobes lanceolate, sharply acuminate; plant strict, the branches nearly erect.
 11. *G. WRIGHTII.*
 11. Corolla less than 20 mm. long (12).
 12. Calyx spathaceous (split down one side), the tube thin-scarious, much like the corolla in texture, whitish or purplish, much longer than the thick, subulate, green teeth, these less than 1 mm. long; corolla conspicuously fimbriate internally.
 12. *G. WISLIZENI.*

12. Calyx not spathaceous, the tube not like the corolla in texture, much shorter than the teeth (13).
 13. Plant open, the branches ascending at a relatively wide angle; calyx 2 to 3 mm. long; corolla ochroleucous, naked internally.
 13. G. MICROCALYX.
 13. Plant strict, the branches erect or nearly so; calyx 5 to 10 mm. long; corolla ochroleucous to violet, fimbriate internally.
 14. G. STRICTIFLORA.

1. **Gentiana fremontii** Torr. in Frém., Exped. Rocky Mount. Rpt. 94. 1845.

Chondrophylla fremontii A. Nels., Torrey Bot. Club Bul. 31: 245. 1904.

San Francisco Peaks (*Toumey* 490, in 1892), probably above 10,000 feet, summer. Alberta to New Mexico and northern Arizona.

2. **Gentiana monantha** A. Nels., Torrey Bot. Club Bul. 31: 244. 1904.

San Francisco Peaks, 11,500 to 12,000 feet (*Knowlton* 131, *Little* 4728), August. Colorado and Idaho to northern Arizona.

3. **Gentiana parryi** Engelm., Acad. Sci. St. Louis Trans. 2: 218. 1863.

Dasystephana parryi Rydb., Torrey Bot. Club Bul. 33: 149. 1906.

White Mountains (Apache and Greenlee Counties), Kaibab Plateau (Coconino County), 8,500 to 11,300 feet, alpine and subalpine meadows, August and September. Wyoming and Utah to New Mexico and eastern Arizona.

4. **Gentiana forwoodii** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 86. 1883.

De Motte Park, Kaibab Plateau (Buckskin Mountains), 9,000 feet (*Jones* 6056a), September. Alberta to Colorado and northern Arizona.

5. **Gentiana affinis** Griseb. in Hook., Fl. Bor. Amer. 2: 56. 1838.

Apache, Navajo, Coconino, and northern Greenlee Counties, 7,200 to 9,500 feet, mountain meadows, August to October. Saskatchewan to British Columbia, south to Colorado and northern Arizona.

Flowers dark blue or violet.

6. **Gentiana bigelovii** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 87. 1883.

Dasystephana bigelovii Rydb., Torrey Bot. Club Bul. 33: 149. 1906.

Mountains of Graham, Cochise, and Pima Counties, August and September. Colorado, New Mexico, and southeastern Arizona.

The Arizona form, which is very similar to *G. interrupta* Greene, was referred by Gray to *G. bigelovii*, but seems at least varietally distinct from typical *G. bigelovii* of northern New Mexico.

7. **Gentiana barbellata** Engelm., Acad. Sci. St. Louis Trans. 2: 216. 1863.

Anthopogon barbellatus Rydb., Torrey Bot. Club Bul. 33: 148. 1906.

San Francisco Peaks, 10,500 to 12,000 feet (*Knowlton* 126, *Brady* 725/2490, *Little* 4780), August and September. Wyoming to New Mexico and northern Arizona.

8. *Gentiana thermalis* Kuntze, Rev. Gen. Pl. 2: 427. 1891.

Gentiana elegans A. Nels., Torrey Bot. Club Bul. 25: 276.
1898.

Anthopogon elegans Rydb., Torrey Bot. Club Bul. 33: 148.
1906.

Pinaleno Mountains, Graham County, 9,000 feet (*Rothrock* 751, *Shreve* 5370), September. Mackenzie to New Mexico and Arizona.

9. *Gentiana grandis* (A. Gray) Holm, Ottawa Nat. 15: 110. 1901.

Gentiana serrata Gunner var. *grandis* A. Gray, Syn. Fl. ed. 2,
2¹: 117. 1886.

Huachuca and Santa Rita Mountains (Cochise and Pima Counties), 5,000 to 6,000 feet, rich soil in shade along brooks, September and October, type from near Babocomari, Cochise County. Known only from southern Arizona.

Arizona's most beautiful gentian, the very large fringed corolla with a violet-purple limb and white throat veined with purple. It is evidently closely related to the Mexican *G. superba* Greene.

10. *Gentiana heterosepala* Engelm., Acad. Sci. St. Louis Trans. 2: 215. 1853.

Amarella heterosepala Greene, Leaflets 1: 53. 1904.

Kaibab Plateau, Grand Canyon, and San Francisco Peaks (Cocconino County), White Mountains (Apache and Greenlee Counties), 7,000 to 11,000 feet, June to September. Colorado, Utah, New Mexico, and Arizona.

11. *Gentiana wrightii* A. Gray, Syn. Fl. ed. 2, 2¹: 118. 1886.

Known in Arizona only from the type collection, in Santa Cruz County near Santa Cruz, Sonora (*Wright* 1659), flowering in autumn. Southern Arizona and northern Mexico.

12. *Gentiana wislizeni* Engelm., Acad. Sci. St. Louis Trans. 2: 215. 1853.

Sierra Blanca (White Mountains), Apache County (*Rothrock* 799), Chiricahua Mountains, Cochise County (*Blumer* 1414, *Eggleston* 10819), 7,000 to 8,000 feet, openings in pine forest, September and October. Southeastern Arizona and northern Mexico.

13. *Gentiana microcalyx* Lemmon ex Engelm., Amer. Acad. Arts and Sci. Proc. 17: 222. 1881.

Chiricahua and Huachuca Mountains (Cochise County), Rincon, Santa Rita, and Santa Catalina Mountains (Pima County), 6,000 to 7,500 feet, frequent in rich soil in canyons, August to October, type from the Chiricahua Mountains (*Lemmon*). Known only from southern Arizona.

14. *Gentiana strictiflora* (Rydb.) A. Nels., Bot. Gaz. 34: 26. 1902.

Gentiana acuta Michx. var. *strictiflora* Rydb., N. Y. Bot. Gard. Mem. 1: 309. 1910.

Amarella strictiflora Greene, Leaflets 1: 53. 1904.

Kaibab Plateau and vicinity of Flagstaff (Coconino County), White Mountains (Apache and Greenlee Counties), 7,200 to 11,500 feet, mountain meadows and forests, August to September. Sas-

katchewan to Alaska, south to New Mexico, Arizona, and California.

The taxonomy of the forms closely related to *G. amarella* L. is confused. The Arizona specimens are probably referable to *G. scopulorum* (Greene) Tidestrom (*Amarella scopulorum* Greene) if the latter be considered as specifically distinct from *G. strictiflora*.

3. FRASERA⁹

Plants short-lived perennials; stems tall, leafy or subscapose; leaves opposite or in whorls; flowers in cymes, these forming ample panicles; corolla greenish usually flecked with purple, rotate, deeply 4-lobed, each lobe with 1 or 2 large fringed glands toward the base; filaments often united at base; style persistent; stigma 2-lobed; seeds flat, winged.

It is reported that the Apache Indians ate the bitter roots of *Frasera speciosa*, but the root of *F. carolinensis* of the eastern United States is known to possess emetic and cathartic properties.

Key to the species

1. Plant not scapose; stems very tall and stout, with numerous whorls and pairs of large leaves, even those of the inflorescence foliaceous; leaf blades membranaceous, not white-margined, the basal ones 3 to 14 cm. wide; herbage puberulent or glabrous; glands 2 on each corolla lobe, elongate, the pits not tubular below, very conspicuously fringed..... 1. *F. SPECIOSA*.
1. Plant scapose or subscapose, all of the stem leaves much smaller than the basal ones, the uppermost reduced to small bracts, none of them in whorls; leaf blades coriaceous, usually conspicuously white-margined, the basal ones not more than 2 cm. wide; gland 1 on each corolla lobe, sometimes deeply notched, the pit or pits elongate, fringed, tubular toward the base (2).
 2. Stems tall, often 1 m. long, seldom branched near the base, usually rather sparingly branched above, the branches erect or ascending; basal leaves plane or with moderately undulate margins; corolla lobes obtuse or apiculate, the gland proper broad, the pit double, with margins appearing as 4 fringed crests..... 2. *F. PANICULATA*.
 2. Stems seldom more than 0.5 m. long, branched from near the base, the branches numerous and ascending-spreading; basal leaves with conspicuously crisped margins; corolla lobes cuspidate-acuminate, the gland narrow, the pit single, with margins appearing as 2 fringed crests.
 3. *F. ALBOMARGINATA*.

1. *Frasera speciosa* Dougl. ex Hook., Fl. Bor. Amer. 2: 66. 1838.

Frasera venosa Greene, Pittonia 4: 185. 1900.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,200 to 8,500 feet, common in rich soil in open pine forests, May to August. South Dakota to Oregon, south to New Mexico, Arizona, and California.

Deers-ears. A large-leaved conspicuous plant with stout stems up to 1.8 m. (6 feet) high.

2. *Frasera paniculata* Torr., U. S. Rpt. Expl. Miss. Pacific 4: 126. 1856.

Apache County to northeastern Mohave County north of the Colorado River, 4,500 to 7,500 feet, June. New Mexico and northern Arizona.

The stems reach a height of 1 m. (3.5 feet), from a thick, yellow root.

⁹ Reference: CARD, H. H. A REVISION OF THE GENUS FRASERA. Mo. Bot. Gard. Ann. 18: 245-282. 1931.

3. *Frasera albomarginata* S. Wats. in King, Geol. Expl. 40th Par. 5: 280. 1871.

Navajo County to Mohave County, on both sides of the Grand Canyon, 4,800 to 5,700 feet, June and July. Southern Utah and northern Arizona to southeastern California.

4. SWERTIA

A perennial herb, very similar to *Frasera* except in the characters given in the key to the genera.

Frasera is combined with *Swertia* by some authorities.

1. *Swertia perennis* L., Sp. Pl. 226. 1753.

Swertia scopulina Greene, Pittonia 4: 184. 1900.

White Mountains, Apache County (*Ellis* 17 in part, *Peebles* and *Smith* 12501), about 10,000 feet, August. Montana to New Mexico and eastern Arizona; Eurasia.

Corolla deep slate blue, white-veined beneath.

5. HALENIA

Small annual herb; stems erect, leafy, usually simple; flowers in panicles of cymes; corolla light yellow, without glands, folds, or fringe, the lobes erect, usually extended at base into nectariferous spurs; stigmas 2, sessile, persistent; capsule somewhat flattened.

1. *Halenia recurva* (Smith) Allen, Mo. Bot. Gard. Ann. 20: 161. 1933.

Swertia recurva Smith, Rees's Cycl. 34: 9. 1819.

Halenia rothrockii A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 84. 1876.

White Mountains (northern Greenlee County) and Mogollon Escarpment (southern Coconino County) to the Chiricahua Mountains (Cochise County), 7,500 to 10,000 feet, rich moist soil in coniferous forests, August and September, type of *H. rothrockii* from Mount Graham (*Rothrock* 733). Arizona and northern Mexico.

6. EUSTOMA

Plant perennial, glaucous; stems leafy, erect or nearly so, up to 0.7 m. (2.5 feet) high; leaves oblong, oblong-lanceolate, or slightly oblanceolate; calyx lobes keeled, long-acuminate; corolla deeply campanulate, violet, the lobes 2 to 3 cm. long, about twice as long as the tube; capsule ellipsoid, very obtuse, 2-valved.

1. *Eustoma exaltatum* (L.) Griseb. in DC., Prodr. 9: 51. 1845.

Gentiana exaltata L., Sp. Pl. ed. 2, 331. 1762.

Eustoma silenifolium Salisb., Parad. London. pl. 34. 1805.

Gila, Maricopa, and Pima Counties, 1,000 to about 2,500 feet, along ditches and in beds of streams, June to September. Florida, southern Arizona, southern California, and Mexico.

Catchfly-gentian, a very showy plant, rare in Arizona.

101. APOCYNACEAE. DOGBANE FAMILY

Plants perennial, herbaceous or slightly woody at base, commonly with acrid milky juice; leaves simple, entire, opposite or alternate; flowers perfect, regular, 5-merous; stamens attached separately to the corolla; pistils 2, the ovaries separate, superior, the styles or the stigmas united; fruit a pair of elongate follicles; seeds often with coma.

This mainly tropical family comprises many handsome plants, including the well-known oleander (*Nerium oleander* L.). Not a few of the Apocynaceae are poisonous.

Key to the genera

1. Anthers not produced at base, free from the stigma; leaves all, or mostly, alternate; corolla normally blue or bright yellow; seeds naked, or comose at both ends (2).
2. Corolla not constricted at the throat, bright yellow, the lobes longer than the tube; seeds with coma at both ends..... 1. HAPLOPHYTON.
2. Corolla constricted at or near the throat, blue (exceptionally whitish), the lobes shorter than the tube; seeds naked..... 2. AMSONIA.
1. Anthers produced basally into a sterile appendage below the polliniferous portion, connivent around and more or less adherent to the stigma; leaves opposite; corolla whitish or pink; seeds with apical coma (3).
3. Flowers few, large and showy; corolla salverform, with a long tube and a long throat; stamens inserted in the throat of the corolla; ovary superior. 3. MACROSIPHONIA.
3. Flowers numerous, small; corolla campanulate, cylindric, or urceolate; stamens inserted near the base of the corolla; ovary partly inferior. 4. APOCYNUM.

1. HAPLOPHYTON. COCKROACH-PLANT, HIERBA-DE-LA-CUCARACHA

Stems branched, woody below; leaves mostly alternate, bright green, the blades lanceolate or lance-ovate; flowers showy, terminal, solitary or in clusters of 2 or 3, the corolla bright yellow, salverform, with broad lobes longer than the tube; follicles slender, terete; seeds long, slender, black, with a pappuslike, deciduous tuft of long white hairs at each end.

Superficially, this plant somewhat resembles *Menodora*. An extract of the dried leaves, mixed with molasses, is an effective poison for insects such as cockroaches, flies, mosquitoes, fleas, and lice.

1. *Haplophyton cimicidum* A. DC. in DC., Prodr. 8: 412. 1844.

Pinal and Pima Counties, 2,500 to 4,500 feet, rocky slopes and canyons, July to September. Southern Arizona and Mexico.

2. AMSONIA¹⁰

Plants herbaceous; stems leafy, commonly erect, often numerous from 1 root; leaves alternate or appearing whorled, sessile or short-petioled; flowers in terminal cymose panicles; corolla salverform, pale blue or whitish; seeds numerous, in one series, cylindric.

The Arizona species grow in the open or among shrubs, often along streams and washes, preferring sandy soil.

¹⁰ Reference: WOODSON, ROBERT E., JR. STUDIES IN THE APOCYNACEAE. III. A MONOGRAPH OF THE GENUS AMSONIA. Mo. Bot. Gard. Ann. 15: 379-434. 1928.

Key to the species

1. Pods torulose (constricted between the seeds on the edges as well as on the faces), more or less compressed; corolla lobes 4 to 7 mm. long (2).
2. Stems and leaves lanate-tomentose, the hairs subappressed; pods pubescent, usually permanently so; corolla tube and throat 8 to 12 mm. long.
 1. *A. TOMENTOSA*.
2. Stems, leaves, and pods glabrous (3).
 3. Blades of the upper leaves lanceolate or ovate-lanceolate; corolla tube and throat 7 to 10 mm. long----- 2. *A. BREVIFOLIA*.
 3. Blades of the upper leaves linear or linear-lanceolate; corolla tube and throat 10 to 20 mm. long----- 3. *A. EASTWOODIANA*.
1. Pods not torulose (4).
 4. Lobes of the corolla very nearly as long as the tube, 5 to 7 mm. long; plant glabrous; leaf blades broadly ovate to ovate-oblong, 3 to 5 cm. long, 1.5 to 3 cm. wide, slightly glaucous; calyx 2 mm. long-- 4. *A. JONESII*.
 4. Lobes of the corolla not more than half as long as the tube (5).
 5. Corolla tube very slender below, swollen toward the apex, slightly constricted just below the limb but without a distinct neck, 16 to 18 mm. long; lobes of the corolla about 10 mm. long, half as long as the tube; plant glabrous; leaves slightly dimorphic, the upper ones almost filiform, shorter and more crowded than the middle ones.
 5. *A. GRANDIFLORA*.
 5. Corolla tube relatively stout, swollen near the middle, usually strongly constricted below the limb and with a distinct neck; lobes of the corolla less than 10 mm. long, rarely more than one-third as long as the tube (6).
 6. Pods compressed, regularly but shallowly impressed on the faces between the seeds, about 6 mm. wide at maturity, glabrous; seeds fully 10 mm. long; herbage soft-villous with spreading hairs, rarely glabrate; leaves short-petioled, the blades of the upper ones lanceolate, 5 mm. wide or wider; corolla lobes 3 to 4 mm. long.
 6. *A. KEARNEYANA*.
 6. Pods terete or nearly so, not impressed between the seeds or irregularly and obscurely so, 3 to 4 mm. wide; seeds (so far as known) seldom more than 8 mm. long (7).
 7. Leaf blades linear-lanceolate to ovate-lanceolate, the largest ones sometimes 2 cm. wide; calyx lobes long-ciliate; herbage glabrous to villous; corolla lobes 4 to 8 mm. long----- 7. *A. HIRTELLA*.
 7. Leaf blades mostly linear, the lower ones narrowly lanceolate or oblanceolate, all much less than 1 cm. wide; calyx and herbage glabrous or very nearly so (8).
 8. Corolla lobes 3 to 4 mm. long, one-fifth to one-third as long as the tube, the latter 10 to 15 mm. long----- 8. *A. PALMERI*.
 8. Corolla lobes 7 to 12 mm. long, fully one-third as long as the tube, the latter 16 to 18 mm. long----- 9. *A. PEEBLESHII*.

1. *Amsonia tomentosa* Torr. and Frém. in Frém., Exped. Rocky Mount. Rpt. 316. 1845.

Along the Big Sandy River, southern Mohave County (*Goodding* 6379). Southern Nevada, western Arizona, and southeastern California.

Goodding's collection represents the typical broad-leaved form of the species. A narrow-leaved form, var. *stenophylla* Kearney and Peebles, occurs in Monument Valley (Navajo County) and along the Colorado and Little Colorado Rivers (eastern Coconino County), about 5,000 feet. This variety is nearly intermediate between *A. tomentosa* and *A. arenaria* Standl., the latter being a species of western Texas, southern New Mexico, and Chihuahua.

2. *Amsonia brevifolia* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 64. 1876.

Known in Arizona only by the type collection at Mokiak Pass, northern Mohave County (*Palmer* 302), flowering in spring. Southern Utah and northern Arizona to southern California.

3. *Amsonia eastwoodiana* Rydb., Torrey Bot. Club Bul. 40: 465. 1913.

Near Holbrook, Navajo County (*Ward* in 1901), Lees Ferry, Coconino County (*Jones* in 1890, *Peebles* 13021), 3,200 to 5,000 feet, May to June. Southern Utah and northeastern Arizona.

4. *Amsonia jonesii* Woodson, Mo. Bot. Gard. Ann. 15: 414. 1928.

Navajo Spring, western edge of the Kaibab Indian Reservation, Pagumpa Springs, and Pipe Springs (Coconino and Mohave Counties), 4,000 to 5,000 feet, April and May. Colorado, Utah, and northern Arizona.

5. *Amsonia grandiflora* Alexander, Torrey 34: 116. 1934.

Near Patagonia and Ruby (Santa Cruz County), 4,000 to 4,500 feet, April and May, type from near Patagonia (*Peebles* and *Harrison* 6986). Southern Arizona and northern Mexico.

6. *Amsonia kearneyana* Woodson, Mo. Bot. Gard. Ann. 15: 415. 1928.

Plains and mouths of canyons along the western front of the Baboquivari Mountains (Pima County), about 3,500 feet, March and April, type collected by F. A. Thackery (No. 55). Known only from this well-isolated locality, which is farther southwest than any other recorded station of *Amsonia* in Arizona.

7. *Amsonia hirtella* Standl., Biol. Soc. Wash. Proc. 26: 118. 1913.

Amsonia pogonosepala Woodson, Mo. Bot. Gard. Ann. 15: 412. 1928.

Amsonia arizonica A. Nels., Amer. Jour. Bot. 18: 432. 1931.

Greenlee and Graham Counties to Mohave, Maricopa, and Pinal Counties, 1,500 to 5,000 feet, March to April, type of *A. pogonosepala* from near Clifton, Greenlee County (*Rusby* 256), type of *A. arizonica* from south of Ash Fork, Yavapai County (*Nelson* 10247). Western Texas to Arizona and Chihuahua.

Typical *A. hirtella*, with copious pubescence and linear-lanceolate leaves, has been collected along the Salt River in eastern Maricopa County (*Peebles* 11655). Much more common in Arizona is a glabrous or nearly glabrous form with some of the leaves usually broadly lanceolate (*A. pogonosepala*).

8. *Amsonia palmeri* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 64. 1876.

Mohave and Yavapai Counties, 2,500 to 4,300 feet, March to May (occasionally September). Known only from Arizona, where the type was collected by E. Palmer, without definite locality.

9. *Amsonia peeblesii* Woodson, Torrey Bot. Club Bul. 63: 35. 1936.

Eastern Coconino County, 4,500 to 5,000 feet, April to June, type from near Leupp (*Peebles* 9568). Known only from northern Arizona.

Resembles *A. eastwoodiana*, except in the characters of the fruit.

3. MACROSIPHONIA

Plant low, suffrutescent, puberulent or glabrate; leaves opposite, the blades ovate or elliptic-ovate; flowers mostly terminal, solitary or in 2's or 3's, sessile or nearly so; corolla funnellform, the limb 1.5

to 2.5 cm. wide; anthers connivent and cohering with the large stigma.

The showy white flowers, opening in the evening, are said to be used medicinally in Mexico. The plant is browsed by livestock (*L. N. Goodding*, personal communication) but, like most plants of this family, it is suspected of being poisonous.

1. *Macrosiphonia brachysiphon* (Torr.) A. Gray, Syn. Fl. 2¹: 83. 1878.

Echites brachysiphon Torr., U. S. and Mex. Bound. Bot. 159. 1859.

? *Macrosiphonia dulcis* A. Nels., Amer. Jour. Bot. 21: 577. 1934.

Cochise, Santa Cruz, and eastern Pima Counties, 4,000 to 5,500 feet, dry mesas and slopes, August and September, type of *M. dulcis* (not seen by the writers), from the Huachuca Mountains (*Goodding* 2413). Southern New Mexico and Arizona, northern Mexico.

4. APOCYNUM.¹¹ DOGBANE, INDIAN-HEMP

Plants herbaceous; stems leafy, commonly erect; leaves large, opposite (exceptionally in whorls of 3); flowers small for the family, in usually dichotomous compound cymes; corolla cylindric, urceolate, or campanulate, pink or whitish, the tube with internal basal appendages; anthers connivent and coherent with the stigma; follicles long, slender, terete.

The American aborigines used the bark of *Apocynum* for cordage. A cardiac stimulant similar, although inferior, to digitalin has been obtained from the root of *A. cannabinum*. The medicinal properties of the plant appear to have been known to the Indians. Some, if not all, of the species develop cyanogen and are toxic to cattle, horses, and sheep in both the green and the dry state.

Key to the species

1. Corolla whitish or greenish, cylindric or narrowly urceolate, seldom more than 3 mm. long, not more (usually less) than twice as long as the calyx, the lobes erect or nearly so; leaves ascending or somewhat spreading, slightly paler beneath (2).
 2. Calyx lobes less than 2 mm. long; corolla cylindric; plant glabrous throughout; leaves mostly short-petioled, the blades narrowed at base.
 1. *A. SUKSDORFII*.
 2. Calyx lobes 2 mm. long or longer (3).
 3. Leaves of the main stem distinctly petioled, the blades narrowed at base, oblong-lanceolate to ovate; plant pubescent or glabrous.
 2. *A. CANNABINUM*.
 3. Leaves of the main stem sessile or subsessile, the blades rounded or subcordate at base, lanceolate or oblong-lanceolate; plant glabrous throughout.----- 3. *A. SIBIRICUM*.
1. Corolla normally pink or striped with pink, campanulate or broadly urceolate, usually at least 4 mm. long, 2 to 3 times as long as the calyx, the lobes more or less spreading; leaves wide-spreading or drooping, the blades commonly ovate or oblong-ovate, deep green above, conspicuously paler or whitish beneath (4).
 4. Calyx usually about one-third as long as the corolla; corolla 5 mm. long or longer, broadly campanulate, the lobes conspicuously spreading, often recurved at apex.----- 4. *A. ANDROSAEMIFOLIUM*.
 4. Calyx about half as long as the corolla; corolla 4 to 5 mm. long, narrowly campanulate or urceolate, the lobes moderately or slightly spreading, not recurved.----- 5. *A. MEDIUM*.

¹¹ Reference: WOODSON, ROBERT E. JR. STUDIES IN THE APOCYNACEAE I. Mo. Bot. Gard. Ann. 17: 83-212. 1930.

1. *Apocynum suksdorfii* Greene, Pittonia 5: 65. 1902.

Apache County to Coconino and Yavapai Counties (apparently also in the Santa Catalina Mountains, Pima County), 3,000 to 7,000 feet, May to August. Colorado to Washington, south to New Mexico and Arizona.

The var. *angustifolium* (Wooton) Woodson (*A. angustifolium* Wooton), with lanceolate leaf blades not more than 2 cm. wide, is more common in Arizona than the typical form which has oblong-lanceolate blades, some of them commonly at least 2.5 cm. wide.

A. jonesii Woodson, known only by the type collection at Flagstaff, Arizona (*M. E. Jones* in 1884), is closely related to *A. suksdorfii*, differing chiefly in having somewhat broader calyx lobes and a somewhat more urceolate corolla.

2. *Apocynum cannabinum* L., Sp. Pl. 213. 1753.

Collections in the White Mountains (Apache County), at Fort Whipple (Yavapai County), and in the Huachuca Mountains (Cochise County) are cited by Woodson, who refers them to var. *glaberrimum* A. DC., characterized by absence of pubescence. The species occurs throughout the United States and in southern Canada.

3. *Apocynum sibiricum* Jacq., Hort. Bot. Vind. 3: 37. 1770.

Apocynum hypericifolium Ait., Hort. Kew. 1: 304. 1789.

Willow Spring, southern Apache County (*Palmer* 511), White Mountains, Navajo County (*Hough* 109), Clemenceau, Yavapai County (*W. W. Jones* 79), June to July. Throughout much of North America.

The form occurring in Arizona is var. *salignum* (Greene) Fernald (*A. salignum* Greene), which has a narrower corolla tube than in typical *A. sibiricum*.

4. *Apocynum androsaemifolium* L., Sp. Pl. ed. 2, 311. 1762.

Apocynum ambigens Greene, Pl. Baker. 3: 17. 1901.

Apache County to Coconino County, south to Cochise and Pima Counties, 7,000 to 8,800 feet, openings in pine forests, etc., June and July. Canada southward to Georgia and Arizona.

The most attractive of the species occurring in Arizona and also the most widely distributed and abundant. Most of the Arizona specimens belong to the presumably typical form, with leaves pubescent beneath, but var. *glabrum* Macoun (*A. ambigens* Greene), with leaves glabrous beneath, has been collected in the White Mountains, Apache County (*Goodding* 1210), and at Flagstaff, Coconino County (*Thorner* in 1930).

5. *Apocynum medium* Greene, Pittonia 3: 229. 1897.

Apocynum abditum Greene, Leaflets 2: 105. 1910.

Coconino, Yavapai, Gila, and Cochise Counties, 5,000 to 7,000 feet, May to August, type of *A. abditum* from the Coconino National Forest (*Pearson* 235). Throughout much of North America.

The typical form, with leaves pubescent beneath, is much more common in Arizona than var. *floribundum* (Greene) Woodson (*A. floribundum* Greene) with leaves entirely glabrous. The variety has been collected at the Grand Canyon (*Hitchcock* in 1915) and near Prescott (*Sparks* in 1902).

102. ASCLEPIADACEAE. MILKWEED FAMILY

Plants perennial, herbaceous or somewhat woody, mostly with milky sap; leaves simple, entire-margined; flowers perfect, regular, 5-merous, usually in umbels, of highly specialized structure; stamens and style coherent in a column, this adnate to the base of the corolla, a crown (corona) of separate or united, often hoodlike appendages usually present between the corolla and the column, and adnate to one or the other or both; anthers commonly winged, often scariosus-tipped; pollen in pear-shaped masses (pollinia), usually 1 in each anther cell, these attached in pairs to the summit of the column; ovaries 2, united only by the common stigma; fruit a pair of follicles (or 1 by abortion); seeds usually with a pappuslike crown of fine bristles or hairs.

The flowers of this family rival those of the Orchidaceae in complexity of structure and in the manner in which they are adjusted for cross-pollination by insects. The plants are probably somewhat poisonous to livestock but are scarcely eaten except when other forage is unavailable.

Key to the genera

1. Stems not twining, commonly erect; leaves never sagittate or deeply cordate at base; anthers scariosus-tipped, usually conspicuously so (2).
2. Corolla bearded within with stiff, white hairs; segments of the crown flat or slightly concave, not crested within..... 11. *PHEROTRICHIS*.
2. Corolla not bearded within, at most puberulent; segments of the crown strongly concave, at least at base (3).
3. Hoods (segments of the crown) not appendaged within or, if so (in *Acerates rusbyi*) then the stems tall and wandlike, the leaves mostly alternate, narrowly linear and elongate, and the inflorescences lateral (4).
4. Leaves all opposite, the blades oval or ovate; inflorescences terminal or subterminal; flowers dark red; hoods concave only near the base, strap-shaped above, much surpassing the column, with long narrow auricles at base; anther wings widest at base.. 2. *GOMPHOCARPUS*.
4. Leaves mostly alternate or only approximately opposite, the blades lanceolate or narrower; inflorescences lateral; flowers greenish or tinged with pale purple; hoods concave most of their length, not surpassing the column, with short broad auricles at base; anther wings widest above the base 3. *ACERATES*.
3. Hoods crested within with a winglike or hornlike appendage; inflorescences often terminal as well as lateral (5).
5. Corolla mostly reflexed in anthesis; anther wings widened down to the base, usually triangular; hoods involute or complicate, not arched at apex..... 4. *ASCLEPIAS*.
5. Corolla rotate-spreading in anthesis; anther wings narrowed at base, broadest near the middle; hoods arched and hollow at apex. 5. *ASCLEPIODORA*.
1. Stems twining; flowers lateral, solitary or clustered (6).
6. Crown none, the campanulate corolla and the staminal column unappendaged; stems filiform; leaves narrowly linear, almost filiform; flowers yellowish, less than 3 mm. long..... 1. *ASTEPHANUS*.
6. Crown present, sometimes reduced to subulate teeth; leaf blades cordate or sagittate (7).
7. Anthers not or very inconspicuously scariosus-tipped (8).
8. Corolla greenish or brownish, rotate-campanulate or funnellform-campanulate; segments of the crown each with a median winglike internal crest; stems puberulent or pilose with soft, more or less retrorse hairs. 10. *GONLOBUS*.
8. Corolla whitish, funnellform-campanulate; segments of the crown not wing-crested within; stems hirsute or pilose with stiff hairs. 12. *LACHNOSTOMA*.

7. Anthers conspicuously scarious-tipped; corolla rotate or broadly campanulate, deeply lobed, the tube very short (9).
9. Corolla rotate, the lobes short, ovate, flat; crown double, the outer portion annular and adnate to the base of the corolla, the inner portion consisting of 5 large turgid bodies adnate to the base of the column; inflorescences pedunculate, umbellike.
8. FUNASTRUM.
9. Corolla very open-campanulate, the lobes elongate, lanceolate or strap-shaped, recurved at apex, more or less pubescent within; crown single, the segments lanceolate or subulate, at least above; stems with a well-defined line of pubescence (10).
10. Leaves long-petioled the blades triangular-ovate, cordate, thin; inflorescences short-racemose or corymbiform, pedunculate, several-flowered; corolla 8 mm. long or longer, whitish, with strap-shaped lobes; segments of the crown subulate from a broad, ovate, or subquadrate base, nearly equaling to slightly surpassing the corolla lobes ----- 9. MELLICHAMPIA.
10. Leaves short-petioled or sessile, the blades linear or narrowly lanceolate, not cordate, thickish; inflorescences umbellike, nearly sessile, few-flowered or the flowers solitary; corolla about 3 mm. long, with lanceolate lobes; segments of the crown subulate or lanceolate, much shorter than the corolla lobes (11).
11. Corolla lobes valvate in the bud, conspicuously white-pilose within; segments of the crown subulate; stigma truncate, rounded, or merely apiculate ----- 6. METASTELMA.
11. Corolla lobes slightly imbricate in the bud, puberulent within; segments of the crown lanceolate or triangular-subulate; stigma long-beaked ----- 7. BASISTELMA.

1. ASTEPHANUS

A glabrous herb with slender twining stems; leaves narrowly linear; flowers small, yellowish, in axillary clusters of 3 to 5; corolla without a crown, campanulate, dull yellow, the lobes inflexed at apex; pods long-acuminate; seeds rough-granulate.

1. *Astephanus utahensis* Engelm., Amer. Nat. 9: 349. 1875.

Near Yucca, Mohave County (*Jones* in 1884), also, without definite locality (*Palmer* 440), April to June. Southern Utah and north-western Arizona to southeastern California.

2. GOMPHOCARPUS

An erect, leafy-stemmed herb, similar to *Asclepias* but the hoods not appendaged within; leaves short-petioled, the blades oval or oblong, white-tomentose beneath; umbels terminal or nearly so, long-stalked, many-flowered; hoods of the flowers lurid red.

1. *Gomphocarpus hypoleucus* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 222. 1882.

Mountains of Cochise and Pima Counties, 6,000 to 8,000 feet, open pine forests, July and August, type from the Santa Rita Mountains (*Pringle* in 1881). Southern New Mexico and Arizona, northern Mexico.

3. ACERATES¹²

Leafy-stemmed herbs, similar to *Asclepias*; leaves alternate or nearly opposite; umbels lateral, many-flowered; flowers green or greenish purple.

¹² Reference: VAIL, ANNA M. A REVISION OF THE GENUS ACERATES IN THE UNITED STATES. Torrey Bot. Club Bul. 25: 30-38. 1898.

Key to the species

1. Mass of the anthers and stigma nearly globose, usually considerably surpassing the hoods; column evident below the hoods but very short; hoods broadly ovate or the upper part rectangular, truncate, with large winglike basal auricles; leaves mostly alternate, the blades narrowly linear, elongate; stems and leaves glabrous or very sparsely pubescent (2).
2. Anther wings entire or very nearly so; hoods (in the natural position) three-fourths as high as to nearly equaling the stigma, often emarginate at apex, usually without trace of an internal appendage.
 1. A. AURICULATA.
 2. Anther wings notched near the base; hoods one-half to three-fourths as high as the stigma, not emarginate, nearly always crested within on the midnerve, the free portion of the crest appearing as a minute or elongate subulate horn.-----
 2. A. RUSBYI.
1. Mass of the anthers and stigma longer than wide, usually very slightly surpassing the hoods; column concealed by the insertions of the hoods; hoods oblong-lanceolate, obtuse, with small, concealed, basal auricles; leaves often opposite or nearly so, the blades lanceolate, elliptic, or oblong; stems and leaves tomentulose (3).
3. Hoods auricled at base, otherwise entire-----
3. A. VIRIDIFLORA.
3. Hoods 2-parted, the divisions lanceolate-----
4. A. BIFIDA.

1. **Acerates auriculata** Engelm. in Torr., U. S. and Mex. Bound. Bot. 160. 1859.

Pinal Mountains, Gila County (*King* and *Belden* 2427), probably elsewhere in the State. Nebraska to Texas and Arizona.

2. **Acerates rusbyi** Vail, Torrey Bot. Club Bul. 25: 37. 1898.

Navajo and Coconino Counties to Cochise and Pima Counties, 4,000 to 7,000 feet, commonly in open pine forests, June to September, type from Oak Creek, Yavapai County (*Rusby* in 1883). Known only from Arizona.

This species has the hoods with a minute to well-developed hornlike appendage within, thus breaking down the only technical character separating *Acerates* from *Asclepias*. Without flowers it is indistinguishable from *A. auriculata*.

3. **Acerates viridiflora** (Raf.) Eaton, Man. Bot. ed. 5, 90. 1829.

Asclepias viridiflora Raf., Med. Repos. N. Y. 5: 360. 1808.

Near Flagstaff (Coconino County) and Prescott (Yavapai County), 5,400 to 7,000 feet, June and July. Massachusetts to Saskatchewan, south to Florida and Arizona.

The Arizona form is var. *lanceolata* (Ives) Gray (*A. ivesii* (Britton) Woot. and Standl.) with lanceolate leaves, these narrower than in typical *A. viridiflora*.

4. **Acerates bifida** Rusby ex A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 296. 1885.

Known only by the type collection, presumably in Yavapai County, Arizona, but a letter from Rusby to Gray, filed with the type in the Gray Herbarium, leaves it wholly uncertain where the type was actually collected.

4. ASCLEPIAS. MILKWEED

Stems herbaceous or woody below, commonly erect, never twining, the sap usually milky; leaves commonly opposite or whorled, sometimes early deciduous; inflorescences terminal or lateral, usually many-flowered; corolla lobes commonly reflexed in anthesis; hoods

usually with a hornlike internal crest; pods ovoid, lanceolate, or fusiform.

A. galioides and perhaps other species contain a glucoside that is poisonous to livestock, especially to sheep, but the plants are seldom eaten. Appreciable quantities of rubber are found in the sap of some of the Arizona species. The Hopi Indians are reported to cook the young shoots and leaves of *A. speciosa* with meat. *A. galioides* is considered by the Hopi to increase the flow of milk in women. Milk-weeds contain a substance, asclepain, which can be used as a substitute for papain for tenderizing meat.

Key to the species

1. Stems naked or nearly so (the leaves soon deciduous), rushlike, glaucous, more or less puberulent above; pods fusiform (2).
 2. Stems usually 10 or fewer, 10 mm. or more in diameter at base, decidedly woody below; corolla lobes 5 to 6 mm. long, white tinged with purple; hoods shorter than the anthers, spreading, not dilated at apex.
 1. *A. ALBICANS.*
 2. Stems usually 20 or more, less than 10 mm. in diameter at base, not noticeably woody above the caudex; corolla lobes 7 to 8 mm. long, pale green; hoods at least twice as long as the anthers, erect, dilated at apex.
 2. *A. SUBULATA.*
1. Stems leafy, not rushlike, the leaves persistent (3).
 3. Corolla lobes orange or scarlet; stems villous or hirsute; leaves very numerous, linear- to oblong-lanceolate..... 3. *A. TUBEROSA.*
 3. Corolla lobes whitish, greenish, or purplish; stems not villous or hirsute, except in *A. lemmoni* (4).
 4. Leaf blades seldom more than 15 mm. wide, ovate-lanceolate or narrower, usually more than 3 times as long as wide (5).
 5. Fruiting pedicels normally erect or ascending and straight, but sometimes sigmoid-curved; leaf blades linear or linear-lanceolate, not more than 5 mm. wide; pods fusiform; column about 1 mm. long (6).
 6. Hoods oblong-ovate, conspicuously surpassing the anthers; leaves distinctly short-petioled, rather flaccid, mostly in pairs; corolla pinkish white..... 4. *A. LINIFOLIA.*
 6. Hoods broadly ovate, not or but slightly surpassing the anthers; leaves sessile or subsessile, not flaccid, mostly in whorls of 3 or 4; corolla greenish white..... 5. *A. GALIOIDES.*
 5. Fruiting pedicels deflexed or decurved (7).
 7. Plant suffrutescent, puberulent; leaf blades narrowly linear or almost filiform, with more or less revolute margins (8).
 8. Hoods with long, subulate, recurved, hispidulous tips; leaves opposite, not crowded or rigid; umbels seldom more than 5-flowered; pods fusiform..... 6. *A. MACROTIS.*
 8. Hoods not subulate-attenuate; leaves alternate or falsely verticillate, crowded, rather rigid; umbels usually more than 10-flowered; pods ovate-lanceolate to broadly ovate in outline.
 7. *A. LINARIA.*
 7. Plant herbaceous above the caudex (9).
 9. Hoods conspicuously dentate at the truncate apex; plant obscurely puberulent or glabrate; leaf blades narrowly linear, not more than 4 mm. wide; corolla lobes pale green; pods fusiform, about 10 cm. long..... 8. *A. QUINQUEDENTATA.*
 9. Hoods not conspicuously dentate at apex; plant more or less floccose-tomentose, at least on the young parts; leaf blades linear to lanceolate; corolla lobes usually purple or purplish; pods ovate to lance-ovate in outline, considerably less than 10 cm. long (10).
 10. Leaf blades at most obscurely ciliolate; umbels mostly lateral, few-flowered; hoods shorter than to equaling the anthers (11).
 11. Leaf blades lanceolate, the lower ones 6 to 15 mm. wide near the base; umbels distinctly stalked; hoods much shorter than the anthers, strongly angulate-toothed in front; pods conspicuously longitudinally striate with darker-colored stripes..... 9. *A. BRACHYSTEPHANA.*

11. Leaf blades narrowly linear; umbels sessile or nearly so; hoods equaling the anthers, not toothed in front; pods not striate; stems slender, 10 to 20 cm. long-----10. *A. CUTLERI*.
10. Leaf blades conspicuously white-ciliate with curved hairs, at least when young; umbels terminal, usually sessile or nearly so and appearing involucrate (closely subtended by 2 to 4 long leaves); hoods nearly equaling to much surpassing the anthers (12).
12. Stems 5 to 15 cm. long; umbels mostly more than 10-flowered; corolla lobes oblong-ovate, 4.5 to 6 mm. long; hoods quadrangular-ovate, subauriculate near the base, the horn broadly triangular with a somewhat exerted subulate tip.
11. *A. INVOLUCRATA*.
12. Stems 2.5 to 5 cm. long; umbels 3- or 4-flowered; corolla lobes broadly ovate, 3 to 4 mm. long; hoods strongly cucullate, with an orbicular body and triangular wings nearly as large as the body, the whole structure much broader than high, the horn represented by a broadly ovate plate somewhat shorter than the body of the hood.
12. *A. UNCIALIS*.
4. Leaf blades more than 15 mm. wide, lanceolate-oblong or broader, usually less than 3 times as long as wide (13).
13. Anther wings broadest considerably above the base; umbels all lateral; hoods at least 3 times as long as the anthers, about 8 mm. long, strongly compressed laterally, the lower portion stalklike, the apical portion dilated.....13. *A. NYCTAGINIFOLIA*.
13. Anther wings broadest at base; umbels usually both terminal and lateral; hoods not stalklike below (14).
14. Leaf blades acutish to acuminate at apex (15).
15. Pods bearing soft, subulate processes, densely tomentose; hoods 9 mm. or longer, attenuate-acuminate, 4 or more times as long as the anthers; corolla lobes purple, 8 to 10 mm. long.
14. *A. SPECIOSA*.
15. Pods without subulate processes; hoods not attenuate-acuminate (16).
16. Leaf blades acute or acutish, the margin not cartilaginous or erose-denticulate; corolla-lobes purplish; hoods 5 to 6 mm. long, 2 to 3 times as long as the anthers....15. *A. HALLII*.
16. Leaf blades cuspidate-acuminate, the margin cartilaginous and erose-denticulate; corolla lobes pale green; hoods 3 to 4 mm. long, not more than 1.5 times as long as the anthers.
16. *A. EROSA*.
14. Leaf blades obtuse, truncate, or retuse, often mucronate at apex (17).
17. Leaves 2 to 4 pairs, broadly ovate to suborbicular, or even wider than long; stems seldom more than 20 cm. long (18).
18. Stems 10 cm. long or shorter, the plant often subcaulescent; leaves mostly crowded near the base of the stem, lanate-tomentose at least when young; peduncles longer (often much longer) than the leaves; corolla lobes purplish, the lobes 4 to 5 mm. long; hoods purplish, much surpassing the anthers.....17. *A. NUMMULARIA*.
18. Stems commonly 15 to 20 cm. long; leaves well distributed along the stem, glabrous or ciliolate; umbels sessile or short-peduncled; corolla lobes pale yellow, about 10 mm. long; hoods pink, shorter than to barely surpassing the anthers.
18. *A. CRYPTOCERAS*.
17. Leaves usually more than 4 pairs; stems seldom less than 30 cm. long (19).
19. Stems and leaves more or less villous with delicate, flaccid, pluricellular hairs; hoods about 3 times as long as the anthers, 7 mm. long, with a thin oblique attenuate tip; leaf blades very large, up to 25 cm. long and 15 cm. wide; corolla lobes 8 to 10 mm. long.....19. *A. LEMMONI*.
19. Stems and leaves puberulent or glabrate; hoods not more than twice as long as the anthers, 3 to 4 mm. long, not attenuate at apex, their sides petaloid, whitish or yellow (20).

20. Plant more or less glaucous; leaf blades thin, oblong or elliptic, 2 to 3 times as long as wide, sessile and often cordate-clasping; peduncles nearly as long as to longer than the leaves; corolla lobes 8 to 10 mm. long.

20. *A. ELATA.*

20. Plant not glaucous; leaf blades thick, ovate, obovate, or nearly orbiculate, usually not more than 1.5 times as long as wide, very short-petioled; peduncles much shorter than the leaves; corolla lobes 7 to 8 mm. long.

21. *A. LATIFOLIA*

1. *Asclepias albicans* S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 59. 1889.

Western Maricopa County and Yuma County, 1,000 feet or lower, dry granitic or volcanic slopes, March. Southwestern Arizona, southeastern California, and northwestern Mexico.

Stems as many as 50 from 1 root, reaching a height of 3 m. (10 feet) and a diameter of 2 cm.

2. *Asclepias subulata* Decne. in DC., Prodr. 8: 571. 1844.

Mohave, Gila, Maricopa, Pinal, and Yuma Counties, 3,000 feet or lower, locally abundant on dry slopes, mesas, and plains, April to October. Southern Arizona, southeastern California, and northwestern Mexico.

The sap contains an appreciable quantity of rubber, latex sometimes constituting as much as 6 percent of the dry weight. *A. subulata* and *A. albicans* are extreme xerophytes.

3. *Asclepias tuberosa* L., Sp. Pl. 217. 1753.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,000 to 8,000 feet, mostly in open places in pine forests, May to July. Throughout much of the United States.

Butterflyweed, pleurisy-root. The plant is very showy in flower and is notable in the genus in not having milky sap. The flowers are normally orange red, but vary to pale orange or even yellow. The roots are said to be used locally in treatment of affections of the lungs.

4. *Asclepias linifolia* H. B. K., Nov. Gen. et Sp. 3: 190. 1819.

Huachuca Mountains (Cochise County), Sycamore Canyon near Ruby (Santa Cruz County), Santa Catalina Mountains (Pima County), 4,000 to 5,000 feet, June and July. Southern Arizona and Mexico.

The identification of the Arizona specimens as *A. linifolia* is perhaps questionable.

5. *Asclepias galioides* H. B. K., Nov. Gen. et Sp. 3: 188. 1819.

Apache County to Coconino and Yavapai Counties, south to Cochise and Santa Cruz Counties, 4,000 to 7,000 feet, open plains and mesas, common at roadsides, June to August. Kansas and Colorado to Texas, Arizona, and northern Mexico.

Horsetail milkweed. Very poisonous to livestock, especially to sheep, but fortunately the plant is unpalatable and eaten only in absence of better liked forage. This dangerous weed should be eradicated from pastures and ranges wherever practicable.

6. *Asclepias macrotis* Torr., U. S. and Mex. Bound. Bot. 164. 1859.

Chiricahua, Swisshelm, and Mustang Mountains (Cochise County), about 6,000 feet, June and July. Western Texas to southeastern Arizona.

7. *Asclepias linaria* Cav., Icon. Pl. 1: 42. 1791.

Graham, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,700 to 6,000 feet, common on dry rocky slopes and mesas, April to August. Southern Arizona and Mexico.

8. *Asclepias quinquedentata* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 71. 1876.

Huachuca Mountains (Cochise County), Santa Rita and Rincon Mountains (Pima County), June to August. Western Texas to southern Arizona.

9. *Asclepias brachystephana* Engelm. in Torr., U. S. and Mex. Bound. Bot. 163. 1859.

Yavapai, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, dry plains and mesas, May to August. Kansas and Wyoming to Arizona and northern Mexico.

10. *Asclepias cutleri* Woodson, Mo. Bot. Gard. Ann. 26: 263. 1939.

Near Rock Point, Apache County (*Cutler* 2177, the type collection), 27 miles west of Carrizo, Apache County (*Peebles* and *Smith* 13581), about 5,000 feet, in sand, rare. Known only from northeastern Arizona.

11. *Asclepias involucrata* Engelm. in Torr., U. S. and Mex. Bound. Bot. 163. 1859.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 7,200 feet, common on dry plains and mesas, sometimes with yellow pine, April to June. Southern Utah, New Mexico, and Arizona.

The extremely pubescent var. *tomentosa* Eastw. (*A. macrosperma* Eastw.) is occasional in northern Arizona.

12. *Asclepias uncialis* Greene, Bot. Gaz. 5: 64. 1880.

White Mountains near Springerville, Apache County (*Ellis* 9). Wyoming to New Mexico and eastern Arizona.

13. *Asclepias nyctaginifolia* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 70. 1876.

Mohave County to Cochise, Santa Cruz, and Pima Counties, 1,500 to 5,000 feet, common on plains and mesas, often in sandy washes, May to September. Arizona and southern California.

Many of the Arizona specimens have been identified as *A. longicornu* Benth. and *A. lindheimeri* Engelm. and Gray.

14. *Asclepias speciosa* Torr., Ann. Lye. N. Y. 2: 218. 1828.

Apache, Navajo, Coconino, Greenlee, and Gila Counties, 6,000 to 9,000 feet, mostly in open coniferous forests, June to August. Saskatchewan to British Columbia, south to New Mexico and Arizona.

A large showy, coarse plant with dull-pink flowers.

15. *Asclepias hallii* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 69. 1876.

Asclepias lonchophylla Greene, Leaflets 2: 231. 1912.

San Francisco Peaks, Coconino County (*Purpus* 30, the type collection of *A. lonchophylla*). Colorado and northern Arizona.

16. *Asclepias erosa* Torr., U. S. and Mex. Bound. Bot. 162. 1859.

Asclepias demissa Greene, Leaflets 2: 231. 1912.

Mohave and Yuma Counties, 3,500 feet or lower, usually at roadsides and in washes, September and October. Southern Utah and western Arizona to southeastern California and northwestern Mexico.

Desert milkweed. The stems grow in clumps, reaching a height of 1.8 m. (6 feet). This is one of the most promising sources of rubber among plants native in the United States. *A. demissa*, based on an Arizona type, appears to be merely an extremely depauperate form.

17. *Asclepias nummularia* Torr., U. S. and Mex. Bound. Bot. 163. 1859.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, dry mesas and slopes, March to June. Western Texas to southern Arizona.

18. *Asclepias cryptoceras* S. Wats. in King, Geol. Expl. 40th Par. 5: 283. 1871.

Near Pipe Springs, Mohave County, 5,000 feet (*Peebles* and *Parker* 14705). Utah to Oregon, northwestern Arizona, and California.

19. *Asclepias lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 85. 1883.

Mountains of Cochise and Pima Counties, 4,000 to 6,000 feet, mostly in open pine woods, July and August, type from the Chiricahua or the Huachuca Mountains (*Lemmon* in 1881). Known only from southern Arizona.

One of the largest leaved of the Arizona species, with pale-pink hoods.

20. *Asclepias elata* Benth., Pl. Hartw. 290. 1848.

Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, openings in pine forests, etc., August and September. New Mexico, Arizona, and Mexico.

Flowers greenish yellow, faintly fragrant. *A. elata* is doubtfully distinct from *A. glaucescens* H. B. K.

21. *Asclepias latifolia* (Torr.) Raf., Atlant. Jour. 146. 1832-33.

Asclepias obtusifolia Michx. var. *latifolia* Torr., Ann. Lyc. N. Y. 2: 217. 1828.

Apache County to Coconino and Yavapai Counties, 5,000 to 7,000 feet, plains and mesas, often abundant along roadsides, June to August. Nebraska to Utah, Texas, and Arizona.

5. ASCLEPIODORA. ANTELOPE-HORNS

Stems usually decumbent, leafy; leaves thickish, lanceolate to linear; flowers many, large, in a terminal umbel, like those of *Asclepias* except as stated in the key to genera.

1. *Asclepiodora decumbens* (Nutt.) A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 66. 1876.

Anantherix decumbens Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 201. 1837.

Almost throughout the State, 4,000 to 7,500 feet, common on dry plains and slopes, sometimes in openings in pine forests, April to

August. Kansas and Arkansas to Nevada and Arizona, south to northern Mexico.

Flowers greenish yellow and maroon, slightly fragrant. Abandonment of grazing grounds for sheep because of the prevalence of this plant has been reported.

6. METASTELMA

Stems twining (often around one another), slightly woody at base; leaf blades narrow, rather thick; flowers small, solitary or in few-flowered lateral umbels; corolla 5-parted, white-pubescent inside, the segments of the crown not hooded, narrow, inserted at base of the column, surpassing the stigma; pods slender, long-acuminate.

1. *Metastelma arizonicum* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 85. 1883.

Pinal, Maricopa, and Pima Counties, 1,500 to 3,500 feet, dry rocky slopes, flowering almost throughout the year, type from near Tucson (*Pringle*). Known only from southern Arizona.

7. BASISTELMA

Plant very similar to *Metastelma arizonicum* except in the characters given in the key to genera.

*1. *Basistelma angustifolium* (Torr.) Bartlett, Amer. Acad. Arts and Sci. Proc. 44: 631. 1909.

Metastelma (?) *angustifolia* Torr., U. S. and Mex. Bound. Bot. 159. 1859.

Melinia angustifolia A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 73. 1877.

Not known definitely to occur in Arizona, but the type (*Wright* 1677) was collected at Santa Cruz, Sonora, only a few miles south of the Arizona border.

8. FUNASTRUM

Stems twining; leaves opposite, with linear to cordate-ovate or sagittate blades; flowers numerous in lateral umbels; corolla campanulate-rotate, deeply lobed, the lobes twisted, the crown double; pods fusiform, attenuate-acuminate, smooth or warty.

The whitish, yellowish, or purplish flowers are fragrant. It is reported that the Papago Indians ate the pods, raw or cooked.

Key to the species

1. Peduncles much shorter than the leaves; leaf blades with usually crisped margins, thickish, narrowly to broadly lanceolate, hastate or sagittate at base; herbage copiously cinereous-puberulent; pods 9 to 16 cm. long, 1 to 2 cm. wide where widest, long-acuminate at apex, acute or short-attenuate at base, smooth..... 1. *F. CRISPUM*.
1. Peduncles equaling or surpassing the leaves; leaf blades not crisped; pods not more than 10 cm. long (2).
2. Leaf blades ovate-lanceolate to broadly ovate, cuspidate-acuminate at apex (often abruptly so), cordate or sagittate at base (usually deeply so), thin; flowers white or whitish; pods 1 to 1.5 cm. wide where widest, rounded to attenuate at base, finely ridged; herbage sparsely short-pubescent or glabrate..... 2. *F. CYNANCHOIDES*.

2. Leaf blades narrowly linear to broadly lanceolate, acuminate at apex, acute and entire to pronouncedly hastate at base; flowers yellowish or purplish; pods barely 1 cm. wide where widest, not noticeably ridged, pubescent or glabrous (3).
3. Herbage and pods canescent-pilose with short, spreading hairs; corolla 3 to 4 mm. long, greenish yellow, the segments of the inner crown longer than wide, joined to the outer crown; pods acutish at base; leaf blades narrowly linear, not at all hastate or auriculate at base.
3. F. HIRTELLUM.
3. Herbage glabrous or sparsely puberulent with subappressed hairs (rarely sparsely pilose); corolla 5 to 6 mm. long, purplish, the segments of the inner crown subglobose, free from the outer crown; pods short-attenuate at base; leaf blades narrowly linear to lanceolate, the base acute and entire, angled, or auriculate, up to 2 cm. wide but usually much narrower----- 4. F. HETEROPHYLLUM.

1. **Funastrum crispum** (Benth.) Schlechter, Repert. Spec. Novarum Regni Veg. 13: 284. 1914.

Sarcostemma crispum Benth., Pl. Hartw. 291. 1841.

Greenlee, Gila, Pinal, Cochise, and Santa Cruz Counties, 4,000 to 6,000 feet, canyons among shrubs, summer. Western Texas to southern Arizona and Mexico.

2. **Funastrum cynanchoides** (Decne.) Schlechter, Repert. Spec. Novarum Regni Veg. 13: 284. 1914.

Sarcostemma cynanchoides Decne. in DC., Prodr. 8: 540. 1844.

Greenlee County to Maricopa, Cochise, and Pima Counties, 1,500 to 4,500 feet, along streams and washes, climbing over bushes, May to September. Western Texas to southern Arizona and northern Mexico.

The var. *subtruncatum* (Robinson and Fernald) Macbride, with leaf blades truncate or subcordate at base and attenuate at apex (these deeply cordate at base and apiculate or short-acuminate at apex in the typical form), is occasional in Arizona.

3. **Funastrum hirtellum** (A. Gray) Schlechter, Repert. Spec. Novarum Regni Veg. 13: 286. 1914.

Sarcostemma heterophyllum var. *hirtellum* A. Gray, Bot. Calif. 1: 478. 1876.

Black Mountains and near Boulder Dam, western Mohave County (*Epling* and *Robinson* in 1935, *Peebles* 14785), Colorado River Valley, Yuma(?) County (*Palmer* in 1876). Southern Nevada, western Arizona, and southeastern California.

4. **Funastrum heterophyllum** (Engelm.) Standl., Contrib. U. S. Natl. Herbarium 23: 1170. 1924.

Sarcostemma heterophyllum Engelm. in Torr., U. S. Rpt. Expl. Miss. Pacif. 5: 362. 1876.

Grand Canyon (Coconino County) to Yucca (Mohave County), south to Gila, Pinal, Pima, and Yuma Counties, 5,000 feet or lower, common along washes, etc., climbing over small trees and shrubs, April to September. Western Texas to southeastern California and Mexico.

9. MELLICHAMPIA

Stems twining, retrorsely short-pilose in a definite line; leaves long-petioled, the blades triangular-ovate, cordate; inflorescences short-

racemose or corymbiform; corolla whitish, broadly campanulate, the lobes strap-shaped, 8 to 13 mm. long, strongly recurved at apex, the segments of the crown subulate from a broad base, shorter than or slightly longer than the corolla lobes; anthers round, conspicuously scariosus-tipped; stigma 2-lipped; pods oblong-lanceolate in outline.

1. **Mellichampia sinaloensis** (T. S. Brandeg.) Kearney and Peebles, Wash. Acad. Sci. Jour. 29: 488. 1939.

Roulinia sinaloensis T. S. Brandeg., Zoe 5: 243. 1908.

Along the Sonoita, Nogales to Patagonia, Santa Cruz County (Peebles et al. 4654), Baboquivari Mountains, Pima County (Proctor, Goodding, in 1936), August. Southern Arizona and western Mexico.

The cream-white flowers are fragrant.

10. GONOLOBUS. ANGLEPOD

Stems trailing or weakly climbing; leaves opposite, subhastate to sagittate-cordate at base; flowers lateral (not axillary), solitary or in umbellike clusters; corolla rotate-campanulate or funnellform-campanulate, greenish or dull purple; stigma truncate or depressed.

Key to the species

1. Flowers solitary or in pairs, nearly sessile, with scarcely any common peduncle; herbage canescent-puberulent, the hairs subappressed; leaf blades less than 2 cm. long, not more than 1 cm. wide, deltoid-oblong, obtuse or acutish at apex, shallowly hastate or subhastate at base; corolla 3 to 4 mm. long, rotate-campanulate with spreading lobes and a very short tube; internal crests of the crown segments attached to the column; pods fusiform, not more than 1 cm. wide, sparsely warty.----- 1. *G. PARVIFOLIUS*.
1. Flowers in peduncled umbels, seldom solitary; herbage pilose, the hairs somewhat spreading; leaf blades up to 5 cm. long and 3 cm. wide, triangular-ovate, attenuate-acuminate at apex, sagittate-cordate at base; corolla more than 5 (commonly about 10) mm. long, funnellform-campanulate with nearly erect lobes and a well-developed tube; internal crests of the crown segments not attached to the column; pods ovoid, smooth.

2. *G. PRODUCTUS*.

1. **Gonolobus parvifolius** Torr., U. S. and Mex. Bound. Bot. 166. 1859.

Vincetoxicum parvifolium Heller, Muhlenbergia 1: 2. 1900.

Western Gila County to Cochise, Pinal, Pima, and eastern Yuma Counties, 2,200 to 5,000 feet, dry slopes and mesas, March to October. Western Texas and southern Arizona.

2. **Gonolobus productus** Torr., U. S. and Mex. Bound. Bot. 165. 1859.

Vincetoxicum productum Vail, Torrey Bot. Club Bul. 26: 431. 1899.

Near Kirkland, Yavapai County (Peebles et al. 2607), Babocomari Creek, Santa Cruz County (Lemmon 2821), apparently rare in Arizona, June to August. Western Texas to Arizona.

11. PHEROTRICHIS

Stems erect or ascending from a thick woody tuberlike root; herbage and calyx hispid-hirsute; leaf blades broadly oblong or ovate, rounded or subcordate at base; flowers in lateral sessile or subsessile umbels; corolla rotate-campanulate, the lobes lineate-veined, the segments of the crown truncate; stigma capped by a large globose appendage.

1. *Pherotrichis schaffneri* A. Gray, Syn. Fl. ed. 2, 2¹: 462. 1886.

Huachuca Mountains, Cochise County (*Lemmon* 2816), September. Southern Arizona and northern Mexico.

12. LACHNOSTOMA

Stems twining; leaves opposite, petioled, the blades triangular-ovate; inflorescences lateral, few-flowered; corolla whitish, conspicuously reticulate with green veins, cleft about halfway, the lobes oblong-ovate, the tube retrorsely villous within; stigma depressed, not surpassing the stamens, with a broad 5-angled disk; pods large, lance-ovate in outline, strongly angled and finely ridged longitudinally.

1. *Lachnostoma arizonicum* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 296. 1885.

Rincon, Santa Catalina, and Baboquivari Mountains (Pima County), 3,500 to 4,500 feet, along streams in canyons, May to August, type from the Santa Catalina Mountains (*Lemmon*). Known only from southern Arizona.

Rothrockia cordifolia A. Gray has been attributed to Arizona, apparently by confusion with *Lachnostoma arizonicum*, from which it may be distinguished by the larger, much more deeply cleft corolla, this glabrous within and not conspicuously veined, the elevated stigma much surpassing the stamens, and the smooth pods. It occurs in Sonora not far from the southern boundary of Arizona.

103. CONVULVULACEAE. CONVULVULUS FAMILY

Plants herbaceous or suffrutescent, mostly with twining or trailing stems, in one genus without chlorophyll and parasitic; leaves alternate, simple but sometimes deeply lobed or parted, in 1 genus reduced to minute scales; flowers perfect, regular, mostly 5-merous, often showy, axillary, solitary or in cymes, the peduncle jointed; pistil of 2 united or separate carpels, the styles 1 or 2, often cleft; fruit a capsule, dehiscent or indehiscent.

The morning-glories and other favorite ornamentals belong to this family, of which the most important member, economically, is the sweetpotato (*Ipomoea batatas* Poir.).

Key to the genera

1. Plants without green coloring matter, parasitic on the stems of various hosts; stems twining; leaves reduced to small scales; flowers small; corolla white or whitish, usually with fimbriate or dentate appendages within.
 1. CUSCUTA.
1. Plants with green coloring matter, autophytic; leaves with well-developed blades (2).
 2. Ovary deeply 2-lobed; styles 2; stems creeping, rooting at the nodes; leaf blades reniform, wider than long; flowers solitary, small and inconspicuous; pedicels after anthesis often strongly revolute or sigmoid-curved.----- 2. DICHONDRA.
 2. Ovary not lobed (3).
 3. Corolla imbricate in the bud, white; styles 2, entire; stigmas capitate.
 4. CRESSA.
 3. Corolla plicate-convolute in the bud (4).
 4. Styles 2, separate to the base or nearly so, each 2-cleft; stigmas linear-filiform or slender-clavate; stems not twining; corolla rotate-campanulate or broadly funnelliform.----- 3. EVOLVULUS.
 4. Style 1 or, if 2-cleft, then the divisions entire (5).
 5. Stigma 1, globose or nearly so, entire or lobed.----- 7. IPOMOEA.

5. Stigmas 2, more or less elongate (6).
 6. Style entire; stigmas ovate or oblong; stems not or scarcely twining.
 5. JACQUEMONTIA.
 6. Style 2-cleft at apex, or entire; stigmas linear-filiform to ovate;
 stems mostly twining----- 6. CONVULVULUS.

1. CUSCUTA.¹³ DODDER

Contributed by T. G. YUNCKER

Plants leafless and rootless, herbaceous, parasitic; stems yellowish, filiform, twining; flowers small (mostly 2 to 6 mm. long), sessile or short-pedicellate, in few- to many-flowered cymose clusters, commonly 5-merous but regularly 3- or 4-merous in a few species; perianth parts mostly united; stamens inserted in the throat of the corolla, alternating with the lobes; appendages commonly present at base of the corolla opposite the stamens, these scalelike, more or less toothed, fringed, or fimbriate; ovary 2-celled, the styles 2, the stigmas (in the Arizona species) capitate; fruit a capsule, this remaining closed, or opening with a regular or irregular line of circumscission near the base; embryo acotyledonous, filiform or more or less enlarged at one end.

Upon emergence from the seed the slender, elongate seedling coils about an available host to which it becomes firmly attached by means of its suckerlike organs (haustoria). A few species have been shown to possess small amounts of chlorophyll and are thereby partly autophytic. Although certain dodders show a preference in the choice of host, most of them grow readily upon various plants. Those which parasitize economically important crops sometimes cause considerable damage. This is especially true in fields of clover and alfalfa, where dodder seeds are commonly introduced with those of the host.

Key to the species

1. Capsules not circumscissile, i. e., not separating in a regular line of cleavage, when forcibly separated either coming away entirely from the receptacle or breaking very irregularly (2).
 2. Flowers mostly 3- or 4-parted (3).
 3. Perianth membranaceous, the lobes obtuse; corolla lobes not inflexed at tip; scales oblong, reaching the filaments and free from the corolla tube above; corolla when withered remaining at top of the capsule.
 1. C. CEPHALANTHI.
 3. Perianth fleshy-papillate, the lobes acute; corolla lobes erect with inflexed tips; scales reduced to lateral wings along the stamen attachment.
 5. C. CORYLLI.
 2. Flowers mostly 5-parted (4).
 4. Infrastaminal scales lacking; perianth parts acute to acuminate; calyx lobes triangular-ovate to sublanceolate; corolla lobes lanceolate, reflexed----- 3. C. CALIFORNICA.
 4. Infrastaminal scales present (5).
 5. Perianth fleshy-papillate; corolla lobes commonly erect, with inflexed tips; scales prominent and mostly free from the corolla tube, at least above----- 4. C. INDECORA.
 5. Perianth not fleshy-papillate; corolla lobes various, but not as in C. indecora (6).
 6. Corolla lobes triangular or lanceolate, acute to acuminate (7).
 7. Scales free from the corolla tube only at the upper end, included; perianth lobes lanceolate, acute to acuminate; capsules globose-conic, mostly 1-seeded----- 6. C. SALINA.

¹³ References: YUNCKER, T. G. REVISION OF THE NORTH AMERICAN AND WEST INDIAN SPECIES OF CUSCUTA. Univ. Ill. Biol. Monog. 6: 1-142. 1921.
 ——— THE GENUS CUSCUTA. Torrey Bot. Club Mem. 18: 113-331. 1932.

7. Scales prominent, commonly exerted; corolla lobes triangular to sublanceolate, acute, reflexed with inflexed tips; capsules mostly depressed-globose, 2- to 4-seeded..... 2. *C. CAMPESTRIS*.
6. Corolla lobes ovate or suborbicular, obtuse (8).
8. Flowers about 2 mm. long, subsessile, in few-flowered glomerules; margins of the perianth lobes denticulate; calyx lobes orbicular, broadly overlapping; capsules conic, mostly 1-seeded.
7. *C. DENTICULATA*.
8. Flowers mostly much larger, pedicellate, in many-flowered, cymose clusters; calyx lobes ovate, obtuse; capsules globose-ovoid, mostly 3- or 4-seeded..... 8. *C. GRONOVII*.
1. Capsules circumscissile, i. e., easily separating near the base in a more or less regular line of cleavage (9).
9. Styles subulate, commonly much thicker at base; calyx lobes commonly more or less carinate (10).
10. Flowers mostly 3 to 5 mm. long; styles pronouncedly subulate, becoming subconic in fruit..... 9. *C. MITRAEFORMIS*.
10. Flowers mostly about 3 mm. long; styles subulate but not becoming conic in fruit; perianth lobes more or less irregularly denticulate, thickened medianally to form a carina..... 10. *C. EROSA*.
9. Styles more slender, mostly about equally thick throughout but sometimes slightly thicker near the base (11).
11. Scales dentate only toward the apex (12).
12. Flowers whitish when dry, more or less granulate- or scabrous-papillate; calyx lobes broad, ovate-deltoid, short-acute; scales bridged below the middle..... 12. *C. ODONTOLEPIS*.
12. Flowers reddish when dry, smooth; calyx lobes triangular, acute, commonly somewhat thickened in the center to form a low carina; scales bridged near the middle..... 13. *C. DENTATASQUAMATA*.
11. Scales fimbriate (13).
13. Calyx one-half to three-fourths as long as the cylindric corolla tube, the lobes triangular to sublanceolate, acute, often carinate; scales reaching to about the middle of the corolla tube.
15. *C. TUBERCOLATA*.
13. Calyx equaling or surpassing the campanulate corolla tube; scales reaching the filaments; capsules mostly quickly and definitely circumscissile (14).
14. Lobes of the calyx triangular-ovate, obtuse, commonly carinate; pedicels short or almost none..... 11. *C. APPLANATA*.
14. Lobes of the calyx triangular-ovate-lanceolate, acute to acuminate; pedicels definite, often as long as or longer than the flowers, these in loose umbellate cymes..... 14. *C. UMBELLATA*.

1. *Cuscuta cephalanthi* Engelm., Amer. Jour. Sci. 43: 336. 1842.

Apparently rare in Arizona, where collected in the southern part of the State by Wright without indication of definite locality, probably in Cochise County. Massachusetts to Oregon and south to Mexico, infrequent westward.

Host genera numerous, including *Salix*, *Spiraea*, *Vicia*, *Dracoccephalum*, *Teucrium*, *Cephalanthus*, *Solidago*, *Aster*, *Sonchus*. This species is often confused with *C. gronovii*, to which it bears some resemblance. It is distinguished by the mostly 3- or 4-parted flowers and the persistence of the corolla at the top of the capsule instead of about it or at base, as with *C. gronovii*. The capsule is subglobose rather than conic as in that species.

2. *Cuscuta campestris* Yuncker, Torrey Bot. Club Mem. 18: 138. 1932.

Cuscuta pentagona var. *calycina* Engelm., Amer. Jour. Sci. 45: 76. 1845.

Cuscuta arvensis var. *calycina* Engelm., Acad. Sci. St. Louis Trans. 1: 495. 1859.

Coconino, Yavapai, and Pima Counties. Widely distributed throughout the range of the genus.

Hosts numerous, mostly herbaceous, including grasses. If this species has any host preference it is for clover, alfalfa, and other legumes, and probably its wide distribution is due to association of its seeds with those of such economically important hosts. Pedicels mostly shorter than the flowers, which are yellow when dry and mostly about 2 mm. long; calyx lobes broadly ovate to oval-ovate, almost enclosing the corolla tube; corolla campanulate, enlarging about the base of the rapidly developing capsule, which becomes up to 4 mm. wide; scales abundantly fringed; styles slender, scarcely subulate; capsules mostly wider than long.

3. *Cuscuta californica* Choisy, Soc. Phys. Hist. Nat. Genève Mém. 9: 279. 1841.

Topock, Mohave County (*Eastwood* 8907). Common in the Pacific Coast States, especially California, but apparently rare in Arizona.

Host plants include: *Eriogonum*, *Abronia*, *Dalea*, *Foeniculum*, *Asclepias*, *Franseria*. An attractive species, easily recognized by the lanceolate, reflexed corolla lobes, and the absence of infrastaminal scales.

4. *Cuscuta indecora* Choisy, Soc. Phys. Hist. Nat. Genève Mém. 9: 278. 1841.

Yavapai, Gila, Maricopa, Pinal, and Pima Counties. Southern and western United States, Mexico, West Indies, and South America.

This species occurs on a great variety of both woody and herbaceous hosts including *Crossosoma*, *Acacia*, *Prosopis*, *Sapindus*, *Condalia*, *Solidago*, *Aster*, *Hymenoclea*, *Baccharis*, and *Pluchea*. Though named *indecora*, the plant is ordinarily attractive with its abundant, white, fleshy, and more or less papillate flowers. Styles about as long as the somewhat pointed ovary, becoming divaricate on the globose capsule, which is enveloped by the withered corolla.

5. *Cuscuta coryli* Engelm., Amer. Jour. Sci. 43: 337. 1842.

Grand Canyon, Coconino County (*Eggert* in 1886). Eastern United States to Montana and northern Arizona, more common eastward.

This dodder occurs on a great variety of woody and herbaceous hosts including *Salix*, *Rhus*, *Ceanothus*, *Daucus*, *Stachys*, *Symphoricarpos*, *Solidago*, *Aster*, *Helianthus*, and *Chrysanthemum*. Flowers about 2 mm. long, on pedicels longer or shorter than the flowers, or the flowers originating endogenously; calyx lobes triangular-ovate, about reaching the sinuses of the corolla or somewhat longer; corolla lobes triangular-ovate or more or less lanceolate; scales mostly reduced to toothed wings along the line of attachment of the filaments but sometimes free, and bifid or toothed; stamens nearly as long as the corolla lobes; styles shorter than or equaling the globose-ovoid ovary, becoming divergent in fruit; capsule depressed-globose, enveloped by the withered corolla.

6. *Cuscuta salina* Engelm. in A. Gray, Bot. Calif. 1: 536. 1876.

Pinal and Pima Counties. British Columbia to Arizona and southern California.

Host plants include *Atriplex*, *Suaeda*, *Allenrolfea*, *Salsola*, *Nitrophila*, and *Cressa*. Flowers 2 to 3 mm. long, narrowly campanulate,

mostly pedicellate with pedicels of different lengths, forming close or loose cymose inflorescences; calyx enclosing the corolla tube; corolla lobes mostly spreading to reflexed and equaling the tube; anthers oval, on short filaments; scales oblong, shallowly fringed, free from the corolla tube at the upper end only.

7. *Cuscuta denticulata* Engelm., Amer. Nat. 9: 348. 1875.

Hope, Yuma County (*Fulton* 8508), near Topock and Boulder Dam, Mohave County, where apparently not uncommon (*Clover* 4177, *Peebles* and *Parker* 14780, 14793). Southern Utah to southern California and western Arizona.

Host plants of this species include *Coleogyne*, *Larrea*, *Gutierrezia*, *Chrysothamnus*, and *Hymenoclea*, but Arizona specimens have been collected only on *Larrea*. Stems very slender; flowers small, mostly in 2- or 3-flowered clusters; calyx yellow and more or less glistening in dry specimens, with large and conspicuous cells, almost enclosing the corolla tube; corolla becoming urceolate, the lobes oval-oblong, commonly obtuse; scales about reaching the anthers, oblong, denticulate; embryo with an enlarged globose, knoblike end, a character found otherwise only in the closely allied *C. veatchii* of Baja California.

8. *Cuscuta gronovii* Willd. ex Roem. and Schult., Syst. Veg. 6: 205. 1820.

Grand Canyon, Coconino County (*Eggert* in 1886). Eastern and central United States, where this is the commonest species of dodder, to northern Arizona.

It occurs on a very wide range of both woody and herbaceous hosts with no apparent preference. Flowers 2 to 4 mm. long, in loose or somewhat dense, paniculate cymes; calyx mostly shorter than the corolla tube; corolla lobes spreading to reflexed, shorter than the campanulate tube; scales commonly oblong, about reaching the stamens; styles commonly about equaling the ovary; capsule enveloped by the withered corolla.

9. *Cuscuta mitraeformis* Engelm. ex Hemsl., Diagn. Pl. Mex. 54. 1880.

Cave Creek, Chiricahua Mountains, Cochise County (*Kearney* and *Harrison* 6176), about 6,000 feet, on *Lupinus*. Southeastern Arizona and Mexico.

Stems coarse; flowers on short pedicels, forming compact, globular clusters; calyx lobes about as long as the corolla tube, ovate, obtuse, more or less unequal, irregular, the larger lobes often strongly and unevenly carinate; corolla lobes ovate, obtuse, about as long as or exceeding the campanulate tube; scales oblong, mostly somewhat truncate and bifid, or less commonly ovate, as long as the tube, and deeply fringed; styles shorter than the conic ovary, becoming widely divergent; capsule 5 to 8 mm. long, enveloped by the withered corolla.

10. *Cuscuta erosa* Yuncker, Ill. Univ. Biol. Monog. 6: 116. 1921.

Mountains of Pima County. Southern Arizona and northern Sonora.

Host plants include *Amaranthus*, *Ipomoea*, *Siphonoglossa*, *Anisacanthus*, and *Franseria*. Pedicels mostly shorter than the flowers; calyx lobes orbicular, membranaceous, denticulate on the margin, fleshier in the median part, nearly distinct; corolla lobes erect to reflexed, about as long as or slightly shorter than the campanulate tube, ovate-oblong, obtuse; scales broad, fringed, about equaling the

corolla tube, bridged at about the middle; styles longer than the globose ovary, becoming divergent in fruit; capsule globose, thin toward the base, bearing the withered corolla about the middle or at top.

11. *Cuscuta applanata* Engelm., Acad. Sci. St. Louis Trans. 1: 479. 1859.

Coconino, Cochise, and Santa Cruz Counties, type from "Arizona Territory south of the Gila River" (Wright 541). New Mexico, Arizona, and Mexico.

Hosts various, including *Boerhaavia* and *Ambrosia*. Flowers in dense clusters; corolla lobes oblong to ovate-lanceolate, spreading; scales exserted, fringed; capsules globose-depressed, thin, readily circumscissile.

12. *Cuscuta odontolepis* Engelm., Acad. Sci. St. Louis Trans. 1: 486. 1859.

Santa Rita Mountains (Pima County), on various hosts including *Amaranthus*, type from "near a deserted rancho on a rocky hillside in Arizona" (Wright 1624). Southern Arizona and Sonora.

Flowers 4 to 5 mm. long, short-pedicellate, forming rather large, dense clusters; corolla cylindric-campanulate, the lobes ovate-lanceolate, acute; scales oblong or subspatulate, dentate near the apex only; styles slender, mostly longer than the ovary; capsule globose.

13. *Cuscuta dentatasquamata* Yuncker, Torrey Bot. Club Bul. 49: 107. 1922.

Florida Canyon, Santa Rita Mountains, Pima County (Kearney and Peebles 10580), on *Bowardia*. A rare species known elsewhere only from Los Pinitos, Sonora, the type locality.

Flowers pedicellate, somewhat fleshy; calyx deep, the lobes equaling or exceeding the corolla tube; corolla campanulate, the lobes triangular, acute, shorter than the tube, spreading; scales oblong, dentate; styles slender, slightly subulate, about equaling or longer than the depressed-globose ovary; capsule depressed-globose, thin, somewhat irregularly circumscissile.

14. *Cuscuta umbellata* H. B. K., Nov. Gen. et Sp. 3: 121. 1818.

Pinal, Pima, and Cochise Counties. Southern United States to Arizona, West Indies, Mexico, and northern South America.

On a variety of herbaceous hosts including *Polygonum*, *Atriplex*, *Suaeda*, *Achyranthes*, *Amaranthus*, *Boerhaavia*, *Trianthema*, *Sesuvium*, *Kallstroemia*, and *Euphorbia*. Flowers in compound cymes, the ultimate divisions of these umbellate, of 3 to 7 flowers; calyx turbinate, yellow and shining when dry; corolla lobes lanceolate, acute to acuminate, reflexed; styles longer than the globose ovary; capsule depressed-globose, surrounded by the withered corolla. Specimens bearing unusually large flowers (4 to 6 mm. long) have been distinguished as variety *reflexa* (Coul.) Yuncker (*C. californica* var. *reflexa* Coul.).

15. *Cuscuta tuberculata* T. S. Brandeg., Calif. Univ. Pubs. Bot. 3: 389. 1909.

Pinal and Pima Counties. Southwestern New Mexico, southern Arizona, and northwestern Mexico.

It occurs most commonly on *Boerhaavia* but is found occasionally on other hosts, such as *Euphorbia*. Flowers cylindrical, on slender pedicels; calyx thickened and keeled toward the base; corolla papillose in the basal, calyx-enveloped part; stamens somewhat shorter than or equaling the corolla lobes; styles slender, longer than the ovary, exerted; capsule globose, enveloped and surmounted by the withered corolla.

2. DICHONDRA

Plants perennial, more or less sericeous; stems creeping, rooting at the nodes; leaves petioled, the blades round-reniform; flowers small, solitary on bractless peduncles, the corolla broadly campanulate, whitish; pistils separate or nearly so; capsules 1- or 2-seeded.

These plants are very efficient soil binders but are rare in Arizona.

Key to the species

1. Stems and petioles relatively stout, the petioles straight or nearly so; leaf blades densely silvery-sericeous on both faces, with a very shallow sinus or nearly truncate at base; corolla very villous outside; peduncles stout, about 5 mm. long, strongly decurved after flowering.----- 1. *D. ARGENTEA*.
1. Stems and petioles slender, the petioles mostly curved; leaf blades bright green and sparsely sericeous above, with a deep, broad or narrow sinus; corolla glabrous or sparsely villous outside (2).
 2. Leaf blades silvery-sericeous beneath, seldom more than 2 cm. wide; peduncles filiform, commonly more than 1 cm. long.--- 2. *D. REPENS*.
 2. Leaf blades green and sparsely sericeous beneath, commonly more than 2 (up to 5) cm. wide; peduncles relatively stout, mostly less than 1 cm. long.----- 3. *D. BRACHYPODA*.

1. *Dichondra argentea* Willd., Hort. Berol. pl. 81. 1816.

Foothills near Bisbee, Cochise County (*Harrison* 8256), about 5,300 feet, late summer. Western Texas to southeastern Arizona and Mexico.

2. *Dichondra repens* Forst., Char. Gen. Pl. 39. 1776.

Sycamore Canyon near Ruby, Santa Cruz County, about 4,000 feet (*Goodding* 6620). Widely distributed in tropical America.

The collection cited belongs to var. *sericea* (Swartz) Choisy.

3. *Dichondra brachypoda* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 160. 1913.

Near San Bernardino, Cochise County, about 4,000 feet, in a canyon (*Goodding* 6629). Western Texas to southeastern Arizona and northern Mexico.

3. EVOLVULUS¹⁴

Small pubescent perennial herbs; stems numerous, erect or diffuse, never twining; flowers solitary or few in a cluster, sessile to long-pedunculate; corolla rotate-campanulate or broadly funnelform, cream-colored, purple, or sky blue; styles 2, each 2-cleft.

The plants are sun loving, growing on dry plains and mesas, often among grasses.

¹⁴ Reference: VAN OOSTSTROOM, S. J. A MONOGRAPH OF THE GENUS EVOLVULUS. Meddel. Bot. Mus. Herb. Rijksuniv. Utrecht 14: 1-267. 1934.

Key to the species

1. Stems rarely more than 15 cm. long, spreading or decumbent; upper leaves only slightly reduced; flowers mostly solitary; peduncles or pedicels much shorter than the subtending leaves, often decurved in fruit (2).
2. Sepals linear or narrowly lanceolate; corolla rotate-campanulate, lavender drying violet purple; leaves appressed or narrowly ascending, closely imbricate along the stem, at least above, densely villous-sericeous on both faces----- 1. *E. PILOSUS*.
2. Sepals lanceolate or ovate-lanceolate; corolla rotate, cream-colored or azure blue; leaves spreading, not closely imbricate along the stem, commonly glabrous above----- 2. *E. SERICEUS*.
1. Stems commonly 30 cm. long or longer, erect or ascending; upper leaves greatly reduced; flowers one or few on very slender, bracted peduncles longer than the subtending leaves, the inflorescence a very open, leafy, terminal panicle; corolla rotate, azure blue or occasionally white (3).
3. Corolla not more than 7 mm. in diameter----- 3. *E. ALSINOIDES*.
3. Corolla 8 to 20 mm. in diameter----- 4. *E. ARIZONICUS*.

1. *Evolvulus pilosus* Nutt., Gen. Pl. 1: 174. 1818.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, March to July. North Dakota and Montana to Texas and Arizona.

2. *Evolvulus sericeus* Swartz, Prodr. Veg. Ind. Occ. 55. 1788.

Evolvulus wilcoxianus House, Torrey Bot. Club Bul. 33: 315. 1906.

Navajo and Yavapai Counties to Cochise, Santa Cruz, and Pinal Counties, 3,500 to 5,500 feet, May to September, type of *E. wilcoxianus* from Fort Huachuca (*Wilcox* 96). Texas to southeastern California, south to Argentina; West Indies.

The common form in Arizona is var. *discolor* (Benth.) Gray (*E. discolor* Benth., *E. wilcoxianus* House). This has the upper leaf surface green and glabrate, and the corolla usually cream-colored. The form with leaves sericeous on both faces is occasional in Cochise County.

3. *Evolvulus alsinoides* L., Sp. Pl. ed. 2, 392. 1762.

Eastern Maricopa, Cochise, Santa Cruz, and Pima Counties, 2,500 to 5,000 feet, April to September. Widely distributed in tropical and subtropical regions of both the Eastern and the Western Hemisphere.

The Arizona form is var. *acapulcensis* (Willd.) Van Ooststroom (*E. acapulcensis* Willd.), which intergrades in Arizona with *E. arizonicus*, differing chiefly in its smaller corolla.

4. *Evolvulus arizonicus* A. Gray, Syn. Fl. ed. 2, 2†: 218. 1886.

Graham County to Yavapai County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, April to October, type from Sonora near the border of Arizona. Southwestern New Mexico, Arizona, and northern Mexico; Argentina.

One of Arizona's most beautiful wild flowers, with flowers a deep sky blue. The typical form has the hairs of the herbage all or nearly all short and appressed. Almost equally abundant, in the 3 southern counties, is var. *laetus* (Gray) Van Ooststroom (*E. laetus* A. Gray) with many of the hairs long and spreading. There is complete intergradation of the 2 forms. The type of *E. laetus* was collected in the Santa Rita Mountains (*Pringle* in 1881).

4. CRESSA

Plant small, perennial, herbaceous, silky-villous; stems erect or spreading, very leafy; leaves sessile, narrowly elliptic, entire; flowers small, solitary in the upper axils, rather crowded; corolla whitish, the lobes becoming reflexed.

1. *Cressa truxillensis* H. B. K., Nov. Gen. et Sp. 3: 119. 1818.

Along the Little Colorado River (Coconino County), near Phoenix (Maricopa County), Gila Crossing (Pinal County), Yuma (Yuma County), 100 to 4,000 feet, strongly saline soil, May to August. Texas to southern Utah and southern California, south to tropical America.

5. JACQUEMONTIA

Plants annual or perennial, often suffruticose, pubescent; leaves petioled, the blades entire, rounded or subcordate at base; flowers long-peduncled, solitary or in small loose inflorescences, the corolla funnellform, blue or lavender; sepals all alike or the outer ones much broader than the inner ones.

Key to the species

1. Plant annual (in Arizona); stems herbaceous throughout; herbage loosely soft-pilose; sepals nearly alike in size and shape, lanceolate or lance-ovate, acuminate; corolla narrowly funnellform, 8 to 10 mm. long, deep blue.
 1. J. PALMERI.
 1. Plant perennial; stems woody at least toward the base; herbage finely canescent or subtomentose, the hairs mostly appressed; outer sepals much wider than the inner ones, broadly ovate or suborbicular, acutish or apiculate; corolla broadly funnellform, 20 to 25 mm. long, pale lavender.
 2. J. PRINGLEI.
1. *Jacquemontia palmeri* S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 63. 1889.

Canyons on the western slope of the Baboquivari Mountains (Pima County), about 4,000 feet, September and October. Southern Arizona, Sonora, and Baja California.

2. *Jacquemontia pringlei* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 227. 1882.

Santa Catalina Mountains (Pima County), also a doubtful record from the Chiricahua Mountains, 3,000 to 4,000 feet, canyons, July to September, type from the Santa Catalina Mountains (*Pringle*). Southern Arizona to Central America.

6. CONVULVULUS. BINDWEED

Plants mostly perennial, herbaceous; stems (in the Arizona species) twining or trailing; leaves more or less lobed; corolla broadly funnel-form, white or pink; stigmas more or less elongate; capsule normally 2-celled or imperfectly 4-celled.

C. tricolor L., a w annual with erect or spreading stems, narrow entire leaves, and small but showy, parti-colored flowers, is sometimes cultivated as an ornamental. Specimens of what appears to be this species were collected at Tucson by Toumey in 1892, but there is no evidence that the plant has become established in Arizona.

Key to the species

1. Bracts larger than the sepals, ovate, obtuse or apiculate, inserted immediately below the calyx and enclosing it; stigmas oblong or oval; herbage glabrous or soft-pilose; leaf blades deltoid-hastate; corolla 3 to 6 cm. long, white or pink..... 1. *C. SEPIUM*.
1. Bracts much smaller than the sepals, remote from or not closely subtending the calyx; stigmas linear, filiform, or slender-clavate (2).
 2. Leaf blades shallowly sagittate or hastate with short, entire or sparingly dentate, triangular-ovate basal lobes, oblong or oblong-ovate, commonly very obtuse; herbage glabrous or sparsely soft-pilose; bracts seldom more than 5 mm. long, lanceolate, oblanceolate, or narrowly oblong; corolla white or striped with pink, 1.5 to 2.5 cm. long..... 2. *C. ARVENSIS*.
 2. Leaf blades hastately lobed, some of them usually with elongate, linear or lanceolate lobes (3).
 3. Herbage and calyx sericeous, rarely glabrate; peduncles seldom more than twice as long as the subtending leaf; bracts 2 to 3 mm. long, subulate; corolla not more than 2 cm. long, usually pink, drying purplish; anthers 2 mm. long; leaf blades narrowly lanceolate to oblong, the basal lobes usually several-toothed or cleft; sepals truncate, emarginate, and usually mucronate at apex..... 3. *C. INCANUS*.
 3. Herbage and calyx glabrous, often slightly glaucous; peduncles usually 3 or more times as long as the subtending leaf; bracts up to 15 mm. long, linear-lanceolate; corolla 3 to 4 cm. long, pale pink or white; anthers 3 to 4 mm. long; leaf blades deeply hastate, the basal lobes narrowly linear to lanceolate, entire or coarsely few-toothed; sepals truncate to acutish, entire or somewhat erose and conspicuously mucronate at apex..... 4. *C. LINEARILOBUS*.

1. *Convolvulus sepium* L., Sp. Pl. 153. 1753.

Lakeside, Navajo County (*Harrison* 5506), about 6,000 feet, June. Throughout most of temperate North America; Eurasia.

Hedge bindweed. The plant is sometimes a troublesome weed.

2. *Convolvulus arvensis* L., Sp. Pl. 153. 1753.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, roadsides and fields, May to July. Extensively naturalized in North America, from Europe.

Field bindweed. A troublesome weed, difficult and expensive to eradicate, considered in California the worst weed in the State.

3. *Convolvulus incanus* Vahl, Symb. Bot. 3: 23. 1794.

Navajo and Coconino Counties to Cochise and Pima Counties, 3,000 to 5,500 feet, common on dry slopes and mesas, May to September. Nebraska and Colorado to Texas and Arizona.

Stems trailing or clambering over bushes.

4. *Convolvulus linearilobus* Eastw., Calif. Acad. Sci. Proc. ser. 4, 20: 152. 1931.

Mohave, Yavapai, and Gila Counties, chiefly in the Mazatzal and Hualpai Mountains, 3,400 to 5,000 feet, slopes and banks, often among oaks, May to October, type from the Mazatzal Mountains (*Eastwood* 17264). Known only from central Arizona.

This species is closely related to *C. longipes* Wats. of Nevada and southern California. The numerous long stems often form tangled masses. The narrowly lobed leaves and the large, pale pink or white flowers are distinctive.

7. IPOMOEA.¹⁵ MORNING-GLORY

Plants herbaceous, annual or perennial; stems erect, trailing, or twining; leaves with entire to pedately parted blades; flowers solitary or in few-flowered clusters; outer sepals commonly larger than the inner ones; corolla mostly funnelform, sometimes salverform, the limb entire or very shallowly lobed; capsule globose, 2- to 4-valved; seeds commonly 4.

Several species of this large genus are favorite ornamentals, cultivated under the names morning-glory, cypressvine, etc.

Key to the species

1. Corolla bright red, salverform, or the elongate tube narrowly funnelform, the limb not more and usually less than 15 mm. in diameter; plant glabrous or nearly so; stems twining----- 1. *I. COCCINEA*.
1. Corolla pink, purple, blue, or white (2).
 2. Leaf blades entire, obtuse or short-cuneate at base, linear to oblong-lanceolate, often 10 cm. long or longer, 6 or more times as long as wide; plant perennial, glabrous; stems stout, prostrate except near the base, not at all twining; sepals broad, very obtuse, scarious-margined; corolla white with a pink throat, broadly funnelform, 6 to 10 cm. long.
 2. *I. LONGIFOLIA*.
 2. Leaf blades variously toothed or lobed or, if entire, then cordate at base, much less than 6 times as long as wide (3).
 3. Plants perennial with a tuberous-thickened root, glabrous or nearly so; stems not twining or very weakly so (4).
 4. Sepals setaceous-caudate; corolla 5 to 8 cm. long, the tube elongate, narrow, rather abruptly expanded into the throat; tuber elongate; leaf blades usually sparsely strigose, deeply sagittate to pedately lobed, the lobes divergent, lanceolate, linear, or oblong; calyx not warty or very obscurely so at base----- 3. *I. THURBERI*.
 4. Sepals not setaceous-caudate; corolla not more than 5 cm. long, the tube gradually expanded into the throat; leaf blades glabrous (5).
 5. Leaf blades laciniate-dentate at the broad apex, otherwise entire, obovate-cuneate; tuber globose or nearly so; petioles less than 5 mm. long; calyx conspicuously warty----- 4. *I. EGREGIA*.
 5. Leaf blades pedately parted or divided, the segments elongate, narrowly linear or filiform, not more than 2 mm. wide (6).
 6. Sepals not or not conspicuously warty; petioles 10 to 20 mm. long; corolla 4 to 5 cm. long; tuber elongate----- 5. *I. LEMMONI*.
 6. Sepals conspicuously warty; petioles seldom more than 5 mm. long; corolla not more than 3 cm. long (7).
 7. Tuber elongate; sepals 5 to 6 mm. long; peduncle and pedicel together usually not much longer than the calyx.
 6. *I. MURICATA*.
 7. Tuber usually globose or nearly so; sepals 7 to 9 mm. long; peduncle and pedicel considerably longer than the calyx, often twice as long----- 7. *I. PLUMMERAE*.
 3. Plants annual or, if perennial, then the root not tuberous-thickened (8).
 8. Leaf blades pedately 5- to 9-parted or divided, the lobes linear or almost filiform, the midlobe rarely more than 4 mm. wide; sepals conspicuously scarious-margined (9).
 9. Corolla 5 to 8 cm. long, trumpet-shaped, with a long, narrow tube; plant entirely glabrous; stems twining; calyx and pedicel often sparsely verrucose----- 8. *I. TENUILOBA*.
 9. Corolla not more than 4 cm. long; plants sparsely and inconspicuously hirsute, or glabrate; stems erect to procumbent, sometimes feebly twining at apex (10).
 10. Calyx and pedicel glabrous; sepals often crested or warty on the midrib, 3 to 7 mm. long; corolla with the tube and throat not more than 10 mm. long, the limb less than 10 mm. in diameter.
 9. *I. COSTELLATA*.

¹⁵ Reference: HOUSE, H. D. THE NORTH AMERICAN SPECIES OF THE GENUS IPOMOEA. N. Y. Acad. Sci. Ann. 18: 181-263. 1908.

10. Calyx and pedicel hirsute; sepals 8 to 12 mm. long; corolla with the tube and throat 20 to 25 mm. long, the limb 25 to 40 mm. in diameter----- 10. I. LEPTOTOMA.
8. Leaf blades entire or angulate-lobed or, if pedately parted, then the midlobe not less than 6 mm. wide (except sometimes in the upper leaves of *I. barbatisepala*); stems twining (11).
11. Outer sepals conspicuously dilated toward the base, attenuate-acuminate toward the apex, not scarious-margined, the inner ones much narrower, lanceolate, scarious-margined toward the base; stems, leaves, and calyx sericeous with long, very fine, more or less appressed hairs, these not pustulate at base; leaf blades pedately 5- to 7-parted, the midlobe strongly constricted at base; corolla 6 to 9 cm. long; capsule 5-celled-- 11. I. HETEROPHYLLA.
11. Outer sepals not conspicuously dilated toward the base, much like the inner ones; stems, leaves, and calyx not sericeous; capsule 2- or 3-celled (12).
12. Calyx hispid, the hairs stout, conspicuously subulate, mostly 2 to 3 mm. long; stems and leaves glabrous; petioles usually sparsely beset with elevated, pricklelike warts; leaf blades pedately 3- to 5-parted, the basal lobes usually deeply cleft; sepals narrowly lanceolate; corolla about 2 cm. long-- 12. I. BARBATISEPALA.
12. Calyx villous, hirsute, or glabrous, the hairs, if any, very slender, not conspicuously subulate (13).
13. Leaf blades all entire, cordate (14).
14. Stems, leaves, and calyx glabrous; peduncles mostly 1-flowered; calyx and pedicel rugose-verrucose; sepals ovate, 4 to 5 mm. long at anthesis, scarious-margined to the apex; corolla 2 to 3 cm. long-- 13. I. CARDIOPHYLLA.
14. Stems, leaves, and calyx more or less hirsute; peduncles mostly 2- to several-flowered; calyx and pedicel not rugose-verrucose but the bases of the hairs often enlarged; sepals lanceolate or somewhat spatulate, 8 to 25 mm. long at anthesis, not scarious-margined to the apex; corolla 4 to 6 cm. long----- 14. I. PURPUREA.
13. Leaf blades (some or all of them) angulate-lobed or more deeply cleft (15).
15. Corolla not more than 2 cm. long, narrowly funnelform; calyx at anthesis less than 10 mm. long, the sepals ovate or lance-ovate, scarious-margined, usually conspicuously so, sparsely villous, long-ciliate, or glabrous; stems glabrous or sparsely villous; leaf blades commonly glabrous, deeply 3-lobed, or some of them entire and deeply cordate. 15. I. TRILOBA.
15. Corolla 2.5 to 4 cm. long, broadly funnelform; calyx at anthesis at least 10 mm. long, the sepals lanceolate, not or not conspicuously scarious-margined, copiously villous-hirsute; stems and leaves more or less villous-hirsute; leaf blades angulate-lobed to pedately 5-parted-- 16. I. HIRSUTULA.

1. *Ipomoea coccinea* L., Sp. Pl. 160. 1753.

Quamoelit coccinea Moench, Meth. Pl. 453. 1794.

Coconino County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, hillsides and canyons, May to October. Western Texas to Arizona and southward into tropical America.

Easily distinguished from all the other Arizona species by the scarlet, narrowly trumpet-shaped corolla. The typical form, with cordate or subsagittate, otherwise nearly entire leaf blades, is less common in Arizona than var. *hederifolia* (L.) Gray (*I. hederifolia* L.) with some or all of the blades deeply 3-lobed to pedately 5-parted.

2. *Ipomoea longifolia* Benth., Pl. Hartw. 16. 1839.

Cochise and Santa Cruz Counties, 4,000 to 6,000 feet, plains and mesas, usually with grasses, July and August. Oklahoma to southern Arizona and Mexico.

The trailing stems up to 3 m. long, long narrow entire leaves, and large white, pink-throated corolla, make this species easily distinguishable.

3. *Ipomoea thurberi* A. Gray, Syn. Fl. 2¹: 212. 1878.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, plains and mesas, August and September, type from southern Arizona near Santa Cruz, Sonora (*Thurber* 966). Southern Arizona and Sonora.

Stems trailing, the purple flowers opening in the evening.

4. *Ipomoea egregia* House, Torreya 6: 124. 1906.

Ipomoea cuneifolia A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 90. 1883. Not Meisn., 1869.

Known only from the type collection in the Huachuca Mountains, Cochise County (*Lemmon* 2837), September.

5. *Ipomoea lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 90. 1883.

Known only from the type collection in the Huachuca Mountains (*Lemmon* 2840), August.

6. *Ipomoea muricata* Cav., Icon. Pl. 5: 52. 1794.

Ipomoea patens (A. Gray) House, N. Y. Acad. Sci. Ann. 18: 237. 1908.

Cochise and Santa Cruz Counties, 5,000 to 6,000 feet, August and September. New Mexico and southern Arizona to northern South America.

7. *Ipomoea plummerae* A. Gray, Syn. Fl. ed. 2, 2¹: 434. 1886.

Apache County to Coconino County, south to the Pinaleno Mountains (Graham County) and Santa Catalina Mountains (Pima County), 5,000 to 9,000 feet, mostly in coniferous forests, August and September, type from Arizona (*Lemmon* 2839). Arizona and northern Mexico.

Corolla pink, the tuber reported to be edible.

8. *Ipomoea tenuiloba* Torr., U. S. and Mex. Bound. Bot. 148. 1859.

Chiricahua Mountains, Cochise County, 6,000 feet (*Blumer* 2138), September. Western Texas to southeastern Arizona and northern Mexico.

9. *Ipomoea costellata* Torr., U. S. and Mex. Bound. Bot. 149. 1859.

Yavapai County to Cochise, Santa Cruz, and Pima Counties, 3,500 to 6,000 feet, common on dry grassy plains and mesas, July to October. Western Texas to Arizona and Mexico.

10. *Ipomoea leptotoma* Torr., U. S. and Mex. Bound. Bot. 150. 1859.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 4,500 feet, common on dry grassy plains and mesas, August to October, type from Sonora near the Arizona border. New Mexico, southern Arizona, and Mexico.

An attractive plant with rather large pink (seldom white) corollas, apparently hybridizing occasionally with *I. costellata*. Specimens with noticeably hirsute stems belong to var. *wootoni* Kelso, of which the type was collected in the Santa Rita Mountains (*Wooton* in 1914).

11. *Ipomoea heterophylla* Ortega, Hort. Matr. Dec. 1: 9. 1797.

Near Tombstone and Hereford (Cochise County), western slope of the Baboquivari Mountains (Pima County), 3,500 to 4,500 feet,

mesas and plains, September. Western Texas, southern Arizona, and northern Mexico.

The corolla is purple. Specimens from Cochise County resemble Mexican specimens, but those from the Baboquivari Mountains probably represent a distinct variety, having the leaf lobes narrower and more attenuate at both ends, the calyx with shorter and less dense pubescence, and the sepals with broader bases and more abrupt tips.

12. *Ipomoea barbatisepala* A. Gray, Syn. Fl. 2¹: 212. 1878.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,000 feet, canyons, etc., climbing on shrubs, August and September. Western Texas, southern Arizona, and Mexico.

The corolla is normally purplish pink, sometimes white.

13. *Ipomoea cardiophylla A. Gray, Syn. Fl. 2¹: 213. 1878.

House (see footnote 15, p. 708, House, p. 258), gives the range as "western Texas to Arizona and Mexico," but cites no collections, and the writers have seen no specimens from this State.

14. *Ipomoea purpurea* (L.) Lam., Tabl. Encycl. 1: 466. 1797.

Convolvulus purpureus L., Sp. Pl. ed. 2, 219. 1762.

Occasional in cultivated fields in southern Arizona, September. Widely distributed in the United States; naturalized from tropical America.

One of the cultivated morning-glories, in places a troublesome field weed.

15. *Ipomoea triloba* L., Sp. Pl. 161. 1753.

Valley of the Santa Cruz River near Tucson, Pima County (*Pringle* in 1884). Southern Florida, southern Arizona, Mexico, and southward.

Pringle's specimen differs from the common form of the species in having glabrous leaves, sepals, and capsules, and nearly glabrous stems.

16. *Ipomoea hirsutula* Jacq. f., Eclog. Pl. Rar. 1: 63. 1811.

Ipomoea desertorum House, N. Y. Acad. Sci. Ann. 18: 203. 1908.

Southern Navajo, Graham, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,300 to 5,500 feet, in various situations, July to October. Western Texas to central and southern Arizona, south to Central America.

Sometimes a weed in cultivated land, especially in cotton fields in Graham County. A common form with elongate sepal tips is *I. desertorum* House. A similar variation is found occasionally also in *I. purpurea*. The type of *I. desertorum* was collected at Tucson (*Thornber* 29).

104. POLEMONIACEAE. PHLOX FAMILY

Plants annual or perennial, herbaceous or suffrutescent; leaves simple or compound; flowers perfect, mostly regular, 5-merous; stamens separately attached to the corolla, inserted equally or unequally; ovary superior, mostly 3-celled; style usually 3-cleft; fruit a longitudinally dehiscent capsule.

An almost wholly American family, comprising many plants with

beautiful flowers. Species of the genera *Phlox*, *Gilia*, and *Polemonium* and the climbing *Cobaea scandens* are garden favorites.

Key to the genera

1. Calyx in fruit not becoming ruptured by the capsule; corolla regular; leaves alternate, not prickly (2).
2. Leaves simple; calyx tube scarious and whitish between the ribs, with a short toothlike fold in each sinus..... 2. COLLOMIA.
2. Leaves pinnately compound with numerous leaflets; calyx entirely herbaceous and green, the tube not distended or folded between the ribs.
 4. POLEMONIUM.
1. Calyx in fruit becoming ruptured by the capsule or, if not so (in *Gilia*, subgenus *Navarretia*), then the plant annual, the leaves prickly, the inflorescence involucrate, and the sepals unequal (3).
3. Corolla regular, salverform or, if somewhat funnelform, then the plant suffrutescent, the stems tall and weak, and the corolla whitish, 1.5 to 2 cm. long; stamens included, inserted at different levels in the corolla tube; leaves entire, narrow, mostly opposite..... 1. PHLOX.
3. Corolla regular or irregular, funnelform, campanulate, nearly rotate or, if salverform, then the stamens all inserted at the same level; stamens often exerted (4).
4. Bracts (when present) and the calyx only partly scarious; corolla regular or only slightly bilabiate; stamens included or moderately exerted, the filaments erect or slightly declined; leaves usually lobed or dissected..... 3. GILIA.
4. Bracts and calyx wholly scarious except the midrib; corolla usually distinctly bilabiate; stamens long-exserted, the filaments strongly declined and incurved; leaves entire, or merely serrate or dentate.
 5. LOESELIA.

1. PHLOX

Contributed by EDGAR T. WHERRY

Perennial herbs or the plants somewhat woody; leaves opposite, entire; inflorescence cymose, often reduced to a solitary flower; corolla salverform or rarely funnelform; stamens 5, irregular; ovules 1 to 3 in each carpel.

Flowering occurs twice a year, in spring and occasionally again after summer rains. The species are in many cases not well defined. Some have been renamed more than once, and names are often applied to specimens not closely related to the type material on which those names were originally founded.

The phloxes are popular garden plants, especially where a mass of blooms is desired. Several of the native species of Arizona have been brought under cultivation. *Phlox tenuifolia* grows naturally in the chaparral and may do well under cultivation in desert regions. The flowers of phlox are relished by sheep.

Key to the species

1. Shoots tending to be short and branched, and the inflorescence to be simple: Depressed phloxes (2).
2. Pubescence more or less glandular (3).
3. Glandular pubescence extending throughout the herbage and even on to the corolla tube..... 1. P. GLADIFORMIS.
3. Glandular pubescence limited to the inflorescence-herbage; corolla tube glabrous..... 2. P. CAESPITOSA.
2. Pubescence wholly eglandular (4).
4. Leaves thickish, gray green, more or less acerose (5).
5. Leaf outline linear-subulate; pubescence sparse; calyx intercostally carinate..... 3. P. AUSTROMONTANA.
5. Leaf outline ovate; pubescence copious; calyx intercostally flat.
 4. P. COVILLEI.

4. Leaves thinnish, soft, scarcely acerose (6).
 6. Herbage bright- (rarely gray-) green, glabrate to moderately pubescent; leaves linear-subulate, the larger ones often more than 1 mm. wide; calyx intercostally somewhat carinate----- 5. *P. DIFFUSA*.
 6. Herbage gray green, canescent to arachnoid-tomentose, rarely glabrate; leaves subulate, rarely more than 1 mm. wide; calyx intercostally flat----- 6. *P. HOODII*.
 1. Shoots tending to be elongate and little-branched, and the inflorescence to be compound: Elate phloxes (7).
 7. Corolla funnelform; leaves small and sparse----- 7. *P. TENUIFOLIA*.
 7. Corolla salverform (8).
 8. Underground parts chiefly long slender rootstocks, terminating in clusters of evergreen leaves, from which arise the flowering shoots of the next season; leaves mostly narrowly elliptic and obtusish; calyx intercostally flat----- 8. *P. CLUTENA*.
 8. Underground parts chiefly taproots; leaves deciduous, or a few cauline ones evergreen (9).
 9. Styles short, not equaling the sepals (10).
 10. Woody tissue well developed; petals notched----- 9. *P. WOODHOUSEI*.
 10. Woody tissue little developed; petals entire----- 10. *P. NANA*.
 9. Styles elongate, exceeding the sepals (11).
 11. Corolla tube 20 to 25 mm. long----- 11. *P. STANSBURYI*.
 11. Corolla tube 12 to 18 mm. long (12).
 12. Calyx intercostally bulging-carinate; leaves tending to be long-acuminate and thin----- 12. *P. LONGIFOLIA*.
 12. Calyx intercostally flat to moderately carinate; leaves tending to be short-acuminate and thick----- 13. *P. AMABILIS*.

*1. **Phlox gladiformis** (M. E. Jones) E. Nels., Rev. Phlox 21. 1899.

Phlox longifolia var. *gladiformis* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 711. 1895.

Phlox gooddingii A. Nels. and Kenn., Muhlenbergia 3: 141. 1908.

Phlox caesia Eastw., Leaflets West. Bot. 2: 54. 1937.

Although not yet actually collected in Arizona, this *Phlox* occurs so near the State borders in both Nevada and Utah that it seems likely to be found here. It is a caespitose plant characterized by having the herbage and even the corolla tube densely covered with gland-tipped hairs that emit a musky odor.

*2. **Phlox caespitosa** Nutt., Acad. Nat. Sci. Phila. Jour. 7: 41. 1834.

This *Phlox* grows in Nevada, Utah, and Colorado, not far from the Arizona line, and its occurrence in Arizona is to be expected. The plants are pulvinate, with linear-subulate, coarsely ciliate leaves.

3. **Phlox austromontana** Coville, Contrib. U. S. Natl. Herbarium 4: 151. 1893.

Northern and central Arizona, also in Graham County, up to 8,000 feet, rocky slopes. Idaho and Oregon to northwestern New Mexico, Arizona, California, and Mexico.

This species forms grayish-green prickly cushions and mats, more or less pubescent with fine eglandular hairs, the flowers pink or white.

Key to the subspecies

1. Plant spreading, with long-decumbent stems; longest leaves 15 to 30 mm. long; corolla tube 12 to 18 mm. long; styles 4.5 to 6 mm. long.
 subsp. *PROSTRATA*.
 1. Plant compact; corolla tube 8 to 14 mm. long; styles 2.5 to 6 mm. long (2).
 2. Stems short-decumbent or erect; longest leaves 12 to 20 mm. long.
 subsp. *VERA*.
 2. Stems short; longest leaves 8 to 12 mm. long----- subsp. *DENSA*.

The subsp. *prostrata* (E. Nels.) Wherry (*P. austromontana* var. *prostrata* E. Nels., *P. acerba* A. Nels.) occurs in northern Coconino and western Graham Counties. The subsp. *vera* Wherry occurs in Coconino, Yavapai, and Mohave Counties. The subsp. *densa* (Brand) Wherry (*P. densa* Brand), is found in Navajo, Coconino, and Mohave Counties.

4. *Phlox covillei* E. Nels., Rev. Phlox. 15. 1899.

Northwestern corner of Mohave County, 4,000 feet, dry sandy barrens, early spring. Nevada, northwestern Arizona, and California.

The original material of this species has the pubescence partly glandular, but the phase occurring in Arizona and eastern Nevada is wholly eglandular. Further study may show the latter to constitute a different subspecies.

5. *Phlox diffusa* Benth., Pl. Hartw. 325. 1849.

Northern Apache and Coconino Counties, 6,000 to 9,000 feet, plateaus and canyon rims, on rock ledges and gravelly slopes, late spring. Idaho and Washington to northern Arizona and southern California.

The Arizona plants belong to subsp. *subcarinata* Wherry, which forms mats densely covered with soft, bright-green or exceptionally grayish, linear-subulate leaves, producing an abundance of white to pink flowers. The typical subspecies, which differs in being less compact and in having flat intercostal calyx membranes, grows chiefly in the California Sierras.

6. *Phlox hoodii* Richards., Bot. App. Frankl. Journ. 733. 1823.

Northwestern corner of Mohave County, 4,000 feet, dry sandy barrens, early spring. Western North America.

This widespread species reaches its southern limit in Arizona, where it is represented by a small-leaved variant (*P. muscoides* Nutt.), apparently only an ecologic form. The longer-leaved *P. hoodii* subsp. *canescens* (T. and G.) Wherry is also to be looked for in northernmost Arizona.

7. *Phlox tenuifolia* E. Nels., Rev. Phlox 27. 1899.

Phlox gilioides A. Nels., Wyo. Univ. Pubs. Bot. 1: 127. 1926.

Roosevelt (Gila County), to the mountains of Cochise and Pima Counties, 1,500 to 5,000 feet, rocky slopes, flowering in spring and rarely again in autumn, type from the Santa Catalina Mountains (*Pringle* in 1881). Known only from Arizona.

When growing in the open, the plants form tufts of slender, woody-based stems up to 75 cm. long, bearing sparse small leaves. In partial shade the stems elongate, supporting themselves on other shrubs and attaining a length of 1.2 m. The white to lavender, strongly scented flowers are unique in the genus in having the corolla tube funnelliform.

8. *Phlox clutena* A. Nels., Amer. Bot. 28: 24. 1922.

Lukachukai Mountains (Apache County), Keet Seel, etc. (Navajo County), Navajo Mountain (Coconino County), 6,000 to 10,000 feet, pine forests, late spring and early summer. Southern Utah and northeastern Arizona.

The slender rootstocks creep through the humus of the forest floor, producing numerous clusters of evergreen leaves. The flowers are large and brilliantly phlox purple.

9. **Phlox woodhousei** Torr. in A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 256. 1870 (as *P. woodhousii*).

Phlox speciosa subsp. *eu-speciosa* var. *woodhousei* Brand. Pflanzenreich IV. 250: 73. 1907.

Phlox woodhousei oculata A. Nels., Amer. Jour. Bot. 18: 433. 1931.

White Mountains (southern Apache and Navajo Counties) to the San Francisco Peaks (Coconino County), Prescott (Yavapai County), Pinal Mountains (Gila County), and southwestern Cochise County, 3,500 to 7,500 feet, open woods on rocky slopes, flowering in spring and autumn, type from near the present Fairview, Coconino County (*Woodhouse* in 1851). Almost endemic in Arizona, extending but a short distance into New Mexico.

This dwarf shrub is easily recognized by its thick oblong acutish or obtusish leaves, and bright pink flowers with deeply notched corolla lobes and short styles.

10. **Phlox nana** Nutt., Acad. Nat. Sci. Phila. Jour. ser 2, 1: 153. 1848.

Rucker Valley, Cochise County, about 5,500 feet (*Lemmon* 415). Western Texas, New Mexico, southeastern Arizona, and Chihuahua.

The species is represented in Arizona by subsp. *glabella* (A. Gray) Brand (*P. triovulata* Thurb.), distinguished by eglandular pubescence. The Lemmon collection was named by Brand *P. nelsonii*, but his diagnostic character—lobes of the calyx $1\frac{1}{2}$ times as long as the tube—is too inconstant and trivial for nomenclatorial recognition. *P. nana* is a herbaceous perennial, varying in habit from one season to another, with purple to white corollas larger than in any other *Phlox* of Arizona.

11. **Phlox stansburyi** (Torr.) Heller, Torrey Bot. Club Bul. 24: 478. 1897.

Phlox speciosa var. (?) *stansburyi* Torr., U. S. and Mex. Bound. Bot. 145. 1859.

Northern Navajo County to eastern Mohave County, 4,000 to 6,000 feet, dry soil, often with sagebrush, spring. Utah, Nevada, New Mexico, northern Arizona, and eastern California.

This species name has been applied to all sorts of dissimilar phloxes, but the type material is characterized by having the corolla tube 20 to 25 mm. long, and there seems to be no reason for expanding the definition of the species to cover the shorter-tubed *P. clutena*, *P. longifolia*, *P. amabilis*, etc.

12. **Phlox longifolia** Nutt., Acad. Nat. Sci. Phila. Jour. 7: 41. 1834.

Coconino, Mohave, and northern Yavapai Counties, 4,000 to 6,800 feet, dry sandy or rocky slopes, spring. Wyoming to British Columbia, south to New Mexico, Arizona, and California.

Key to the subspecies

1. Herbage eglandular; leaves short..... subsp. HUMILIS.
 1. Herbage glandular in the inflorescence (2).
 2. Leaves (the larger ones) 50 to 70 mm. long, rather narrow
 and thin..... subsp. LONGIPES.
 2. Leaves (none of them) more than 45 mm. long..... subsp. COMPACTA.

The subsp. *humilis* (Dougl.) Wherry (*P. humilis* Dougl.) has been collected at Black Rock Spring, northern Mohave County (*Jones* 5098j). The subsp. *longipes* (*Jones*) Wherry (*P. linearifolia* var.

longipes M. E. Jones) is found in the Grand Canyon region (Coconino County) and in Mohave County. The subsp. *compacta* (Brand) Wherry (*P. stansburyi* subsp. *compacta* Brand), which intergrades to some extent with *P. amabilis*, occurs throughout the range of the species in Arizona.

13. *Phlox amabilis* Brand, Pflanzenreich IV. 250: 74. 1907.

Phlox longifolia var. *brevifolia* A. Gray, Syn. Fl. 2¹: 133. 1878.

Phlox stansburyi subsp. *eu-stansburyi* var. *brevifolia* subvar. *microcalyx* Brand, Pflanzenreich IV. 250: 67. 1907.

Phlox grayi Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 161. 1913.

Phlox visenda A. Nels., Amer. Jour. Bot. 18: 434. 1931.

Southern Navajo County to Mohave County, south to Santa Cruz County, 4,000 to 9,000 feet, dry gravelly slopes, spring and occasionally autumn, type of *P. amabilis* from near Prescott, Yavapai County (*E. Palmer* 391), type of *P. visenda* from Grandview, Coconino County (*A. Nelson* 10219). Western New Mexico, Arizona, southern Utah, Nevada, and eastern California.

Phlox amabilis is a low plant with thick oblong leaves, and when, as is often the case, its corolla lobes are deeply notched, it bears a striking resemblance to *P. woodhousei*. In the former, however, the stamens and styles are nearly as long as the corolla tube, whereas in the latter they are much shorter than the tube. The real difficulty lies in the intergradation between *P. amabilis* and *P. longifolia compacta*, intermediates between these being met with more frequently than is usually the case when two plants are really independent species. The broad, thick, short-acuminate to acute, or even obtusish leaves of *P. amabilis* are, however, so unlike the narrow, thin, long-acuminate leaves of the several subspecies of *P. longifolia* that the views of the more recent workers as to their distinctness are here accepted.

2. COLLOMIA

Plants annual; leaves sessile, the blades entire, linear to lanceolate or the floral ones sometimes ovate; flowers in dense terminal leafy heads; corolla regular, funnelform-salverform, the tube long and slender; stamens unequally inserted; seeds mucilaginous in water.

Key to the species

1. Corolla purplish, 6 to 15 mm. long and about twice as long as the calyx, with a narrow throat and a small limb; calyx usually less than 7 mm. long, the lobes subulate or narrowly lanceolate, acute..... 1. C. LINEARIS.
1. Corolla salmon pink or apricot color, usually at least 20 mm. long and thrice as long as the calyx, with an ample throat and limb; calyx 7 mm. long or longer, the lobes ovate-lanceolate, obtusish..... 2. C. GRANDIFLORA.

1. *Collomia linearis* Nutt., Gen. Pl. 1: 126. 1818.

Kaibab Plateau to Oak Creek (Coconino County), 6,500 to 8,500 feet, July and August. Quebec to British Columbia, south to Colorado, Arizona, and California.

2. *Collomia grandiflora* Dougl. ex Lindl., Bot. Reg. 14: pl. 1174. 1828.

North rim of the Grand Canyon (Coconino County), mountains of Gila County, 3,400 to 8,000 feet, mostly in coniferous forests but some-

times on open slopes, May (and perhaps later). Montana to British Columbia, south to Arizona and California.

The flower color is commonly salmon or apricot, but varies to cream.

3. GILIA

Plants of diverse habit, commonly herbaceous; leaves simple or compound; calyx gamosepalous, tubular or campanulate, 5-lobed, the lobes often spinescent; corolla regular or slightly irregular, campanulate, funnelform, or salverform.

A difficult genus, partly because of its size, but the numerous segregate genera accepted by some authorities seem to the writers to be of only subgeneric rank. Many of the species have beautiful flowers and are well worth cultivating.

Key to the species

1. Leaf blades pinnatifid, with all of the lobes sharply setose and the lower ones reduced to long setae; stems decumbent or prostrate; calyx teeth long-setose; corolla pale blue or whitish; stamens more or less exserted: Subgenus *Langloisia* (2).
2. Corolla distinctly irregular, more or less bilabiate; stamens more or less declined at apex (3).
 3. Corolla lobes not more than half as long as the tube, the latter little if at all longer than the calyx..... 1. *G. SCHOTTII*.
 3. Corolla lobes nearly equaling the tube, the latter distinctly longer than the calyx..... 2. *G. MATTHEWSII*.
2. Corolla regular or nearly so; stamens not or scarcely declined (4).
 4. Corolla lobes little shorter than the tube..... 3. *G. PUNCTATA*.
 4. Corolla lobes about one-third as long as the tube.... 4. *G. SETOSISSIMA*.
1. Leaf blades commonly pinnatifid, but none of the lobes reduced to setae or, if nearly so (in subgenus *Navarretia*), then the corolla white or yellow with a limb less than 2 mm. wide (5).
 5. Stamens inserted at different levels on the corolla tube, the anthers appearing at different levels, not exserted from the throat of the corolla; ovules normally solitary in each cell of the ovary; corolla narrowly funnelform, not more than 10 mm. long: Section *Phlogastrum* (6).
 6. Leaves mostly opposite, the blades entire; corolla not more than 1½ times as long as the calyx, pink or lavender; flowers axillary, or clustered at the ends of the stems; stems up to 12 cm. long.... 5. *G. GRACILIS*.
 6. Leaves alternate, with some or all of the blades pinnately or subpalmately parted or divided; corolla about twice as long as the calyx, bright blue; flowers in subcorymbose or subcapitate, terminal clusters; stems 15 cm. long or longer..... 6. *G. GILIOIDES*.
 5. Stamens inserted at the same level or nearly so, or the anthers appearing at nearly the same level, often exserted from the throat of the corolla; ovules 2 or more (rarely solitary) in each cell of the ovary (7).
 7. Calyx teeth unequal (8).
 8. Corolla campanulate (9).
 9. Flowers crowded in few-flowered clusters, sessile, or on pedicels much shorter than the calyx; corolla white, or tinged or marked with purple, 6 to 8 mm. long; leaf blades entire or 3-parted, often opposite; stems not more than (usually much less than) 8 cm. long..... 7. *G. DACTYLOPHYLLUM*.
 9. Flowers solitary, on pedicels 1 to several times as long as the calyx; corolla yellow, not more than 5 mm. long; leaf blades all entire, mostly alternate; stems usually 10 to 20 cm. long.
 8. *G. FILIFORMIS*.
 8. Corolla funnelform or nearly tubular; inflorescences dense, subcapitate (10).
 10. Inflorescence sparsely villous; anthers oval or nearly orbicular, not sagittate; corolla white or yellow, very narrow, the tube shorter than the calyx; leaves pinnatifid, the lobes needlelike, rigid, spinescent, as are also the calyx teeth: Subgenus *Navarretia* (11).

11. Stems depressed, often forming dense tufts; herbage not glandular, loosely villous in the inflorescence; corolla white, 3 to 4 mm. long; stamens usually included..... 9. *G. MINTMA*.
11. Stems erect, often diffusely branched; herbage glandular-puberulent; corolla yellow, 6 to 8 mm. long; stamens usually exerted..... 10. *G. BREWERI*.
10. Inflorescence lanate; anthers sagittate; corolla limb normally blue or lavender; leaves entire, or pinnately parted with 2 to 4 narrowly linear or filiform divisions, these and the calyx lobes acerose but not rigidly spinescent; Subgenus *Hugelia* (12).
12. Corolla less than 1 cm. long; anthers 0.5 to 1 mm. long.
11. *G. FILIFOLIA*.
12. Corolla 1 cm. long or longer; anthers rarely less than 1, commonly about 2 mm. long..... 12. *G. EREMYCA*.
7. Calyx teeth equal or nearly so (13).
13. Corolla rotate, the limb bright blue; plant suffrutescent, depressed; leaves pinnate or subpalmate with few narrow, rigid, acerose divisions..... 13. *G. RIGIDULA*.
13. Corolla funnelliform or salverform (14).
14. Leaves opposite or, if alternate, then palmately 3- to 7-parted or divided, rigidly pungent, and often with very short branchlets in the axils (15).
15. Plants perennial; leaves alternate or opposite; corolla showy, white, salverform or funnelliform-salverform; plant with a phloxlike odor when dry: Section *Leptodactylon* (16).
16. Corolla funnelliform-salverform, the tube considerably surpassing the calyx; leaves (at least the upper ones) alternate, rigid, appressed or ascending at a narrow angle, the divisions acicular, usually less than 1 cm. long; seeds unchanged in water..... 14. *G. PUNGENS*.
16. Corolla salverform, the tube not or but slightly surpassing the calyx; leaves opposite, soft, spreading, the divisions narrowly linear or filiform, usually more than 1 cm. long; seeds mucilaginous in water..... 15. *G. NUTTALLII*.
15. Plants annual; leaves opposite: Section *Linanthus* (17).
17. Corolla broadly funnelliform, yellow or with a whitish limb, 10 to 15 mm. long; leaves palmately parted, short, seldom more than 1 cm. long; stems usually diffusely branched, 5 to 20 cm. long..... 16. *G. AUREA*.
17. Corolla funnelliform-salverform, white or tinged outside with brown purple; leaves entire, narrowly linear to nearly filiform, or parted with very few similar divisions, usually more than 1 cm. long; flowers vespertine (18).
18. Seeds unchanged in water; corolla 20 to 30 mm. long, the lobes equaling or longer than the tube.
17. *G. DICHOTOMA*.
18. Seeds mucilaginous in water; corolla less than 15 mm. long, the lobes half as long as the tube.
18. *G. BIGELOVII*.
14. Leaves all (or the upper ones) alternate, never palmately parted (19).
19. Plants perennial (occasionally biennial?); flowers showy; stems mostly erect: Section *Ipomopsis* (20).
20. Inflorescence short and broad, corymbiform, loose or somewhat compact; leaf blades dentate or pinnately cleft, the basal ones obovate or oblanceolate; corolla coral pink when fresh; stamens included, the filaments almost none; seeds not changing in water..... 19. *G. SUBNUDA*.
20. Inflorescence elongate, thyrsoïd; leaf blades pinnately parted (sometimes entire in *G. multiflora*); filaments well developed; seeds mucilaginous in water (21).
21. Corolla 10 to 12 mm. long, light blue, lavender, or whitish; stamens usually conspicuously exerted and the upper ones declined; plant often suffrutescent.
20. *G. MULTIFLORA*.

21. Corolla usually 15 mm. long or longer; stamens not declined (22).
22. Color of the corolla normally red or pink, the lobes acute or acuminate (23).
23. Tube and throat of the corolla 18 to 40 mm. long, the lobes caudate-acuminate; stamens exerted.
21. G. AGGREGATA.
23. Tube and throat of the corolla 10 to 15 mm. long, the lobes acute or short-acuminate; stamens included.
22. G. ARIZONICA.
22. Color of the corolla blue, violet, or deep purple, the lobes rounded, more or less emarginate and apiculate (24).
24. Corolla 15 to 20 mm. long; style glabrous; stamens not or only moderately exerted ----- 23. G. MACOMBII.
24. Corolla 30 to 35 mm. long; style pubescent; stamens exerted.----- 24. G. THURBERI.
19. Plants annual (25).
25. Inflorescence normally capitate or subcapitate; stems leafy (26).
26. Flower clusters subtended by leafy bracts; corolla not more than 10 mm. long, the limb white or whitish; stems usually decumbent or spreading, not more than 30 cm. long; Section *Elaphocera* (27).
27. Corolla regular or nearly so, 4 to 5 mm. long; stamens not exerted; style glabrous; leaves all or nearly all pinnatifid or dentate.----- 25. G. POLYCLADON.
27. Corolla slightly bilabiate, 6 to 10 mm. long; stamens exerted, somewhat declined; style sparsely puberulent, at least below (28).
28. Leaf blades, at least the basal ones, pinnatifid or dentate.
26. G. PUMILA.
28. Leaf blades all entire.----- 27. G. GUNNISONI.
26. Flower clusters naked; corolla limb normally blue or violet (29).
29. Corolla narrowly funnelform, deep blue, not more than 7 mm. long; herbage viscid; leaves pinnatifid; ovules and seeds normally 1 in each cell; clusters few-flowered, loosely subcapitate to thyrsoid, sometimes even more open, short-staked or nearly sessile. 6. G. GILIOIDES.
29. Corolla broadly funnelform, pale violet or lavender, 7 to 10 mm. long; herbage not viscid; leaves bipinnatifid; ovules and seeds several in each cell (30).
30. Inflorescence densely capitate, many-flowered; peduncles very long; calyx lanate.--- 28. G. ACHILLEAEFOLIA.
30. Inflorescence loosely subcapitate, few-flowered; peduncles long or short; calyx not lanate 29. G. MULTICAULIS.
25. Inflorescence open, paniculate or corymbiform (31).
31. Seeds not changing in water; root leaves coarsely dentate or serrate or, at most, shallowly pinnatifid; inflorescence an open, rather few-flowered panicle (32).
32. Root leaves oblong-ovate to nearly orbicular, 15 to 50 mm. wide, irregularly and coarsely serrate or incised with long-cuspidate teeth; corolla 8 to 10 mm. long, the limb 4 to 5 mm. in diameter.----- 30. G. LATIFOLIA.
32. Root leaves oblong-linear, 3 to 15 mm. wide, rather regularly pinnately cleft; corolla 4 to 6 mm. long, the limb 2 to 3 mm. in diameter; stem leaves reduced, bractlike.
31. G. LEPTOMERIA.
31. Seeds mucilaginous in water; leaf blades, at least the basal ones, pinnatifid or bipinnatifid; inflorescence paniculate or corymbiform, the flowers numerous (33).
33. Corolla 30 to 50 mm. long, pale blue or nearly white; mature capsules $1\frac{1}{2}$ to 2 times as long as the calyx; flowers long-pedicelcd, in very open, corymbiform panicles; leaves pinnately parted, with few, long, narrowly linear or filiform divisions.----- 32. G. LONGIFLORA.

33. Corolla seldom more than 25 mm. long, the limb usually lavender or pink, drying blue; mature capsules not or but little surpassing the calyx: Section *Eugilia* (34).
34. Corolla tube much longer than the throat, usually at least twice as long; leaf blades pinnately toothed or cleft, the teeth little longer than wide; inflorescence an open panicle----- 33. *G. SCOPULORUM*.
34. Corolla tube less than twice as long as the throat, usually about equally long; leaf blades pinnately to tripinately parted, the divisions oblong to nearly filiform, usually much longer than wide (35).
35. Corolla broadly funnellform, 15 to 30 mm. long, $3\frac{1}{2}$ to 6 times as long as the calyx-- 34. *G. TENUIFLORA*.
35. Corolla less than 15 mm. long (36).
36. Calyx about one-third as long as the corolla, this usually broadly funnellform-- 35. *G. ARENARIA*.
36. Calyx about one-half as long as the corolla, this usually narrowly funnellform. 36. *G. INCONSPICUA*.

1. *Gilia schottii* (Torr.) S. Wats. in King, Geol. Expl. 40th Par. 5: 267. 1871.

Navarretia schottii Torr., U. S. and Mex. Bound. Bot. 145. 1859.

Langloisia schottii Greene, Pittonia 3: 30. 1896.

Mohave and Yuma Counties, 2,000 feet or lower, sandy desert washes, March and April. Southern Utah to Sonora and southeastern California.

2. *Gilia matthewsii* A. Gray, Syn. Fl., N. Amer. ed. 2, 2¹: 409. 1886.

Langloisia matthewsii Greene, Pittonia 3: 30. 1896.

"Central Arizona" (*Palmer* 404, in 1876, part), a doubtful basis for including this species in the flora of Arizona.

3. *Gilia punctata* (Coville) Munz, Man. South. Calif. Bot. 599. 1935.

Gilia setosissima var. *punctata* Coville, Biol. Soc. Wash. Proc. 7: 72. 1892.

Langloisia punctata Goodding, Bot. Gaz. 37: 58. 1904.

Fort Mohave (*Lemmon* in 1884, part), April. Western Nevada western Arizona, and southeastern California.

4. *Gilia setosissima* (Torr. and Gray) A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 271. 1870.

Navarretia setosissima Torr. and Gray in Ives, Colo. River Rpt. 22. 1860.

Langloisia setosissima Greene, Pittonia 3: 30. 1896.

Western Maricopa, Mohave, and Yuma Counties, 5,000 feet or lower, sandy desert washes, March and April. Idaho to Arizona and southeastern California.

5. *Gilia gracilis* (Dougl.) Hook., Curtis's Bot. Mag. 56: pl. 2924. 1829.

Collomia gracilis Dougl. ex Hook., *ibid.* as synonym.

Microsteris gracilis Greene, Pittonia 3: 300. 1898.

Microsteris macdougali Heller, Torrey Bot. Club Bul. 26: 621. 1899.

Coconino and Mohave Counties to Santa Cruz and Pima Counties, 3,000 to 7,000 feet, moist soil around springs and along streams,

February to May, type of *M. macdougalii* from Flagstaff (*MacDougal* 42). Nebraska to British Columbia, south to Arizona and California.

The Arizona form appears to be var. *micrantha* (Kellogg) Brand.

6. *Gilia gilioides* (Benth.) Greene, *Erythea* 1: 93. 1893.

Collomia gilioides Benth., *Edward's Bot. Reg.* 19: pl. 1622. 1833.

Gila and Yavapai Counties to Pima County, 3,000 to 5,000 feet, moist soil along streams, March to May. Nevada and Oregon to Arizona and California.

7. *Gilia dactylophyllum* Torr. in Ives, *Colo. River Rpt.* 22. 1860.

Gilia demissa A. Gray, *Amer. Acad. Arts and Sci. Proc.* 8: 263. 1870.

Linanthus demissus Greene, *Pittonia* 2: 257. 1892.

Linanthus dactylophyllus Rydb., *Fl. Rocky Mount.* 698, 1065. 1917.

Mohave, Pinal, Maricopa, and Yuma Counties, 2,000 feet or lower, desert sands, locally abundant, March to April, type from mouth of Diamond Creek, Mohave County (*Newberry* in 1858). Utah, Arizona, and southeastern California.

8. *Gilia filiformis* Parry ex A. Gray, *Amer. Acad. Arts and Sci. Proc.* 10: 75. 1874.

Mohave County, at Fort Mohave (*Lemmon* in 1884), and Yucca (*Jones* 3909), 500 to 1,800 feet, April and May. Utah, western Arizona, and southeastern California.

9. *Gilia minima* (Nutt.) A. Gray, *Amer. Acad. Arts and Sci. Proc.* 8: 269. 1870.

Navarretia minima Nutt., *Acad. Nat. Sci. Phila. Jour. ser. 2*, 1: 160. 1848.

Coconino County, 7,000 to 8,000 feet, openings in pine forests, June to August. Washington to Arizona and California.

10. *Gilia breweri* A. Gray, *Amer. Acad. Arts and Sci. Proc.* 8: 269. 1870.

Navarretia breweri Greene, *Pittonia* 1: 137. 1887.

Navajo Mountain, Coconino County (*Peebles* and *Smith* 13957), about 8,000 feet, June. Wyoming to California and northern Arizona.

11. *Gilia filifolia* Nutt., *Acad. Nat. Sci. Phila. Jour. ser. 2*, 1: 156. 1848.

Mohave County to Cochise, Santa Cruz, and Pima Counties, 1,200 to 4,000 feet, plains and mesas, April and May. Idaho and Washington to western Texas, Arizona, and Baja California.

The Arizona form is var. *diffusa* Gray, with floccose pubescence. The typical form of the species varies from pilose to nearly glabrous.

12. *Gilia eremica* (Jepson) Craig, *Torrey Bot. Club Bul.* 61: 417. 1934.

Hugelia eremica Jepson, *Man. Fl. Pl. Calif.* 793. 1925.

Coconino and Mohave Counties to Graham, Santa Cruz, Pima, and Yuma Counties, up to 5,000 feet, common on dry plains and mesas,

March to June. Southern Utah and Nevada to Sonora and southeastern California.

Sometimes so abundant as to color large areas with its sky-blue flowers. Intergrades with *G. filifolia*. The common form, especially in southern Arizona, is var. *arizonica* Craig,¹⁶ with a nearly regular corolla, the lobes about half as long as the tube. The var. *zionis* Craig, with a distinctly irregular corolla, the lobes about two-thirds as long as the tube, is found in Coconino and Mohave Counties.

13. *Gilia rigidula* Benth. in DC., Prodr. 9: 312. 1845.

Apache, Navajo, Cochise, and Santa Cruz Counties, 4,500 to 6,500 feet, dry plains and mesas, May to September. Kansas and Colorado to Arizona and Mexico.

The species is represented in Arizona by var. *acerosa* A. Gray (*G. acerosa* Britton). The bright-blue flowers are very attractive.

14. *Gilia pungens* (Torr.) Benth. in DC., Prodr. 9: 316. 1845.

Cantua pungens Torr., Ann. Lyc. N. Y. 2: 220. 1828.

Leptodactylon pungens Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 157. 1848.

Navajo and Coconino Counties, 6,500 to 7,000 feet, May and June. Montana to British Columbia, south to New Mexico, northern Arizona, and California.

The Arizona specimens belong to var. *hookeri* (Dougl.) Gray. The flowers of this and the next species resemble those of *Phlox*.

15. *Gilia nuttallii* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 267. 1870.

Leptodactylon nuttallii Rydb., Colo. Agr. Expt. Sta. Bul. 100: 279. 1906.

Apache, Navajo, Coconino, Yavapai, Greenlee, and Gila Counties, 6,000 to 7,000 feet, mostly in open pine forests, July and August. Wyoming to Washington, south to New Mexico, Arizona, and Baja California.

The common, if not the only, form in Arizona is var. *floribunda* (Gray) Munz (*G. floribunda* Gray), characterized by a relatively loose inflorescence and distinctly pedicelled flowers.

16. *Gilia aurea* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 155. 1848.

Linanthus aureus Greene, Pittonia 2: 257. 1892.

?*Gilia ashtonae* A. Nels., Amer. Jour. Bot. 25: 114. 1938.

Navajo County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,000 feet, common on dry plains and mesas, March to June. Western Texas to southern Nevada and southeastern California.

The plant is sometimes so abundant as to color extensive areas with its yellow flowers. A rather rare form, var. *decora* A. Gray, has the corolla limb whitish instead of bright yellow. *G. ashtonae*, of which the type was collected near Canyon Lake, Maricopa County (Nelson 1768), may be merely a form of *G. aurea* with exceptionally long pedicels.

¹⁶ CRAIG, THOMAS. A REVISION OF THE SUBGENUS HUGELIA OF THE GENUS GILIA (POLEMONIACEAE). Torrey Bot. Club Bul. 61: 411-428. 1934. See p. 419.)

17. *Gilia dichotoma* Benth. in DC., Prodr. 9: 314. 1845.

Linanthus dichotomus Benth., Edwards' Bot. Reg. 19: pl. 1622. 1833.

Maricopa and Pinal Counties (probably elsewhere), 1,000 to 2,000 feet, dry mesas and slopes, not common, March. Southern Arizona, southern California, and Baja California.

Known in California as evening-snow. The very fragrant flowers open in the evening, as in the next species.

18. *Gilia bigelovii* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 265. 1870.

Linanthus bigelovii Greene, Pittonia 2: 253. 1892.

Mohave County to southern Gila and Pima Counties, 3,700 feet or lower, common on dry mesas and slopes, March and April. Western Texas to Utah and southern California.

Corolla with a cream-colored limb streaked with crimson, the tube mahogany-colored within. The var. *jonesii* (A. Gray) Brand (*G. jonesii* A. Gray), characterized by a more compact habit and a glandular calyx, has been collected at Beaver Dam and Yucca (Mohave County), and near Sacaton (Pinal County). It is, perhaps, specifically distinct.

19. *Gilia subnuda* Torr. in A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 276. 1870.

Apache County to eastern Coconino County, 5,000 to 7,000 feet, rocky hills, June and July. Utah, Nevada, New Mexico, and northern Arizona. A very attractive plant when in flower.

20. *Gilia multiflora* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 154. 1848.

Navajo County to Mohave County, south to Cochise and Pima Counties, 4,000 to 9,000 feet, common on dry slopes, usually among pines, July to September. New Mexico to southern Nevada and Arizona.

The leaves vary from all entire to all pinnatifid. An exceptionally woody form with all (not merely a few) of the hairs glandular, has been collected in the Santa Catalina Mountains (*Kearney* and *Pebbles* 10330). Medicinal use of the plant by the Indians has been reported.

21. *Gilia aggregata* (Pursh) Spreng., Syst. Veg. 1: 626. 1825.

Cantua aggregata Pursh, Fl. Amer. Sept. 626. 1814.

Navajo County to the Kaibab Plateau (Coconino County) and Hualpai Mountain (Mohave County), south to the Pinaleno Mountains (Graham County) and the Bradshaw Mountains (Yavapai County), 5,000 to 8,100 feet, mostly in open coniferous forests, June to August. Montana to British Columbia, south to New Mexico, Arizona, and California.

Skyrocket. One of the showiest wild flowers of Arizona. The corolla is normally brilliant red but sometimes pink or even pale orange. The plant is sometimes cultivated in gardens. It is reported to be browsed by livestock and deer, and the flowers attract hummingbirds. Of the numerous variants, the most distinct one is var. *macrocephalon* Kearney

and Peebles, with the tube and throat of the corolla 35 to 40 mm. long and less than 3 mm. wide at the orifice, in pressed specimens. In typical *G. aggregata*, the tube and throat are usually less than 35 mm. long and 3 to 4 mm. wide at the orifice. The variety differs also in the color of the corolla, this being purplish pink, the lobes lineate-spotted with darker purple and with long attenuate tips. The var. *macrosiphon* is known only from the type locality, Santa Catalina Mountains, Pima County, about 7,500 feet. A form that is similar to this variety in corolla color but has the normal stout corolla tube occurs on the Kaibab Plateau.

22. *Gilia arizonica* (Greene) Rydb., Torrey Bot. Club Bul. 40: 472. 1913.

Callisteris arizonicus Greene, Leaflets 1: 160. 1905.

Both rims of the Grand Canyon, San Francisco Peaks, and near Flagstaff (Coconino County), near Pipe Springs (Mohave County), 5,000 to 7,500 feet, among pines and junipers, May to September, type from near Flagstaff (*MacDougal*). Southern Utah and Nevada and northern Arizona.

23. *Gilia macombii* Torr. ex A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 301. 1885.

Cochise and Santa Cruz Counties, 4,000 to 8,200 feet, stony slopes and openings in pine forests, August to October. Southern Arizona and northern Mexico.

24. *Gilia thurberi* Torr. in A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 261. 1870.

Mountains of Cochise, Santa Cruz, and Pima Counties as far westward as the Baboquivari Mountains, about 5,000 feet, open slopes and canyons, August to October. Southern New Mexico, southern Arizona, and northern Mexico.

Arizona's showiest species, excepting *G. aggregata*, and worthy of cultivation. The corolla varies from dark bluish purple to wine color, and shows considerable variation in the diameter of the tube and the width and apiculation of the lobes. There is also much variation in the length of the anthers.

25. *Gilia polycladon* Torr., U. S. and Mex. Bound. Bot. 146. 1859.

Coconino, Mohave, Greenlee, and Pinal Counties (probably elsewhere), 3,000 to 5,000 feet, plains and mesas, April to June. Western Texas to Utah and southeastern California.

Two different-looking forms, possibly specifically distinct, are represented by Arizona specimens identified on technical characters as *G. polycladon*.

26. *Gilia pumila* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 156. 1848.

Apache and Navajo Counties, 5,000 to 6,300 feet, plains, May to August. Kansas to Wyoming, Texas, and northeastern Arizona.

27. *Gilia gunnisoni* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacific 2²: 128. 1855.

Apache County to Coconino County, 4,500 to 7,200 feet, plains and mesas, sandy or heavy soil, May to September. Colorado, Utah, New Mexico, and northern Arizona.

Very similar to *G. pumila* and apparently intergrading with it.

28. *Gilia achilleaefolia* Benth., Edwards's Bot. Reg. 19: pl. 1622. 1833.

Near Tucson (*Thornber* in 1903 and 1905), and in the Baboquivari Valley, Pima County (*Griffiths* 3975), March and April, doubtless introduced from California.

29. *Gilia multicaulis* Benth., Edwards's Bot. Reg. 19: pl. 1622. 1833.

Mazatzal Mountains, Gila County, 3,800 feet (*Peebles* 11592, *Collom* 899), May. Central Arizona and California.

The Arizona plant, which is entirely glabrous and has small flowers in few-flowered clusters, seems to belong to var. *alba* Milliken. It is perhaps an introduction from California.

30. *Gilia latifolia* S. Wats. in Parry, Amer. Nat. 9: 347. 1875.

Mohave and Yuma Counties, 1,800 feet or lower, sandy soil, March and April. Southwestern Utah, western Arizona, and southeastern California.

31. *Gilia leptomeria* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 278. 1870.

Northern Apache County to northern Mohave County, 4,200 to 6,100 feet, common on rocky slopes, June. Wyoming to eastern Washington, south to New Mexico, northern Arizona, and California. Corolla lobes lavender.

32. *Gilia longiflora* (Torr.) G. Don, Hist. Dichl. Pl. 4: 245. 1837.

Cantua longiflora Torr., Ann. Lye. N. Y. 2: 221. 1828.

Almost throughout the State, 1,200 to 6,500 feet, common on dry plains and mesas, often on limestone soil, April to October. Nebraska to Utah, Texas, and Arizona.

The plant is conspicuous and attractive, with very long salverform pale-blue to nearly white (rarely variegated) corollas. A remarkable form, with caudate-acuminate corolla lobes, was collected in Segi (Laguna) Canyon, Navajo County (*Cutler* 3022).

33. *Gilia scopulorum* M. E. Jones, Torrey Bot. Club Bul. 8: 70. 1881.

Mohave and Yuma Counties, 2,500 feet or lower, dry rocky slopes, March and April. Southern Utah and Nevada, western Arizona, and southeastern California.

34. *Gilia tenuiflora* Benth., Edwards's Bot. Reg. 19: pl. 1622. 1833.

?*Gilia flavocincta* A. Nels., Amer. Jour. Bot. 21: 577. 1934.

Gila, Yavapai, Pinal, and Maricopa Counties, 1,300 to 4,000 feet, common in sandy soil, February to May, type of *G. flavocincta* from Canyon Lake, Maricopa County (*Nelson* 11228). Arizona, California, and Baja California.

This and the 2 following intergrade freely and should perhaps be regarded as varieties of 1 polymorphic species.

35. *Gilia arenaria* Benth., Edward's Bot. Reg. 19: pl. 1888. 1833.

Gilia hutchinsifolia Rydb., Torrey Bot. Club Bul. 40: 472. 1913.

Yavapai and Mohave Counties to Santa Cruz, Pima, and Yuma Counties, 1,000 to 4,000 feet, very common on plains and mesas, preferring sandy soil, February to May. Washington to Arizona and Baja California.

Resembles the preceding species in the breadth, and the following species in the relative shortness, of the corolla. A form with acute corolla lobes (*G. hutchinsifolia* Rydb.) is of occasional occurrence in Arizona.

36. *Gilia inconspicua* (Smith) Dougl., Curtis's Bot. Mag. 56: pl. 2883. 1829.

Ipomopsis inconspicua J. E. Smith, Exot. Bot. 1: 25. 1804.

Almost throughout the State, up to 7,000 feet but usually much lower, very common, usually in open sandy places, February to June. Wyoming to eastern Washington, south to western Texas, Arizona, and southern California.

Extremely variable in pubescence and leaf shape. Numerous varieties have been described, but there is so much intergradation that it seems useless to attempt to distinguish them. An extreme form, resembling *G. darvi* Milliken in the narrow, simply pinnatifid basal leaves with a very broad rachis, but smaller-flowered than that species, was collected near Kingman, Mohave County (*Kearney* and *Peebles* 13093, 13111).

An apparently undescribed species of *Gilia*, related to *G. brachysiphon* Woot. and Standl., of southwestern New Mexico, was collected near the Grand Canyon (*Whiting* 1047/4311, in 1940). It resembles *G. multiflora* superficially, but has very different flowers, the pale violet corolla being much more deeply cleft, with the tube barely surpassing the calyx and not longer than the lobes. There are 5 or 6 ovules in each cell of the ovary.

4. POLEMONIUM. JACOBS-LADDER, SKUNKLEAF

Plants mostly perennial, herbaceous; stems leafy; leaves alternate, pinnate, the uppermost leaflets often confluent; corolla rotate-campanulate, funnellform, or nearly salverform, violet, yellow, or white; stamens equally inserted, the filaments declined and usually hairy at base.

Key to the species

1. Corolla tubular-funnelform or nearly salverform, the lobes much shorter than the tube and throat (2).
2. Stems 30 cm. long, or longer, rather sparsely villous with flaccid hairs, somewhat viscid; leaflets 15 to 25, not crowded, thin, lanceolate, 10 to 25 mm. long, not appearing verticillate, the uppermost ones decurrent and confluent; corolla light yellow, almost salverform, about 40 mm. long, the tube narrow, about 3 times as long as the lobes; filaments pubescent at base ----- 1. *P. PAUCIFLORUM*.
2. Stems seldom more than 20 cm. long; plant copiously viscid-villous throughout; leaflets many more than 30, thickish, narrowly elliptic to nearly orbicular, less than 5 mm. long, appearing verticillate; corolla blue, funnellform, 15 to 30 mm. long; filaments glabrous. ----- 2. *P. CONFERTUM*.
1. Corolla funnellform-campanulate to rotate-campanulate, the lobes longer than the tube and throat; leaflets thin, not appearing verticillate; inflorescence somewhat viscid (3).
3. Flowering stems usually several, slender, not more than 20 cm. long, with not more than 3 leaves, puberulent to sparsely villous with soft hairs; leaflets 5 to 15 (usually not more than 10) mm. long; inflorescence few-flowered; corolla not more than 10 mm. long, violet-blue, with a yellow or white throat; plant ill-scented ----- 3. *P. PULCHERRIMUM*.
3. Flowering stems usually solitary, stout, 40 cm. long or longer, with numerous leaves; leaflets usually more than 10 (up to 25) mm. long, the uppermost ones decurrent and confluent; inflorescence several- to many-flowered; corolla 12 to 20 mm. long (4).

4. Stem usually pubescent nearly or quite to the base, copiously so above; leaflets elliptic to oblong-ovate, acutish or acute; corolla violet or whitish..... 4. *P. FOLIOSISSIMUM*.
 4. Stem glabrous or nearly so toward the base, sparsely pubescent above; leaflets lanceolate, usually narrowly so, acute or acuminate (5).
 5. Corolla pale yellow..... 5. *P. FLAVUM*.
 5. Corolla rich violet..... 6. *P. FILICINUM*.

1. *Polemonium pauciflorum* S. Wats., Amer. Acad. Arts and Sci. Proc. 23: 280. 1888.

Chiricahua Mountains, Cochise County (*Blumer* 1626, *Kusche* in 1927), 7,500 to 9,500 feet, along brooks, July and August. South-eastern Arizona and northern Mexico.

2. *Polemonium confertum* A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 73. 1864.

?*Polemonium lemmonii* Brand, Pflanzenr. IV. 250: 44. 1907.

San Francisco Peaks (Coconino County), 11,000 to 12,000 feet, June to September, type of *P. lemmonii* from Mount Agassiz (*Lemmon* in 1884). Wyoming to New Mexico and northern Arizona.

The var. *mellitum* A. Gray (*P. mellitum* A. Nels.), with laxer, less capitate inflorescences, has also been collected on the San Francisco Peaks (*Toumey* in 1892, *Thorner* in 1907).

3. *Polemonium pulcherrimum* Hook., Curtis's Bot. Mag. 57: pl. 2979. 1830.

San Francisco Peaks (Coconino County), Baldy Peak (Apache County), 10,000 to 11,000 feet, July and August. Alberta and British Columbia to New Mexico and northern Arizona.

The form occurring in this State is subsp. *delicatum* (Rydb.) Brand (*P. delicatum* Rydb.). The plant has a mephitic odor and is sometimes called skunkleaf.

4. *Polemonium foliosissimum* A. Gray, Syn. Fl. 2¹: 151. 1878.

Kaibab Plateau, Coconino County (*Eggleston* 10233), White Mountains, Apache or Navajo County (*Goodding* 563, 677), moist soil, along streams, July. Colorado, Utah, New Mexico, and Arizona.

Eggleston's specimen is less typical than those from the White Mountains, being more sparsely pubescent. A white-flowered form, subsp. *albiflorum* (Eastw.) Brand (*P. albiflorum* Eastw.), has been collected along Oak Creek, Coconino County (*Whiting* and *Sanders* 756).

5. *Polemonium flavum* Greene, Bot. Gaz. 6: 217. 1881.

Buck Springs, Coconino County (*Collom* 775), Pinaleno Mountains, Graham County (*Peebles* et al. 4492, 9858, etc.), 7,500 to 9,500 feet, rich moist soil in coniferous forests, July and August. Southwestern New Mexico and Arizona.

6. *Polemonium filicinum* Greene, Pittonia 1: 124. 1887.

Hannigan, White Mountains, Greenlee County (*Fulton* 8208, *Kearney* and *Peebles* 12334), Chiricahua Mountains, Cochise County (*Blumer* 1472, 1614), 8,000 to 9,500 feet, rich moist soil along brooks, July and August. Southern New Mexico and eastern Arizona.

There seems to be little but the corolla color to distinguish this from *P. flavum*, and both forms are perhaps better regarded as varieties of *P. foliosissimum*.

5. LOESELIA

Plant perennial, the stems somewhat woody below, with exfoliating bark; herbage glandular-hispidulous; leaves simple, mostly alternate, the blades narrow, spinulose-serrulate; flowers solitary or in pairs, closely invested by the scarious, entire or few-toothed bracts; corolla pale violet with darker spots.

1. *Loeselia glandulosa* (Cav.) G. Don, Hist. Dichl. Pl. 4: 248. 1837.

Hoitzia glandulosa Cav., Icon. Pl. 4: 45. 1797.

Santa Rita Mountains, Pima County (*Pringle* in 1884), Sycamore Canyon near Ruby, Santa Cruz County (*Hardies* and *Proctor* 6093), about 4,000 feet, flowering almost throughout the year. Southern Arizona to Central America.

105. HYDROPHYLLACEAE. WATERLEAF FAMILY

Plants herbaceous or shrubby; eaves simple or pinnate, alternate or (seldom) opposite; flowers perfect, regular or nearly so, 5-merous, mostly in cymes, these often elongate, 1-sided, and racemelike; stamens inserted on the corolla, alternate with its lobes; pistil of 2 united carpels, the ovary mostly 2-celled, the styles 2, or else 1, and 2-cleft; fruit a longitudinally dehiscent capsule; seeds often pitted or reticulate.

Key to the genera

1. Plant an aromatic, somewhat glutinous shrub; leaves evergreen, the blades coriaceous..... 8. ERIDICTYON.
1. Plants herbaceous or barely suffrutescent, not glutinous; leaves not evergreen or coriaceous (2).
 2. Calyx lobes very unequal, the 3 outer ones suborbicular, cordate, enlarged and veiny in fruit; inflorescence loosely racemose; stamens included. 7. TRICARDIA.
 2. Calyx lobes not, or not conspicuously, unequal (3).
 3. Flowers axillary, solitary or in small dense leafy clusters; plants annual; leaves simple, entire, not clasping at base..... 6. NAMA.
 3. Flowers in racemelike or naked headlike clusters, these mostly terminal or forming terminal panicles or, if the flowers scattered and axillary, then the herbage prickly and the leaves pinnatifid, with clasping bases (4).
 4. Corolla marcescent-persistent, pale yellow or cream-colored, campanulate; plants annual; flowers in loose racemes; stamens not exerted. 5. EMMENANTHE.
 4. Corolla deciduous soon after anthesis, blue, purple, or white (5).
 5. Flowers in scorpioid or circinate racemes or, if not so, then the flowers not in long-peduncled headlike clusters and the leaf bases not clasping..... 4. PHACELIA.
 5. Flowers not in scorpioid or circinate racemes (6).
 6. Inflorescences short, headlike, long-peduncled, terminal; plant perennial; leaves long-petioled, the petioles not dilated at base; stamens much-exserted..... 1. HYDROPHYLLUM.
 6. Inflorescences loosely racemose or cymose, or the flowers solitary in the axils; plants annual; leaves (at least the upper ones) sessile and auriculate-clasping, or the petioles with dilated, more or less clasping bases; stamens not exerted (7).
 7. Herbage prickly with stout, white, often retrorse or hooked hairs; calyx with a bractlike appendage in each sinus; corolla rotate, 8 to 14 mm. in diameter..... 2. NEMOPHILA.
 7. Herbage not prickly, hirsutulous and glandular, at least in the inflorescence; calyx not appendaged; corolla campanulate, not more than 4 mm. in diameter..... 3. ELLISIA.

1. HYDROPHYLLUM. WATERLEAF

A perennial pubescent herb; leaves large, mostly basal or nearly so, long-petioled, pinnate or deeply pinnatifid; flowers in dense short terminal clusters; corolla campanulate, pale blue, the lobes appendaged within; filaments hairy; style 2-cleft.

1. **Hydrophyllum occidentale** A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 314. 1875.

Oak Creek Canyon, Coconino or Yavapai County (*A. Nelson* 2112). Mazatzal Mountains, Gila County (*Collom* 108, *Harrison* 7829), 5,000 to 6,000 feet, along streams in shade, preferring rich soil, May. Utah to Oregon, central Arizona, and California.

Western squaw-lettuce.

2. NEMOPHILA

Plant annual; stems weak, few-branched, trailing or clambering, retrorsely prickly, usually at least 30 cm. long; leaves runcinate-pinnatifid with retrorse lobes, these and the calyx hispid; flowers axillary and terminal, solitary or in very few-flowered cymes, the corolla pale blue, with scalelike appendages.

The Arizona species lacks the beauty of the California baby-blue-eyes (*N. menziesii* Hook. and Arn. var. *insignis* Brand), a popular garden annual with large bright-blue flowers.

1. **Nemophila aurita** Lindl., Edwards's Bot. Reg. 19: pl. 1601. 1833.

Pholistoma aurita Lilja ex Lindstrom, Bot. Notiser 1839: 40. 1839.

Pinal, Maricopa, and Pima Counties, 3,000 feet or lower, common on rocky slopes, February and March. Arizona and California.

The Arizona form is var. *arizonica* (M. E. Jones) Brand (*N. arizonica* M. E. Jones). The genus *Pholistoma* is recognized as distinct from *Nemophila* by Constance.¹⁷

3. ELLISIA

Small delicate annuals; stems erect or diffuse, rarely more than 25 cm. long; leaves alternate or opposite, pinnatifid to bipinnate with small segments; inflorescences terminal, racemelike, becoming loose and elongate; flowers very small, the corolla without appendages or these minute.

The plants appear in early spring, preferring the partial shade of shrubs and disappearing as the soil dries out. The Arizona species belong to a separate genus, *Eucrypta*, according to Constance.¹⁷

Key to the species

1. Upper leaves sessile, the blades mostly simply pinnatifid or pinnate, with obovate or spatulate segments; corolla limb violet or drying that color; inflorescence distinctly glandular-puberulent 1. *E. MICRANTHA*.
1. Upper leaves more or less distinctly petioled, the blades (at least of the lower leaves) bipinnatifid with oblong or oblong-ovate primary segments; corolla whitish or pale purple; inflorescence not or obscurely glandular-puberulent.
 2. *E. TORREYI*.

¹⁷ CONSTANCE, LINCOLN. THE GENERA OF THE TRIBE HYDROPHYLLAE OF THE HYDROPHYLLACEAE. *Madroño* 5: 28-33. 1939.

1. *Ellisia micrantha* (Torr.) Brand, Pflanzenreich IV. 251: 42. 1913.*Phacelia micrantha* Torr., U. S. and Mex. Bound. Bot. 144. 1859.*Eucrypta micrantha* Heller, Muhlenbergia 2: 163. 1906.

Throughout the southern and western parts of the State, 4,000 feet or (usually) lower, common, February to May. Western Texas to southern Utah and southern California.

2. *Ellisia torreyi* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 302. 1885.*Eucrypta chrysanthemifolia* (Benth.) Greene var. *bipinnatifida* (Torr.) Constance, Lloydia 1: 147. 1938.

Widely distributed and common in the southern and western parts of the State, 3,000 feet or lower, February to March, type of *E. torreyi* from Yampai Valley (*Newberry* in 1858). Arizona, southern California, and Baja California. Probably only varietally distinct from *E. chrysanthemifolia*.

4. PHACELIA¹⁸

Plants herbaceous, annual or perennial, mostly pubescent; leaves mostly alternate, simple and entire to pinnatifid, or pinnate; flowers mostly in 1-sided false racemes (modified cymes); corolla narrowly funnelform to broadly campanulate, usually with vertical folds or plates in the tube; style 2-cleft or 2-divided; seeds variously roughened, often boat-shaped.

Contact with species having glandular pubescence, such as *P. crenulata* and *P. pedicellata*, causes dermatitis in susceptible persons.

Key to the species

1. Leaves entire or irregularly dentate or crenate, not pinnate or pinnatifid; plants annual; stems not more than 30 cm. long; flowers in simple, mostly few-flowered racemes; stamens and style not exerted (2).
2. Stems rather stout, sparingly branched; leaf blades slightly fleshy, broadly ovate to suborbicular, subcordate, shallowly (seldom deeply) crenate; racemes rather dense in fruit; flowers nearly sessile; seeds transversely corrugate; corolla about 5 mm. long, cylindric-campanulate.
 1. *P. PACHYPHYLLA*.
2. Stems slender, weak, often much branched; leaf blades not fleshy; racemes becoming loose in fruit; flowers distinctly pediceled; seeds not transversely corrugate (3).
3. Fruiting pedicels longer (often much longer) than the calyx; leaf blades orbicular or nearly so, thin; petiole equaling or longer than the blade (4).
4. Corolla 5 to 10 mm. long, white or purple; plant glandular-puberulent; stems up to 12 cm. long; leaf blades truncate or subcordate at base, entire or sparingly crenate----- 2. *P. FILIFORMIS*.
4. Corolla 10 to 15 mm. long, lilac purple; plant viscid-pubescent or nearly glabrous; stems up to 30 cm. long; leaf blades deeply cordate at base, crenate, often coarsely so----- 3. *P. GLECHOMAEFOLIA*.
3. Fruiting pedicels mostly shorter (often much shorter) than the calyx (5).
5. Corolla much longer than the calyx; leaf blades nearly or quite as wide as long, coarsely crenate or dentate; herbage soft-pubescent and glandular-puberulent (6).
6. Leaf blades thin; filaments glabrous----- 4. *P. LEMMONI*.

¹⁸ Reference: VOSS, JOHN W. A REVISION OF THE PHACELIA CRENULATA GROUP FOR NORTH AMERICA. Torrey Bot. Club Bul. 64: 81-96, 133-144. 1937.

6. Leaf blades thickish; filaments sparsely pilose... 5. *P. PULCHELLA*.
5. Corolla not or but slightly longer than the calyx (7).
7. Leaf blades as wide as long or wider, orbicular-cordate or reniform; petiole usually much longer than the blade (8).
8. Plant hirsute or hispid, also glandular-puberulent; leaf blades thin, coarsely crenate; racemes becoming loose, several-flowered, at length surpassing the leafy portion of the stem; capsule abruptly pointed..... 6. *P. ROTUNDIFOLIA*.
8. Plant merely glandular-puberulent; leaf blades thickish, entire; racemes rather dense, few-flowered, not surpassing the leafy portion of the stem; capsule very obtuse..... 7. *P. DEMISSA*.
7. Leaf blades about one-half as wide as long or narrower, narrowly lanceolate or oblanceolate to ovate-oblong, entire or nearly so, thickish; petiole usually about as long as the blade; plant hispid (9).
9. Corolla less than 5 mm. long; glandular pubescence present; filaments glabrous..... 8. *P. SAXICOLA*.
9. Corolla 5 to 10 mm. long; glandular pubescence none; filaments sparsely pilose..... 9. *P. CURVIPES*.
1. Leaves one or more times pinnate or pinnatifid, or pinnately toothed or, if entire, then the veins very prominent beneath and the stems hispid (10).
10. Seeds transversely corrugate all around; flowers in simple, terminal and axillary, more or less scorpioid racemes, these at length rather loose; plants annual, glandular-puberulent and pilose; stems usually less than 30 cm. long; corolla funnelform; stamens and style not exerted (11).
11. Corolla little, if at all, longer than the calyx, not more than 5 mm. long, white or purplish (12).
12. Plant few-branched from the base; stems erect or ascending; leaves pinnatifid, the lobes entire or incised; racemes much surpassing the leafy portion of the stem; calyx lobes broadly spatulate. 10. *P. AFFINIS*.
12. Plant many-branched from the base; stems decumbent or spreading; leaves pinnatifid, pinnatisect, or bipinnatifid; racemes not surpassing the leafy portion of the stem; calyx lobes narrowly spatulate. 11. *P. IVESIANA*.
11. Corolla 2 to 3 times as long as the calyx, 10 to 15 mm. long, deep blue or violet with a yellow throat; leaves pinnatifid or pinnatisect with numerous lobes or divisions, these entire or incised (13).
13. Primary leaf lobes or divisions usually less than twice as long as wide; fruiting calyx slightly to one-third longer than the capsule; corolla funnelform-campanulate..... 12. *P. FREMONTII*.
13. Primary leaf lobes or divisions usually at least twice as long as wide; fruiting calyx $1\frac{1}{2}$ to 2 times as long as the capsule; corolla funnelform..... 13. *P. BICOLOR*.
10. Seeds corrugate (if at all) only on the margins and keel of the excavated side; stamens and style mostly exerted (14).
14. Racemes not circinate or scorpioid, dense, composing a narrow, elongate, spikelike panicle; plant perennial (sometimes biennial?), not glandular, silvery-sericeous or glabrate; leaves pinnately parted, with numerous linear or narrowly oblong divisions, these often incised or pinnatifid; corolla campanulate, usually violet; seeds not cymbiform. 14. *P. SERICEA*.
14. Racemes circinate or scorpioid, at least until anthesis (15).
15. Stems hispid; leaves simple or pinnate with not more than 5 entire-margined leaflets, the veins very prominent beneath; plant perennial; corolla whitish or bluish..... 15. *P. HETEROPHYLLA*.
15. Stems not hispid or, if so, then the leaves pinnate, pinnatifid, or toothed, with more than 5 leaflets, lobes, or teeth, or the veins not prominent beneath, or the plant not perennial (16).
16. Seeds not excavated or corrugate on one side, deeply pitted; stems weak, usually supported by other vegetation, hirsute or hispid; leaves once or twice pinnately parted or divided, the divisions variously incised; calyx densely hirsute or hispid, 2 to 4 times as long as the capsule (17).

17. Plant perennial, glandular-pubescent, at least in the inflorescence, and with scattered glistening granules; leaves not bipinnate (sometimes bipinnatifid), the divisions rather large; racemes dense and relatively short, even in fruit; calyx lobes lanceolate or elliptic; corolla pale blue or whitish; stamens exerted.
16. *P. RAMOSISSIMA.*
17. Plants annual, with little or no glandular pubescence (18).
18. Calyx conspicuously hispid, the lobes narrowly spatulate and contracted into long slender claws, after anthesis elongate (8 to 12 mm. long); corolla lavender purple; leaves usually simply pinnate or pinnatifid, with variously toothed or cleft leaflets or divisions; stamens not or only slightly exerted (19).
19. Corolla not more than 7 mm. wide and usually much smaller.
17. *P. CRYPTANTHA.*
19. Corolla 8 to 16 mm. wide.----- 18. *P. VALLIS-MORTAE.*
18. Calyx hirsute or villous (exceptionally somewhat hispid), the lobes not contracted into long slender claws; corolla blue; leaves often bipinnate or bipinnatifid (20).
20. Scales near the base of the corolla tube with free tips; stamens commonly not or but slightly exerted.----- 19. *P. DISTANS.*
20. Scales wholly adnate to the corolla tube; stamens well exerted.----- 20. *P. TANACETIFOLIA.*
16. Seeds excavated on one side (cymbiform); stems relatively stout, usually erect or ascending; plants annual or biennial, usually glandular-viscid at least in the inflorescence, often ill-scented or, if not so, then the herbage silvery-pilose or the corolla lobes erose-denticulate (21).
21. Corolla funnelliform, the limb about 3 mm. wide; inflorescence usually elongate and narrow; stems stout, erect; leaf blades oblong-lanceolate, crenate, dentate, or cleft, usually not more than halfway to the midrib (22).
22. Seeds not corrugate; leaf blades crenate with broad rounded teeth.----- 21. *P. INTEGRIFOLIA.*
22. Seeds transversely corrugate or crenate on the excavated side (23).
23. Leaf blades shallowly dentate; stems copiously hirsute and tomentulose.----- 22. *P. PALMERI.*
23. Leaf blades deeply serrate-dentate; stems sparingly hirsute and canescent-puberulent.----- 23. *P. SERRATA.*
21. Corolla campanulate, the limb usually more than 3 mm. wide; inflorescences more corymbiform and spreading (24).
24. Seeds not corrugate or crenate (25).
25. Corolla blue, the lobes entire or nearly so; herbage densely silvery-pilose, soft to the touch, not glandular; leaves coarsely pinnatifid, with broad, few-cleft or few-toothed divisions.----- 24. *P. CONGESTA.*
25. Corolla white or pale bluish purple, the lobes erose-denticulate; herbage not silvery-pilose (26).
26. Gland-tipped hairs few or none; stems decumbent or prostrate, not leafy to the inflorescence; leaf blades pinnatifid, the lobes entire, crenate, or irregularly incised; corolla lobes with obtuse or acutish teeth; fruiting racemes rarely more than 4 cm. long; capsule globose.
25. *P. POPEI.*
26. Gland-tipped hairs usually numerous on the upper part of the plant; stems leafy to the inflorescence; leaf blades pinnatisect, the divisions pinnatifid or pinnately incised; corolla lobes with very acute teeth; fruiting racemes 6 to 12 cm. long; capsule short-ovoid.
26. *P. NEOMEXICANA.*
24. Seeds transversely corrugate or crenate on the keel or the margins or both, of the excavated side; corolla normally violet or purple, the lobes entire or nearly so; plants very ill-scented (27).

27. Calyx scarious in fruit, about twice as long as the capsule, the lobes conspicuously spatulate and narrowed at base; stem leaves long-petioled, with broadly ovate to nearly orbicular lobes; pedicels filiform, in fruit often longer than the calyx and decurved; corolla lilac or whitish.
27. P. PEDICELLATA.
27. Calyx not becoming scarious, little if at all longer than the capsule, the lobes not conspicuously spatulate or narrowed at base; pedicels shorter than the calyx, straight; corolla normally violet purple (28).
28. Stamens included; stem leaves often long-petioled and with broadly ovate or oblong-ovate blades, these shallowly cleft with broad rounded lobes, but the blades sometimes narrower and pinnatifid----- 28. P. COERULEA.
28. Stamens exerted; stem leaves usually short-petioled or subsessile (29).
29. Leaf blades oblong, coarsely crenate or cleft not more than halfway to the midrib, seldom deeper.
29. P. CORRUGATA.
29. Leaf blades oblong or ovate-oblong, mostly pinnatisect or deeply pinnatifid, with acute or acutish, usually crenate, leaflets or lobes----- 30. P. CRENULATA.

1. *Phacelia pachyphylla* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 88. 1883.

Western Maricopa, western Pima, and Yuma Counties, 1,000 feet or lower, dry stony soils commonly of volcanic origin, March. Southwestern Arizona, southeastern California, and Baja California.

Corolla pale pink, fading blue.

2. *Phacelia filiformis* Brand, Beitr. Kenntn. Hydroph. 8. 1911.

Kaibab Plateau and Grand Canyon (Coconino County), about 7,000 feet, rare, June to September, type from the Grand Canyon (*MacDougal* 186). Known only from northern Arizona.

3. *Phacelia glechomaefolia* A. Gray, Syn. Fl. ed. 2, 2¹: 417. 1886.

Peach Springs to the Grand Canyon (*Gray* in 1885, the type collection), Grand Canyon, Coconino County (*Lemmon* in 1884, *MacDougal* 198), 4,000 feet, May and June. Southern Utah and northern Arizona.

4. *Phacelia lemmoni* A. Gray, Syn. Fl. ed. 2, 2¹: 417. 1886.

Grand Canyon, Coconino County (*Thornber* 8471), Mineral Park, 12 miles northwest of Kingman, Mohave County (*Lemmon* 3350, the type collection). Northern Arizona, Nevada, and southern California.

5. *Phacelia pulchella* A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 326. 1875.

Mohave County, in Iceberg Canyon, 15 miles above Pierce Ferry, 1,700 feet (*Jones* 5077aj), and near Wolf Hole, about 5,000 feet (*Peebles* and *Parker* 14733, 14761), April to May. Southern Utah, Nevada, and northwestern Arizona.

6. *Phacelia rotundifolia* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 253. 1871.

Mohave and northern Yuma Counties, 2,000 to 5,000 feet, infrequent on rocky talus slopes, March to May. Southern Utah, western Arizona, and southeastern California.

7. *Phacelia demissa* A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 326. 1875.

Known in Arizona only by the type collection at Fort Defiance, Apache County (*E. Palmer*). Utah, Nevada, and northeastern Arizona.

8. *Phacelia saxicola* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 304. 1885.

Kingman, Mohave County (*Lemmon* in 1884, the type collection), 3,300 to 5,000 feet, granitic rocks, April. Southern Nevada and northwestern Arizona.

- *9. *Phacelia curvipes* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 252. 1871.

The writers have seen no specimens from Arizona, but the plant has been collected in the Beaver Dam Mountains, Utah, and this range extends into northern Mohave County. Southern Utah to California.

10. *Phacelia affinis* A. Gray, Syn. Fl. ed. 2, 2¹: 417. 1886.

Yavapai, Maricopa, and Pima Counties, 2,000 to 4,000 feet, along streams, March to May. Southern Utah, Arizona, California, and Baja California.

A specimen collected near Prescott (*Harrison* 4005) seems almost intermediate between this and the next species.

11. *Phacelia ivesiana* Torr. in Ives, Colo. River Rpt. 21. 1860.

Apache County to Mohave and Yuma Counties, 200 to 6,800 feet, sandy soil, plains and mesas, April to June, type from Oraibi, Navajo County (*Newberry* in 1858). Wyoming to Washington, south to Arizona and southern California.

12. *Phacelia fremontii* Torr. in Ives, Colo. River Rpt. 21. 1860.

Mohave County and northwestern Yavapai County, 2,000 to 5,000 feet, plains and mesas, March to June, type from Yampai Valley (*Newberry* in 1858). Southern Utah, Nevada, northwestern Arizona, and southeastern California.

The most beautiful Arizona species, deserving of cultivation as an ornamental. The corolla limb, sky blue to lavender in color, contrasts strongly with the bright-yellow tube and throat.

- *13. *Phacelia bicolor* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 255. 1871.

Fort Mohave, Mohave County (*Lemmon* in 1884). The writers have seen no other specimens from Arizona, and it is possible that *Lemmon's* collection was made in the Mohave Desert, Calif. Utah to Oregon and California.

14. *Phacelia sericea* (Graham) A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 323. 1875.

Eutoca sericea Graham, Curtis's Bot. Mag. 57: pl. 3003. 1830.

Near Flagstaff, Coconino County (*Purpus* in 1899), apparently very rare in Arizona. Alberta to British Columbia, south to Colorado, northern Arizona, and Nevada.

Purpus' specimen belongs to var. *biennis* (A. Nels.) Brand (*P.*

biennis A. Nels.), having green and glabrate herbage, pinnately parted leaves, and the style 2 to 3 times as long as the corolla.

15. *Phacelia heterophylla* Pursh, Fl. Amer. Sept. 140. 1814.

Apache County to Coconino County, south to Cochise and Pima Counties, 4,000 to 9,000 feet, common in rich rather moist soil in coniferous forests, descending lower along streams, April to October. Alberta and British Columbia to New Mexico, Arizona, and Washington.

16. *Phacelia ramosissima* Dougl. ex Lehm., Nov. Stirp. Pugill. 2: 21. 1830.

Gila, eastern Maricopa, Pinal and Pima Counties, 2,000 to 4,000 feet, among shrubs in canyons, March to May. Washington to Arizona and California.

The Arizona form is probably var. *suffrutescens* Parry, although the stems are scarcely woody.

17. *Phacelia cryptantha* Greene, Pittonia 5:21. 1902.

Grand Canyon (Coconino County), and Mohave County to Greenlee (?), eastern Maricopa, and northeastern Pinal Counties, 2,300 to 4,300 feet, dry slopes under *Quercus turbinella* and other shrubs, April to June. Nevada, Arizona, and southeastern California.

18. *Phacelia vallis-mortae* J. Voss, South. Calif. Acad. Sci. Bul. 33: 175. 1935.

Mohave County, Chloride to Boulder Dam (*Kearney* and *Peebles* 13171), Portland Mine to Chloride (*Kearney* and *Peebles* 13164), Yucca (*Jones* 4620), 1,800 to 3,000 feet, among desert shrubbery, April and May. Southern Nevada, northwestern Arizona, and southeastern California.

In Arizona this species seems to intergrade with *P. cryptantha* Greene and with *P. distans* Benth.

19. *Phacelia distans* Benth., Bot. Voy. Sulph. 36. 1844.

Mohave County to Graham, Gila, Pinal, Pima, and Yuma Counties, 1,000 to 4,000 feet, very common under bushes along washes and in the foothills, March to May. Nevada, Arizona, and California.

The delicate foliage and bright-blue flowers are attractive. The plants disappear rapidly as the soil dries out. The commoner form in Arizona is var. *australis* Brand with relatively few and large leaflets or divisions of the leaves; but var. *eudistans* Brand, with fernlike, bipinnate leaves having numerous small leaflets, is also not infrequent. Specimens with well-exserted stamens collected near Kingman, Mohave County, and near Hope, Yuma County (*Kearney* and *Peebles* 11142, 10991) are referable to var. *ammophila* (Greene) Brand.

20. *Phacelia tanacetifolia* Benth., Linn. Soc. London Trans. 17: 280. 1837.

Specimens representing var. *tenuifolia* Thurber were collected in a wheatfield near Yuma (*L. Swingle* in 1916), doubtless introduced from California.

21. *Phacelia integrifolia* Torr., Ann. Lyc. N. Y. 2: 222. 1828.

Apache County to Coconino County, 5,000 to 6,000 feet, May to September. Kansas and western Texas to Utah, northern Arizona, and Chihuahua.

22. *Phacelia palmeri* Torr. ex. S. Wats. in King, Geol. Expl. 40th Par. 5: 251. 1871.

Coconino County, Lees Ferry (*Jones* in 1890), Mohave County, at Mokiak (*Cottam* 4113) and near Wolf Hole (*Peebles* and *Parker* 14741), 3,200 to 5,500 feet. Southern Utah, Nevada, and northern Arizona.

23. *Phacelia serrata* J. Voss, Torrey Bot. Club Bul. 64: 88. 1937.

Grand Canyon, San Francisco Peaks, and near Flagstaff (Coconino County), 5,200 to 7,000 feet, July to September, type from the San Francisco Peaks (*Purpus* 8064). Known only from northern Arizona.

24. *Phacelia congesta* Hook., Curtis's Bot. Mag. 62: pl. 3452. 1835.

A collection in the Chiricahua Mountains, Cochise County (*Goodding* 2330) is cited by Voss, who refers it to var. *rupestris* (Greene) Macbride (*P. rupestris* Greene). Texas to southeastern Arizona.

25. *Phacelia popei* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2: 172. 1855.

Graham, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,600 to 5,000 feet, common on plains and mesas, February to May. Texas to southern Arizona.

This species is represented in Arizona by var. *arizonica* (Gray) J. Voss (*P. arizonica* Gray).

26. *Phacelia neomexicana* Thurber ex Torr., U. S. and Mex. Bound. Bot. 143. 1859.

Apache County to Coconino and Yavapai Counties, 5,500 to 8,500 feet, May to August. Colorado, New Mexico, and Arizona.

Most of the Arizona specimens belong to var. *pseudo-arizonica* (Brand) Voss, characterized by low, spreading or decumbent stems, these not or sparingly branched above the base, and by a bluish-purple (exceptionally whitish) corolla. The var. *alba* (Rydb.) Brand with tall, erect, very leafy, freely branched stems and whitish corollas occurs in Apache County, on open flats at Alpine (*Goodding* 1262), and near Springerville (*Stitt* 1481).

27. *Phacelia pedicellata* A. Gray, Syn. Fl. 2¹: 160. 1878.

Maricopa, Mohave, and Yuma Counties, 1,000 to 3,000 feet, dry rocky slopes, March to May. Western Arizona, southeastern California, and Baja California.

The plant is glandular-viscid and very ill-scented.

28. *Phacelia coerulea* Greene, Torrey Bot. Club Bul. 8: 122. 1881.

Coconino and Mohave Counties to Greenlee, Santa Cruz, Pima, and Yuma Counties, 2,000 to 5,000 feet, rocky slopes, March and April. Western Texas to Arizona and northern Mexico.

Specimens with relatively narrow, pinnatifid leaf blades are difficult to distinguish from *P. crenulata* Torr., except by the included stamens.

29. *Phacelia corrugata* A. Nels., Bot. Gaz. 34: 26. 1902.

Apache County to Coconino County, 5,000 to 7,000 feet, gravelly flats and barren rocky slopes, May to September. Colorado and Utah to Texas, northern Arizona, and northern Mexico.

Scarcely more than a variety of *P. crenulata* Torr. (*P. crenulata* var. *corrugata* Brand).

30. *Phacelia crenulata* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 251. 1871.

Throughout the State except in the extreme eastern portion, 4,000 feet or lower, very common on plains, mesas, and foothills, February to June. Southern Utah to New Mexico, Arizona, southeastern California, and Baja California.

Sometimes called "wild-heliotrope," Arizona's most abundant species, very conspicuous in spring with its rich violet-purple flowers, the plant glandular-viscid and with an unpleasant, somewhat onion-like odor.

The prevailing form in Arizona is var. *ambigua* (M. E. Jones) Macbride (*P. ambigua* M. E. Jones), which has the herbage hispid-hirsute with long very slender hairs, in addition to the (sometimes very scanty) glandular pubescence. The type collection of *P. crenulata* Torr., however, has similar pubescence. *P. intermedia* Wootton, a small-seeded form described by Voss as intermediate between *P. corrugata* and *P. crenulata*, has been collected, according to Voss, at Fort Verde (Yavapai County), Duncan (Greenlee County), and Tanque (Graham County). *P. minutiflora* Voss, a form with the corolla only 3 to 4 mm. long and wide, is known in Arizona only by a collection at Wickenburg (*Palmer 626*), which is probably merely a depauperate form of *P. crenulata*.

5. EMMENANTHE

Plants annual, differing from *Phacelia* chiefly in the persistent, cream-colored or pale-yellow corolla.

Key to the species

- 1 Capsule compressed, oblong; plant villous and glandular; stems erect; leaves sessile or nearly so, often slightly clasping at base, the blades oblong, pinnatifid; pedicels filiform, often longer than the calyx, decurved, the flowers pendulous; corolla much longer than the calyx.
1. *E. PENDULIFLORA.*
1. Capsule turgid, ovoid; plant glabrous; stems diffuse or decumbent; leaves petioled, the blades obovate or spatulate, entire or few-toothed; pedicels stout, shorter than the calyx, not decurved; corolla not, or but slightly, longer than the calyx.----- 2. *E. GLABERRIMA.*

1. *Emmenanthe penduliflora* Benth., Linn. Soc. London Trans. 17: 281. 1835.

Southern Yavapai County to Pima County, 4,200 feet or lower, on slopes and along streams, usually under bushes, March to May. Southern Utah and Arizona to California.

Whisperingbells, so-called from the rustling sound made by the persistent dry corollas.

***2. *Emmenanthe glaberrima* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 257. 1871.**

Militzia glaberrima Brand, Pflanzenreich IV. 251: 131. 1913.

Reported by A. Gray (Syn. Fl. ed. 2, 2¹: 171. 1886) to have been collected by Newberry at Flax River (an old name of the Little Colorado). The plant has not been collected since in Arizona, so far as the writers know. It is known otherwise only from Nevada.

6. NAMA¹⁹

Plants (Arizona species) annual; leaves alternate, the blades narrow, entire or very nearly so; calyx deeply cleft or parted; corolla funnel-form, usually red-purple; stamens not exerted; styles distinct or partly united.

Key to the species

1. Sepals united one-fourth to one-half of their length, the calyx tube narrow, adnate to the ovary; styles partly united; stems leafy, hirsute, up to 35 cm. long: Section *Zonolacus*----- 1. *N. STENOCARPUM*.
1. Sepals separate or nearly so, the calyx free from the ovary; styles separate or nearly so, at least when dry: Section *Eunama* (?).
 2. Stems often matted, prostrate, not more than 10 cm. long and usually much shorter; corolla 3 to 5 mm. long; leaf blades rhombic-ovate or obovate, 3 to 6 mm. long----- 2. *N. PUSILLUM*.
 2. Stems erect or ascending or, if matted and prostrate, then the corolla not less than 6 mm. long (3).
 3. Leaves mostly clustered at the ends of the branches and in a basal rosette, the stems otherwise naked or nearly so; herbage pilose or hirsutulous, the hairs soft, often somewhat retrorse; leaf blades seldom more than 3 mm. wide; corolla up to 15 mm. long----- 3. *N. DEMISSUM*.
 3. Leaves scattered along the stems; stems erect or ascending or, if prostrate, then the herbage hispid (4).
 4. Corolla about 5 mm. long; seeds usually deeply pitted; stems erect, slender, sparingly branched, not more than 20 cm. long; leaf blades linear-elliptic or narrowly spatulate, 1 to 4 mm. wide.----- 4. *N. DICHOTOMUM*.
 4. Corolla 7 to 15 mm. long; seeds not or obscurely pitted; stems usually decumbent or prostrate, branched from the base; herbage hispid-hirsute----- 5. *N. HISPIDUM*.

*1. *Nama stenocarpum* A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 331. 1875.

Yuma (*Vasey* in 1881). It is somewhat doubtful that this specimen was actually collected in Arizona. Southern Texas, southern California, and northern Mexico.

*2. *Nama pusillum* Lemmon ex A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 305. 1885.

The writers have seen no specimens from Arizona but the type is stated to have come from Fort Mohave (*Lemmon* in 1884). The species has been collected at Needles on the California side of the Colorado River. Known definitely only from California.

3. *Nama demissum* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 283. 1870.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 3,500 feet or lower, very common on sandy deserts, March to May. Utah, Arizona, southeastern California, and Baja California.

This small plant is conspicuous in spring because of its abundance and the vivid red-purple color of the flowers. Most of the Arizona specimens belong to the diminutive form var. *deserti* Brand.

4. *Nama dichotomum* (Ruiz and Pavon) Choisy, Soc. Phys. Hist. Nat. Genève Mém. 6: 113. 1833.

Hydrolea dichotoma Ruiz and Pavon, Fl. Peruv. Chil. 3: 22. 1802.

Near the San Francisco Peaks (Coconino County), Chiricahua Mountains (Cochise County), probably elsewhere, 5,500 to 7,000 feet,

¹⁹ Reference: HITCHCOCK, C. LEO. A TAXONOMIC STUDY OF THE GENUS NAMA. Amer. Jour. Bot. 20: 415-430, 518-534. 1933.

August to September. Colorado, New Mexico, Arizona, and Mexico; South America.

5. *Nama hispidum* A. Gray, Amer. Acad. Arts and Sci. Proc. 5: 339. 1861.

Almost throughout the State, 5,000 feet or lower, dry plains and mesas, usually in sandy soil, February to June (sometimes autumn). Oklahoma and Colorado to Arizona, southeastern California, and northern Mexico.

The form common in Arizona is var. *spathulatum* (Torr.) C. L. Hitchc. A collection at Yuma of var. *revolutum* Jepson (*Beard* in 1911) is cited by Hitchcock. This variety is characterized by the presence of soft-hirsute as well as hispid pubescence, and by the strongly revolute leaves. The var. *mentzelii* Brand (*Marilaunidium foliosum* Woot. and Standl.) was collected in the Gila River bed near Sacaton, Pinal County (*Harrison* and *Kearney* 8814), where it doubtless grew from seeds brought down the river from farther east. This variety has more stiffly hispid herbage than the other forms, and the pubescence of the lower leaf surface is glandular.

7. TRICARDIA

Plants perennial; stems branched from the base; leaves mostly basal or nearly so, the blades spatulate; flowers in short racemes, the corolla with 10 narrow internal appendages, broadly campanulate, white and purple; stamens unequal.

1. *Tricardia watsoni* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 258. 1871.

Beaver Dam, northwestern Mohave County, 1,800 feet (*Jones* 5024 ai), April. Southern Utah and northwestern Arizona, to southeastern California.

8. ERIODICTYON. YERBA-SANTA

Shrub up to about 1.2 m. (4 feet) high; leaf blades lanceolate, dentate or denticulate, dark green and resinous above, white-tomentose beneath; flowers numerous in scorpioid, often subcapitate, cymes, these forming terminal panicles; corolla broadly funnellform, deeply lobed, lilac or whitish; styles 2, or 1- and 2-parted; capsules 4-valved.

Sometimes known as mountain-balm. An infusion of the aromatic leaves is used locally in treating respiratory ailments, and is considered by "old timers" to be very efficacious for sore throat and coughs (Collom ms.).

1. *Eriodictyon angustifolium* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 181. 1848.

Southern Coconino and Mohave Counties to Greenlee, Pinal, and Pima Counties, 3,500 to 6,000 feet, dry slopes, common in chaparral, May to August. Southern Utah, southern Nevada, and Arizona.

A large-leaved form collected in the Pinal Mountains, Gila County (*Jones* in 1890) is the type of var. *amplifolium* Brand.

106. BORAGINACEAE BORAGE FAMILY

Contributed by I. M. JOHNSTON

Plants herbaceous or shrubby, usually bristly; leaves simple, prevailingly alternate; flowers perfect, regular, solitary or cymose; cymes glomerate-racemose or spicate, frequently unilateral and coiled (scorpioid), usually with bracts between, to one side of, or opposite the flowers; calyx usually deeply lobed, somewhat irregular; corolla 5-lobed, commonly with folds or saccate-intruded appendages in the throat; stamens 5, borne on the corolla tube alternate with the lobes; ovary superior, bicarpellate, usually 4-ovulate, entire or lobed, becoming tough or bony at maturity; fruit commonly breaking up into 4 single-seeded lobes (nutlets); style lobed or entire, seated in the pericarp at the apex of the fruit or borne between the fruit lobes (nutlets) on the receptacle, or on an upward prolongation thereof (gynobase); endosperm absent or scarce.

The classification of this family is based primarily upon the structure of the fruit. In many cases it is very difficult to recognize the genus and almost impossible to obtain a precise identification of the species, if the specimens lack mature fruiting structures.

The Boraginaceae are of small importance economically, but the family comprises numerous species that are cultivated as ornamentals, notably in the genera *Heliotropium* (heliotrope), *Anchusa*, *Echium*, and *Myosotis* (forget-me-not).

Key to the genera

1. Style 2-cleft; stigmas 2, distinct; flowers solitary or clustered in the stem forks ----- 1. COLDENIA.
1. Style simple; stigmas united (2).
2. Style springing from the pericarp at apex of the fruit, falling away with the nutlets; stigma annulate, usually surmounted by a sterile conic or cylindrical appendage; corolla plaited in the bud ----- 2. HELIOTROPIMUM.
2. Style borne between the lobes of the fruit (i. e., the nutlets), and attached to the receptacle or gynobase; stigma capitate, unappendaged; corolla not plaited (3).
3. Mature calyx very irregular, burlike, 3 of the lobes nearly distinct, the others more united and enclosing the fruit, becoming cornute with 7 to 9 coarse barbed appendages; ovules 2 ----- 3. HARPAGONELLA.
3. Mature calyx usually regular or practically so, not armed with hornlike barbed appendages; ovules usually 4 (4).
4. Nutlets stellately spreading, attached at the apical (radicle) end, armed with hooked appendages; small slender annuals ----- 4. PECTOCARYA.
4. Nutlets erect, incurved, or weakly divergent, attached at or below the middle, i. e., toward the cotyledon end (5).
5. Margin of the nutlets with barbed appendages (6).
 6. Plant annual; pedicels erect; style surpassing the nutlets. ----- 5. LAPPULA.
 6. Plant perennial or biennial; pedicels reflexed; style surpassed by the nutlets ----- 6. HACKELIA.
5. Margin of the nutlets lacking barbed appendages (7).
 7. Corolla blue, clearly differentiated into a tube, throat, and lobes. ----- 7. MERTENSIA.
 7. Corolla white or yellow, the throat not conspicuously differentiated from the tube and lobes (8).
 8. Nutlets attached above the base along a usually open and generally basally forked ventral groove or slit, or by a triangular opening in the pericarp ----- 8. CRYPTANTHA.

8. Nutlets lacking a distinct ventral groove or opening in the pericarp, this usually replaced by an elevated ventral keel (9).
 9. Plant annual; nutlets attached by a caruncular scar borne upon or at the basal end of the ventral keel, the attachment usually lateral or suprabasal; nutlets usually rough (10).
 10. Corolla white; cotyledons entire..... 9. *PLAGIOBOTHRYS*.
 10. Corolla orange or yellow; cotyledons 2-cleft. 10. *AMSINCKIA*.
 9. Plant perennial; nutlets attached by a broad rounded quite basal noncaruncular attachment; nutlets ovoid, smooth and shiny; corolla orange or yellow (11).
 11. Corolla small, 1 to 4 cm. long; stamens short, included. 11. *LITHOSPERMUM*.
 11. Corolla large, 5 to 6 cm. long; stamens reaching to the corolla sinuses----- 12. *MACROMERIA*.

1. *COLDENIA*²⁰

Low spreading fruticulose plants; leaves small and usually with ovate or elliptic, revolute-margined, pinnately veined blades, the veining usually impressed on the upper surface; corolla funnellform or tubular-funnelform, white, pink, or lavender, commonly opening late in the afternoon.

Key to the species

1. Fruit depressed-globose and unlobed until completely mature, bearing the style on its rounded summit, finally breaking up into quarters to form the nutlets; leaves ovate to elliptic, white-tomentose, obscurely veined; flowers borne singly in the leaf axils or at the forks of the stem. 1. *C. CANESCENS*.
 1. Fruit parted into distinct nutlets even in the bud, bearing the style between the apices of the nutlets (2).
 2. Leaf blades not evidently nerved, lanceolate to linear, usually very conspicuously and pungently setose; base of the petiole expanded, indurate, usually distinctly villous; flowers solitary in the leaf axils; nutlets finely warted, ovate, the inner face somewhat angled. 2. *C. HISPIDISSIMA*.
 2. Leaf blades with evident impressed nerves, ovate or obovate to nearly orbicular, lacking conspicuous setae, strigose or merely short-hispid; base of the petiole not expanded, or indurate, or villous; flowers in dense clusters at the forks of the stem; nutlets smooth or merely granulate (3).
 3. Plant annual; corolla pink or white; sepals with short pungent hairs; style surpassed by the calyx; cotyledons horseshoe-shaped. 3. *C. NUTTALLII*.
 3. Plant perennial; corolla blue or bluish; sepals merely villous; style surpassing the calyx; cotyledons ovate or suborbicular, entire or merely nicked at one end (4).
 4. Leaves with about 6 pairs of deeply impressed veins; calyx long-villous within; nutlets elongate, with a somewhat angulate inner face. 4. *C. PLICATA*.
 4. Leaves with only 2 or 3 pairs of shallow veins; calyx glabrous or short-pubescent within; nutlets nearly globose----- 5. *C. PALMERI*.

1. *Coldenia canescens* DC., Prodr. 9: 559. 1845.

Stegnocarpus canescens Torr., U. S. Rpt. Expl. Miss. Pacif. 2: 169. 1855.

Coldenia canescens var. *subnuda* Johnston, Calif. Acad. Sci. Proc. ser. 4, 12: 1137. 1924.

Grand Canyon, and from southern Yavapai County southward, 3,500 feet or lower, frequent on dry sunny mesas and slopes,

²⁰ Reference: JOHNSTON, I. M. [KEY TO THE NORTH AMERICAN SPECIES OF *COLDENIA*.] Calif. Acad. Sci. Proc. ser. 4, 12: 1139-1141. 1924.

especially in rocky calcareous soil. Texas to southeastern California and Mexico.

The distribution in Arizona as stated above is that of the typical form, with corollas 5 to 8 mm. long, 4 to 6 mm. wide. In the Castle Dome, Kofa, and Plomosa Mountains (Yuma County) there occurs var. *pulchella* Johnston, with corollas much larger (9 to 12 mm. long, 5 to 8 mm. wide) and apparently more deeply colored, type from the Kofa Mountains (*Shreve* 6257). This variety is poorly understood, and field observations are needed before its exact relationship to typical *C. canescens* can be established. This species is useful for controlling soil erosion.

2. **Coldenia hispidissima** (Torr.) A. Gray, Amer. Acad. Arts and Sci. Proc. 5: 340. 1862.

Eddyia hispidissima Torr., U. S. Rpt. Expl. Miss. Pacif. 2: 170. 1855.

Basin of the Colorado River and its tributaries, south to near Holbrook, and west to Beaver Dam, 2,000 to 5,000 feet, dunes and dry open slopes. Southern Utah, Nevada, and northern Arizona.

The Arizona form is var. *latior* Johnston, with broader, more lanceolate leaves than in the typical form of the species.

3. **Coldenia nuttallii** Hook., Jour. Bot. and Kew Gard. Misc. 3: 296. 1851.

Northern Arizona (Virgin River, Painted Desert) in dry sandy places. Wyoming to Washington, Arizona, and California; Argentina.

4. **Coldenia plicata** (Torr.) Coville, Contrib. U. S. Natl. Herbarium 4: 163. 1893.

Tiquilia brevifolia plicata Torr., U. S. and Mex. Bound. Bot. 136. 1859.

Coldenia palmeri of S. Wats. and recent authors. Not of A. Gray, 1870.

Extreme western Arizona and eastward along the Gila and Salt Rivers to Sacaton and Tempe, mostly below 1,500 feet, sandy flats and dry river bottoms. Deserts of the *Larrea* belt, southern Nevada and southeastern California to northwestern Mexico.

5. **Coldenia palmeri** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 292. 1870.

Coldenia brevicalyx S. Wats., *ibid.* 24: 62. 1889.

At Topock and Fort Mohave (Mohave County), Yuma and Wellton (Yuma County), 500 feet or lower, dry sandy places in the *Larrea* belt. Extreme western Arizona, southeastern California, and adjacent Mexico.

2. HELIOTROPIUM. HELIOTROPE

Herbs; flowers in scorpioid cymes or borne along the stem usually between or opposite the leaves; corolla white; fruit unlobed, at maturity breaking up into 4 nutlets or falling away entire.

Key to the species

1. Plant entirely glabrous, very succulent..... 3. *H. CURASSAVICUM*.
 1. Plant evidently hairy, not succulent (2).
 2. Corolla 8 to 15 mm. wide, with a long-exserted tube; style elongate, many times longer than the stigma..... 1. *H. CONVOLVULACEUM*.
 2. Corolla 2 to 4 mm. wide, usually with an included tube; style short, about as long as the stigma..... 2. *H. PHYLLOSTACHYUM*.

1. *Heliotropium convolvulaceum* (Nutt.) A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 6: 403. 1859.

Euploca convolvulacea Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 189. 1837.

Northeastern Arizona, southward along the Little Colorado River to near Holbrook, 4,500 to 6,000 (?) feet, dry sandy places. Nebraska to Texas, southern Utah, Arizona, and Mexico.

The corollas are very attractive, being large, pure white, and sweet-scented, opening in the late afternoon. The distribution in Arizona, as given above, is that of the typical form, with stems and leaves closely strigose. The var. *californicum* (Grøene) Johnston (*H. californicum* Greene), a well-marked western variant with spreading pungent bristles on the stems and leaves, occurs in similar situations but at lower altitudes and under drier conditions at Beaver Dam (Mohave County) and near Yuma, also in adjacent California and Sonora.

2. *Heliotropium phyllostachyum* Torr., U. S. and Mex. Bound. Bot. 137. 1859.

Mountains of southeastern Arizona (Pinal, Santa Cruz, and Cochise Counties), 4,000 to 5,000 feet, sands and gravel, frequently near streams, type from near Santa Cruz, Sonora. Southern Arizona, Sonora, and Baja California.

As originally described the species was a complex. The original suite of specimens represents 3 different species.

3. *Heliotropium curassavicum* L., Sp. Pl. 130. 1753.

Valleys of the Little Colorado, Colorado, and Virgin Rivers (Cocino, Mohave, and Yuma Counties), eastward in the valley of the Gila River to Pinal County, moist saline soil. The species is widely distributed in the warmer parts of the Western Hemisphere.

The distribution in Arizona, as given above, is that of var. *oculatum* (Heller) Johnston (*H. oculatum* Heller), with the corolla 3 to 5 (rarely 7) mm. wide, usually becoming distinctly purple or purplish at the throat, and the fruit 1.5 to 2 mm. wide. This variety ranges from southwestern Utah to Baja California. The var. *obovatum* DC. (*H. spathulatum* Rydb.), with the corolla 5 to 10 mm. wide, at most only purplish-tinged at the throat, and the fruit 2.5 mm. wide, has been collected in and near the valley of the Little Colorado River, at Holbrook and Tuba, and ranges from Iowa, southwestward to Chihuahua and Arizona, northwestward to Saskatchewan and Washington. It intergrades northward with var. *oculatum*, but apparently remains distinct in Arizona. Typical *H. curassavicum* (*H. xerophilum* Cockerell), widely distributed in the American tropics and extending northward to New Mexico, is a more slender, less glaucous plant than var.

oculatum, with narrower leaves and smaller flowers. It is to be sought in southeastern Arizona. These plants are sometimes known as "Chinese-pusley" and "quailplant." It is stated that the dried root, finely powdered, was applied to sores and wounds by the Pima Indians.

3. HARPAGONELLA

Slender spreading annual; stems fragile, at maturity disarticulating at the nodes; corolla white, inconspicuous; pedicels deflexed at maturity; sepals united, the tips becoming appressed to the stem below the base of the pedicel.

1. *Harpagonella palmeri* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 88. 1876.

Western Gila County to central Maricopa County, and southward through eastern Pima County to northern Sonora, 3,500 feet or lower, gravelly slopes and benches in the *Larrea* belt, frequently under mesquite.

Only the var. *arizonica* Johnston, type from Camp Lowell, Pima County (Parish 162), occurs in Arizona. The typical form of the species, a mere slender plant, smaller throughout, is confined to coastal southern California and Baja California.

4. PECTOCARYA ²¹

Slender annual herbs with inconspicuous white flowers; pedicels recurving at maturity; nutlets in divergent pairs.

The species frequently grow together and may be very similar in general appearance. Collections made without care may contain mixtures of 2 or even 3 species. The surprising rarity of hybrids among these associated, closely related species suggests that self-pollination or apogamy may occur. Specialized cleistogamic flowers, producing distinctive fruit, are frequently developed about the base of the plant, abundantly so in *P. heterocarpa*. Detailed observation on the behavior of the species is much needed. These little plants are very abundant in spring in southwestern Arizona, growing mostly in dry sandy or gravelly soil in the *Larrea* belt. It is stated that they are eaten by sheep before the fruits mature.

Key to the species

1. Plant erect; body of the nutlet distinctly obovate, entire-margined or merely erose or denticulate..... 1. *P. SETOSA*.
1. Plant prostrate or spreading; body of the nutlet linear or oblong (2).
2. Nutlets conspicuously heteromorphous, 2 of them more or less ascending and having distinct upturned, sparsely toothed or entire margins, the other 2 somewhat recurved and inconspicuously margined; calyx strongly asymmetric; fruit about the base of the plant apparently from cleistogamic flowers, its nutlets reflexed and not margined..... 2. *P. HETEROCARPA*.
2. Nutlets homomorphic or practically so, all of the nutlets with pectinately lacerate or dentate margins, all spreading or all recurved; calyx nearly regular; fruit about the base of the plant apparently from normal flowers, not much modified (3).
3. Nutlets with a very conspicuous, broad, toothed, cartilaginous margin, the triangular or cuneate teeth evidently united at base, the body of the nutlet straight or only moderately recurved..... 3. *P. PLATYCARPA*.
3. Nutlets with a very inconspicuous margin, dissected into distinct pectinately arranged, subulate teeth, the body of the nutlet becoming very strongly and conspicuously recurved..... 4. *P. RECURVATA*.

²¹ Reference: JOHNSTON, I. M. STUDIES IN THE BORAGINACEAE. II. PECTOCARYA. Gray Herbarium Contrib. 70: 34-39. 1924.

1. **Pectocarya setosa** A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 81. 1876.

Pectocarya setosa var. *holoptera* Johnston, Gray Herbarium Contrib. 70: 39. 1924.

Mohave, Yavapai, Gila, Maricopa, and Pinal Counties, 2,000 to 5,000 feet, apparently not common. Idaho and Washington to central Arizona and California.

2. **Pectocarya heterocarpa** Johnston, Arnold Arboretum Jour. 20: 399. 1939.

Pectocarya penicillata (Hook. and Arn.) A. DC. var. *heterocarpa* Johnston, Gray Herbarium Contrib. 70: 37. 1924.

Mohave County, and southward and southeastward across Arizona, 3,000 feet or lower. Southwestern Utah, Arizona, southeastern California, and northern Sonora.

3. **Pectocarya platycarpa** Munz and Johnston, Gray Herbarium Contrib. 81: 81. 1926.

Pectocarya gracilis Johnston var. *platycarpa* Munz and Johnston, Gray Herbarium Contrib. 70: 36. 1924.

Mohave and northern Yuma Counties, southeastward to Cochise and Pima Counties, up to 5,000 feet but mostly lower, type from Camp Lowell, Pima County (*Pringle* in 1884). Southern Utah, Arizona, southeastern California, and northern Sonora.

4. **Pectocarya recurvata** Johnston, Arnold Arboretum Contrib. 3: 97. 1932.

Mohave County southeast to Cochise and Pima Counties, up to 5,000 feet but mostly lower, type from near Chandler, Maricopa County (*Harrison* and *Kearney* 6507). Southwestern Utah, Arizona, southeastern California, and northern Sonora.

This and the preceding species have not been seen from Yuma County although several collections of *P. heterocarpa* are at hand from that area. Elsewhere in Arizona these 3 species are frequently found growing together.

5. LAPPULA. STICKSEED ²²

Small annuals with blue or white flowers in bracted racemes; nutlets 4, erect, attached to a slender elongate gynobase along the length of the well-developed ventral keel; plants of dry open situations.

Key to the species

1. Margin of 2 or more of the nutlets obese, completely inflated, bearing a row of very short, terete, barbed appendages seated upon its usually rounded edge.
 1. L. TEXANA.
1. Margin of the nutlets consisting of a row of distinct barbed appendages, or the margin more or less cup-shaped through the obvious partial union of the appendages, the free upper portion of the appendages sometimes inflated, but always appearing as lobes of the margin and not as though merely seated upon it (2).
 2. Nutlets with 2 rows of distinct marginal appendages, the principal row on the rim of the nutlet and the secondary row just outside the rim; corollas usually larger than in the next species----- 2. L. ECHINATA.
 2. Nutlets with a single row of distinct or partly united appendages on the rim, with no secondary appendages outside----- 3. L. REDOWSKII.

²² Reference: JOHNSTON, I. M. STUDIES IN THE BORAGINACEAE. II. LAPPULA. Gray Herbarium Contrib. 70: 47-51. 1924.

1. *Lappula texana* (Scheele) Britton, Torrey Bot. Club Mem. 5: 273. 1894.

Echinosperrum texanum Scheele, Linnaea 25: 260. 1853.

Echinosperrum redowskii (Hornem.) Lehm. var. *cupulatum*
A. Gray, Bot. Calif. 1: 530. 1876.

Lappula heterosperma Greene, Pittonia 4: 95. 1899.

Apache County to eastern Mohave County, 5,000 to 6,500 feet, type of *L. heterosperma* from Peach Springs (Greene in 1889). Kansas to Idaho, south to Texas, New Mexico, and northern Arizona.

The range in Arizona, as given above, is that of typical *L. texana*, with heteromorphic nutlets. The var. *coronata* (Greene) Nels. and Macbr. (*L. coronata* Greene), with nutlets all alike in form, is found, mostly at lower elevations, in Graham, Cochise, and Pima Counties, type from mesas near Tucson (Pringle in 1884). A very similar form is found in the northern Rocky Mountain States.

2. *Lappula echinata* Gilib., Fl. Lithuan. 1: 25. 1781.

Schultz Pass, Coconino County (Whiting 1173B). Widely distributed in the northern United States and Canada; introduced from Eurasia.

3. *Lappula redowskii* (Hornem.) Greene, Pittonia 2: 182. 1891.

Myosotis redowskii Hornem., Hort. Hafn. 1: 174. 1813.

Lappula occidentalis (S. Wats.) Greene, Pittonia 4: 97. 1899.

Lappula leucotricha Rydb., Torrey Bot. Club Bul. 36: 676. 1909.

Widely distributed in Arizona in the creosotebush, juniper, and pine belts, 1,200 to 8,500 feet, usually in sunny places in disturbed soil, type of *L. leucotricha* from near Tucson (Toumey in 1894). Western United States; Argentina; Asia.

The species has many forms, but these do not seem to be correlated with geography and more than 1 of them may occur in a given locality. The typical form has the marginal appendages distinct or nearly so on all 4 nutlets. This is less common in Arizona than var. *desertorum* (Greene) Johnston (*L. desertorum* Greene, *L. leucotricha* Rydb.), in which the appendages are more or less evidently confluent on 1 or more of the nutlets in each fruit.

6. HACKELIA²³

Coarse perennial or biennial herbs; corolla white or blue, in naked racemes; nutlets attached by a submedial areola to a pyramidal gynobase; plants of meadows, thickets, and pine forests.

Key to the species

1. Corolla white or at most bluish only about the center, 5 to 10 mm. wide; marginal appendages of the nutlets commonly much united. 1. H. URSINA.
1. Corolla normally blue, 3 to 7 mm. wide; marginal appendages of the nutlets free or united only at base (2).
 2. Middle stem leaves tending to be petiolate; branches usually few, elongating, spreading, only very rarely aggregated into a conspicuously cylindrical inflorescence; plant slender..... 2. H. PINETORUM.
 2. Middle stem leaves tending to be sessile; branchlets bearing mature cymes numerous, short, together forming a leafy-bracted elongate terminal panicle; plant coarse, rather strict..... 3. H. FLORIBUNDA.

²³ Reference: JOHNSTON, I. M. RESTORATION OF THE GENUS HACKELIA. Gray Herbarium Contrib. 68: 43-48. 1923.

1. *Hackelia ursina* (Greene) Johnston, Gray Herbarium Contrib. 68: 46. 1923.

Echinospermum ursinum Greene in A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 224. 1882.

Lappula ursina Greene, Pittonia 2: 182. 1891.

Lappula leucantha Greene, Leaflets 1: 152. 1905.

Hackelia leucantha Brand, Pflanzenr. IV. 252²: 131. 1931.

Southern Gila County and Greenlee County to Cochise and Pima Counties, 5,000 to 8,000 feet, moist shaded places in the oak and pine belts, not common. New Mexico, Arizona, and Chihuahua.

2. *Hackelia pinetorum* (Greene) Johnston, Gray Herbarium Contrib. 68: 45. 1923.

Echinospermum pinetorum Greene in A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 224. 1882.

Lappula pinetorum Greene, Pittonia 2: 182. 1891.

Hackelia floribunda var. *pinetorum* Brand, Pflanzenr. IV. 252²: 127. 1931.

Bill Williams Mountain (Coconino County), Chiricahua Mountains (Cochise County), Santa Rita Mountains (Pima County), 6,000 to 8,000 feet, moist shaded places in the pinyon and pine belts, not common. New Mexico, Arizona, and Chihuahua.

3. *Hackelia floribunda* (Lehm.) Johnston, Gray Herbarium Contrib. 68: 46. 1923.

Echinospermum floribundum Lehm., Nov. Stirp. Pugill. 2: 24. 1830.

Lappula floribunda Greene, Pittonia 2: 182. 1891.

San Francisco Peaks, Grand Canyon, etc. (Coconino County), 7,000 feet or higher, stream sides and meadows in the pine and spruce belts. Canada to northern New Mexico and Arizona, and southern Nevada.

7. MERTENSIA.²⁴ BLUEBELLS

Broad-leaved perennial herbs, glabrous or with inconspicuous appressed hairs, never bristly; corolla blue (or pink when immature), heterostyled, the throat cup-shaped or broadly cylindric, usually twice as long as the erect or ascending lobes; nutlets minutely papillate and obscurely rugose, ovoid; plants of meadows and woodlands.

Key to the species

1. Pedicels distinctly strigose; calyx at anthesis cut to the base or nearly so, the margin usually evidently ciliolate; leaves usually glabrous beneath and strigose above..... 1. *M. FRANCISCANA*.
1. Pedicels glabrous or at most merely pustulate; calyx at anthesis cut only to beyond the middle or less, the margin not evidently ciliolate; leaves glabrous (2).
2. Plant 10 to 20 cm. high; nutlets with a distinct, coarse, lobulate, reflexed margin; corolla tube glabrous within..... 2. *M. MACDOUGALII*.
2. Plant 30 to 120 cm. high; nutlets not margined; corolla tube usually hairy inside..... 3. *M. ARIZONICA*.

²⁴ Reference: WILLIAMS, L. O. A MONOGRAPH OF THE GENUS MERTENSIA IN NORTH AMERICA. Mo. Bot. Gard. Ann. 24: 17-159. 1937.

1. *Mertensia franciscana* Heller, Torrey Bot. Club Bul. 26: 549. 1899.

Mertensia pratensis Heller, *ibid.* p. 550.

Mertensia amplifolia Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 165. 1913.

Mertensia grandis Woot. and Standl., *ibid.*

Apache, Navajo, and Coconino Counties to the mountains of Cochise County, mostly above 7,000 feet, moist shaded places in the pine and aspen belts, type from near Flagstaff (*MacDougal* 232). Western Colorado and southeastern Utah to New Mexico and Arizona.

2. *Mertensia maddougallii* Heller, Torrey Bot. Club Bul. 26: 550. 1899.

Grand Canyon (Coconino County), Pine (Gila County), Fort Whipple (Yavapai County), 6,000 to 9,000 feet, mostly in the pine belt, rare, type from near Mormon Lake (*MacDougal* 95). Known only from Arizona.

The margined nutlets of this species are unique in the genus.

- *3. *Mertensia arizonica* Greene, Pittonia 3: 197. 1897.

This species is based upon specimens labeled as collected in Arizona (*E. Palmer* in 1869) but is known definitely only from central and southwestern Utah. The type is probably mislabeled (see footnote 24, p. 747, Williams, p. 62), but the species eventually may be found in meadows at the lower edge of the pine belt in extreme northwestern Arizona.

Mertensia palmeri Nels. and Macbr. is also based upon a Palmer collection labeled as from Arizona. According to Williams (see footnote 24, p. 747, Williams, p. 43), the type represents *M. paniculata* (Ait.) G. Don, of the northern United States and Canada, and could not have been collected in Arizona or adjacent States.

8. CRYPTANTHA²⁵

Annual, biennial, or perennial herbs, usually bristly; corolla white or yellow; cymes prevailingly scorpioid but sometimes glomerate or loosely racemose, with or without bracts; nutlets smooth, tuberculate, or wrinkled, with rounded, angled, or winged edges, attached through a break in the pericarp along a ventral groove or a more or less triangular lateral areola to a somewhat hemispheric or elongate gynobase; plants of dry, open habitats.

Several of the Arizona species are reported to have value as forage for sheep in Arizona. The popular name *nievitas* is applied to white-flowered species in California. *C. crassisejala* is stated to be used by the Hopi Indians in treating boils. Most of the species grow in dry, sandy or gravelly soil.

Key to the species

1. Plants coarse, biennial or perennial: Section *Oreocarya* (2).
2. Corolla tube elongate, distinctly surpassing the calyx; flowers usually heterostyled (3).
3. Nutlets roughened, tuberculate or muricate, dull; corolla white; inflorescence a somewhat interrupted cylindrical thyrse.--- 1. *C. FULVOCANESCENS*.

²⁵ References: PAYSON, E. B. A MONOGRAPH OF THE SECTION OREOCARYA OF CRYPTANTHA. Mo. Bot. Gard. Ann. 14: 211-358. 1927. JOHNSTON, I. M. THE NORTH AMERICAN SPECIES OF CRYPTANTHA. Gray Herbarium Contrib. 74: 1-114. 1925.

3. Nutlets smooth and shiny (4).
4. Corolla white; flowers in a terminal capitate cluster, rarely with 1 or 2 small few-flowered lateral clusters in the upper leaf axils; leaves sparsely strigose, green..... 2. *C. CAPITATA*.
4. Corolla yellow; leaves usually more abundantly strigose and paler (5).
5. Inflorescence an elongate cylindric thyrse; nutlets lance-ovate, more than $1\frac{1}{2}$ times as long as wide, usually only 1 developing, the margin acute; calyx becoming 8 to 10 mm. long in fruit, with abundant spreading bristles; pedicels slender, 2 to 4 mm. long; plant 10 to 30 cm. high..... 3. *C. FLAVA*.
5. Inflorescence consisting of a large terminal cluster, capitate in flower, with 1 or more remote, at maturity frequently stalked, much smaller, lateral clusters; nutlets broadly ovate, less than $1\frac{1}{2}$ times as long as wide, all 4 of them usually maturing, the margin narrowly winged; calyx becoming 8 to 14 mm. long in fruit, its hairs not very conspicuous and commonly more or less appressed; pedicels stout, usually 1 to 2 mm. long; plant 20 to 50 cm. high.
4. *C. CONFERTIFLORA*.
2. Corolla tube short, scarcely if at all surpassing the calyx; flowers not heterostyled (6).
6. Nutlets smooth and shiny, not compressed..... 5. *C. JAMESII*.
6. Nutlets rugose or tuberculate, strongly compressed (7).
7. Margin of the nutlets with a conspicuous papery wing; a coarse bristly biennial 40 to 100 cm. high..... 6. *C. SETOSISSIMA*.
7. Margin of the nutlets not winged, thickened or merely acute; plants less than 40 cm. high (8).
8. Plant biennial; stems from a coarse rosette crowning a short-lived taproot; scorpioid cymes elongating and becoming 3 to 8 cm. long, loosely 6- to 10-flowered..... 7. *C. VIRGINENSIS*.
8. Plant perennial, with a persistent caudex; cymose branches short, 1 to 2.5 cm. long, more or less corymbose, 2- to 6-flowered (9).
9. Pedicels stout, at first 1 to 2 mm. long, becoming 2 to 4 mm. long in fruit; calyx lobes oblong or oblong-lanceolate, 5 mm. long or less, with inconspicuous pale bristles; nutlets about one and one-half times as long as wide, ovate, asymmetric, the ventral face prominently rugose; stems usually less than 10 cm. high..... 8. *C. MODESTA*.
9. Pedicels slender, 3 to 5 mm. long, becoming 5 to 10 mm. long in fruit; calyx lobes lance-linear, 5 to 8 mm. long in fruit, with abundant, conspicuous, usually tawny bristles; nutlets about twice as long as wide, weakly asymmetric, the ventral face weakly rugose; stems usually 15 cm. or more high.
9. *C. HUMILIS*.
1. Plants slender, annual: Section *Krynitzkia* (10).
10. Calyx circumscissile at maturity; low herb with a compact inflorescence; flowers each with a foliaceous bract..... 10. *C. CIRCUMSCISSA*.
10. Calyx not circumscissile (11).
11. Gynobase protruding beyond the nutlets, bearing a sessile stigma on its apex; root and base of the plant conspicuously charged with a purple dye; a small slender dichotomous herb; flowers each with a foliaceous bract..... 11. *C. MICRANTHA*.
11. Gynobase shorter than the nutlets; style developed; root or herbage only very obscurely if at all charged with a purple dye; plant not conspicuously dichotomous; flowers commonly all or in part bractless (12).
12. Nutlets all smooth and shiny (13).
13. Spikes bracteate; stems reddish; nutlet 1, axial; ovules 2.
15. *C. MARITIMA*.
13. Spikes bractless; stems green; nutlets 1 to 4; ovules 4 (14).
14. Calyx broadly conic at base, densely appressed hispid-villous, lacking conspicuous bristles; nutlets 1 to 3; style surpassed by the nutlets..... 12. *C. GRACILIS*.
14. Calyx rounded at base, hispid or hirsute, inconspicuously strigose along the margin; nutlets 4; style about reaching the tips of the nutlets..... 13. *C. FENDLERI*.

12. Nutlets all (or some of them) roughened (15).
15. Calyx conspicuously recurving, most hirsute on the axial side; nutlet solitary, bent; ovules 2----- 14. *C. RECURVATA*.
15. Calyx strict to spreading, not recurving, most hirsute on the abaxial side; nutlets straight (16).
16. Nutlets distinctly heteromorphous, differing in size, frequently also in the markings and in the firmness of the attachment (17).
17. Nutlets 2, one smooth and shiny, the other roughened; ovules 2; stems reddish----- 15. *C. MARITIMA*.
17. Nutlets 4, all more or less roughened; ovules 4; stems not reddish (18).
18. Odd nutlet abaxial; nutlets dark, with pale tuberculations (19).
19. Plant shrubby, much branched, twiggy; inflorescence not scorpioid, loosely racemose; flowers distant and not 2-ranked; pedicels frequently spreading, 1 to 6 mm. long----- 16. *C. RACEMOSA*.
19. Plant herbaceous; inflorescence scorpioid, unilateral, the crowded flowers 2-ranked; pedicels strict or ascending, less than 1 mm. long (20).
20. Nutlets with merely angled margins; style reaching to or only slightly beyond the tip of the odd nutlet; inflorescence naked, except near the base; plant usually prostrate or decumbent----- 17. *C. ANGUSTIFOLIA*.
20. Nutlets with narrowly winged margins; style coarse, much surpassing the odd nutlet; inflorescence bearing scattered minute bracts throughout; plant usually erect----- 18. *C. INAEQUATA*.
18. Odd nutlet axial; nutlets and tuberculations usually pale (21).
21. Consimilar nutlets winged; calyx lobes not noticeably thickened----- 25. *C. PTEROCARYA*.
21. Consimilar nutlets not margined (22).
22. Stems with spreading hairs; calyx with a short but distinct pedicel, evidently spreading or even recurving, the base not gibbous on one side, the mature lobes (particularly the axial one) usually much thickened and very conspicuous----- 19. *C. CRASSISEPALA*.
22. Stems distinctly strigose; calyx sessile, strictly and closely appressed to the rachis, gibbous on the axial side due to a basal prolongation of the odd nutlet, the mature lobes (particularly the axial ones) weakly and inconspicuously thickened----- 20. *C. DUMETORUM*.
16. Nutlets homomorphous or practically so (23).
23. Style distinctly surpassing the nutlets (24).
24. Nutlets strongly bent above the base, glossy; gynobase narrowly pyramidal----- 21. *C. PUSILLA*.
24. Nutlets not bent, dull except in some forms of *C. muricata* (25).
25. Groove of the nutlet replaced by a large more or less excavated triangular areola occupying much of the ventral surface of the nutlet; gynobase narrowly pyramidal; nutlets thick, angulate, not margined.- 22. *C. ALBIDA*.
25. Groove of the nutlet narrow; gynobase subulate (26).
26. Nutlets obscurely rugose, the back high-convex, the face flat, the margin knifelike and inflexed.
23. *C. COSTATA*.
26. Nutlets tuberculate or verrucose, not decidedly plano-convex, the margin spreading, or none (27).
27. Margin of the nutlets merely angled, frequently thickened; nutlets usually glossy and with the back obtusely angled, the body ovate or triangular-ovate.
27. *C. MURICATA*.
27. Margin of the nutlets more or less winged; nutlets with a rounded back, the body lanceolate to narrowly ovate (28).

28. Mature calyx 2.5 to 3 mm. long, 1.5 to 2 mm. wide, the lobes linear-lanceolate, the margins lacking fulvous hairs; nutlets with an entire margin; style much surpassing the nutlets; leaves acute, very roughly hairy; plant with a distinct erect central axis, usually 30 to 60 cm. high.
24. *C. HOLOPTERA.*
28. Mature calyx 3 to 5 mm. long, 2.5 to 3.5 mm. wide, the lobes linear-lanceolate to ovate-oblong, the margin usually with short fulvous hairs; nutlets usually with sinuate to lobulate winged margins; style shortly surpassing the nutlets; leaves usually rounded or obtuse at apex, less rough; plant mostly lacking a definite central axis, usually 10 to 30 cm. high----- 25. *C. PTEROCARYA.*
23. Style surpassed by the nutlets or at most barely surpassing them (29).
29. Margin of the nutlets sharp, knifelike or winged (30).
30. Nutlets 4, wing-margined; calyx broad and symmetric.
25. *C. PTEROCARYA.*
30. Nutlets 1 or rarely 2, usually with a knifelike margin; calyx obliquely conic at base---- 26. *C. UTAHENSIS.*
29. Margin of the nutlets angled or rounded, not sharp (31).
31. Nutlets ovate or triangular-ovate, with an acute usually somewhat thickened margin, the back usually obtusely angled, frequently glossy----- 27. *C. MURICATA.*
31. Nutlets lanceolate, with rounded or obtuse unthickened margins, the back not angulate, dull (32).
32. Nutlets 1 or rarely 2; style reaching two-thirds or less the height of the nutlets----- 28. *C. DECIPIENS.*
32. Nutlets 4; style reaching beyond two-thirds the height of the nutlets (33).
33. Plant bristly with mostly spreading hairs.
29. *C. BARBIGERA.*
33. Plant distinctly strigose, but usually with some interspersed spreading hairs-- 30. *C. NEVADENSIS.*

1. *Cryptantha fulvocanescens* (A. Gray) Payson, Mo. Bot. Gard. Ann. 14: 319. 1927.

Eritrichium fulvocanescens A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 61. 1875.

Oreocarya fulvocanescens Greene, Pittonia 1: 58. 1887.

Apache County to northern Mohave County, 4,500 to 6,000 feet, slopes and mesas. Colorado, Utah, New Mexico, and northeastern Arizona.

The nutlets may be tuberculate with the warts rounded or, as is most common in Arizona, they may be muricate with the roughenings more or less broadly conic and terminated usually by a single short stout bristle-tip.

2. *Cryptantha capitata* (Eastw.) Johnston, Arnold Arboretum Jour. 21: 66. 1940.

Oreocarya capitata Eastw., Leaflets West. Bot. 2: 9. 1937.

Known only from the Grand Canyon, type from Hermit Trail (*Eastwood* 5969), also Kaibab Trail to Roaring Springs (*Eastwood* and *Howell* 1005).

The species is evidently related to *C. confertiflora*, but the plant is smaller, 10 to 30 cm. high, more sparsely strigose and hence greener. It has the large calyx of its relative but somewhat broader more herba-

ceous calyx lobes. The fruit is similar to that of its relative. The inflorescence is also similar but differs in having the small lateral flower clusters very reduced or entirely absent.

3. *Cryptantha flava* (A. Nels.) Payson, Mo. Bot. Gard. Ann. 14: 259. 1927.

Oreocarya flava A. Nels., Torrey Bot. Club Bul. 25: 202. 1898.
Oreocarya lutescens Greene, Pittonia 4: 93. 1899.

Valley of the Little Colorado and eastward, southward to beyond Holbrook (Apache, Navajo, and Coconino Counties), 5,000 to 7,000 feet, slopes and mesas. Wyoming to northwestern New Mexico and northeastern Arizona.

4. *Cryptantha confertiflora* (Greene) Payson, Mo. Bot. Gard. Ann. 14: 256. 1927.

Oreocarya confertiflora Greene, Pittonia 3: 112. 1896.

Mohave County north of the Colorado River, in the juniper belt, commonly on limestone. Western Utah to northwestern Arizona and California.

5. *Cryptantha jamesii* (Torr.) Payson, Mo. Bot. Gard. Ann. 14: 242. 1927.

Eritrichium jamesii Torr. in Marcy, Expl. Red River 294. 1853.

Oreocarya suffruticosa (Torr.) Greene, Pittonia 1: 57. 1887.
Oreocarya lemmoni Eastw., Torrey Bot. Club Bul. 30: 239. 1903.

Widely distributed in Arizona but most common in the northeastern part, 5,000 to 7,500 feet, in the juniper, oak, and lower pine belts. Nebraska and Wyoming to Texas, Arizona, and California.

This variable species occurs in a number of floristic areas, but its geographical variants are vague and a successful definition of them has not been achieved. The problem is complicated by the presence of numerous seasonal and ecological forms, which, even in the same region, differ greatly in appearance. Among the various forms found in Arizona 2 are worthy of special mention. There is the plant with erect stems, 30 to 50 cm. high, which at maturity produces 3 to 7, usually well developed, scorpioid cymes 4 to 10 cm. long, grouped at apex of the leafy stem, which is commonly 2 to 4 times as long as the basal tuft of leaves. This is var. *multicaulis* (Torr.) Payson (*Oreocarya multicaulis* Greene), of which the typical bristly form occurs in the White Mountains and southward to the Santa Catalina Mountains. A strigose variant occurs about Flagstaff.

The most common phase of the species in northern Arizona is var. *cinerea* (Greene) Payson (*Oreocarya cinerea* Greene). This has spreading or decumbent stems usually 10 to 20 cm. long, rarely becoming twice the length of the basal tuft of leaves. The stem leaves are fewer and proportionately longer than in var. *multicaulis*, and at maturity most of them bear reduced cymes in their axils. The inflorescence of var. *cinerea* hence becomes proportionately more elongate, but the individual scorpioid cymes are shorter and less perfectly developed than in var. *multicaulis*. This low form has been found in most parts of Apache, Navajo, and Coconino Counties. Evidently related to it is a similar but more robust plant with looser

somewhat tomentose indument, which has been collected near Prescott and Peach Springs (Yavapai and Mohave Counties). Material collected by Lemmon, almost certainly from Mohave County, was described as *O. lemmoni* Eastw. In southeastern Utah *C. jamesii* tends to become glabrous and to have nonpersistent basal leaves. From that area the completely glabrous form has been described as *Oreocarya pustulosa* Rydb., and a nearly glabrous form as *O. disticha* Eastw. These tendencies are exhibited by some collections from extreme northeastern Arizona.

6. *Cryptantha setosissima* (A. Gray) Payson, Mo. Bot. Gard. Ann. 14: 268. 1927.

Eritrichium setosissimum A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 20. 1876.

Oreocarya setosissima Greene, Pittonia 1: 58. 1887.

White Mountains (Apache County) to Bill Williams Mountain (Coconino County) and northward to the Kaibab Plateau, reported also from the Santa Catalina Mountains (Pima County), 6,000 to 8,500 feet, in the pine belt. South-central Utah and Arizona.

7. *Cryptantha virginensis* (M. E. Jones) Payson, Mo. Bot. Gard. Ann. 14: 274. 1927.

Krynitzkia glomerata var. *virginensis* M. E. Jones, Contrib. West. Bot. 13: 5. 1910.

Oreocarya virginensis Macbride, Amer. Acad. Arts and Sci. Proc. 51: 547. 1916.

Hermit Trail, Grand Canyon, and to be expected in the valley of the Virgin River in northwestern Arizona, chiefly on rocky slopes in the pinyon-juniper belt. Southwestern Utah to northern Arizona and California.

8. *Cryptantha modesta* Payson, Mo. Bot. Gard. Ann. 14: 297. 1927.

Oreocarya depressa (M. E. Jones) Macbride, Gray Herbarium Contrib. 48: 32. 1916.

Beaver Dam (Mohave County), 1,800 feet. Western Utah, adjacent Nevada, and extreme northwestern Arizona.

*9. *Cryptantha humilis* (A. Gray) Payson, Mo. Bot. Gard. Ann. 14: 278. 1927.

Eritrichium glomeratum (Pursh) DC. var. *humile* A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 61. 1875.

Oreocarya humilis Greene, Pittonia 3: 112. 1896.

To be expected in northwestern Arizona, particularly in the valley of the Virgin River. Southwestern Utah to Oregon and California.

10. *Cryptantha circumscissa* (Hook. and Arn.) Johnston, Gray Herbarium Contrib. 68: 55. 1923.

Lithospermum circumscissum Hook. and Arn., Bot. Beechey Voy. 370. 1840.

Greeneocharis circumscissa Rydb., Torrey Bot. Club Bul. 57: 560. 1909.

Mohave and Yavapai Counties, 1,500 to 5,000 feet, mostly in the *Larrea* belt. Wyoming and Colorado to Washington, Arizona, and California; Argentina.

11. **Cryptantha micrantha** (Torr.) Johnston, Gray Herbarium Contrib. 68: 56. 1923.

Eritrichium micranthum Torr., U. S. and Mex. Bound. Bot. 141. 1859.

Eremocarya micrantha Greene, Pittonia 1: 59. 1887.

Western and southern Arizona, common, chiefly in the creosotebush belt, occasional northeastward at higher elevations, as at St. Johns (Apache County) and Prescott (Yavapai County). Western Texas to Oregon and California.

12. **Cryptantha gracilis** Osterh., Torrey Bot. Club Bul. 30: 236. 1903.

Kayenta (Navajo County), Grand Canyon (Coconino County), Ash Fork (Yavapai County), Littlefield (Mohave County), 1,600 to 7,000 feet, mesas and rocky slopes chiefly in the pinyon-juniper belt, frequently on limestone. Eastern Colorado to Idaho, northern Arizona, and eastern California.

13. **Cryptantha fendleri** (A. Gray) Greene, Pittonia 1: 120. 1887.

Krynitzkia fendleri A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 268. 1885.

Apache County to Yavapai and eastern Mohave Counties, 5,000 to 7,000 feet, in the sagebrush-saltbush, juniper, and lower pine belts. Saskatchewan and eastern Washington south along the Rocky Mountains to northern New Mexico and Arizona.

14. **Cryptantha recurvata** Coville, Contrib. U. S. Natl. Herbarium 4: 165. 1893.

Valley of the Virgin River (Mohave County), about 2,000 feet, sandy deserts in the creosotebush belt, rare. Southwestern Utah and extreme northwestern Arizona to southeastern Oregon and eastern California.

15. **Cryptantha maritima** Greene, Pittonia 1: 117. 1887.

Krynitzkia maritima Greene, Calif. Acad. Sci. Bul. 1: 204. 1885.

Western and southern Arizona, eastward to eastern Maricopa County and central Pima County, commonly not above 2,000 feet. Southern Nevada and Arizona to California and northwestern Mexico.

The typical form of the species has evident coarse short bristles on the calyx. A rather common form in which the bristles are hidden by an abundance of spreading white silky hairs, var. *pilosa* Johnston, is sporadic within the range of the species.

16. **Cryptantha racemosa** (S. Wats.) Greene, Pittonia 1: 115. 1887.

Eritrichium racemosum S. Wats. in A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 226. 1882.

Mohave and Yuma Counties, mostly below 3,000 feet, dry rocky slopes in the creosotebush belt. Southern Nevada and western Arizona to California and northern Baja California.

Sheltered by large rocks, this species frequently forms a small much-branched twiggy bush 30 to 60 cm. high. The persistent stems may become more than 1 cm. thick and distinctly woody. The dead

leaves are rather persistent, becoming blanched so that, when numerous, the plants are conspicuous among dark rocks.

17. *Cryptantha angustifolia* (Torr.) Greene, Pittonia 1: 112. 1887.

Eritrichium angustifolium Torr., U. S. Rpt. Expl. Miss. Pacif. 5: 363. 1856.

Western and southern Arizona, generally below 4,000 feet, creosote-bush desert, types from near Yuma (*Thomas, DuBarry*). Western Texas to southern Nevada, southeastern California, and northwestern Mexico.

18. *Cryptantha inaequata Johnston, Univ. Calif. Pubs. Bot. 7: 444. 1922.

Known from the Nevada bank of the Colorado River at El Dorado Canyon and hence to be expected in adjacent Arizona. Deserts of southern Nevada and eastern California.

19. *Cryptantha crassisepala* (Torr. and Gray) Greene, Pittonia 1: 112. 1887.

Eritrichium crassisepalum Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2: 171. 1855.

Most common in northeastern Arizona (Apache County to eastern Coconino County), known also from Yavapai, Greenlee, Graham, Cochise, and eastern Pima Counties (near Tucson), commonly 4,000 to 6,500 feet, slopes, mesas, and plains, frequently in dry grasslands. Southern Colorado and western Texas to southern Utah, Arizona, and northern Mexico.

20. *Cryptantha dumetorum Greene, Pittonia 1: 112. 1887.

Cryptantha intermedia var. *dumetorum* Jepson, Man. Fl. Pl. Calif. 849. 1925.

Near Needles, Calif., possibly in Mohave County, Arizona, creosote-bush desert, not common, usually growing under bushes and scrambling through them. Southern Nevada and southeastern California.

21. *Cryptantha pusilla* (Torr. and Gray) Greene, Pittonia 1: 115. 1887.

Eritrichium pusillum Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2: 171. 1856.

Cochise, Paradise, and Douglas (Cochise County), Nogales (Santa Cruz County), Baboquivari Valley (Pima County). Western Texas to southern Arizona and northern Sonora.

22. *Cryptantha albida* (H. B. K.) Johnston, Gray Herbarium Contrib. 68: 53. 1923.

Myosotis albida H. B. K., Nov. Gen. et Sp. 3: 91. 1818.
Cryptantha ramosa (Lehm.) Greene, Pittonia 1: 115. 1887.

Douglas, Tombstone, Dragoon Valley, Mustang Mountains, and Sonoita (Cochise and Santa Cruz Counties), mostly 4,000 to 5,000 feet, plains and hillsides, in the creosotebush and oak belts, and in disturbed places in grasslands. Western Texas to southeastern Arizona and central Mexico; Argentina.

23. *Cryptantha costata* T. S. Brandeg., Bot. Gaz. 27: 453. 1899.

Cryptantha seorsa Macbride, Gray Herbarium Contrib. 48: 46. 1915.

Western base of the Gila Mountains (Yuma County), creosote-bush desert, rare, type from Needles, Calif. (Jones 3841). Extreme western Arizona and southeastern California.

24. *Cryptantha holoptera* (A. Gray) Macbride, Gray Herbarium Contrib. 48: 44. 1916.

Eritrichium holopterum A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 81. 1876.

Peach Springs (Mohave County) to the Colorado River and southern Yuma County, creosotebush belt, rare, type from Ehrenberg, Yuma County (Palmer). Western Arizona and southeastern California.

25. *Cryptantha pterocarya* (Torr.) Greene, Pittonia 1: 120. 1887.

Eritrichium pterocaryum Torr., U. S. and Mex. Bound. Bot. 142. 1859.

Widely distributed in central, western, and southern Arizona, mostly below 4,000 feet. Western Texas to Washington, northern Sonora, and southeastern California.

The typical form of the species, with fruit composed of 1 wingless and 3 winged nutlets, has been found in Navajo, Mohave, and northwestern Maricopa Counties, ranging northward and northwestward from Arizona. The most common and widely distributed form in Arizona is var. *cycloptera* (Greene) Macbride, with fruit composed of 4 similar winged nutlets. It ranges in Arizona from Mohave and Yavapai Counties southeast to Graham, Cochise, and Pima Counties and has a more southerly distribution outside the State. The var. *stenoloba* Johnston, known only from the Virgin River Valley in Arizona and adjacent Nevada, differs from all other forms of the species in its narrowly linear-lanceolate (rather than ovate or broadly lanceolate) calyx lobes, these 5 to 7 mm. long. Its nutlets are heteromorphic, as in the type of the species.

26. *Cryptantha utahensis* (A. Gray) Greene, Pittonia 1: 120. 1887.

Krynitzkia utahensis A. Gray, Syn. Fl. ed. 2, 2¹: 427. 1886.

Mohave County, 3,000 feet or lower, gravelly slopes and sandy washes in the creosotebush belt. Southwestern Utah and western Arizona to California.

27. *Cryptantha muricata* (Hook. and Arn.) Nels. and Macbr., Bot. Gaz. 61: 42. 1916.

Myosotis muricata Hook. and Arn., Bot. Beechey Voy. 369. 1840.

Known in Arizona from Yucca (Mohave County), Skull Valley (Yavapai County), Oracle (Pinal County), and near Tucson (Pima County), 2,000 to 5,000 feet, usually on gravelly slopes in openings among trees and brush, rare. Southern Utah to southern Arizona and California.

The species is represented in Arizona by var. *denticulata* (Greene) Johnston (*Cryptantha denticulata* Greene).

28. *Cryptantha decipiens* (M. E. Jones) Heller, *Muhlenbergia* 8: 48. 1912.

Krynitzkia decipiens M. E. Jones, *Contrib. West. Bot.* 13: 6. 1910.

Mohave and Yavapai Counties, south to Yuma and eastern Pima Counties, 2,000 to 4,000 feet, among bushes in the creosotebush belt, type from near Yuma (*Jones*). Southern Nevada, Arizona, and California.

29. *Cryptantha barbiger* (A. Gray) Greene, *Pittonia* 1: 114. 1887.

Eritrichium barbigerum A. Gray, *Syn. Fl.* 2¹: 194. 1878.

Krynitzkia mixta M. E. Jones, *Contrib. West. Bot.* 13: 6. 1910.

Mohave County, southward and eastward to Greenlee, Cochise, Pima, and Yuma Counties, 5,000 feet or lower, most frequent in the deserts, type of *K. mixta* from the Mescal Mountains (*Jones*). Western New Mexico and southern Utah to southeastern California and northern Sonora.

The common (typical) form of the species has inconspicuous corollas 1.5 to 3.5 mm. wide. Occurring within the range of the species in central Arizona are plants with more conspicuous corollas, 4 to 7 mm. wide. These represent var. *fergussonae* Macbride, known elsewhere only from the western borders of the Colorado and Mohave deserts in California.

30. *Cryptantha nevadensis* Nels. and Kenn., *Biol. Soc. Washington Proc.* 19: 157. 1906.

Mohave County to Graham and Pima Counties, mostly below 4,000 feet, creosotebush desert, frequently under bushes. Southern Utah and Arizona to California.

Typical *C. nevadensis* has very slender, frequently sinuous stems, very slender calyx lobes, and narrowly lanceolate long-acuminate nutlets. The var. *rigida* Johnston is a stiffly erect, less slender plant with stiffer less elongate calyx lobes and less attenuate, lance-ovate nutlets. It occurs throughout most of the range of true *C. nevadensis* in Arizona.

9. PLAGIOBOTHRYS²⁵

Annual, strigose or bristly herbs with white corollas; nutlets rugose, erect or incurved, attached at or below the middle to a depressed gynobase through a caruncular scar, this decurrent on the lower part of the ventral keel, or situated at the lower end of the keel and sunken below its crest, or elevated to the level of the keel on a more or less well developed, supra-basal, stipelike, lateral projection from the body of the nutlet; basal leaves opposite or crowded into a rosette.

Some of the California species are known as popcornflower. It is stated that the plants are grazed by sheep.

²⁵ Reference: JOHNSTON, I. M. PLAGIOBOTHRYS, A SYNOPSIS AND REDEFINITION OF THE GENUS. *Gray Herbarium Contrib.* 68: 57-80. 1923.

Key to the species

1. Nutlets tessellate with broad flattened contiguous pavementlike tuberculations; plant erect, hispid, with terminal bractless scorpioid cymes. -- 1. *P. JONESII*.
1. Nutlets not tessellate, the back wrinkled or with ridges, the tuberculations scattered, or none (2).
 2. Leaves charged with a purple dye, particularly about the midrib and margins; calyx circumscissile, the lobes short and strongly connivent at maturity; nutlets incurved. ----- 2. *P. ARIZONICUS*.
 2. Leaves green, lacking a conspicuous purple dye; calyx not circumscissile (3).
 3. Basal leaves crowded into a distinct rosette, none opposite; plant slender, erect, loosely branched, not producing flowers near the base; nutlets contracted at both ends, somewhat cruciform, incurved, the transverse ridges very broad and separated by grooves ----- 3. *P. TENELLUS*.
 3. Basal leaves distinct or at least not in a well-developed rosette, the lower leaves opposite; plant decumbent or prostrate, frequently floriferous throughout, even in the axils of the lowermost leaves; nutlets not incurved, rounded at base, the ridges well spaced (4).
 4. Plant sparsely strigose, very slender; nutlets flattened, lanceolate, attached by a broadly affixed sessile ovate scar borne below the level of the ventral keel, the back with low rounded irregular ridges ----- 4. *P. COGNATUS*.
 4. Plant distinctly hispid, rather coarse; nutlets ovoid, not compressed, usually with sharp narrow ridges, attached by a scar elevated to the level of the ventral keel and more or less stiped (5).
 5. Stipe of the nutlet elongate, about equaling the body of the nutlet in length; nutlets commonly united in pairs. -- 5. *P. PRINGLEI*.
 5. Stipe of the nutlet very short; nutlets separate.
 6. *P. CALIFORNICUS*.

1. *Plagiobothrys jonesii* A. Gray, Syn. Fl. ed. 2, 2¹: 430. 1886.

Sonnea jonesii Greene, Pittonia 1: 23. 1887.

Mohave, Maricopa, Pinal, and Yuma Counties, eastward in and near the valley of the Gila River to eastern Pinal County, mostly below 2,000 feet, dry sandy and gravelly soils on slopes and in valleys of the creosotebush belt. Southwestern Utah to south-central and western Arizona, and adjacent California.

2. *Plagiobothrys arizonicus* (A. Gray) Greene in A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 284. 1885.

Eritrichium canescens (Benth.) A. Gray var. *arizonicus* A. Gray, *ibid.* 17: 227. 1882.

Mohave and Yavapai Counties south to Cochise and Pima Counties, 3,600 feet or lower, frequently among bushes or rocks, creosotebush and oak belts, types from Tucson (*Greene, Pringle*).

Western New Mexico to southern Nevada, California, and northern Sonora.

3. *Plagiobothrys tenellus* (Nutt.) A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 283. 1885.

Myosotis tenella Nutt., Jour. Bot. and Kew Gard. Misc. 3: 295. 1851.

Known in Arizona from only a few scattered stations, near Superior (Pinal County), Pinaleno Mountains (Graham County), Santa Catalina Mountains (Pima County), probably in the oak belt. Idaho and Washington to southern Arizona and southern California.

4. *Plagiobothrys cognatus* (Greene) Johnston, Arnold Arboretum Contrib. 3: 59. 1932.

Allocarya cognata Greene, Pittonia 4: 335. 1901.

Flagstaff and Fort Valley (Coconino County), about 7,000 feet, wet soils in the pine belt. Utah, Nevada, and northern Arizona.

5. *Plagiobothrys pringlei* Greene, Pittonia 1: 21. 1887.

Echidiocarya arizonica A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 89. 1876.

Verde Mesa (Yavapai ? County), and Maricopa, Pinal, and Pima Counties, mostly in the creosotebush belt, type from Verde Mesa (*Smart*). Central Arizona to northern Sonora.

6. *Plagiobothrys californicus* Greene, Calif. Acad. Sci. Bul. 2: 407. 1887.

Creek banks near Prescott, Yavapai County (*Nelson* 10232, the type of *P. micranthus*), and in the Santa Catalina and Santa Rita Mountains, Pima County (*Graham* 3463, 3538), about 4,500 feet. Central and southern Arizona and southeastern California.

The Arizona form is var. *fulvescens* Johnston (*Plagiobothrys micranthus* A. Nels.). The species is very closely related to *P. pringlei*, which it resembles in all details except the separate unstalked nutlets and the slightly shorter calyx tube. It is possible that collectors have mistaken the plant for the more common and better known relative and so have failed to collect it. Consequently it may be more common and widely distributed than the few specimens at hand indicate.

10. AMSINCKIA. FIDDLENECK

Bristly erect herbs with scorpioid cymes of yellow or orange flowers; corolla heterostyled, with an elongate tube, the appendages of the throat reduced or absent; leaves alternate; gynobase pyramidal; plants of dry open places.

The plants are very abundant on sandy or gravelly soil in western and southern Arizona and are reported to make good spring forage while young. On the other hand it has been reported recently that horses, cattle, and swine eating the nutlets may develop cirrhosis of the liver.

Key to the species

1. Nutlets tuberculate, roughened by short ridges and a distinct dorsal keel; calyx 5-lobed, the lobes all distinct; corolla tube 10-nerved below the stamens----- 1. *A. INTERMEDIA*.
 1. Nutlets tessellate, the ridges and dorsal keel low and usually rounded; calyx (except in early flowers) 2- to 4-lobed, the broader lobes 2- or 3-dentate at apex; corolla-tube 20-nerved below the stamens--- 2. *A. TESSELLATA*.

1. *Amsinckia intermedia* Fisch. and Meyer, Index Sem. Hort. Petrop. 2: 26. 1836.

Amsinckia echinata A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 54. 1874.

Mohave County southward and eastward to Cochise, Pima, and Yuma Counties, chiefly in the creosotebush belt. Western New Mexico to California.

Amsinckia echinata, based on material from near Fort Mohave (Cooper in 1860), is a form having the tuberculations and the dorsal keel of the nutlets elevated, narrow, and fragile. Such plants are frequent in Arizona and adjacent California but are connected by many transitions to the forms with less prominently roughened nutlets that are typical of *A. intermedia*. Suksdorf described various forms of *A. intermedia* as *A. nana*, *A. demissa*, *A. rigida*, *A. arizonica*, and *A. microphylla*, all based on types collected in Arizona.

2. *Amsinckia tessellata* A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 54. 1875.

Amsinckia macra Suksd., Werdenda 1: 108. 1931.

Mohave County to Pima County, creosotebush desert, type of *A. macra* from Sacaton, Pinal County (*Eastwood* 8025). Eastern Washington to southern and western Arizona, and California; Chile and Argentina.

11. LITHOSPERMUM. GROMWELL²⁷

Plants perennial or biennial; corolla yellow or orange, the lobes rounded. The conspicuous corollas may be more or less sterile and most of the seed may be developed from inconspicuous cleistogamous flowers produced later in the season.

A purple dye was obtained by the Indians from the roots of these plants.

Key to the species

1. Corolla trumpet-shaped, 2 to 4 cm. long, the lobes erose or fimbriate; late flowers cleistogamous, obscure but very fertile----- 1. *L. INCISUM*.
1. Corolla funnelform, 1 to 1.2 cm. long, the lobes entire; cleistogamous flowers usually not developed (2).
2. Basal leaves persistent at anthesis; root biennial or short-lived perennial, usually lacking purple dye----- 2. *L. COBRENSE*.
2. Basal leaves disappearing long before anthesis; root strongly perennial, the crown usually discolored by abundant purple dye-- 3. *L. MULTIFLORUM*.

1. **Lithospermum incisum** Lehm., Asperif. 2: 303. 1818.

Lithospermum angustifolium Michx., Fl. Bor. Amer. 1: 130. 1803. Not of Forsk., 1775.

Lithospermum linearifolium Goldie, Edinb. Phil. Jour. 6: 322. 1822.

Apache County to Coconino, Yavapai, Cochise, and Santa Cruz Counties, 5,000 to 7,500 feet, grassy flats and slopes in the sagebrush-saltbush, juniper, and pine belts. Canada to Illinois, Texas, and Arizona.

This plant was used medicinally by the Hopi.

2. **Lithospermum cobrense** Greene, Bot. Gaz. 6: 157. 1881.

White Mountains (Apache County) and southern Coconino County to Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,700 feet, mostly in the pine belt. Western Texas to Arizona and Mexico.

²⁷ Reference: JOHNSTON, I. M. STUDIES IN THE BORAGINACEAE II. LITHOSPERMUM. Gray Herbarium Contrib. 70: 18-31. 1924.

3. *Lithospermum multiflorum* Torr. ex A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 51. 1875.

Lithospermum arizonicum Gandoger, Soc. Bot. France Bul. 65: 62. 1918.

Apache County to Coconino County, south to Pima County, 6,000 to 8,200 feet, gravelly benches and slopes, mostly in the juniper and pine belts, type of *L. arizonicum* from Flagstaff (*MacDougal* 242). Wyoming to New Mexico and Arizona.

12. MACROMERIA

Coarse bristly perennials with elongate, hairy, greenish yellow corollas and more or less acute corolla lobes; plants of thickets and woodlands.

It is stated that the dried leaves and flowers, mixed with tobacco, are smoked by the Hopi Indians in their "rain-bringing" ceremony.

1. *Macromeria thurberi* (A. Gray) Mackenz., Torrey Bot. Club Bul. 32: 496. 1905.

Onosmodium thurberi A. Gray, Syn. Fl. 2¹: 205. 1878.

Mountains of Apache, Coconino, Greenlee, Cochise, and Pima Counties, 6,000 to 8,500 feet, rocky slopes and valleys, in pine woods. New Mexico, Arizona, and northern Mexico.

This species may have an earlier name in *M. viridiflora* DC., a species based on an illustration of a plant collected somewhere in Mexico.

107. VERBENACEAE. Vervain Family

Herbs or shrubs; stems often 4-angled; leaves opposite or whorled; flowers perfect, in spikes or heads; calyx commonly 5-toothed or 5-lobed; corolla usually slightly 2-lipped; fruit of 2 to 4 nutlets, these separating at maturity, or a drupe containing 1 stone.

The best-known members of this family are the garden verbena, derived from hybrids among several South American species of *Verbena*, and the lemon-verbena (*Lippia triphylla*, *L. citriodora*), also a native of South America. Species of *Lantana* and *Vitex* are extensively planted as ornamental shrubs in the warmer parts of the United States.

Key to the genera

1. Fruit a fleshy drupe containing 1 stone; plant shrubby; corolla orange or yellow, turning bright red..... 2. LANTANA.
1. Fruit of 2 or more dry nutlets, these separating at maturity; plants herbaceous or shrubby; corolla never orange, yellow, or bright red (2).
 2. Calyx short, more or less campanulate, with 2 to 4 teeth or lobes; nutlets 2; plants perennial, herbaceous or shrubby..... 3. LIPPIA.
 2. Calyx elongate, cylindric, 5-toothed and 5-ribbed (3).
 3. Nutlets 4, these at maturity shorter than the calyx, not beaked.
 1. VERBENA.
 3. Nutlets 2, these at maturity usually equaling or surpassing the calyx, with a short stout beak..... 4. BOUCHEA.

1. VERBENA.²⁸ VERVAIN

Plants mostly biennial or perennial; flowers sessile, in elongate spikes, these often forming panicles, or in short headlike clusters; corolla salverform, the tube often curved; stamens included; style slender; stigma often 2-lobed; nutlets elongate, normally 4.

The species, especially in section *Glandularia*, are difficult to distinguish. It is believed that natural hybrids are of frequent occurrence in this genus.

Key to the species

1. Flowers showy, greatly surpassing the bracts, in short, broad, dense spikes, these becoming elongate and more open in fruit; corolla usually bright pink or mauve (rarely violet), 9 mm. long or longer; Section *Glandularia* (2).
2. Leaf blades coarsely crenate-dentate and often shallowly cleft, the teeth or lobes not or but slightly longer than wide, obtuse or rounded at apex, the lobes (if any) approximate, with narrow sinuses; bracts lanceolate, shorter than the calyx; stems copiously villous or subhirsute, also finely puberulent and often glandular..... 1. *V. GOODINGII*.
2. Leaf blades 3-parted, the primary divisions pinnatifid, the ultimate divisions narrowly lanceolate to oblong, considerably longer than wide, commonly acute or acutish; stems and leaves hirsute-hispid (3).
3. Stems widely spreading or prostrate, commonly less than 25 cm. long; plant often grayish, copiously to densely pubescent; leaves very crowded and overlapping, more or less appressed to the stem, not more than 3 cm. long, the lobes approximate (much less than 1 cm. apart), their margins often strongly revolute; spikes sessile or nearly so; bracts commonly shorter than the calyx..... 2. *V. CILIATA*.
3. Stems erect to decumbent-ascending, commonly more than 25 cm. long; plant usually green, not densely pubescent; leaves not very crowded, not appressed to the stem, mostly more than 3 cm. long, the lobes often 1 cm. or more apart; spikes usually distinctly pedunculate (4).
4. Glandular puberulence none; bracts with long, setaceous tips, usually equaling or nearly equaling the calyx..... 3. *V. BIPINNATIFIDA*.
4. Glandular puberulence present at least on the calyx, but sometimes very obscure; bracts with shorter, often barely setaceous tips, considerably shorter than the calyx..... 4. *V. WRIGHTII*.
1. Flowers not showy or greatly surpassing the bracts (except in *V. neomexicana*), in narrow, elongate spikes or if the spikes relatively short and broad at first then the bracts greatly surpassing the flowers; corolla whitish, blue, or violet, not more than 6 mm. long; Section *Verbenacea* (5).
5. Bracts conspicuous, much surpassing the flowers, commonly at least 5 mm. long; stems strongly decumbent or prostrate, diffusely branched from at or near the base; leaf blades not or not much longer than wide, more or less incised (6).
6. Leaf veins conspicuously whitish beneath toward the margin; blades incised-serrate or, at most, shallowly cleft; corolla dark blue; plant short-hirsute and glandular-puberulent..... 5. *V. PLICATA*.
6. Leaf veins not conspicuously whitish; corolla pale blue; plants hispid-hirsute (7).
7. Blades very deeply incised, the terminal division several-cleft nearly to the midvein; spikes much less than 1 cm. wide; inflorescence copiously glandular; plant not drying blackish..... 6. *V. GRACILIS*.
7. Blades not very deeply incised, the terminal division coarsely toothed or, if cleft, then not nearly to the midvein; spikes commonly at least 1 cm. wide; inflorescence not or obscurely glandular; plant often drying blackish..... 7. *V. BRACTEATA*.
5. Bracts inconspicuous, not or barely surpassing the flowers; stems erect or strongly ascending, not diffusely branched from the base (8).
8. Corolla white or whitish, barely surpassing the calyx, about 2 mm. long, the limb not more than 3 mm. in diameter; fruits divaricate; spikes filiform, very long, loose, more or less flexuous; leaf blades coarsely crenate-dentate, never pinnatifid; bracts minute (9).

²⁸ Reference: PERRY, LILY M. A REVISION OF THE NORTH AMERICAN SPECIES OF VERBENA. Mo. Bot. Gard. Ann. 20: 239-362. 1933.

9. Leaves distinctly petioled, the lower petioles about 1 cm. long, the blades extremely scabrous above, broadly ovate (at least the lower ones), abruptly short-cuneate at base; stems short-pilose with ascending, subappressed hairs..... 8. *V. SCABRA*.
9. Leaves subsessile, or the petioles less than 1 cm. long, the blades not or only slightly scabrous above, oblong-lanceolate, gradually cuneate at base; stems hirsute with spreading hairs..... 9. *V. CAROLINA*.
8. Corolla blue or violet, but usually distinctly surpassing the calyx, 4 mm. long or longer, the limb usually more than 3 mm. in diameter; fruits erect or strongly ascending; spikes not filiform, not or scarcely flexuous (10).
10. Spikes very dense even in fruit, forming a compact terminal panicle, occasionally solitary; corolla violet; leaf blades oblong-lanceolate, much longer than wide, coarsely serrate (often double-serrate), not cleft, or at most subhastately so at base; stems tall, stout, strictly erect (11).
11. Leaf blades thick, coarsely and prominently rugose-reticulate beneath; stems copiously villous-hirsute with spreading hairs; fruiting spikes stout, 8 to 10 mm. in diameter.
10. *V. MACDOUGALII*.
11. Leaf blades relatively thin, not prominently reticulate beneath, often subhastately lobed at base; stems pilose with short, antrorse, subappressed hairs; fruiting spikes much less than 8 mm. in diameter..... 11. *V. HASTATA*.
10. Spikes loose in fruit, not forming a compact terminal panicle; corolla blue; leaf blades more or less cleft (12).
12. Leaf blades seldom more than 1.5 times as long as wide, rather shallowly 3-cleft or merely incised-serrate, the veins whitish beneath toward the margin; stems seldom more than 30 cm. long; corolla dark blue, the limb less than 5 mm. in diameter.
5. *V. Plicata*.
12. Leaf blades commonly more than 1.5 times as long as wide, pinnatifid, or 3-parted and the (much longer) terminal division pinnatifid, the veins not whitish beneath; stems commonly more than 30 cm long; corolla light blue..... 12. *V. NEOMEXICANA*.

1. *Verbena goodingii* Briq., Ann. Conserv. et Jard. Bot. Genève 10: 103. 1907.

Mohave County to Cochise, Santa Cruz, Pima, and Yuma Counties, 5,000 feet or (usually) lower, common on dry slopes and mesas, flowering almost throughout the year. Southern Utah and Arizona to southeastern California and northwestern Mexico.

The typical form, with leaf blades several-cleft, is more frequent in Arizona than var. *nepetifolia* Tidestrom (*V. verna* A. Nels.) with leaf blades not cleft, or cleft only near the base. The variety is largely confined to the western half of the State and intergrades freely with the typical form. The type of *V. verna* was collected along Diamond Creek, Mohave County (*N. C. Wilson* 95).

2. *Verbena ciliata* Benth., Pl. Hartw. 21. 1839.

Verbena pubera Greene, Pittonia 5: 136. 1903.

Verbena ciliata var. *pubera* Perry, Mo. Bot. Gard. Ann. 20: 332. 1933.

Apache, Navajo, and Coconino Counties to Cochise and Pima Counties, 4,000 to 7,000 feet, dry plains and mesas, April to July. Western Texas to Arizona and Mexico.

The writers believe that Greene's *V. pubera* corresponds more closely with Bentham's *V. ciliata*, at least as interpreted by A. Gray, than do most of the specimens referred by Miss Perry to *V. ciliata*. *V. ciliata* and the 2 following species seem to be completely confluent, and it is almost impossible to identify many Arizona specimens with assurance as belonging to one or the other species.

3. *Verbena bipinnatifida* Nutt., Acad. Nat. Sci. Phila. Jour. 2: 123. 1821.

Verbena ambrosifolia Rydb. f. *eglandulosa* Perry, Mo. Bot. Gard. Ann. 20: 328. 1933.

Southern Apache and southern Coconino Counties to Cochise and Pima Counties, 5,000 to 10,000 feet, common in open coniferous forests, May to September. South Dakota to Alabama, Arizona, and northern Mexico.

The var. *latilobata* Perry, characterized by less deeply incised and broader-lobed leaf blades, is rather frequent in Cochise, Santa Cruz, and Pima Counties.

4. *Verbena wrightii* A. Gray, Syn. Fl. 2¹: 337. 1878.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,500 feet, common on mesas and slopes, April to October. Southern Colorado and western Texas to Arizona.

The writers have been unable to distinguish from *V. wrightii* most of the Arizona specimens identified by Miss Perry as *V. ambrosifolia* Rydb. and as *V. ciliata* Benth.

5. *Verbena plicata* Greene, Pittonia 5: 135. 1903.

Near Tucson, Pima County (several collections, including *Toumey* 306), March to September. Western Texas to southern Arizona and northern Mexico.

6. *Verbena gracilis* Desf., Cat. Hort. Paris, ed. 3, 393. 1829.

Verbena remota Benth., Pl. Hartw. 21. 1839.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), 5,000 to 6,700 feet, June to October. Southern Utah to southern Mexico.

7. *Verbena bracteata* Lag. and Rodr., An. Cienc. Nat. 4: 260. 1801.

Verbena bracteosa Michx., Fl. Bor. Amer. 2: 13. 1803.

Apache County to Coconino County, south to Pinal County, 1,200 to 7,000 feet, waste land, river bottoms, May to August, appearing like an introduced weed. Throughout the United States and in northern Mexico.

8. *Verbena scabra* Vahl, Elog. Amer. 2: 2. 1798.

Twenty miles north of Rice, Gila County (*Harrison* 4897), Tucson, Pima County (*Pringle* in 1884), July to October. North Carolina to Florida, westward to southern California and northern Mexico.

9. *Verbena carolina* L., Syst. Nat. ed. 10, 852. 1759.

Verbena polystachya H. B. K., Nov. Gen. et Sp. 2: 274. 1817.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), 5,000 to 6,000 feet, along streams, September and October. Florida to Texas, southern Arizona, and south to Central America.

10. *Verbena macdougalii* Heller, Torrey Bot. Club Bul. 26: 588. 1899.

Both sides of the Grand Canyon (Coconino County), 6,500 to 7,500 feet, mostly in open forests of yellow pine, June to September,

type from Flagstaff (*MacDougal* 249). Southern Wyoming to New Mexico and northern Arizona.

11. *Verbena hastata* L., Sp. Pl. 20. 1753.

Without definite locality (*Palmer* in 1869). Specimens collected at Flagstaff (Coconino County) and near Prescott (Yavapai County) are cited by Miss Perry. Canada to Florida, New Mexico, Arizona, and California.

12. *Verbena neomexicana* (A. Gray) Small, Fl. Southeast. U. S. 1010. 1903.

Verbena canescens H. B. K. var. *neomexicana* A. Gray, Syn. Fl. 2¹: 337. 1878.

Yavapai County to Cochise, Santa Cruz, and Pima Counties, 2,000 to 6,000 feet, foothills and canyons, common, March to October. Western Texas to southern California and northern Mexico.

The Arizona form is var. *xylopoda* Perry, which has larger flowers than the typical form of the species. The species is doubtfully distinct from *V. menthaefolia* Benth. A collection near Yuma (*Jones* in 1906), cited by Miss Perry under the latter species, greatly resembles *V. neomexicana*.

2. LANTANA

A shrub, usually prickly; leaves petioled, the blades broadly ovate, crenate; flowers in dense headlike axillary clusters, these subtended by several narrow bracts; fruit a fleshy drupe, black and shiny when mature.

1. *Lantana camara* L., Sp. Pl. 627. 1753.

Near Sells (western Pima County), about 2,500 feet, bank of a stream, August. Georgia to southern Texas, southern Arizona, Mexico, and widely distributed in tropical America.

It is unlikely that the plants at this Arizona locality were introduced by man, but the seeds may have been brought there by migrating birds. The plant contains an alkaloid that is reported to resemble quinine in its action.

3. LIPPIA

Plants perennial, shrubby or herbaceous; flowers in slender elongate spikes, these forming open terminal panicles, or in short, dense, peduncled axillary heads; calyx 2- to 4-cleft; corolla with a cylindrical tube and a somewhat bilabiate limb; nutlets 2.

L. ligustrina and *L. wrightii* are neat and graceful shrubs with aromatic foliage, responding well to cultivation. They afford browse for livestock, and the flowers are reported to yield excellent honey. *L. cuneifolia* and *L. lanceolata* are efficient soil binders but are nowhere abundant in Arizona. An introduced species of similar habit is sometimes used for lawns.

Key to the species

1. Plants shrubby, aromatic; leaf blades scabrous-strigose above, tomentose or tomentulose beneath; flowers in slender spikes or spikelike racemes, these more than 4 times as long as wide and forming loose leafy panicles; bracts narrow, not closely subtending the flowers; calyx conspicuously villous-hirsute: Subgenus *Aloysia* (2).

2. Leaf blades entire or sparsely and irregularly denticulate, lance-oblong, dull green and scarcely rugose above; young stems canescent-puberulent; corolla pale blue.----- 1. *L. LIGUSTRINA*.
2. Leaf blades regularly crenate with numerous teeth, ovate or suborbicular, bright green and rugose above, whitish beneath; young stems finely whitish tomentose; corolla whitish.----- 2. *L. WRIGHTII*.
1. Plants herbaceous, not aromatic; leaf blades cuneate, serrate, strigose but scarcely scabrous; inflorescences few, dense, short-spicate or subcapitate, not more than 4 times as long as wide; bracts broad, imbricate, closely subtending the flowers; calyx strigose; stems procumbent, rooting at the nodes: Subgenus *Phyla* (3).
3. Leaf blades rigid, thick, oblanceolate-cuneate, with 1 to 4 pairs of teeth near the apex; herbage strigillose-canescens.----- 3. *L. CUNEIFOLIA*.
3. Leaf blades not rigid, thin, lanceolate to rhombic-ovate, with more than 4 pairs of teeth, these extending well below the apex; herbage green.----- 4. *L. LANCEOLATA*.

1. *Lippia ligustrina* (Lag.) Britton, N. Y. Acad. Sci. Trans. 9: 181. 1891.

Verbena ligustrina Lag., Gen. et Sp. Pl. 18. 1816.

Near Ruby, Santa Cruz County, about 4,000 feet (*Harrison and King* 6964). Western Texas, southern Arizona, and Mexico.

2. *Lippia wrightii* A. Gray, Amer. Jour. Sci. ser. 2, 16: 98. 1853.

Grand Canyon (Coconino County) and northern Mohave County to Greenlee, Cochise, Pima, and Yuma Counties, 2,000 to 6,000 feet, common on dry rocky slopes, August to October. Western Texas to southeastern California and northern Mexico.

Reported as growing only on northern slopes at low altitudes and only on southern exposures at its higher altitudinal limit.

3. *Lippia cuneifolia* (Torr.) Steud. in Marcy, Expl. Red River 293. 1854.

Zapania cuneifolia Torr., Ann. Lyc. N. Y. 2: 234. 1828.

Phyla cuneifolia Greene, Pittonia 4: 47. 1899.

Apache County to eastern Coconino County and along the Colorado River at Fort Mohave and near Yuma, stream beds and "playas," usually in heavy soil, June to August. Nebraska and Wyoming to Texas and Arizona.

A form collected in the White Mountains (*Ellis* 4) approaches *Phyla incisa* Small in its elongate peduncles.

4. *Lippia lanceolata* Michx., Fl. Bor. Amer. 2: 15. 1803.

Phyla lanceolata Greene, Pittonia 4:47. 1899.

Tucson, Pima County (*Toumey* in 1892), also at St. Thomas, Nevada, very near the northwestern border of Arizona (*Purpus* 6180). New Jersey to Minnesota, Florida, Texas, Arizona, and southern California.

4. BOUCHEA

Plant annual; stem erect, leafy, sparingly branched; leaves long-petioled, the blades oval or ovate, crenate or serrate; flowers in slender elongate spikes; corolla deep violet.

1. *Bouchea prismatica* (Jacq.) Kuntze, Rev. Gen. Pl. 2: 502. 1891.*Verbena prismatica* Jacq., Collect. 2: 301. 1788.

Cochise and Santa Cruz Counties, 3,500 to 6,000 feet, infrequent in rich shaded ground along streams, August to October. Southern Arizona, Mexico, and tropical America.

The species is represented in Arizona by var. *brevirostra* Grenzebach, with beaks of the nutlets very short.

108. LABIATAE. MINT FAMILY

Contributed by CARL EPLING

Plants herbaceous, annual or spreading by rhizomes, less often woody shrubs or undershrubs; stems herbaceous, usually square; leaves opposite; flowers variously disposed; calyx commonly more or less 2-lipped, the upper 3 teeth more or less joined, the lower pair usually free, all sometimes equal, the tube sometimes enlarged in fruit; corolla obscurely to (usually) evidently bilabiate, the upper 2 petals usually joined to form an erect, sometimes galeate lip enclosing the stamens, or this sometimes very short and deeply notched, the 5 lobes rarely subequal, the lower lip usually spreading; stamens 4 or 2, usually in 2 unequal pairs, the connective sometimes strongly developed at the expense of the filament, the anthers parallel or divergent, with 1 theca sometimes completely or partly aborted; style bifid at apex, arising from the base of the 4-lobed ovary between the quite distinct lobes, or from near the apex of the ovary when the lobes (and the nutlets) are partly united below.

An attractive family of largely aromatic plants, including such notable contributions to the herb garden as mint, sage, lavender, thyme, and rosemary. Nearly all of the Arizona Labiatae are good honey plants.

Key to the genera

1. Functional stamens 2, with small staminodes sometimes also present (2).
 2. Stamens appearing jointed, the connective strongly developed, often arcuate and bearing fertile thecae at both ends, or straight and thrust downward into the corolla tube, or the lower end wholly abortive; calyx teeth apparently 3 ----- 16. SALVIA.
 2. Stamens not as in genus *Salvia*, both thecae fertile and approximate or confluent (3).
 3. Corolla nearly regular, small; flowers in axillary glomerules; herbage glabrous or merely puberulent ----- 22. LYCOPUS.
 3. Corolla irregular, distinctly bilabiate (4).
 4. Flowers in dense subglobose verticils, these forming an interrupted spike, or terminal, the glomerules subtended by numerous conspicuous bracts; leaves 3 to 8 cm. long or longer ----- 17. MONARDA.
 4. Flowers 1 to 6 (seldom more), in sessile or pedunculate axillary clusters, sometimes subtended by small bracteoles, the clusters never dense and subglobose; leaves rarely as long as 2 cm. (5).
 5. Stems ashy with small, curled or spreading, not at all feltlike hairs; calyx variously pubescent but not as in genus *Poliomntha*, the lower pair of teeth usually bristly with stiffish hairs along the margin ----- 18. HEDEOMA.
 5. Stems whitened with a dense feltlike tomentum; calyx softly and densely hairy with hairs as long as the calyx teeth. ----- 19. POLIOMINTHA.

1. Functional stamens 4 (6).
6. Calyx teeth 10, hooked at apex; flowers in dense subglobose glomerules; upper lip of the corolla deeply notched----- 7. MARRUBIUM.
6. Calyx teeth 5 or none (7).
7. Teeth of the calyx none, the lips even and rounded; upper lip of the corolla galeate, completely enclosing the stamens (8).
8. Entire calyx becoming enlarged and bladderlike at maturity, completely enclosing the nutlets----- 5. SALAZARIA.
8. Upper surface of the calyx bearing a small appendage, this developing at maturity into an erect conspicuous flap, the calyx at maturity separating into 2 portions longitudinally, the upper, flap-bearing portion deciduous----- 6. SCUTELLARIA.
7. Teeth of the calyx five (9).
9. Calyx enlarging into a flaring veiny funnel 2.5 cm. across; plant quite glabrous----- 14. MOLUCCELLA.
9. Calyx enlarging to some extent but not as in *Moluccella* (10).
10. Lobes of the calyx markedly unequal; flowers in dense oblong bracteate spikes (11).
11. Upper calyx lip with the middle tooth ovate, twice as broad as the other teeth, all of the teeth spine-tipped; bracts spinose-toothed, hollylike----- 10. MOLDAVICA.
11. Upper calyx lip with the teeth completely joined to form a tricuspidate squarish lip; bracts ciliate, entire, clasping. 11. PRUNELLA.
10. Lobes of the calyx sometimes unequal in length but otherwise all much alike, deltoid, lanceolate, or subulate; flowers in axillary clusters or forming interrupted spikes, less often in congested spikes (12).
12. Hairs of the canescent calyx and foliage branched, intricately tangled; middle lobe of the lower lip of the corolla distinctly dipper-shaped; plant a shrub----- 24. HYPTIS.
12. Hairs simple; middle lobe of the lower lip of the corolla plane and spreading or at most lightly cupped (13).
13. Flowers solitary or not more than 3 in the cluster (14).
14. Flowers solitary and subsessile in the axils of small bracts, disposed in racemes or panicles; lower pair of stamens attached near the middle of the corolla tube, the latter distended above----- 12. DRACOCEPHALUM.
14. Flowers solitary or in pedunculate cymules of 2 or 3, in the axils of the upper leaves; calyx teeth equaling the calyx tube or longer; nutlets pitted (15).
15. Flowers solitary in the axils; leaves pinnatifid, or (at least some of them) 3-lobed; upper lip of the corolla much shorter than the lower, which is spreading and obvious. 1. TEUCRIUM.
15. Flowers usually in small cymules, sometimes solitary; leaves entire or somewhat toothed, not at all lobed; limb of the corolla bell-shaped, the lobes subequal (16).
16. Stamens about as long as the corolla, the latter about 5 mm. long----- 3. ISANTHUS.
16. Stamens clearly surpassing the corolla, the latter 10 to 15 mm. long (17).
17. Stamens straight; hairs of the calyx curled downward. 2. TETRACLEA.
17. Stamens arched and curving; hairs of the calyx curled upward----- 4. TRICHOSTEMA.
13. Flowers several or many at each node, forming an interrupted or congested spike, rarely a terminal head; corolla tube short or, if elongate, then narrow and gradually enlarged upward (except in genus *Clinopodium*); stamens attached near the throat of the corolla (18).
18. Anther sacs parallel or nearly so (19).
19. Leaves 3-parted, the divisions incised----- 13. LEONURUS.
19. Leaves crenate, serrate, or entire (20).
20. Leaves (at least the lower ones) deltoid-ovate, truncate or cordate at base; upper lip of the corolla galeate. 8. AGASTACHE.

20. Leaves elliptic or oblong, narrowed at base, not at all cordate (21).
21. Upper lip of the corolla apparently wanting, very short and scarcely exerted from the calyx, deeply notched; stamens exerted through the notch, arched; calyx saccate; nutlets pitted 1. *TEUCRIUM*.
21. Upper lip of the corolla plane, entire, subequal to the other lobes; calyx top-shaped; nutlets smooth.
23. *MENTHA*.
18. Anther sacs divergent or divaricate, forming an angle of about 90 degrees, or placed end to end (22).
22. Flowers disposed in 1 or 2 hemispherical glomerules at the end of each branch (23).
23. Glomerules often 2; upper calyx teeth joined to the middle; bracts acicular or linear; corolla lobes 4, the upper 2 joined to form an erect lip.
20. *CLINOPODIUM*.
23. Glomerules solitary and terminal; calyx teeth subequal; bracts ovate or ovate-lanceolate; corolla lobes 5, subequal..... 21. *MONARDELLA*.
22. Flowers disposed in spikes (24).
24. Spikes loose, the clusters pedicellate; upper lip of the corolla essentially plane, the tube glabrous within; leaves petiolate, truncate or cordate at base; calyx evidently 14- or 15-veined, the veins bright green, the intervenous tissue transparent..... 9. *NEPETA*.
24. Spikes compact, the clusters sessile; upper lip of the corolla cupped, the tube bearing a hairy annulus within; leaves sessile or, if petiolate and truncate at base, then the corolla bright red; calyx with an indefinite number of veins (usually more than 15), the intervenous tissue opaque and green.
15. *STACHYS*.

1. *TEUCRIUM*. GERMANDER

Perennial herbs up to 1 m. high, with serrate, oblong leaves and the flowers in terminal slender spikes, or else smaller plants, annual or perennial, with at least some of the leaves pinnatifid and with the flowers in the axils of the reduced upper leaves; calyx saccate and toothed, or deeply 5-lobed; corolla pinkish, bluish, or pallid, the upper lip very short, deeply notched, the lower lip conspicuous and spreading, with small lateral lobes; stamens 4, paired; nutlets roughened.

Key to the species

1. Leaves oblong, serrate; flowers in a terminal bracteate spike; calyx saccate, 5-toothed..... 1. *T. CANADENSE*.
1. Leaves lacinate or pinnatifid, less often 3-lobed or some of them entire and linear; flowers in the axils of the reduced upper leaves; calyx deeply lobed, the lobes lanceolate (2).
2. Pedicels 20 mm. long; plant perennial..... 2. *T. GLANDULOSUM*.
2. Pedicels 1 to 5 mm. long; plant annual..... 3. *T. DEPRESSUM*.

1. *Teucrium canadense* L., Sp. Pl. 564. 1753.

Bed of the Santa Cruz River near Tucson (*Pringle* in 1881, *Thornber* 455). Canada to Florida, southern Arizona, and Mexico.

2. *Teucrium glandulosum* Kellogg, Calif. Acad. Sci. Proc. 2: 23. 1863.

Chemehuevi (Mohave County), Horse Tanks in the Castle Dome Mountains (Yuma County), 2,000 feet (*Nichol* 30, *Epling* in 1939), locally abundant in depressions and arroyos, May to July. Western Arizona, southern California, and Baja California.

An ample collection made recently on Cedros Island, the type

locality, permits comparison with the Arizona specimens. The habit and pubescence are very similar. The flowers of the Arizona specimens are somewhat larger and seem paler, but no other differences are apparent.

3. *Teucrium depressum* Small, N. Y. Bot. Gard. Bul. 1: 288. 1899.

Pinal, Santa Cruz, Pima, and Yuma Counties, 4,000 feet or lower, commonly in wet soil along streams, March to May. Southern Texas and southern Arizona.

Arizona specimens have usually been identified as *Melosmon cubense* (L.) Small (*Teucrium cubense* L.).

2. TETRACLEA

Perennial herbs, with ashy-green foliage and fine rough pubescence; leaves ovate or oblong, mostly toothed; flowers in axillary cymes; calyx equally 5-lobed, the lobes acute or acuminate, longer than the tube, this hemispheric in fruit; corolla at least twice as long as the calyx, the lobes oval, subequal; stamens clearly exerted beyond the corolla, curving up under the upper lobes but not strongly so; nutlets obovate, pitted, hirtellous.

Key to the species

1. Lobes of the mature calyx about 4 mm. long, broadly deltoid, acuminate at apex only, the breadth of the lobe not much less than its length.
 1. *T. ANGUSTIFOLIA*.
1. Lobes of the mature calyx 5 to 8 mm. long, narrowly deltoid or deltoid-lanceolate, acuminate usually in the upper half, the breadth of the lobe half its length or less----- 2. *T. COULTERI*.

1. *Tetradlea angustifolia* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 170. 1913.

Cochise County near Rodeo, N. Mex., about 4,000 feet (*Pebbles and Loomis* 5378). Southern New Mexico and southeastern Arizona. Doubtfully distinct from the following species.

2. *Tetradlea coulteri* A. Gray, Amer. Jour. Sci. ser. 2, 16: 98. 1853.

Coconino, Yavapai, Greenlee, Maricopa, Cochise, Santa Cruz, and Pima Counties, 4,000 feet or lower, April to August. Western Texas to southern Arizona and Mexico.

3. ISANTHUS. FALSE-PENNYROYAL

Small annual glandular-puberulent herbs, branching throughout, the branches ascending; leaves entire, elliptic, acute, usually equaling or longer than the internodes; flowers axillary; calyx equally 5-lobed, the lobes acute, longer than the tube, the latter hemispheric in fruit; corolla somewhat exceeding the calyx, the lobes oval, subequal; stamens 4, about equaling the corolla, ascending under the upper lobes; nutlets pitted, hirtellous.

1. *Isanthus brachiatus* (L.) B. S. P., Prelim. Cat. N. Y. 44. 1888.

Trichostema brachiatum L., Sp. Pl. 598. 1753.

Hilltop and Fort Apache, Navajo County (*Harrison* 4893, *King* 12929), Mogollon Escarpment, Coconino or Gila County (*Purpus* 8309), also in Cochise County. Canada to Georgia, Texas, and eastern Arizona.

4. TRICHOSTEMA. BLUECURLS

A small half-shrub, woody at base; flowering stems mostly annual, dying back, puberulent and glandular; leaves oval or ovate, usually obtuse, entire, usually shorter than the internodes; flowers in cymes, these in the axils of the upper reduced leaves or bracts; calyx equally 5-lobed, the lobes obtuse, about equal to the tube, the latter hemispheric in fruit; corolla twice as long as the calyx; stamens ascending between the upper lobes of the corolla, strongly curved and exserted; nutlets pitted or wrinkled, somewhat hirtellous.

1. *Trichostema arizonicum* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 371. 1872.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, rocky slopes, August and September, type from the Chiricahua Mountains (*Wright* 1541). Southern New Mexico and Arizona, and northern Mexico.

5. SALAZARIA. BLADDER-SAGE

A subspinose shrub with divaricate branches and inconspicuous leaves; flowers in the axils of small bractlike leaves; calyx equally 2-lipped, the lips entire, becoming inflated at maturity into a papery bladder enclosing the nutlets; corolla violet and white, tubular, the limb relatively short, the lateral lobes more or less joined with the upper lip to form a galea, this including the stamens and style; stamens 4, paired; nutlets roughened.

1. *Salazaria mexicana* Torr., U. S. and Mex. Bound. Bot. 133. 1859.

Mohave, Yavapai, Maricopa, and Yuma Counties, usually below 3,000 feet, foothills and washes in the creosotebush association, reaching the margin of the juniper association. Western Texas to southern Nevada, Arizona, southern California, and northern Mexico.

This plant is reported to furnish forage for livestock throughout the year, in the drier parts of the State. The flowers and bladderlike fruits (see pl. 17) are attractive.

6. SCUTELLARIA.²⁹ SKULLCAP

Small perennial herbs, either with few stems and slender spreading rhizomes, or with several stems ascending from a woody caudex; leaves petiolate, entire or crenate-serrate; flowers axillary in the upper part of the plant, or borne in lateral racemes and subtended by leaflike bracts; corolla violet, tubular, the limb relatively short, the lateral lobes more or less joined with the upper lip to form a galea, this including the stamens and style; stamens 4, in pairs, with 1 anther sac abortive in the lower pair; nutlets variously tuberculate.

Key to the species

1. Plants with spreading slender rhizomes; leaves deltoid-ovate or oblong, crenate-serrate, mostly 3 to 7 cm. long; nutlets buff- or straw-colored (2).
2. Galea and tube of the corolla 5 to 7 mm. long; flowers in lateral bracteate racemes 1. *S. LATERIFLORA*.
2. Galea and tube of the corolla 13.5 to 21 mm. long; flowers in the axils of the upper leaves 2. *S. GALERICULATA*.

²⁹ Reference: EPLING, CARL. NOTES ON THE SCUTELLARIAE OF WESTERN NORTH AMERICA. *Madroño* 5: 49-72. 1939.

1. Plants with tufted stems from a woody caudex; leaves mostly ovate or oval, mostly 1 to 2.5 cm. long, entire or subentire; nutlets dark (3).
3. Pubescence minute, curled, essentially eglandular; nutlets dark, the protuberances flattened, giving the appearance of a mosaic.
3. Pubescence spreading and obvious, often dense, more or less glandular; nutlets black, evenly and closely tuberculate-----

3. *S. TESSELLATA.*4. *S. POTOSINA.*

1. *Scutellaria lateriflora* L., Sp. Pl. 598. 1753.

Beaver Creek, Oak Creek, Aultman, Fort Verde (Yavapai County), about 3,000 feet, moist ground, August. Canada to Florida, New Mexico, and central Arizona.

These Arizona stations represent the southernmost extension of this species.

2. *Scutellaria galericulata* L., Sp. Pl. 599. 1753.

Scutellaria epilobiifolia Hamilt., Soc. Linn. Lyon Ann. 1: 32. 1832.

White Mountains (Apache County), Lakeside (Navajo County), Buck Springs (Coconino County), 6,000 to 7,500 feet, moist ground, June to August. Widely distributed in temperate North America; Eurasia.

These stations in Arizona represent the southernmost extension of this species.

3. *Scutellaria tessellata* Epling, Wash. Acad. Sci. Jour. 29: 488. 1939.

Yavapai, Maricopa, Cochise, Santa Cruz, and Pima Counties, mostly 4,000 to 6,000 feet, rocky slopes and canyons, type from the Huachuca Mountains (*Jones* in 1903). Southern New Mexico and Arizona.

An ally of *S. resinosa* Torr. and *S. wrightii* A. Gray, separable from them chiefly on the basis of the pubescence and nutlets and, to a less extent, the habit of growth.

4. *Scutellaria potosina* T. S. Brandeg., Calif. Univ. Pubs. Bot. 4: 187. 1911.

Gila, Maricopa, and Pinal Counties, 2,500 to 5,500 feet, April to August. Central Arizona and Mexico.

The Arizona form is subsp. *platyphylla* Epling. Specimens from this State have commonly been referred to *S. drummondii* Benth., an annual species of Texas with similar pubescence.

7. MARRUBIUM. HOARHOUND

Perennial herbs with densely white-woolly stems and strongly corrugate leaves; flowers crowded in subglobose verticils, these forming interrupted spikes; calyx tubular, with 10 hooked teeth; corolla white, small, the upper lip erect, notched, laterally reflexed; stamens 4, paired; nutlets black, somewhat roughened.

1. *Marrubium vulgare* L., Sp. Pl. 583. 1753.

Coconino, Yavapai, Graham, Gila, and Pinal Counties, a common roadside weed in some places. Widely distributed in the United States; naturalized from Europe.

The hooked calyx teeth, at maturity, cling to wool and clothing. The present use of hoarhound in medicine is limited almost entirely to a confection for checking coughs and easing sore throat. It formerly

was used in domestic medicine for colds and dyspepsia, and to expel worms.

8. AGASTACHE. GIANT-HYSSOP

Perennial herbs, with short sparse pubescence; leaves deltoid, crenate, at least at the base of the plant; flowers either in pedunculate cymes, these disposed in a slender spare panicle, or sessile in verticils, these forming an interrupted or dense spike; calyx tubular, 5-toothed, the teeth usually thin and membranaceous, less often subulate and somewhat rigid, deltoid, or attenuate, subequal; corolla pallid or rose-colored, tubular, arcuate, somewhat hooded, the lips subequal; stamens 4, slightly exerted from the corolla tube.

A widespread genus of North America, centered in the southwestern United States, but of Eurasian affinities. The species are apparently localized.

Key to the species

1. Leaves (only the basal ones) deltoid, the upper and floral leaves linear, entire, 4 to 5 mm. wide; flowers reddish, in pedicellate cymes, not crowded; corolla tube 2 cm. or longer----- 1. *A. RUPESTRIS*.
1. Leaves all deltoid-ovate (2).
2. Calyx 3 to 3.5 mm. long, the teeth and the tube subequal, the teeth whitish; corolla tube 4 to 4.5 mm. long----- 3. *A. WRIGHTII*.
2. Calyx 5 to 11 mm. long, the teeth shorter than the tube; corolla tube 6 to 23 mm. long (3).
3. Flowers in pedicellate cymes, not crowded; calyx 11 mm. long; corolla tube 17 to 23 mm. long----- 2. *A. BARBERI*.
3. Flowers in verticillate spikes; calyx 5 to 8 mm. long; corolla tube 6 to 13 mm. long (4).
4. Corolla tube 6 to 8 mm. long; calyx teeth 1.5 mm. long.----- 4. *A. BREVIFLORA*.
4. Corolla tube 10 to 13 mm. long; calyx teeth 2 to 4 mm. long (5).
5. Flowers pallid, the calyx greenish or dull white.----- 5. *A. PALLIDIFLORA*.
5. Flowers purple, the calyx reddish or purple.----- 6. *A. NEOMEXICANA*.

1. **Agastache rupestris** (Greene) Standl., Contrib. U. S. Natl. Herbarium 13: 212. 1910.

Cedronella rupestris Greene, Pittonia 1: 164. 1888.

Near Payson and in Barnhart Pass, Mazatzal Mountains (Gila County), Baboquivari Mountains (Pima County), 4,000 to 5,000 feet. Southwestern New Mexico, and central and southern Arizona.

2. **Agastache barberi** (Robinson) Epling, Wash. Acad. Sci. Jour. 29: 489. 1939.

Brittonastrum barberi Robinson, Amer. Acad. Arts and Sci. Proc. 43: 24. 1907.

Patagonia Mountains (Santa Cruz County), about 5,000 feet (*Peebles* and *Harrison* 4748, *Kearney* and *Peebles* 10122). Southern Arizona and northern Mexico.

Flowers showy for the genus, lavender purple.

3. **Agastache wrightii** (Greenm.) Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 168. 1913.

Cedronella wrightii Greenm., Amer. Acad. Arts and Sci. Proc. 41: 244. 1905.

Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, commonly 4,000 to 6,000 feet, rich soil, canyons and slopes, June to October. Southern New Mexico, southern Arizona, and northern Mexico.

4. **Agastache breviflora** (A. Gray) Epling, Wash. Acad. Sci. Jour. 29: 489. 1939.

Cedronella breviflora A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 309. 1885.

Mountains of Graham, Cochise, Santa Cruz, and Pima Counties, type from the Santa Rita Mountains, Pima County, 7,000 feet (*Pringle*). Western Texas to southern Arizona and Mexico.

5. **Agastache pallidiflora** (Heller) Rydb., Torrey Bot. Club Bul. 33: 150. 1906.

Brittonastrum pallidiflorum Heller, *ibid.* 26: 621. 1899.

White Mountains (Apache County), and at many localities in Coconino County, 7,000 to 10,000 feet, rich moist soil of coniferous forests, July and August. New Mexico and northern Arizona.

Flowers whitish or tinged with lavender.

6. **Agastache neomexicana** (Briq.) Standl., Contrib. U. S. Natl. Herbarium 13: 211. 1910.

Brittonastrum neomexicanum Briq., Conserv. et Jard. Bot. Genève Ann. 6: 158. 1902.

Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), 7,500 to 9,000 feet, rich soil in coniferous forests. New Mexico and southeastern Arizona.

Flowers purplish pink.

9. NEPETA

Plant perennial, herbaceous; leaves soft, ample, usually canescent, truncate or subcordate at base, rather coarsely toothed; flowers in dense, usually pedunculate cymes, these disposed in an interrupted spike; calyx tubular or campanulate, the tube somewhat constricted above, the teeth deltoid-subulate, somewhat spreading, the posterior 3 teeth joined at base, the orifice therefore oblique; corolla white or pinkish, the upper lip erect, notched, laterally reflexed; stamens 4, paired; nutlets smooth, oblong-ovate.

1. **Nepeta cataria** L., Sp. Pl. 570. 1753.

Near Flagstaff (Coconino County), Prescott (Yavapai County), Chiricahua Mountains (Cochise County), usually at roadsides, July and August. Widely distributed in North America; naturalized from the Mediterranean region.

Catnip. Although having no therapeutic virtue other than that of a mild aromatic, this is an official drug plant. It is reputed to have a quieting effect on the nerves and is used as a mild stimulant, tonic, and emmenagogue. The odor of the plant has a peculiar attraction for cats.

10. MOLDAVICA. DRAGONHEAD

A glabrate annual or biennial herb; leaves oblong, sharply and coarsely toothed; flowers in dense, oblong, often leafy spikes, these sometimes interrupted or the lower verticils remote, the subtending bracts spinose along the margins; calyx tubular, strongly veined, the anterior teeth deltoid-lanceolate, spinose at tip, the posterior tooth ovate, twice as broad as the others; corolla blue or purplish pink,

scarcely exerted from the calyx, the upper lip erect, notched; stamens 4, paired; nutlets oblong-ovate, smooth.

1. **Moldavica parviflora** (Nutt.) Britton in Britt. and Brown, Illus. Fl. ed. 2, 3: 115. 1913.

Dracocephalum parviflorum Nutt., Gen. Pl. 2: 35. 1818.

Coconino, Gila, eastern Maricopa, and Pinal Counties, 3,500 to 7,000 feet, pine woods, April to June. Canada to New Mexico and Arizona.

11. PRUNELLA. SELFHEAL.

A small perennial herb; leaves oblong, long-petioled, subentire; flowers in dense terminal bracteate spikes, the bracts sheathing; calyx 2-lipped, the upper lip truncate, bearing 3 cusps, the lower teeth essentially free; corolla violet, the upper lip galeate, enclosing the stamens; stamens 4, paired; nutlets smooth, ovate.

1. **Prunella vulgaris** L., Sp. Pl. 600. 1753.

White Mountains (Apache County) and Kaibab Plateau (Coconino County) to the mountains of Greenlee, Graham, and Pima Counties, 7,000 to 9,000 feet, moist ground, June to September. Throughout the cooler parts of North America; Eurasia.

The plant was formerly used as a domestic remedy for various disorders.

12. DRACOCEPHALUM. FALSE-DRAGONHEAD

Perennial herbs; stems erect, stiffish; leaves glabrous, serrate, sessile; flowers in terminal, showy racemes or panicles; calyx 5-toothed, tubular; corolla rose-colored or pallid, funnellform with an inflated throat and an arched entire upper lip; stamens 4, in 2 pairs, included in the galea or but slightly exerted, the longer pair attached near the middle of the tube.

A specimen which may represent an undescribed species of *Dracocephalum* (*Physostegia*), although identified by Gray as *Physostegia virginiana* (L.) Benth. var. *obovata* (Ell.) A. Gray, was collected at Santa Cruz, Sonora (*Wright* 1530), about 10 miles south of the border of Arizona.

13. LEONURUS. MOTHERWORT

Plant herbaceous, tall, puberulent or glabrate; leaves long-petioled, the blades 3-parted, the divisions incised; flowers in axillary clusters much shorter than the leaves; calyx campanulate, 5-veined, the teeth triangular-aristate, somewhat unequal in length; corolla pink, markedly bilabiate, the tube about equaling the calyx, the upper lip erect and slightly concave, the lower lip spreading and 3-lobed; nutlets 3-sided, truncate at apex.

1. **Leonurus sibiricus** L., Sp. Pl. 584. 1753.

Lakeside, Navajo County (*Thornber* 8902) and reported by Mrs. Collom as occurring near Mormon Lake (Coconino County). Here and there in the United States; naturalized from eastern Asia.

14. MOLUCCELLA. MOLUCCA-BALM

Plant annual, herbaceous, glabrous; leaves coarsely toothed, rotund, petiolate; flowers several in the axils of the upper leaves; calyx with

lobes wholly united into a flaring funnel-shaped structure resembling a small morning-glory flower; corolla white or pinkish, the upper lip concave or galeate, including the stamens; stamens 4, paired; nutlets truncate at apex.

1. *Moluccella laevis* L., Sp. Pl. 587. 1753.

Oracle, Pinal County, 4,900 feet (*Oslar* in 1903), also in southern Utah, very near the Arizona border. An occasional escape from gardens in the United States; native of the Mediterranean region.

15. STACHYS. BETONY, HEDGENETTLE

Perennial herbs; leaves deltoid-ovate or oblong, the upper ones gradually reduced; flowers usually 3 in the axils of leaflike bracts, disposed in interrupted spikes; flowering calyx turbinate, somewhat larger at maturity, the teeth more or less deltoid and spinulose at tip; corolla bright red or whitish, the tube cylindric, pilose-annulate within below the middle and often constricted at the annulus, even saccate, the upper lip galeate, including the stamens, the lower lip spreading; stamens 4, attached near the middle of the corolla tube, paired; nutlets obovate, smooth or roughened.

Key to the species

1. Corolla bright red, the tube 18 to 21 mm. long, transversely annulate near the base; leaves deltoid-ovate, petiolate----- 1. *S. COCCINEA*.
 1. Corolla white, pallid, or pink, the tube 5.5 to 8.5 mm. long, obliquely annulate below the middle and more or less constricted and saccate on the lower side; leaves oblong, sessile or nearly so (2).
 2. Stems clothed with soft appressed silvery hairs; leaves prevailing 8 to 12 mm. wide, appressed-pubescent on both faces, the upper face somewhat silky----- 2. *S. ROTHROCKII*.
 2. Stems clothed with spreading stiffish hairs; leaves prevailing 1.5 to 4 cm. wide, thinly clothed with spreading hairs on both faces. 3. *S. PALUSTRIS*.
1. ***Stachys coccinea* Jacq., Pl. Hort. Schoenbr. 3:18. 1798.**

?*Stachys limitanea* A. Nels., Amer. Jour. Bot. 25: 115. 1938.

Gila, Graham, Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 8,000 feet, rich soil in canyons, etc., March to October. Western Texas to southern Arizona and Mexico.

A showy plant, responding readily to cultivation. *S. limitanea* A. Nels., based on a collection near Ruby, Santa Cruz County (*Nelson* 1471), is described as lacking fine puberulence and as pubescent with long soft ciliae below.

2. *Stachys rothrockii* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 82. 1876.

Apache County to eastern Mohave and northern Yavapai Counties, 5,000 to 7,000 feet, chiefly in open pine forests, summer, type from Arizona near Zuni, N. Mex. (*Rothrock* 177). Western New Mexico and Arizona.

The plants grow in colonies from deep rootstocks. The wilted corollas are purplish.

3. *Stachys palustris* L., Sp. Pl. 580. 1753.

White Mountains (Apache and Greenlee Counties), Flagstaff and Willow Spring (Coconino County), 7,000 to 9,000 feet, moist shady

places, summer. Widely distributed in the cooler parts of North America; Eurasia.

The Rocky Mountain (and Arizona) form of this widespread complex is subsp. *pilosa* (Nutt.) Epling. The flowers are lavender pink.

16. SALVIA.³⁰ SAGE

Shrubs or herbs of varied habit; flowers in interrupted spikes or terminal heads; calyx 2-lipped, usually laterally compressed, the upper lip commonly entire, less often 3-mucronate or 3-toothed, the lower lip usually 2-toothed; corolla blue, red, or white, tubular, strongly 2-lipped, the upper lip either plane and notched, or galeate and entire; stamens 2, exserted from the corolla-tube beyond the limb, or contained within the galea, the connective strongly developed, often more prominent than the filament, bearing a single terminal anther sac (rarely one at each end), either straight and projected back into the corolla tube, or geniculate; style usually exserted from the galea or beyond the upper lip; nutlets smooth.

Key to the species

1. Upper lip of the corolla essentially plane or laterally reflexed and usually notched, not at all galeate; stamens clearly exserted beyond the tube and limb of the corolla (2).
2. Plant annual, with dissected leaves; lower arm of the connective bearing a fertile anther sac; corolla light blue----- 1. *S. COLUMBARIÆ*.
2. Plants shrubby (3).
3. Leaves rugose, deltoid or oblong-elliptic, crenulate, green, thinly hispidulous----- 4. *S. MOHAVENSIS*.
3. Leaves smooth, obovate, entire, canescent (4).
4. Calyx 5 to 7 mm. long; corolla tube 5 to 10 mm. long, pubescent within above the middle----- 2. *S. CARNOSA*.
4. Calyx 8 to 13 mm. long; corolla tube 15 to 22 mm. long, strongly pilose-annulate below the middle----- 3. *S. PACHYPHYLLA*.
1. Upper lip of the corolla clearly galeate, including the stamens, or these not much exserted (5).
5. Leaves 10 to 25 cm. long; flowers subtended by persistent sheathing bracts; a coarse woolly herb----- 14. *S. AETHIOPIS*.
5. Leaves rarely as much as 8 cm. long; bracts deciduous or, if persistent, not sheathing the flowers (6).
6. Perennial herbs; leaves usually pinnate, at least below; stamen connectives bearing fertile thecae at both ends; flowers red (7).
7. Leaves 3-foliolate, or simple by suppression of the lateral pair of smaller leaflets, the terminal leaflet essentially rotund or broadly and obtusely deltoid, coarsely sinuate-dentate----- 5. *S. DAVIDSONII*.
7. Leaves 3- to 5-foliolate, rarely simple by suppression of the lateral leaflets, the terminal leaflet deeply and irregularly toothed or lobed. 6. *S. HENRYI*.
6. Perennial or annual herbs, or shrubs; leaves simple throughout; lower theca of each stamen wholly abortive; flowers blue or (in *S. lemmonii*) purple (8).
8. Stamen connective essentially straight, directed downward into the tube and across it, usually bearing a small triangular tooth near the middle (9).
9. Verticils usually several-flowered; leaves deltoid-ovate, 5 to 10 cm. long; corolla violet, the tube 6.5 to 7 mm. long. 12. *S. AMISSA*.
9. Verticils mostly of 2 opposite flowers (10).
10. Plant annual; corolla blue----- 11. *S. REFLEXA*.
10. Plant perennial, suffrutescent; corolla lavender pink. 13. *S. LEMMONI*.

³⁰ References: EPLING, CARL. THE CALIFORNIAN SALVIAS, A REVIEW OF SALVIA, SECTION AUDIBERTIA. Mo. Bot. Gard. Ann. 25: 95-188. 1938. ——— A REVISION OF SALVIA: SUBGENUS CALOSPHACE. Repert. Spec. Novarum Regni Veg. Beih. 110: 1-380. 1938-9.

8. Stamen connective patently bent at a sharp angle within the corolla tube, the terminal portion assurgent into the throat, often expanded at apex but bearing no theca; flowers, at least the lower ones, usually 3 or more in the verticil (11).
11. Leaves tomentulose and incanous with minute hairs, at least beneath; verticils crowded (12).
12. Calyx densely villous with branched hairs; herb, woody only at base----- 7. *S. PARRYI*.
12. Calyx canescent with minute simple appressed hairs; shrub, 1 m. high or more----- 8. *S. PINGUIFOLIA*.
11. Leaves essentially green and glabrous on both faces, not at all canescent; verticils spaced at intervals of 1 to 3 cm. or more (13).
13. Perennial herb with creeping rootstocks; leaves deltoid-ovate, crenate, commonly 2.5 to 4 cm. wide----- 9. *S. ARIZONICA*.
13. Annual herb; leaves oblong, sharply toothed, rarely more than 1.5 cm. wide----- 10. *S. SUBINCISA*.

1. *Salvia columbariae* Benth., Labiat. Gen. et Sp. 302. 1833.

Mohave County to Graham, Cochise, and Pima Counties (doubtless also Yuma County), 3,500 feet or lower, common in sandy washes, March and April. Southern Nevada, Arizona, and California.

One of the species known as chia. The seeds were utilized by the Indians to make pinole and also mucilaginous poultices. A mucilaginous beverage prepared from the seeds was popular with the Pima Indians. The seeds of other species known as chia are extensively used in Mexico for similar purposes.

2. *Salvia carnososa* Dougl. ex Benth., Edwards's Bot. Reg. 17: pl. 1469. 1831.

Audibertia incana Benth., *ibid*.

Coconino, Mohave, and Yavapai Counties, 2,400 to 5,000 feet, sandy soil, plains and washes, spring. Washington to Arizona and California.

Desert sage. A small compact much-branched shrub, very ornamental in flower, the sky-blue corollas contrasting with the purple bracts. Although browsed to some extent by livestock, its palatability is considered low.

S. carnososa subsp. *mearnsii* (Britton) Epling (*Audibertia mearnsii* Britt.) a little known form, characterized by oblanceolate or linear leaves 2 to 4 mm. wide, is based on a collection at Fort Verde, Yavapai County (*Mearns* 246). The forms occurring in Coconino and Mohave Counties are subsp. *argentea* (Rydb.) Epling (*Audibertiella argentea* Rydb.), and subsp. *pilosa* (Merriam) Epling (*Salvia pilosa* Merriam). The leaves are 8 to 15 (20) mm. wide in subsp. *argentea*, and 7 to 10 (15) mm. wide in subsp. *pilosa*. The outer surface of the bracts is glabrate in subsp. *argentea*, thinly hairy in subsp. *pilosa*.

3. *Salvia pachyphylla* Epling ex Munz, Man. South. Calif. Bot. 445. 1935.

Audibertia incana Benth. var. *pachystachya* A. Gray, Syn. Fl. ed. 2, 2¹: 461. 1886.

Near Winslow, Navajo County, 5,000 to 5,600 feet (*Jones* in 1929, *Whiting* 756, *Peebles* 14406), eroded slopes, etc. Northern Arizona, southern California, and Baja California.

4. *Salvia mohavensis* Greene, Pittonia 2: 235. 1892.

Audibertia capitata A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 387. 1868.

Black Mountains, Chemehuevi (Mohave County), Sierra Estrella (Maricopa County), 2,500 to 4,000 feet, dry rocky slopes, spring. Western Arizona, southeastern California, and northwestern Sonora.

A small shrub with a strong sagelike odor.

5. *Salvia davidsonii* Greenm., Amer. Acad. Arts and Sci. Proc. 41: 246. 1906.

Metcalf (Greenlee County), Chiricahua Mountains (Cochise County), Fish Creek and Horse Mesa (eastern Maricopa County), 2,000 to 5,500 feet, among rocks in shade, April and May, type from the Chiricahua Mountains (*Lemmon* 3077). Southern Arizona, probably also in southern New Mexico.

6. *Salvia henryi* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 368. 1872.

Chiricahua Mountains, Cochise County (*Lemmon* in 1882), Santa Rita Mountains, Pima County (*Pringle* in 1884). Western Texas to southern Arizona and Chihuahua.

The bright-red flowers of this and the preceding species are very showy.

7. *Salvia parryi* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 369. 1872.

Salvia confinis Fernald, *ibid.* 35: 523. 1900.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, May to August, type of *S. confinis* from near Fort Huachuca (*Lemmon* 2861). Southwestern New Mexico, southern Arizona, and northern Sonora.

8. *Salvia pinguifolia* (Fernald) Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 169. 1913.

Salvia ballotaeiflora Benth. var. *pinguifolia* Fernald, Amer. Acad. Arts and Sci. Proc. 35: 523. 1900.

Greenlee, Graham, Maricopa, Pinal, Cochise, and Pima Counties, 2,000 to 7,000 feet, rocky slopes, July to September. Western Texas to southern Arizona and Chihuahua.

A shrub, up to about 1.5 m. (5 feet) high, the flowers blue.

9. *Salvia arizonica* A. Gray, Syn. Fl. ed. 2, 2¹: 370. 1886.

Salvia arizonica var. *huachucana* M. E. Jones, Contrib. West. Bot. 12: 71. 1908.

Mountains of Graham, Cochise, and Pima Counties, 7,000 to 9,000 feet, July to September, type from Mount Graham (*Rothrock* 407). Western Texas and southern Arizona. Flowers indigo blue.

10. *Salvia subincisa* Benth., Pl. Hartw. 20. 1839.

Yavapai, Greenlee, Cochise, Santa Cruz, and Pima Counties, up to 5,500 feet, plains and mesas, August and September. Western Texas to Arizona and northern Mexico.

11. *Salvia reflexa* Hornem., Enum. Pl. Hort. Hafn. 1: 34. 1807.

Salvia lanceolata Brouss., App. Elench. Pl. Hort. Monsp. 15. 1805. Not Lamarck, 1791.

Salvia lanceaeifolia Poir. in Lam., Encycl. Sup. 5: 49. 1817.

Apache, Navajo, Coconino and Yavapai Counties, south to Pinal, Cochise, and Santa Cruz Counties, 4,000 to 7,000 feet, plains and mesas, July to October. North Dakota and Wyoming to Texas, Arizona, and Mexico.

Sometimes called Rocky Mountain sage. Medicinal properties are attributed to this plant, of which infusions are sometimes used in treating malarial and rheumatic fevers and as a tonic and astringent.

12. *Salvia amissa* Epling, Repert. Spec. Novarum Regni Veg. Beih. 110: 187. 1939.

Salvia albiflora Mart. and Gal. var. *pringlei* A. Gray, Syn. Fl. ed. 2, 2¹: 461. 1886.

Fish Creek, eastern Maricopa County (*Kearney* and *Peebles* 14488), by streams in the Santa Catalina Mountains, Pima County (*Pringle* in 1881, the type collection), May to October. Known only from southern Arizona.

13. *Salvia lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 309. 1885.

Salvia microphylla H. B. K. var. *wislizeni* A. Gray, *ibid.* p. 408.

Mountains of Cochise and Pima Counties, 6,000 to 8,000 feet, rocky slopes and canyons, July to October, type from the Huachuca Mountains (*Lemmon* in 1881). Southern Arizona and northern Mexico.

This species appears to be confluent with a polymorphic complex ranging from Arizona to central and eastern Mexico. Although the Arizona plants have a somewhat different habitat aspect, they seem hardly separable from the variety of *S. microphylla* from Chihuahua described by Gray as var. *wislizeni*. The plant has an odor of peppermint, according to Blumer.

14. *Salvia aethiopsis* L., Sp. Pl. 27. 1753.

South rim of the Grand Canyon (Coconino County), Peebles Valley (Yavapai County), fields and roadsides. Here and there in the United States (Texas, Arizona, Oregon); introduced from the Mediterranean region.

The plant has spread rapidly in Peebles Valley during the past 12 years and has become a pest in overgrazed range land.

17. MONARDA.³¹ BEEBALM

Perennial or annual herbs; leaves oblong, elliptic, or ovate; flowers crowded in dense axillary or terminal glomerules, these subtended by an involucre of linear, oblong, or ovate, reflexed or ascending bracts; calyx tubular, the teeth aristate or deltoid; corolla white, yellowish, pink, or rose, the tube longer than the lips, slender, abruptly expanded into a funnel-shaped throat, the upper lip galeate, arched or straight; stamens seated in the corolla throat, included within the galea or somewhat exerted; nutlets smooth, oblong.

³¹ Reference: EPLING, CARL. NOTES ON MONARDA: THE SUBGENUS CHELYCTIS. Madroño 3: 20-31. 1935.

Several species of this genus have been used in domestic medicine. *M. menthaefolia* has limited value as a forage plant and is sometimes cultivated by the Hopi Indians, who use it as a potherb, drying the plants for use in winter.

Key to the species

1. Flowers in terminal heads; leaf blades ovate, subsessile, commonly 2 to 3 cm. wide; corolla purple 1. *M. MENTHAEFOLIA*.
 1. Flowers in axillary clusters; leaf blades oblong or elliptic, commonly 1 to 1.5 cm. wide, on petioles usually 5 to 10 mm. long, or longer; corolla whitish (2).
 2. Bracts strongly reflexed, usually puberulent and whitish or purple, only the midvein at all prominent 2. *M. AUSTROMONTANA*.
 2. Bracts spreading or ascending, glabrous on the upper surface, 3 of the veins usually prominent 3. *M. PECTINATA*.
1. **Monarda menthaefolia** Graham, Edinb. Phil. Jour. 1829: 347. 1829.

Monarda stricta Wooton, Torrey Bot. Club Bul. 25: 263. 1898.
Monarda mollis L. var. *menthaefolia* Fernald, Rhodora 3: 15. 1901.

Apache County to Coconino County, south to Graham and Pima Counties, 5,000 to 8,000 feet, mostly in pine forest, summer. Canada to New Mexico and Arizona.

2. **Monarda austromontana** Epling, Madroño 3: 28. 1935.

Navajo County to Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,500 feet, mesas and slopes, usually with grasses, late summer. Southwestern New Mexico, Arizona, and northern Mexico.

3. **Monarda pectinata** Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 82. 1847.

Apache County to Coconino, Yavapai, and Gila Counties, also at Avondale (Maricopa County) where probably from seeds carried down by floodwater, commonly 5,000 to 7,000 feet, late summer. Nebraska and Colorado to Texas and Arizona.

18. HEDEOMA.³² MOCK-PENNYROYAL

Small perennial herbs; leaves small, simple, essentially sessile; flowers in small cymules in the axils of the upper leaves, these either bractlike or not much reduced; calyx tubular, the teeth relatively short, the upper 3 teeth usually joined below the middle, the lower 2 teeth free, subulate, longer than the upper teeth, bristly with stiffish hairs, the orifice of the calyx more or less hispid-annulate; corolla rose, lavender, or white, tubular; stamens 2, exceeding the corolla tube; nutlets smooth, oblong.

The genus *Hedeoma* is largely confined to the Texan-Arizonan region, but occurs also in South America. Probably some of the Arizona species are diaphoretic and stimulant-aromatic like *H. pulegioides* (L.) Pers., the American pennyroyal of the eastern United States.

³² Reference: EPLING, C., and STEWART, WM. S. A REVISION OF HEDEOMA WITH A REVIEW OF ALLIED GENERA. Repert. Spec. Novarum Regni Veg. Beih. 115: 1-50. 1939.

Key to the species

1. Calyx teeth connivent at maturity, closing the tube, the whole calyx thus tapering from the middle of the tube to the apex--- 4. *H. DRUMMONDII*.
1. Calyx teeth usually spreading, the upper ones more or less reflexed, the calyx thus clearly bilabiate (2).
 2. Tube of the calyx notably distended at base at maturity, the pouch forming more than half of the length of the tube, the latter about one-third as wide as long----- 2. *H. NANUM*.
 2. Tube of the calyx only slightly distended, about one-fourth as wide as long (3).
 3. Leaves clearly and sharply dentate, at least in the upper half (4).
 4. Leaves serrate, with several or numerous teeth, the veins apparent; corolla tube retrorsely hairy within; early leaves villous.
 5. *H. DENTATUM*.
 4. Leaves inconspicuously dentate, with 4 to 6 teeth, or entire, the veins inconspicuous; corolla tube glabrous within; early leaves glabrous.
 6. *H. OBLONGIFOLIUM*.
 3. Leaves entire or essentially so (5).
 5. Leaves linear-lanceolate, pointed, strict, stiffish, the lateral veins straight, rather prominent, parallel----- 1. *H. HYSOPIFOLIUM*.
 5. Leaves elliptic-lanceolate, oblong, or oval, usually spreading, the lateral veins not markedly straight and parallel (6).
 6. Stems prostrate, wiry, 5 to 20 cm. long; corolla tube hirtellous within and somewhat annulate near the middle----- 3. *H. DIFFUSUM*.
 6. Stems erect, 25 to 50 cm. long, stiffish; corolla tube glabrous within or essentially so----- 6. *H. OBLONGIFOLIUM*.

1. *Hedeoma hyssopifolium* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 96. 1876.

Southern Apache and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,000 feet, slopes and canyons, May to October, type from Mount Graham (*Rothrock* 418). New Mexico, Arizona, and northern Mexico.

2. *Hedeoma nanum* (Torr.) Greene, Pittonia 3: 339. 1898.

Hedeoma dentata var. *nana* Torr., U. S. and Mex. Bound. Bot. 130. 1859.

Hedeoma thymoides A. Gray, Syn. Fl. 2¹: 362. 1878. Not of Persoon.

Key to the subspecies

1. Calyx tube 3.5 to 4 mm. long; corolla tube 5 to 7 mm. long; basal leaves present, purple beneath, more than 1 cm. long----- subsp. *MACROCALYX*.
1. Calyx tube 2.5 to 3 (rarely 4) mm. long; basal leaves usually deciduous (2).
 2. Stems forming a close bunch or tuft, 10 to 15 cm. high, sparingly covered with retrorse pubescence above, glabrous below; leaves about 5 mm. long.
 - subsp. *CALIFORNICUM*.
 2. Stems loose, 10 to 35 cm. high, with downward-curling pubescence; leaves usually 5 to 10 mm. long----- subsp. *TYPICUM*.

Subsp. *macrocalyx* Stewart occurs in Yavapai, Gila, Maricopa, Pinal, and Pima Counties. Subsp. *californicum* Stewart is known in Arizona only from Toroweap Valley (northern Mohave County). Subsp. *typicum* Stewart ranges from Coconino and Mohave Counties to Cochise, Pima, and Yuma Counties. The species as a whole ranges from western Texas to southeastern California and northeastern Mexico.

3. *Hedeoma diffusum* Greene, Pittonia 3: 338. 1898.

Hedeoma blepharodonta Greene, *ibid.* p. 339.

Navajo, Coconino, and Yavapai Counties, commonly 6,000 to 7,000 feet, May to July, type from Flagstaff (*Rusby* in 1883). Known only from northern Arizona.

4. *Hedeoma drummondii* Benth., Labiat. Gen. et Sp. 368. 1836.

Carrizo Mountains (Apache County), Kaibab Plateau (Coconino County), and eastern Mohave County to Greenlee, Cochise, and Santa Cruz Counties, 3,500 to 7,000 feet, May to September. North Dakota and Montana to Texas, Arizona, and northern Mexico.

5. *Hedeoma dentatum* Torr., U. S. and Mex. Bound. Bot. 130. 1859.

Graham, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,500 feet, August to October. Southern Arizona and northern Mexico.

6. *Hedeoma oblongifolium* (A. Gray) Heller, *Muhlenbergia* 1: 4. 1900.

Hedeoma piperita var. *oblongifolia* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 366. 1872.

Coconino and Mohave Counties to Cochise and Pima Counties, 4,000 to 8,000 feet, June to September. New Mexico, Arizona, and northern Mexico.

19. POLIOMINTHA

Shrub, clothed with a minute feltlike whitish tomentum; leaves essentially linear or linear-oblong, thickish; flowers 1 to 3, in small, axillary, sometimes subspicate cymules; calyx 15-veined, the tube pilose with silky spreading hairs, the teeth subequal, more or less connivent, the calyx strongly annulate in the throat; corolla pale blue, the tube strongly but incompletely annulate somewhat above the middle, with coarse ascending hairs; stamens 2, seated well above the middle of the corolla tube, ascending against the upper lip; nutlets smooth, oblong.

1. *Poliomintha incana* (Torr.) A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 296. 1870.

Hedeoma incana Torr., U. S. and Mex. Bound. Bot. 130. 1859.

Apache, Navajo, and Coconino Counties, 4,500 to 6,000 feet, common in sandy deserts, May to September. Western Texas to southern Utah and northern Arizona.

An attractive plant, reported as responding well to cultivation. It is stated that the Hopi Indians eat the herbage raw or boiled, sometimes drying it for use in winter, and use the flowers for seasoning food.

20. CLINOPODIUM. WILD-BASIL

Perennial herb, hirsute with spreading hairs; leaves ovate, subentire; flowers in rather dense cymules, these either terminal and hemispheric or more commonly 2, forming an interrupted spike; calyx tubular, bilabiate, the 3 posterior teeth united to the middle, subulate, somewhat reflexed, the lower teeth free, subulate; corolla rose-colored, the upper lip erect, somewhat concave but scarcely galeate; stamens 4, paired, seated well within the corolla throat; nutlets smooth, ovate.

1. *Clinopodium vulgare* L., Sp. Pl. 587. 1753.

Coconino County, and Santa Catalina Mountains (Pima County), 6,000 to 7,500 feet, rich shaded ground, July to September. Canada to North Carolina, New Mexico, and Arizona; Eurasia

21. MONARDELLA³³

Perennial herbs, usually forming a low bush with several or numerous ascending branches; leaves elliptic or oblong, entire; flowers in terminal subglobose heads, these subtended by a few bracts similar to the leaves but usually thinner and colored; calyx tubular, the teeth narrowly deltoid, erect, subequal; corolla white and usually purple-punctate, or rose-colored, the tube somewhat exerted from the calyx, the lobes oblong-linear, subequal; stamens 4, exerted; nutlets oblong, smooth.

The genus *Monardella* is inexplicable in terms of a conventional system. The forms of each isolated region have a more or less characteristic aspect, difficult or impossible to define, and form a continuous spectrum of variation with the forms of other regions. The genus is predominantly Californian. *M. lanceolata* Gray, an annual species, may occur in northern Arizona.

Key to the species

1. Pubescence curled downward; bracts ovate to rotund, usually cupped.
 1. Pubescence spreading; bracts narrowly ovate, spreading. 1. *M. ODORATISSIMA*.
 2. *M. ARIZONICA*.

1. *Monardella odoratissima* Benth., *Labiat. Gen. et Sp.* 332. 1834.

Monardella parvifolia Greene, *Pl. Baker.* 3: 22. 1901.

Madronella parvifolia Rydb., *Torrey Bot. Club Bul.* 33: 150. 1906.

Kaibab Plateau, San Francisco Peaks (Coconino County), Hualpai Mountain (Mohave County), 5,700 to 10,000 feet, mostly in coniferous forests. Montana to Washington, south to New Mexico, northern Arizona, and California.

2. *Monardella arizonica* Epling, *Wash. Acad. Sci. Jour.* 29: 489. 1939.

Black Mountains (Mohave County), Sierra Estrella (Maricopa County), Silver Bell and Quijotoa Mountains (Pima County), Kofa Mountains (Yuma County), 2,200 to 4,000 feet, rocky ledges in canyons, spring, type from the Sierra Estrella (Epling). Known only from Arizona.

The form from the Black Mountains is perhaps not conspecific.

22. LYCOPUS. BUGLEWEED

Plant perennial, pubescent or glabrate; stems erect, up to 1 m. high; leaves sessile or nearly so, oblong-lanceolate, sharply serrate; flowers small, in dense sessile axillary clusters; calyx campanulate, nearly equaling the corolla, regular or nearly so, with 4 or 5 subulate-aristate teeth; corolla whitish, nearly equally 4-cleft; perfect stamens 2, the others rudimentary; nutlets turbinate, trigonous.

1. *Lycopus lucidus* Turcz. ex Benth. in DC., *Prodr.* 12: 178. 1848.

Only 1 collection is known from Arizona, without definite locality (Palmer in 1869). Minnesota to British Columbia, south to Kansas, Arizona, and California; northern Asia.

Palmer's specimen has continuous corklike wings on the angles and summit of the nutlet, and the leaves are sessile and merely serrate.

³³ Reference: EPLING, CARL. MONOGRAPH OF THE GENUS MONARDELLA. *Mo. Bot. Gard. Ann.* 12: 1-106. 1925.

23. MENTHA. MINT

Perennial aromatic herbs, usually of wet places, with creeping, mat-forming rhizomes; leaves ovate or oblong, serrate; flowers small and pinkish in dense clusters in the axils of the upper leaves, or in narrow dense terminal spikes; calyx equally 5-toothed, the teeth deltoid, acute, usually shorter than the tube; corolla subequally 5-lobed; stamens 4, exserted; nutlets smooth.

Two Old World species, peppermint (*Mentha piperita*) and spearmint (*M. spicata*), are commonly cultivated. Oil of peppermint is used extensively in medicine and confectionery. Spearmint is used fresh for flavoring juleps, mint sauce, etc., and the oil is extracted, chiefly for medicinal use. The Hopi use mint leaves for flavoring mush.

Key to the species

1. Flowers in axillary clusters..... 1. *M. ARVENSIS*.
 1. Flowers in terminal spikes..... 2. *M. SPICATA*.

1. *Mentha arvensis* L., Sp. Pl. 577. 1753.

Mentha penardi (Briq.) Rydb., Torrey Bot. Club Bul. 33: 150. 1906.

Apache, Coconino, Greenlee, and Cochise Counties, probably elsewhere, 5,000 to 9,500 feet, July to October. Species circumpolar, polymorphic.

2. *Mentha spicata* L., Sp. Pl. 576. 1753.

Prescott, Yavapai County (*Peebles* et al. 2684), Tonto Basin, Gila County (*Toumey* 302). Extensively distributed in North America; naturalized from Europe.

M. rotundifolia L., a species closely related to *M. spicata* but distinguished by more obtuse and hairy leaves, is to be looked for in Arizona.

24. HYPTIS

A shrub, usually canescent, the hairs branched; leaves ovate; flowers several in axillary or subspicate globose woolly cymules, these sometimes paniculate; calyx usually 10-veined, the tube cylindrical, enlarging somewhat at maturity, the teeth subequal, subulate; corolla violet, the tube little exserted from the calyx, the upper lip plane or laterally reflexed, the middle lobe of the lower lip deeply saccate; stamens 4, declined along the lower lip, paired; nutlets smooth, oblong.

1. *Hyptis emoryi* Torr. in Ives, Colo. River Rpt. 20. 1860.

Hyptis lanata Torr., U. S. and Mex. Bound. Bot. 129. 1859.
 Not Pohl.

Mohave, Yavapai, Graham, Maricopa, Pinal, Pima, and Yuma Counties, up to 5,000 feet (usually lower), dry rocky slopes and canyons, flowering almost throughout the year at lower elevations, type from the lower Gila River (*Emory*). Southern Arizona, southern California, and northwestern Mexico.

Desert-lavender. The plant is browsed to a limited extent by livestock. The seeds, like those of certain species of *Salvia*, are used in Mexico as food under the name "chia."

109. SOLANACEAE.³⁴ POTATO FAMILY

Plants herbaceous or shrubby; leaves usually alternate; flowers in umbels, cymes, or panicles, or solitary and lateral, perfect, regular, the parts in 4's or 5's (rarely in 6's); ovary superior, usually 2-celled; fruit a berry or a capsule.

This large family comprises numerous economically important plants, such as the potato (*Solanum tuberosum*), eggplant (*S. melongena*), tomato (*Lycopersicum esculentum*), redpepper (*Capsicum* spp.), and tobacco (*Nicotiana tabacum*), as well as a number of very poisonous species, among them henbane (*Hyoscyamus niger*) and belladonna (*Atropa belladonna*), sources of the powerful drugs hyoscyamine and atropine, respectively. Many species in the genera *Solanum*, *Nicotiana*, *Petunia*, and others are grown as ornamentals.

Tomato plants (*Lycopersicum esculentum*) are found occasionally growing wild (e. g., at Paradise, Cochise County, Blumer 2266). But there is no evidence that this species has become established anywhere in the State, and therefore it is not regarded as a member of the flora.

Key to the genera

1. Fruit a dry capsule, dehiscent by valves or, if bursting irregularly, then the capsule large and spiny (2).
 2. Flowers solitary in the forks of the stem; corolla broadly funnellform or trumpet-shaped, 4 cm. long or longer, white or pale violet; capsules very large, usually spiny, regularly dehiscent or bursting irregularly. 8. DATURA.
 2. Flowers in terminal inflorescences or, if solitary in the leaf axils, then the corolla less than 1 cm. long; capsules small, not spiny, regularly dehiscent (3).
 3. Flowers in terminal racemes or panicles; corolla more than 1 cm. long, white, greenish, or yellow..... 9. NICOTIANA.
 3. Flowers axillary, solitary; corolla less than 1 cm. long, the limb purple; stems prostrate, forming mats; leaves oblanceolate or spatulate, not more than 2 cm. long..... 10. PETUNIA.
1. Fruit berrylike, indehiscent, commonly fleshy but (in genus *Lycium*) sometimes dry and bony (4).
 4. Plants spiny shrubs; flowers axillary, solitary or in very few-flowered fascicles; calyx scarcely enlarged in fruit; corolla campanulate, funnellform, or salverform; fruit commonly juicy when ripe..... 1. LYCIUM.
 4. Plants mostly herbaceous or suffrutescens, if shrubby then not spiny, if spiny then herbaceous (5).
 5. Anthers opening by terminal pores or slits, not dehiscent throughout; plants sometimes spiny; inflorescence terminal or extra-axillary. 7. SOLANUM.
 5. Anthers completely dehiscent longitudinally; plants not spiny; inflorescence axillary (6).
 6. Calyx thick, unaltered in fruit, truncate; berry pungent... 6. CAPSICUM.
 6. Calyx papery, accrescent in fruit, obviously toothed; berry not pungent (7).
 7. Flowers in a sessile or pedunculate umbel; calyx saucer-shaped at maturity, not at all enclosing the fruit..... 5. SARACHA.
 7. Flowers solitary; calyx enclosing the fruit at maturity (8).
 8. Corolla urceolate..... 2. MARGARANTHUS.
 8. Corolla rotate to funnellform-campanulate (9).
 9. Calyx in fruit not angled, the lobes not connivent, leaving the top of the berry exposed..... 3. CHAMAESARACHA.
 9. Calyx in fruit angled, the lobes connivent over the berry. 4. PHYSALIS.

³⁴ Prepared in collaboration with C. V. Morton, Smithsonian Institution.

1. LYCIUM.³⁵ DESERT-THORN

Plants shrubby, usually spiny; leaves mostly fascicled, the blades entire; flowers chiefly axillary, solitary or in small clusters; calyx campanulate, irregularly toothed or cleft; corolla campanulate, tubular-funnelform, or salverform; stamens 4 or 5; style slender, the stigma capitate or 2-lobed; berry fleshy or dry, globose or ovoid, subtended by the persistent calyx.

These plants, also known as squawberry, tomatillo, and wolfberry, have contributed to the subsistence of the Indians. Several of the species produce abundant quantities of insipid, slightly bitter, juicy berries that are eaten raw or prepared as a sauce. Probably all of the native species furnish winter forage for livestock. They grow commonly along washes and on dry slopes, in desert or semidesert areas. Some of the species tolerate a rather high degree of soil salinity. All of the Arizona species, with the possible exception of *L. pallidum*, shed their leaves and become dormant during periods of drought, refoliating quickly when conditions become favorable. They flower regularly in spring, often again after summer rains.

Key to the species

1. Twigs tomentose when young; fruit transversely constricted, the upper part dry, bony, brown (2).
 2. Fruit constricted below the middle; calyx lobes subulate or linear, equaling to twice as long as the tube; corolla glabrous..... 1. *L. MACRODON*.
 2. Fruit constricted above the middle; calyx lobes from one-third to as long as the tube; corolla densely pubescent to glabrous..... 2. *L. COOPERI*.
1. Twigs not tomentose; fruit a plump, succulent, scarlet berry, or (in *L. californicum*) the endocarp hardened (3).
 3. Calyx tube densely glandular-pubescent; leaves, except in age, abundantly glandular-pubescent (4).
 4. Calyx campanulate to turbinate, the lobes longer than the tube and rounded, to one-half as long as the tube and acute; berry 7- to 20-seeded; corolla lobes purple; foliage often cinereous..... 5. *L. PARISHII*.
 4. Calyx cylindrical, or turbinate in small-flowered forms, the lobes rarely more than one-quarter as long as the tube; berry usually many-seeded; foliage not cinereous; plants sexually dimorphic (5).
 5. Filaments densely villous on the lower half of the free portion; corolla lobes pale lavender; flowers mostly pendulous.... 6. *L. EXSERTUM*.
 5. Filaments glabrous or sparsely villous at base of the free portion; corolla lobes purple; flowers not pendulous.... 7. *L. FREMONTII*.
 3. Calyx tube glabrous or nearly so; leaves glabrous or slightly scurfy, rarely minutely puberulent (6).
 6. Corolla greenish white, the tube 15 to 20 mm. long, greatly expanded above the middle, the mouth 5 to 6 mm. in diameter; leaves large, pallid; berry glaucous. 4. *L. PALLIDUM*.
 6. Corolla ochroleucous, the lobes pale lavender or pinkish; corolla tube 4 to 15 (rarely 18) mm. long, if greatly expanded then less than 10 mm. long (7).
 7. Corolla lobes finely lanate-ciliate; corolla tube funnelform, 8 to 15 mm. long..... 8. *L. TORREYI*.
 7. Corolla lobes glabrous or sparsely ciliate (8).
 8. Corolla lobes one-half to as long as the tube, normally 4; corolla tube 1 to 5 (usually 2 or 3) mm. long; leaves very succulent and thickened, often pyriform, less than 10 mm. long; fruit with a hardened endocarp, 2 to 4 mm. long; seeds 2.
 3. *L. CALIFORNICUM*.
 8. Corolla lobes one-sixth to one-third as long as the tube; fruit entirely succulent, 3 to 8 mm. long; seeds several to many (9).

³⁵ Reference: HITCHCOCK, C. LEO. A MONOGRAPHIC STUDY OF THE GENUS LYCIUM OF THE WESTERN HEMISPHERE. Mo. Bot. Gard. Ann. 19: 179-374. 1932.

9. Tube of the corolla tubular-funnelform; leaves glabrous or slightly scurfy, very rarely pubescent..... 9. L. ANDERSONII.
 9. Tube of the corolla funnelform, often greatly expanded, 4 to 6 (8) mm. long; leaves glabrous or minutely puberulent; corolla lobes 4 or 5..... 10. L. BERLANDIERI.

1. **Lycium macrodon** A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 45. 1862.

Maricopa, Pinal, western Pima, and Yuma Counties, up to 2,000 feet, February to May. Southern Arizona and Sonora.

A large spiny shrub with shining mahogany-colored branches, locally common in parts of Pinal County.

2. **Lycium cooperi** A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 388. 1868.

Mohave and Yuma Counties, up to 3,000 feet, March and April. Southwestern Utah and Arizona to southeastern California.

3. **Lycium californicum** Nutt. ex A. Gray, Bot. Calif. 1: 542. 1876.

Lycium californicum var. *arizonicum* A. Gray, Syn. Fl. ed. 2, 2^d: 437. 1886.

Maricopa, Pinal, Cochise, Pima, and (doubtless) Yuma Counties, saline soils, ordinarily at low altitudes but occasionally (in Cochise County) up to 5,000 feet, February (and probably later). Southern Arizona, California, Sonora, and Baja California, commonly littoral outside of Arizona.

Arizona's smallest species, ordinarily about 0.6 m. (2 feet) high. Berry small, scarlet, of bony hardness except for the thin, succulent, orange-red exocarp.

4. **Lycium pallidum** Miers, Ann. and Mag. Nat. Hist. ser. 2, 14: 131. 1854.

Almost throughout the State, 3,500 to 7,000 feet, April to June. Colorado, Utah, New Mexico, Arizona, southern California, and Mexico.

The Indians of northern Arizona ate the fresh berries, and, during famines, ate a mixture of the dried berries and saline clay.

5. **Lycium parishii** A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 305. 1885.

Lycium pringlei A. Gray, *ibid.*

Maricopa, southern Pinal, western Pima, and Yuma Counties, up to 1,500 feet, February to April (occasionally November). Southern Arizona, southeastern California, and Sonora.

6. **Lycium exsertum** A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 305. 1885.

Lycium fremontii var. *bigelovii* A. Gray, *ibid.* 6: 47. 1862.

Graham (?), Maricopa, Pinal, Pima, and Yuma Counties, up to 4,000 feet, flowering throughout the year, mostly January and February. Southern Arizona and northwestern Mexico.

The fertile pistillate form with reduced abortive stamens formerly passed as *L. fremontii* var. *bigelovii*.

7. *Lycium fremontii* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 46. 1862.

Lycium gracilipes A. Gray, ibid. 12: 81. 1877.

Western and southern Arizona, up to about 2,500 feet, throughout the year, mostly January to February. Also in southeastern California and northwestern Mexico.

The abundant juicy berries produced by this and the preceding species were gathered by the desert Indians for food. Both species are hosts of the destructive root-rot fungus, *Phymatotrichum omnivorum* (Shear) Dug.

8. *Lycium torreyi* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 47. 1862.

Western and southern parts of the State, mostly below 3,000 feet, March to June. Southeastern Utah and New Mexico to southeastern California and Mexico.

9. *Lycium andersonii* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 388. 1868.

Practically throughout the State, from Coconino and Mohave Counties southward to Graham, Cochise, and Yuma Counties, up to 5,600 feet, February to April (August and September). Utah and New Mexico to California and northwestern Mexico.

The typical form has the corolla 7 to 14 mm. long, usually 5-merous, and the leaves 3 to 15 mm. long, usually thickened and succulent. The var. *deserticola* (C. L. Hitchc.) Munz (*L. andersonii* f. *deserticola* C. L. Hitchc.), with thin, flat leaves up to 35 mm. long, and plants usually large and robust, is not uncommon along washes in Maricopa and Yuma Counties, below 1,500 feet, and in southeastern California. The var. *wrightii* A. Gray, with corolla 4 to 8 mm. long, usually 4-merous, and leaves 3 to 8 mm. long but occasionally larger, occurs from Greenlee County to Cochise and Yuma Counties, and in Sonora.

10. *Lycium berlandieri* Dunal in DC., Prodr. 13: 520. 1852.

Greenlee, Maricopa, Pinal, Pima, and Yuma Counties, up to about 3,000 feet, March to September. Texas to Arizona and Mexico.

Represented in Arizona by var. *parviflorum* (Gray) Terrac. (*Lycium parviflorum* Gray, *L. berlandieri* var. *longistylum* C. L. Hitchc., *L. berlandieri* var. *brevilobum* C. L. Hitchc.), which is distinguished by stout leafy branches and flowers mostly 4 to 6 mm. long.

2. MARGARANTHUS

Small annual herbs, resembling *Physalis*; stems leafy, branched; leaves petioled, the blades thin, entire or somewhat sinuate, ovate or lanceolate; flowers small, solitary, on slender pedicels; corolla subglobose.

Key to the species

1. Stems spreading, diffusely branched from the base; corolla apparently white, deeply cleft, the lobes at least as long as the tube. 1. *M. LEMMONI*.
1. Stems erect, not or sparingly branched from the base; corolla greenish yellow or lurid purple, cylindric-urceolate, merely denticulate at the orifice. 2. *M. SOLANACEUS*.

1. **Margaranthus lemmoni** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 91. 1883.

Known only from the type collection in the Huachuca Mountains, Cochise County (*Lemmon* 2847), September.

2. **Margaranthus solanaceus** Schlecht., Index Sem. Hort. Hal. 1838; *Linnaea* 13: Litt. 99. 1839.

Yavapai and Gila Counties to Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, rich soil in shade, August and September. New Mexico, Arizona, and Mexico.

3. CHAMAESARACHA

Low perennial herbs; stems leafy, decumbent or prostrate, branched; flowers axillary, solitary on slender pedicels, these recurved or reflexed in fruit; corolla rotate; berry closely invested but not hidden by the calyx.

Key to the species

1. Herbage scurfy (very sparsely so when mature) with short, flat, white, mostly stellate hairs (these often stalked below the rays), not viscid; leaves mostly sessile or subsessile, the blades oblong-lanceolate to linear, nearly entire to (commonly) laciniate-pinnatifid; corolla greenish white or tinged with purple, with large, cushionlike appendages nearly filling the throat.

1. *C. coronopus*.

1. Herbage villous with long, slender, weak, simple hairs, also densely viscid-puberulent; leaves mostly distinctly petioled, the blades oblong-lanceolate, ovate, oblanceolate, or obovate-spatulate, repand to incisely pinnatifid, the lobes sometimes incised; corolla pale yellow or purplish, with relatively small and flat appendages not filling the throat.--- 2. *C. conioides*.

1. **Chamaesaracha coronopus** (Dunal) A. Gray, Bot. Calif. 1: 540. 1876.

Solanum coronopus Dunal in DC., Prodr. 13¹: 64. 1852.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 2,500 to 7,500 feet, dry plains and mesas, April to September. Kansas to Utah, south to northern Mexico.

The berries are eaten by the Navajo and Hopi Indians.

2. **Chamaesaracha conioides** (Moric.) Britton, Torrey Bot. Club Mem. 5: 287. 1895.

Solanum conioides Moric. ex Dunal in DC., Prodr. 13¹: 64. 1852.

Cochise and Pima Counties, 3,500 to 5,500 feet, dry plains and mesas, often on limestone, March to October. Kansas and Colorado to southeastern Arizona and northern Mexico.

4. PHYSALIS.³⁶ GROUNDCHERRY

Annual or perennial herbs (rarely suffrutescent); stems branched, leafy; flowers solitary, on lateral peduncles; calyx 5-toothed or 5-cleft, becoming greatly enlarged, papery, veiny; berry globose, many-seeded; seeds flat.

The berries are more or less edible and are sometimes used in making preserves. The Indians ate them, both raw and cooked. Two Old World species, the strawberry groundcherry (*P. alkekengi*) and the lantern groundcherry (*P. franchetii*) are often grown as ornamentals.

³⁶ Reference: RYDBERG, P. A. THE NORTH AMERICAN SPECIES OF PHYSALIS AND RELATED GENERA. Torrey Bot. Club Mem. 4: 297-372. 1896.

Key to the species

1. Corolla rotate (at least in early flowers), purple or whitish; leaf blades sinuately denticulate or dentate, or pinnately cleft, cuneate at base, long-petioled (2).
2. Plant perennial, sparsely whitish-scurfy, at least on the young parts; leaf blades oblong to ovate; corolla violet or purple, with a white eye; anthers yellow; seeds thick, coarsely and irregularly rugose on the back.
 1. *P. LOBATA*.
2. Plant annual, not scurfy, sparsely puberulent or glabrate; leaf blades lanceolate or oblong-lanceolate (exceptionally ovate); corolla (in early flowers) 15 to 20 mm. in diameter, whitish, often with a large yellow eye; anthers purplish; seeds thin, not coarsely rugose on the back.
 2. *P. WRIGHTII*.
1. Corolla campanulate, yellow or yellowish, usually with a brown or purplish eye (3).
3. Pubescence partly of forked or stellate hairs, minute, cinereous, not or very slightly viscid; plant perennial; leaf blades broadly ovate or deltoid, scarcely cordate at base, acute or acutish at apex, sinuate-dentate, usually shallowly so; corolla open-campanulate.
 3. *P. FENDLERI*.
3. Pubescence of simple hairs (4).
4. Stems and leaves conspicuously pubescent, many of the stem hairs spreading (5).
5. Pubescence not viscid, rather sparse, many of the stem hairs long, flat, segmented, tapering; plant perennial; leaf blades lanceolate or ovate-lanceolate, acute at both ends, entire to coarsely few-toothed; corolla 15 to 20 mm. in diameter; fruiting calyx 25 to 35 mm. long.
 4. *P. LANCEOLATA*.
5. Pubescence viscid, copious; leaf blades ovate, deltoid, or suborbicular (6).
6. Plant annual; main stem erect, stout, seldom branching from the base; leaf blades thin, broadly ovate to nearly orbicular, sparingly repand-dentate to nearly entire, often subcordate at base; corolla yellow or greenish with a conspicuous dark eye; fruiting calyx conspicuously acuminate; stem hairs slender, not noticeably tapering.
 5. *P. PUBESCENS*.
6. Plants perennial; flowering stems from creeping rootstocks, usually diffusely branched from the base; leaf blades thickish, usually coarsely toothed; fruiting calyx not conspicuously acuminate (7).
7. Leaf blades commonly at least 5 cm. long, acute or acuminate at apex; pubescence of both short glandular hairs, and long flat segmented hairs; corolla 15 mm. in diameter or larger; fruiting calyx 2.5 to 4 cm. long.
 6. *P. HETEROPHYLLA*.
7. Leaf blades commonly less than 5 cm. long, obtuse to acute at apex; plant copiously glandular-pilose with very few, if any, long flat segmented hairs; corolla commonly less than 15 mm. in diameter; fruiting calyx not more than 2.5 cm. long.
 7. *P. HEDERAEFOLIA*.
4. Stems and leaves inconspicuously pubescent or glabrate, the hairs chiefly minute, not or scarcely viscid; plants perennial (8).
8. Leaf blades lanceolate or oblong-lanceolate (exceptionally oblanceolate), entire or repand (exceptionally sinuate-dentate), usually acuminate at both ends; herbage sparsely pubescent with short, stiff, appressed or subappressed hairs, or often glabrate; flowering stems from creeping rootstocks, stout, erect, sparingly branched; corolla 15 to 25 mm. in diameter, pale yellow with a dark eye; fruiting calyx 25 to 35 mm. long, ovoid, the teeth triangular-lanceolate.
 8. *P. LONGIFOLIA*.
8. Leaf blades broadly ovate, rounded deltoid, or suborbicular; herbage persistently puberulent; flowering stems diffusely branched (9).
9. Leaf blades thin, coarsely and rather deeply sinuate-dentate; corolla with a distinct eye, greenish yellow, drying purplish.
 9. *P. VERSICOLOR*.
9. Leaf blades thickish, entire to shallowly sinuate-dentate; corolla often without an eye, drying yellow; plant often suffruticose; leaf blades occasionally subcordate.
 10. *P. CRASSIFOLIA*.

1. **Physalis lobata** Torr., Ann. Lyc. N. Y. 2: 226. 1828.

Quincula lobata Raf., Atlant. Jour. 145. 1832.

Navajo, Maricopa, Pinal, and Pima Counties (probably elsewhere), 1,200 to 5,000 feet, plains and mesas, often at roadsides, March to October. Kansas to Texas, Arizona, and northern Mexico.

2. **Physalis wrightii** A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 63. 1874.

Navajo County to Cochise, Pima, and Yuma Counties, 100 to 4,000 feet, fields, along ditches, etc., June to September. Western Texas to southern California and northern Mexico.

A common weed in irrigated fields in southern Arizona. It is suspected that Arizona specimens which have been referred to *P. lanceifolia* Nees (see footnote 36, p. 790, Rydberg, p. 332) are in reality *P. wrightii* with small, late-season flowers. They resemble that species in all other characters. Some specimens of *P. wrightii* have both large and flat corollas and much smaller, more campanulate ones.

3. **Physalis fendleri** A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 66. 1874.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 3,200 to 7,500 feet, dry mesas and slopes, often on limestone and associated with juniper and pinyon, May to August. Colorado and Utah to Arizona, southeastern California, and northern Mexico.

4. **Physalis lanceolata** Michx., Fl. Bor. Amer. 1: 149. 1803.

White Mountains (Apache or Greenlee County) and mountains of Cochise and Pima Counties, 5,000 to 8,500 feet, August. Illinois to South Dakota, Arkansas, and eastern Arizona.

5. **Physalis pubescens** L., Sp. Pl. 183. 1753.

Santa Cruz and Pima Counties, 3,000 to 4,000 feet, mostly along streams in partial shade, August and September. Pennsylvania to Colorado, Florida, and Arizona, southward to Panama.

The Arizona form, with a relatively tall, stout, erect stem not branching from the base, probably is *P. neomexicana* Rydb., but is scarcely more than varietally distinct from *P. pubescens*.

6. **Physalis heterophylla** Nees, Linnaea 6: 463. 1831.

Navajo and Coconino Counties to Pima County, 4,000 to 7,000 feet, June to October. Canada to Florida and Arizona.

7. **Physalis hederifolia** A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 65. 1874.

Coconino and Mohave Counties to Cochise and Pima Counties, 3,000 to 5,000 feet, foothills and plains, April to July. Colorado and Utah to Texas, Arizona, southeastern California, and northern Mexico.

Plant with the aspect of *P. fendleri*, but very different in character of the pubescence.

8. **Physalis longifolia** Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 193. 1837.

Southern Navajo County and Cochise and Pima Counties, 2,300 to 5,000 feet, rare in Arizona, April to August. Iowa to Montana, south to Arkansas, Arizona, and northern Mexico.

9. *Physalis versicolor* Rydb., Torrey Bot. Club Bul. 22: 307. 1895.

Western Pima County, 2,000 to 4,000 feet, mesas and foothills, August and September. Southern Arizona and northern Mexico.

10. *Physalis crassifolia* Benth., Bot. Voy. Sulph. 40. 1844.

Canyons of the Colorado River in Coconino and Mohave Counties, to Pima and Yuma Counties, 3,000 feet or lower, dry rocky slopes, February to October. Southern Utah and Arizona to southeastern California and Baja California.

Arizona's only suffrutescent species and also the most xerophytic one. A form with subcordate leaf blades, var. *cardiophylla* Gray, is occasional in Arizona.

5. SARACHA ³⁷

A large perennial herb with a vertically elongate tuberous root; stems branching, sharply 4-angled; leaves long-petioled, the blades large, very thin, ovate, acuminate, cuneate at base, entire or nearly so; flowers in axillary umbels; corolla rotate, greenish; berry many-seeded, dark purple when mature.

1. *Saracha procumbens* (Cav.) Ruiz and Pavon, Fl. Peruv. Chil. 2: 43. 1799.

Atropa procumbens Cav., Icon. Pl. 1: 53. 1791.

Saracha sessilis Greene, Leaflets 2: 23. 1909.

Mountains of Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, shady canyons in rich soil, August to September, type of *S. sessilis* from the Chiricahua Mountains (*Blumer*). Southern Arizona to South America.

6. CAPSICUM. REDPEPPER

Plant more or less shrubby; stems widely branched; leaves slender-petioled, the blades thin, ovate or lance-ovate, acuminate, entire; peduncles long and slender, often in pairs, spreading or somewhat reflexed; calyx small, shallowly toothed or truncate; corolla rotate, deeply cleft, whitish; fruit short-ovoid or nearly globose, persistent.

1. *Capsicum baccatum* L., Mant. 1: 46. 1767.

Capsicum frutescens L. var. *baccatum* Irish, Mo. Bot. Gard. Ann. Rpt. 9: 97. 1898.

West slope of the Baboquivari Mountains, Pima County, about 4,000 feet, in a canyon (*Peebles* et al. 403, 610), probably elsewhere in southern Arizona, September. Florida to southern Texas, southern Arizona, and south to tropical America.

Birdpepper, chillipiquin. The very pungent berries are used as a condiment and medicinally as a local stimulant.

7. SOLANUM. NIGHTSHADE

Plants herbaceous or suffrutescent, sometimes prickly; leaves petioled, entire to bipinnatifid, the pairs often very unequal in size; flowers mostly lateral (extra-axillary), solitary or in cymes; corolla rotate or rotate-campanulate, 5-toothed to 5-parted; anthers opening by apical pores or short slits; seeds numerous, more or less flattened.

³⁷ Reference: MORTON, C. V. NOTES ON THE GENUS SARACHA. Biol. Soc. Wash. Proc. 51: 75-78. 1938.

A few of the species are troublesome weeds and the leaves and unripe fruits of several of them are reported to be poisonous, e. g., those of the black nightshade (*S. nigrum*), *S. triflorum*, *S. elaeagnifolium*, and *S. rostratum*. An alkaloid, solanin, is the active principle. However, the fruits of the cultivated "wonderberry," a form of *S. nigrum*, are used for making preserves and desserts.

Key to the species

1. Fruit closely invested by the accrescent calyx, this densely armed with long, straight, very sharp, straw-colored spines; stems and leaves similarly armed; plants annual; leaves pinnatifid or bipinnatifid (2).
 2. Herbage and corolla not glandular, copiously stellate-pubescent, often also puberulent; leaf segments broad, very obtuse; corolla yellow, 15 to 25 mm. in diameter..... 1. *S. ROSTRATUM*.
 2. Herbage and corolla glandular-puberulent, frequently also villous or hirsute with simple or forked, nonglandular hairs (3).
 3. Corolla violet; leaf segments broadly ovate or obovate, very obtuse.
 2. *S. HETERODOXUM*.
 3. Corolla yellow; leaf segments linear or lanceolate, acute or acutish; spines, when fresh, nearly black at base..... 3. *S. LUMHOLTZIANUM*.
1. Fruit not invested by the calyx, or loosely so (4).
 4. Herbage and calyx spiny, or if (exceptionally) unarmed, then densely and minutely whitish lepidote; corolla 20 to 30 mm. in diameter, purple, violet, or nearly white (5).
 5. Leaf blades pinnatifid or bipinnatifid; spines up to 20 mm. long, often stout; stems and leaves copiously villous, the pubescence more or less glandular; plant annual; calyx loosely investing the fruit.
 4. *S. SISYMBRIIFOLIUM*.
 5. Leaf blades oblong or lanceolate, entire to coarsely sinuate-dentate; spines not more than 5 mm. long, slender, sometimes wanting; stems and leaves densely and minutely whitish lepidote; plant perennial, with long, deep, creeping rootstocks; calyx not investing the fruit or very loosely investing it at base..... 5. *S. ELAEAGNIFOLIUM*.
 4. Herbage and calyx not spiny; pubescence never lepidote (6).
 6. Plants with nearly globose tubers and long slender stolons; leaves pinnate, with 5 or more leaflets, some of these often very small; herbage pilose, usually sparsely so, with flat, simple, flaccid hairs; corolla 12 to 18 mm. in diameter (7).
 7. Leaflets oval, ovate, or obovate; corolla angulately 5-toothed, normally violet..... 6. *S. FENDLERI*.
 7. Leaflets narrowly lanceolate to broadly oblong-lanceolate; corolla deeply 5-cleft, normally white; plant often very sparsely pubescent, or glabrate..... 7. *S. JAMESII*.
6. Plants not tuberiferous or stoloniferous (8).
 8. Corolla violet or lilac purple, rarely white, 20 to 30 mm. in diameter, angulately 5-lobed; peduncle shorter than the pedicels, the latter with a cupulate thickening at base; plant perennial, becoming somewhat woody at base, puberulent or soft-pilose, sometimes copiously glandular but usually without glandular hairs; leaf blades ovate to oblong-lanceolate, entire or undulate, occasionally somewhat auriculate at base..... 8. *S. XANTI*.
 8. Corolla white or whitish (sometimes tinged with purple), not more than 20 mm. in diameter, deeply 5-cleft; pedicels not cupulate at base or very obscurely so (9).
 9. Flowers solitary or geminate (exceptionally in 2's or 4's), on slender, strongly deflexed pedicels, without an evident peduncle; stems, leaves, and calyx pubescent with stiff more or less spreading hairs; seeds radially rugose; plant annual; leaf blades ovate to oblong-lanceolate, entire or slightly repand..... 9. *S. DEFLEXUM*.
 9. Flowers commonly in cymes (sometimes solitary), these borne on peduncles nearly as long as to longer than the pedicels; pubescence of more or less appressed, or of soft and viscid hairs; seeds not radially rugose (10).

10. Leaf blades deeply pinnatifid, with acute, triangular segments; plant annual, the pubescence appressed, almost scurfy; stems strongly decumbent or prostrate; cymes 1- to 3- (commonly 2-) flowered; corolla less than 10 mm. in diameter; berry green at maturity----- 10. *S. TRIFLORUM*.
10. Leaf blades entire to sinuate-dentate (11).
11. Plant perennial, often suffrutescens, sparsely to densely cinereous-puberulent or short-pilose, the hairs mostly appressed or subappressed; corolla 10 to 18 mm. in diameter; berry commonly black at maturity----- 11. *S. DOUGLASSII*.
11. Plant annual; corolla not more than 8 mm. in diameter (12).
12. Stems and leaves viscid-villous; berry yellow at maturity.----- 12. *S. VILLOSUM*.
12. Stems and leaves sparsely puberulent, strigose, or glabrate; berry black at maturity----- 13. *S. NIGRUM*.

1. ***Solanum rostratum*** Dunal, Solan. Syn. 234. 1813.

Androcera rostrata Rydb., Torrey Bot. Club Bul. 33: 150. 1906.

Apache County to Coconino County, south to Cochise and Pima Counties, 1,200 to 7,000 feet, common on plains and at roadsides in the northern part of the State, perhaps introduced from farther east, July and August. North Dakota and Wyoming to Arizona and Mexico.

Buffalo-bur. This species, believed to be the original host of the Colorado potato beetle, is considered a pest in range land.

2. ***Solanum heterodoxum*** Dunal, Hist. Solan. 235. 1813.

Kirkland, Yavapai County (*Peebles* et al. 7422), 4,000 feet, abundant at roadsides, October. Western Texas to Arizona and Mexico.

The form occurring in Arizona is var. *novomexicanum* Bartlett (*Androcera novomexicana* Woot. and Standl.), which is described as being more densely pubescent and more spiny, and as having a larger corolla and stamens, than in typical *S. heterodoxum*. It is stated that the spines are brownish yellow in the variety, olivaceous in the typical form.

3. ***Solanum lumholtzianum*** Bartlett, Amer. Acad. Arts and Sci. Proc. 44: 629. 1909.

Patagonia, Santa Cruz County (*Harrison* and *Fulton* 8185), near Arivaca, Pima County (*Kearney* and *Peebles* 13775), 3,200 to 4,000 feet, sandy soil at roadsides, August to October. Southern Arizona and northern Sonora.

The plants are about 0.6 m. (2 feet high), with long widespreading branches.

4. ***Solanum sisymbriifolium*** Lam., Tabl. Encyl. 2: 25. 1793.

Near the Boyce-Thompson Southwestern Arboretum, Superior, Pinal County (*McLellan*), perhaps not established. Adventive from tropical America.

The leaves resemble those of the watermelon.

5. ***Solanum elaeagnifolium*** Cav., Icon. Pl. 3: 22. 1794.

Navajo County to Cochise and Pima Counties, 1,000 to 5,500 feet, fields and roadsides, May to September. Kansas and Colorado to Arizona and California, south to tropical America.

White (or silver) horsenettle, bullnettle, trompillo. A troublesome weed in irrigated land, especially in the southern counties, difficult

and expensive to eradicate. The crushed berries are added to milk by the Pima Indians in making cheese. A protein-digesting enzyme, resembling papain, has been discovered recently in this plant.

6. *Solanum fendleri* A. Gray, Amer. Jour. Sci. ser. 2, 22: 285. 1856.

Mountains of Greenlee, Gila, Cochise, Santa Cruz, and Pima Counties, 6,000 to 8,500 feet, rich soil in open pine forests, July and August. New Mexico and Arizona.

7. *Solanum jamesii* Torr., Ann. Lye. N. Y. 2: 227. 1828.

Apache County to Coconino County, south to Cochise and Yavapai Counties, 5,300 to 8,600 feet, mostly in coniferous forests, July and August. Colorado and Utah to Texas and Arizona.

Wild-potato, a name applied also to *S. fendleri*. Both species are closely related to the cultivated potato and have similar, although much smaller tubers. The plants sometimes are found growing wild in the gardens of the Indians, who used them as food. The tubers are cooked by the Hopi with a saline clay, and are said to have been used by them also in making yeast.

8. *Solanum xanti* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 90. 1876.

Southern Navajo, southern Coconino, Yavapai, Gila, and eastern Maricopa Counties, 3,500 to 5,000 feet, rocky slopes, usually in chaparral, April to August. Arizona, California, and Baja California.

Purple nightshade. A showy plant when in flower. The copiously glandular form is var. *intermedium* Parish. *S. xanti* is very close to *S. umbelliferum* Esch., the latter being characterized by stellate pubescence. A specimen collected at Fort Apache, Arizona (*Palmer* 607), has some of the hairs forked, but otherwise resembles *S. xanti*.

9. *Solanum deflexum* Greenm., Amer. Acad. Arts and Sci. Proc. 32: 301. 1897.

Salpichroa wrightii A. Gray, Syn. Fl. 2¹: 231. 1878. Not *Solanum wrightii* Benth., 1861.

Cochise, Santa Cruz, and Pima Counties, 3,000 to 4,500 feet, not infrequent in sandy soil. August and September, type of *Salpichroa wrightii* collected "on the Sonoita" (*Wright* 1692). Southern Arizona to Central America.

The berries are milk white at maturity.

10. *Solanum triflorum* Nutt., Gen. Pl. 1: 128. 1818.

Apache County to Coconino County, south to Pinal and Yavapai Counties, 1,200 to 7,000 feet, roadsides, stream beds, July to September. Canada to Kansas, Arizona, and southern California.

The Hopi are reported to plant this species in hills with watermelons, believing that the growth of the latter is thus stimulated.

11. *Solanum douglasii* Dunal in DC., Prodr. 13¹: 48. 1852.

Solanum arizonicum Parish, Calif. Acad. Sci. Proc. ser. 3, 2: 165. 1901.

Gila and Yavapai Counties to Cochise, Santa Cruz, Pima, and Yuma Counties, also in the Grand Canyon, 1,500 to 6,000 feet, common on rocky slopes and in canyons, mostly in chaparral, March to October, type of *S. arizonicum* from Hot Springs, southern Yavapai

County (*Toumey* 397). Western New Mexico and Arizona to Oregon and southern California.

12. *Solanum villosum* Mill., Gard. Dict. ed. 8, no. 2. 1768.

Mogollon Escarpment, Coconino County (*Collom* 945), Paradise, Cochise County (*Blumer* 1768), Eloy, Pinal County, a weed in cotton fields (*Peebles* 13085), 1,400 to 6,800 feet, July to September. Sparingly adventive in the United States; introduced from Europe.

13. *Solanum nigrum* L., Sp. Pl. 186. 1753.

Solanum interius Rydb., Torrey Bot. Club Bul. 31: 641. 1904.

Coconino, Pinal, and Maricopa Counties, 1,000 to 6,000 feet, roadsides, not common, summer. Throughout the United States; probably introduced from Europe.

8. DATURA.³³ THORNAPPLE

Coarse, weedlike herbs with ill-scented herbage; stems stout, mostly erect, branched; leaves petioled, the blades large, ovate, repand to pinnately lobed; flowers large and showy, short-peduncled, solitary in the forks of the stem, fragrant; calyx cylindric or prismatic, 5-toothed; corolla funnelform, purple to nearly white; fruit a large, globose or ovoid, normally prickly capsule.

All parts of the plants are poisonous, containing various alkaloids, notably atropine (daturine). Children as well as horses, cattle, and sheep have been poisoned by *D. stramonium*, the common jimsonweed. The roots and other parts of *D. meteloides* are narcotic and are sometimes eaten by the Indians, even the children, to induce visions, a dangerous practice. One of the effects is dilation of the pupil of the eye, the effect being similar to that of belladonna. Contact with these plants is reported to cause dermatitis in susceptible persons.

Key to the species

1. Fruit erect, regularly dehiscent, 4-valved, ovoid; corolla not more than 10 cm. long, 5-toothed (2).
2. Spines of the fruit many, subequal, less than 10 mm. long, relatively slender, sometimes much reduced or wanting; leaf blades repand to coarsely sinuate-toothed; corolla 6 cm. long or longer, whitish or purple.
 1. *D. STRAMONIUM*.
2. Spines of the fruit relatively few, very unequal, the longer ones more than 10 mm. long, very stout; leaf blades usually pinnately lobed; corolla not more than 6 cm. long, purple..... 2. *D. QUERCIFOLIA*.
1. Fruit nodding, bursting irregularly, globose or nearly so; leaf blades repand to sinuate-dentate (3).
3. Corolla broadly funnel-shaped, 5-toothed, 15 to 20 cm. long; herbage canescent-puberulent; calyx 8 to 10 (rarely only 6) cm. long; fruit puberulent, not viscid, with slender spines usually less than 1 cm. long; seeds light brown when ripe..... 3. *D. METELOIDES*.
3. Corolla trumpet-shaped, 10-toothed, usually less than 15 cm. long; herbage green, sparsely puberulent; calyx seldom more than 6 cm. long; fruit viscid-pubescent, with relatively stout spines, the longer ones about 1 cm. long; seeds black when ripe..... 4. *D. DISCOLOR*.

1. *Datura stramonium* L., Sp. Pl. 179. 1753.

Datura tatula L., Sp. Pl. ed. 2, 256. 1762.

Tonto Creek, Gila County (*Kearney* and *Harrison* 8364), Paradise, Cochise County (*Blumer* 2267), 5,500 feet, October. Naturalized

³³ Reference: SAFFORD, W. E. SYNOPSIS OF THE GENUS DATURA. Wash. Acad. Sci. JOUR. 11: 173-189. 1921.

throughout the United States; from South America or the Eastern Hemisphere.

Jimsonweed. The form with herbage and flowers purplish (*D. tatula*) may also occur in Arizona.

2. ***Datura quercifolia*** H. B. K., Nov. Gen. et Sp. 3: 7. 1818.

Near Tombstone (Cochise County), Patagonia and Elgin (Santa Cruz County), 4,000 to 5,000 feet, October. Texas to southern Arizona and Mexico.

3. ***Datura meteloides*** DC., Prodr. 13¹: 544. 1852.

Navajo County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 1,000 to 6,500 feet, roadsides and along ditches May to October. Colorado to Texas, Arizona, southern California and Mexico.

Sacred datura. With its very large, trumpet-shaped, pale lavender flowers this plant is a conspicuous feature of the vegetation. It is used by the Indians for various medicinal purposes, the seeds, it is reported, being sometimes administered to prevent miscarriage.

4. ***Datura discolor*** Bernh., Neues Jour. Pharm. Trommsd. 26: 149. 1838.

Pinal, Maricopa, Cochise, Pima, and Yuma Counties, seldom above 2,000 feet, roadsides and waste ground, autumn. Southern Arizona, southeastern California, and Mexico.

9. NICOTIANA. TOBACCO

Plants herbaceous or (one species) arborescent; leaves sessile or petioled, the blades entire or sinuate-margined; inflorescence terminal, paniculate or racemelike; calyx 5-lobed; corolla tubular to salverform; capsule apically dehiscent, 2- or 4-valved; seeds small, very numerous.

The leaves of many of the species beside *N. tabacum* contain nicotine and were smoked by the Indians. *N. trigonophylla* is still used for this purpose, chiefly on ceremonial occasions. Animals usually avoid these plants, but cases of poisoning in cattle, horses, and sheep have been reported. Tree-tobacco (*N. glauca*) contains an alkaloid, anabasine, reported to be more efficacious than nicotine in killing certain species of aphid.

Key to the species

1. Plant shrubby or arborescent; herbage glabrous and very glaucous; corolla yellow, tubular-funnelform, 25 to 50 mm. long, densely pubescent externally, with a very short, erect limb; flowers diurnal; leaf margins entire or slightly undulate..... 1. *N. GLAUCA*.
1. Plants herbaceous, annual or (in *N. trigonophylla*) sometimes perennial and suffrutescent; herbage pubescent or puberulent, viscid, not at all glaucous; corolla white or greenish white, with a well-developed, more or less spreading limb (2).
2. Leaves mostly cordate- or auriculate-clasping, sessile or with short broad petioles; corolla rather copiously pubescent on the whole external surface, 15 to 25 mm. long; flowers diurnal..... 2. *N. TRIGONOPHYLLA*.
2. Leaves not cordate or auriculate at base; corolla glabrous or very sparsely pubescent externally with hairs mostly confined to the throat and limb; flowers vespertine (3).
3. Calyx lobes linear-lanceolate, very unequal, the longer ones in fruit equaling or longer than the calyx tube; stem leaves mostly sessile, the blades prevailinglly ovate or lance-ovate; corolla 10 to 18 mm. long.
3. *N. CLEVELANDI*.
3. Calyx lobes deltoid, nearly equal, all much shorter than the calyx tube; stem leaves mostly petioled, the blades prevailinglly linear-lanceolate to oblong-lanceolate; corolla 20 to 40 mm. long..... 4. *N. ATTENUATA*.

1. *Nicotiana glauca* Graham, Edinb. Phil. Jour. 1828: 174. 1828.

Greenlee, Gila, Maricopa, Pinal, Cochise, Pima, and Yuma Counties, common below 3,000 feet, flowering nearly throughout the year. Texas to southern California; naturalized from South America.

Tree-tobacco. Stems up to 4 m. (13 feet) high. A conspicuous plant in southern Arizona, along streams, ditches, and dry washes.

2. *Nicotiana trigonophylla* Dunal in DC., Prodr. 13¹: 562. 1852.

Nicotiana palmeri A. Gray, Syn. Fl. 2¹: 242. 1878.

Practically throughout the State, 6,000 feet or (usually) lower, very common along sandy washes, flowering the year around, type of *N. palmeri* from Williams River (*Palmer* 433). Western Texas to southern California and Mexico.

The plant is sometimes perennial in southwestern Arizona.

3. *Nicotiana clevelandi* A. Gray, Syn. Fl. ed. 2, 2¹: 242. 1886.

Fort Mohave (*Cooper* 415), and rather frequent in southern Yuma County, 500 feet or lower, sandy washes, March and April. Western Arizona, southern California, and Baja California.

4. *Nicotiana attenuata* Torr. ex S. Wats. in King, Geol. Expl. 40th Par. 5: 276. 1871.

Almost throughout the State, 1,000 to 7,000 feet, common along streams and washes, May to September. Utah to Texas, Arizona, and California.

10. PETUNIA

Plant annual, glandular-puberulent; stems prostrate and rooting at the nodes, diffusely branched, forming mats, leafy; leaves narrow, rather fleshy, seldom more than 1 cm. long; flowers solitary, lateral, 4 to 6 mm. long; corolla funnellform, slightly irregular, with a purple limb and a whitish tube.

1. *Petunia parviflora* Juss., Paris Mus. Hist. Nat. Ann. 2: 216. 1803.

Navajo County to Graham, Maricopa, Pima, and Yuma Counties, 1,000 to 5,000 feet, moist soil in beds of streams and muddy flats, April to September. Southern Florida to California, south to tropical America.

The Arizona plant is a humble relative of the showy cultivated petunias, which are derived from 2 South American species, *P. axillaris* and *P. violacea*, and from hybrids between them.

110. SCROPHULARIACEAE.³⁹ FIGWORT FAMILY

Plants annual or perennial, a few shrubby, in some genera partially parasitic; leaves opposite or alternate, simple, the blades entire to pinnately parted; flowers perfect, very irregular to nearly regular; calyx 4- or 5-toothed or -lobed; stamens inserted on the corolla tube, commonly 4, in unequal pairs, a fifth stamen (staminode) often present but nonfunctional, or sometimes only 2 of the stamens perfect, or (in 1 genus) all 5 of the stamens perfect; style 1, the stigma entire or 2-lobed, the ovary superior, more or less completely 2-celled; fruit a 2-valved capsule; seeds usually many.

³⁹ Reference: PENNELL, FRANCIS W. NEW SPECIES OF SCROPHULARIACEAE FROM ARIZONA. Notul. Nat. Acad. Nat. Sci. Phila. 43: 1-10. 1940.

A large and diverse family, comprising many plants that are cultivated as ornamentals. The plants are mostly innocuous, but the Old World foxglove (*Digitalis purpurea* L.), often grown in the United States as an ornamental, is the source of the drug digitalis, a powerful cardiac stimulant.

Key to the genera

1. Anther-bearing stamens 5; corolla nearly regular, rotate, yellow. 1. VERBASCUM.
1. Anther-bearing stamens 4 or 2 (rarely 5 in genus *Penstemon*); corolla usually distinctly irregular and bilabiate (2). 5. COROLLA TUBE MERELY GIBBOUS OR SACCCATE AT BASE. 2. LINARIA.
2. Corolla spurred, saccate, or gibbous on the lower side at base, mostly with a prominent palate in the throat; capsules not valvate, opening by pores near the apex, or bursting irregularly; leaves mostly alternate (3). 5. COROLLA TUBE MERELY GIBBOUS OR SACCCATE AT BASE. 4. ANTIRRHINUM.
3. Perfect stamens 2. 3. MOHAWDYA.
3. Perfect stamens 4 (4). 4. LEAF BLADES BROAD, TRIANGULAR-HASTATE, OR RENIFORM AND DEEPLY LOBED. 5. MAURANDYA.
4. Leaf blades broad, triangular-hastate, or reniform and deeply lobed. 5. COROLLA TUBE MERELY GIBBOUS OR SACCCATE AT BASE. 2. LINARIA.
5. Corolla tube merely gibbous or saccate at base. 4. ANTIRRHINUM.
2. Corolla not spurred or saccate at base, without a prominent palate, sometimes with ridges on the lower side of the throat; capsules opening by valves (6). 6. UPPER LIP OF THE STRONGLY BILABIATE COROLLA HELMET-SHAPED, KEELED, OR DEEPLY CONCAVE, ERECT; STAMENS 4 OR 2 (7).
6. Upper lip of the strongly bilabiate corolla helmet-shaped, keeled, or deeply concave, erect; stamens 4 or 2 (7). 7. ANTHERS EQUAL, PARALLEL, APPROXIMATE; STAMENS 4 (8).
7. Anther cells equal, parallel, approximate; stamens 4 (8). 8. LEAVES OPPOSITE; CALYX 4-TOOTHED, BECOMING BLADDERLIKE AND VEINY, COMPLETELY ENCLOSING THE FRUIT AND NOT FILLED BY IT. 23. RHINANTHUS.
8. Leaves mostly alternate or basal; calyx cleft on one or both sides, becoming distended, but not bladderlike or completely enclosing the fruit. 24. PEDICULARIS.
7. Anther cells unequal, separated, the outer one versatile, the inner one pendulous by its apex and mostly smaller, sometimes sterile or rudimentary; leaves alternate, commonly (at least the upper ones) more or less dissected (9). 9. CALYX MOSTLY SPATHELIKE, 1-LOBED (SOMETIMES APPEARING 2-LOBED WHEN THE OPPOSITE BRACT IS SIMILAR); FLORAL BRACTS AND CALYX NOT HIGHLY COLORED, SOMETIMES DULL PURPLE; STAMENS 4 OR 2. 21. CORDYLANTHUS.
9. Calyx mostly spathe-like, 1-lobed (sometimes appearing 2-lobed when the opposite bract is similar); floral bracts and calyx not highly colored, sometimes dull purple; stamens 4 or 2. 9. CALYX GAMOSEPALOUS, TUBULAR OR TUBULAR-CAMPANULATE; FLORAL BRACTS AND CALYX (AT LEAST THEIR TIPS) OFTEN BRIGHTLY COLORED; STAMENS 4 (10). 10. UPPER COROLLA LIP (GALEA) VERY MUCH LONGER THAN THE SMALL, 3-TOOTHED OR 3-KEELED LOWER LIP; CALYX TUBULAR, CLEFT ABOVE AND BELOW, THE LIPS USUALLY TOOTHED OR CLEFT; PLANTS MOSTLY PERENNIAL. 20. CASTILLEJA.
10. Upper corolla lip (galea) very much longer than the small, 3-toothed or 3-keeled lower lip; calyx tubular, cleft above and below, the lips usually toothed or cleft; plants mostly perennial. 10. UPPER COROLLA LIP NOT, OR NOT GREATLY, SURPASSING THE INFLATED, SACCCATE LOWER LIP; CALYX TUBULAR-CAMPANULATE, EQUALLY 4-CLEFT, OR CLEFT ON ONE OR BOTH SIDES AND THE LIPS CLEFT OR PARTED; PLANTS ANNUAL. 22. ORTHOCARPUS.
6. Upper lip of the corolla not helmet-shaped, keeled, or deeply concave (11). 11. STAMENS 5, OF THESE 4 ANTHERS BEARING AND THE FIFTH STERILE; LEAVES OPPOSITE; COROLLA MODERATELY TO STRONGLY BILABIATE (12). 12. PLANT A SMALL ANNUAL; COROLLA WITH THE MIDLOBE OF THE LOWER LIP DEEPLY CONCAVE AND ENCLOSING THE STAMENS; STERILE STAMEN REPRESENTED BY A MINUTE GLANDLIKE BODY NEAR THE BASE OF THE COROLLA TUBE. 6. COLLINSIA.
11. Stamens 5, of these 4 anther-bearing and the fifth sterile; leaves opposite; corolla moderately to strongly bilabiate (12). 12. PLANTS PERENNIAL; LOWER LIP OF THE COROLLA NOT WITH A CONCAVE LOBE ENCLOSING THE STAMENS (13).
12. Plant a small annual; corolla with the midlobe of the lower lip deeply concave and enclosing the stamens; sterile stamen represented by a minute glandlike body near the base of the corolla tube. 12. PLANTS PERENNIAL; LOWER LIP OF THE COROLLA NOT WITH A CONCAVE LOBE ENCLOSING THE STAMENS (13). 13. STERILE STAMEN REPRESENTED BY A SCALE, THIS PARTLY ADNATE TO THE UPPER SIDE OF THE COROLLA THROAT; COROLLA SOMEWHAT URCEOLATE, BROAD AND OPEN, WITH LITTLE DISTINCTION OF TUBE AND THROAT. 7. SCROPHULARIA.
12. Plants perennial; lower lip of the corolla not with a concave lobe enclosing the stamens (13). 13. STERILE STAMEN REPRESENTED BY A SCALE, THIS PARTLY ADNATE TO THE UPPER SIDE OF THE COROLLA THROAT; COROLLA SOMEWHAT URCEOLATE, BROAD AND OPEN, WITH LITTLE DISTINCTION OF TUBE AND THROAT. 7. SCROPHULARIA.

13. Sterile stamen an elongate, often bearded filament not or not much shorter than the anther-bearing filaments; corolla large, showy, often bearded in the throat..... 8. *PENSTEMON*.
11. Stamens 4 or fewer, without any rudiment of a fifth (14).
14. Anther-bearing stamens normally 2 (15).
15. Cells of the anthers separated by a relatively broad membranaceous connective; corolla whitish with a yellow tube; sterile stamens none or very rudimentary..... 11. *GRATIOLA*.
15. Cells of the anthers contiguous at apex and often confluent; corolla blue, purple, or whitish (16).
16. Stems leafy; leaves opposite, at least below the inflorescence; flowers in relatively loose racemes; corolla nearly regular, 4-lobed, rotate or nearly so; stamens not or not conspicuously exerted at anthesis..... 16. *VERONICA*.
16. Stems scapellike; cauline leaves alternate; flowers in very dense, cylindric, spikelike racemes; corolla very irregular, cleft nearly to the base; stamens and style conspicuously exerted at anthesis..... 17. *BESSEYA*.
14. Anther-bearing stamens 4 or (in genus *Mimetanthe*) exceptionally 2 (17).
17. Anthers 1-celled; calyx elongate, cylindric; corolla violet, with a long slender tube and scarcely any throat... 19. *BUCHNERA*.
17. Anthers 2-celled or (in genus *Limosella*) 1-celled by confluence (18).
18. Calyx prismatic, more or less tubular, 5-toothed and with 5 longitudinal ribs or plaits; corolla more or less distinctly bilabiate, often showy; stamens 4, all anther-bearing; stigma often much dilated..... 9. *MIMULUS*.
18. Calyx not prismatic (19).
19. Corolla yellow; herbage pubescent (20).
20. Plant annual; herbage viscid-villous; calyx nearly equaling the corolla, campanulate; corolla less than 1 cm. long. 14. *MIMETANTHE*.
20. Plant perennial; herbage hispidulous; calyx much shorter than the corolla, turbinate; corolla about 2 cm. long. 18. *GERARDIA*.
19. Corolla white or purple or, if yellow, then the herbage glabrous (21).
21. Anther cells confluent; corolla nearly regular, the tube campanulate; leaf blades entire..... 15. *LIMOSELLA*.
21. Anther cells distinct; corolla distinctly bilabiate, the tube cylindric; leaf blades not entire (22).
22. Divisions of the calyx unequal in width, the 3 outer ones much broader; herbage glabrous; anther cells of the 2 longer stamens divergent and stipitate. 13. *PAGESIA*.
22. Divisions of the calyx nearly equal in width, all narrow; herbage glandular-pubescent; anther cells of all of the stamens somewhat divergent and stipitate; limb of the corolla violet purple (23).
23. Leaf blades denticulate to serrate; stems seldom less than 25 cm. long..... 10. *STEMODIA*.
23. Leaf blades pinnately parted, with narrow divisions; stems not more than 15 cm. long... 12. *CONOBEA*.

1. *VERBASCUM*. MULLEIN

Plants herbaceous, biennial; stems tall, leafy; leaves sessile, clasping or decurrent at base; flowers in elongate spikes or spikelike racemes; corolla yellow, with 5 rounded slightly unequal lobes; filaments (some or all of them) bearded; style flattened at apex.

Coarse introduced weeds. The leaves and flowers of *V. thapsus* have been used medicinally. It is reported that the Hopi Indians dry and smoke them, mixed with *Macromeria thurberi*, in treatment of mental aberrations.

Key to the species

1. Herbage densely woolly-tomentose throughout, not glandular; leaves all with entire or obscurely crenate margins, those of the stem oblanceolate, decurrent at base; flowers in long, thick, very dense spikes. 1. *V. THAPSUS*.
1. Herbage loosely pilose, glandular in the inflorescence; lower leaves with dentate-serrate margins, those of the stem lanceolate, clasping at base; flowers in open, elongate, spikelike racemes----- 2. *V. VIRGATUM*.

1. *Verbascum thapsus* L., Sp. Pl. 177. 1753.

Flagstaff and Walnut Canyon (Coconino County), Prescott (Yavapai County), Chiricahua Mountains (Cochise County), 5,000 to 7,000 feet, waste ground and roadsides, summer. Widely distributed in North America; naturalized from Europe.

2. *Verbascum virgatum* Stokes in Withering, Bot. Arrang. Veg. Brit. ed. 2, 1: 227. 1787.

Flagstaff (Coconino County), Chiricahua and Mule Mountains (Cochise County), 6,000 to 7,000 feet, waste land, late summer and fall. Here and there in North America; adventive from Europe.

2. LINARIA. TOADFLAX

Plants herbaceous, glabrous or nearly so, flaxlike in habit and foliage; flowering stems erect, simple or few-branched, leafy; leaves sessile, narrow, entire; flowers in terminal racemes; corolla strongly bilabiate, with a long slender basal spur (this rarely obsolete), and a prominent palate in the throat; capsule opening near the apex by pores or chinks.

Key to the species

1. Plant perennial; racemes dense; corolla yellow with an orange-colored palate, 25 to 30 mm. long; seeds winged----- 1. *L. VULGARIS*.
1. Plant annual or biennial, with short sterile basal shoots; racemes slender, becoming elongate; corolla bright blue, not more than 10 mm. long; seeds wingless----- 2. *L. CANADENSIS*.

1. *Linaria vulgaris* Mill., Gard. Dict. ed. 8, no. 1. 1768.

Flagstaff, Coconino County (*Deaver* 909). Widely distributed in waste ground in North America; naturalized from Eurasia.

Common toadflax, often called butter-and-eggs.

2. *Linaria canadensis* (L.) Du Mont de Cours, Bot. Cult. 2: 96. 1802.

Antirrhinum canadense L., Sp. Pl. 618. 1753.

Graham, Gila, Maricopa, Pinal, Cochise, and Pima Counties, 1,300 to 5,200 feet, plains and mesas, February to May. Throughout most of North America; South Africa.

Represented in Arizona by var. *texana* (Scheele) Pennell (*L. texana* Scheele), a relatively large-flowered form.

3. MOHAVEA

Plants annual, viscid-villous; leaves alternate, petioled, the blades narrowly to broadly lanceolate, entire; flowers in leafy spikes or racemes; corolla pale or bright yellow, with a short tube and an ample limb, the lower lip with a relatively small palate, spotted with red or purple.

Key to the species

1. Corolla 25 to 35 mm. long, pale yellow, conspicuously marked with numerous, commonly linear, purple spots, the lower lip shallowly cleft (not nearly down to the palate); stems up to 30 cm. long ----- 1. *M. CONFERTIFLORA*.
1. Corolla 15 to 20 mm. long, bright yellow, rather inconspicuously marked with few, reddish-brown spots, the lower lip deeply cleft (nearly to the palate); stems not more than 15 cm. long ----- 2. *M. BREVIFLORA*.

1. **Mohavea confertiflora** (Benth.) Heller, Muhlenbergia 8: 48. 1912.

Antirrhinum confertiflorum Benth. in DC., Prodr. 10: 592. 1846.

Mohave and Yuma Counties, 2,000 feet or lower, locally abundant in sand and on stony talus-slopes, February to April. Nevada, western Arizona, southeastern California, and Baja California.

2. **Mohavea breviflora** Coville, Contrib. U. S. Natl. Herbarium 4: 168. 1893.

Northern Mohave County, near Beaver Dam (*Kearney and Peebles* 13225), and 20 miles south of Boulder Dam (*Kearney and Peebles* 11230), 1,800 feet or lower, dry sandy or stony slopes, April. Nevada, northwestern Arizona, and southeastern California.

4. ANTIRRHINUM.⁴⁰ SNAPDRAGON

Plants annual or biennial; stems erect or twining; leaves (at least the upper ones) alternate, the blades entire; flowers axillary, solitary or in leafy terminal racemes; corolla strongly bilabiate, with a prominent palate in the throat.

The popular garden snapdragon (*A. majus* L.) is a native of southern Europe.

Key to the species

- Stems climbing by the filiform, tendrillike peduncles, these commonly at least 3 cm. long; herbage villous or lanate at base of the stem, otherwise glabrous blades of the lower leaves oblong-ovate, of the upper ones narrowly lanceolate or linear; corolla bright yellow, conspicuously saccate at base; seeds very irregularly corky-tuberculate and winged ----- 1. *A. FILIPES*.
1. Stems not climbing, commonly erect; corolla not yellow (2).
 2. Herbage not viscid-pilose, glandular-puberulent in the inflorescence and sparsely lanate at base of the stem; leaf blades lanceolate or linear; corolla white with purple veins; capsule oblique; seeds somewhat winged. ----- 2. *A. KINGII*.
 2. Herbage copiously viscid-pilose throughout; leaf blades ovate (3).
 3. Flowers sessile or on pedicels shorter than the calyx; corolla rose purple and white (drying violet); capsule nearly globose, not oblique, somewhat didymous, rounded or depressed at apex; seeds 1 mm. or more in greatest diameter, with an elliptic or orbicular, deeply cup-shaped wing much larger than the body ----- 3. *A. CYATHIFERUM*.
 3. Flowers mostly on pedicels as long or longer than the calyx; corolla violet; capsule oblong-lanceolate or narrowly ovate in outline, very oblique, not at all didymous, attenuate at apex; seeds minute, much less than 1 mm. in greatest diameter, sharply ribbed and muricate; flowers variable in size ----- 4. *A. NUTTALLIANUM*.

1. **Antirrhinum filipes** A. Gray in Ives, Colo. Riv. Rpt. 19. 1860.

Pinal, Maricopa, Mohave, and Yuma Counties, 2,500 feet or lower, sandy plains and slopes, February and March, type from above Fort Mohave, Mohave County (*Newberry* in 1858). Southern Utah and western Arizona to southeastern California.

⁴⁰ Reference: MUNZ, PHILIP A. THE ANTIRRHINOIDEAE-ANTIRRHINEAE OF THE NEW WORLD. Calif. Acad. Sci. Proc. ser. 4, 15: 323-397. 1926.

- *2. *Antirrhinum kingii* S. Wats. in King, Geol. Expl. 40th Par. 5: 215. 1871.

This plant is not known definitely to occur in Arizona, but the var. *watsoni* (Vasey and Rose) Munz has been collected in northwestern Sonora.

3. *Antirrhinum cyathiferum* Benth., Bot. Voy. Sulph. 40. 1844.

Pinal and Yuma Counties, 1,700 feet or lower, usually on stony talus slopes, preferring partial shade, January to March. Southwestern Arizona, northwestern Sonora, and Baja California.

4. *Antirrhinum nuttallianum* Benth. in DC., Prodr. 10: 592. 1846.

Pinal and Pima Counties, 3,800 feet or lower, canyons, March and April. Southwestern Arizona, southern California, and Baja California.

A form with most of the flowers nearly sessile was collected by L. N. Goodding in the Baboquivari Mountains.

5. MAURANDYA

Perennial herbs of diverse habit; stems twining or procumbent; leaves alternate, petioled, the blades coarsely toothed or lobed; corolla bilabiate, with or without a palate; filaments pubescent, often bearing tack-shaped glands; capsule irregularly dehiscent near the apex.

Key to the species

1. Plant densely viscid-villous throughout; stems prostrate, matted, stout, very brittle; leaf blades cordate or reniform, wider than long, coarsely several-toothed; calyx lobes triangular-ovate; corolla pale yellow, with a narrow cylindrical tube scarcely expanded at apex, the throat open, without a palate.
 1. *M. ACERIFOLIA*.
1. Plant glabrous throughout; stems climbing by the tendrillike petioles and peduncles, slender, not brittle; leaf blades triangular-hastate, often also cordate; calyx lobes narrowly lanceolate; corolla violet purple or carmine (exceptionally white), with a short tube expanded into a wide, campanulate throat, the latter partly closed by a large hairy palate.
 2. *M. ANTIRRHINIFLORA*.

1. *Maurandya acerifolia* Pennell, Wash. Acad. Sci. Jour. 19: 69. 1929.

Eastern Maricopa County, side canyons along Salt River, about 2,000 feet, shaded rock ledges and cliffs, the stems often hanging, March to May, type from Fish Creek Canyon (*Peebles* et al. 5246). Known only from southern central Arizona.

2. *Maurandya antirrhiniflora* Humb. and Bonpl. in Willd., Hort. Berol. pl. 83. 1807.

Grand Canyon (Coconino County), and Mohave County to Cochise, Santa Cruz, Pima, and Yuma Counties, 1,500 to 6,000 feet, common on stony slopes usually among shrubs, April to October. Western Texas to southeastern California and southward.

The showy snapdragonlike flowers make this plant well worth cultivating. It is well suited to growing on trellises. There are 2 sharply distinct color forms, lilac or pale violet and rose red.

6. COLLINSIA ⁴¹

A small annual herb; stems decumbent or erect, widely branched; leaves opposite, the blades oblong to narrowly lanceolate or spatulate;

⁴¹ Reference: NEWSOM, VERA M. A REVISION OF THE GENUS COLLINSIA. Bot. Gaz. 87: 260-301. 1929.

flowers axillary, mostly in whorls, the lower flowers often solitary; corolla small, blue and white, deeply 2-lipped; filaments glabrous; capsule few-seeded.

1. *Collinsia parviflora* Dougl. ex Lindl., Edwards's Bot. Reg. 13: pl. 1082. 1827.

Gila and Yavapai Counties, 4,000 to 6,000 feet, moist soil along streams, February to May. Canada to New Mexico, Arizona, and California.

Miss Newsom doubtfully refers to this species a collection in the Chiricahua Mountains, Cochise County (*Lemmon* 3073) in which "the corolla-throat is open, the upper lip not at all reflexed, the tube slender and not gibbous, and the plant quite conspicuously glandular."

7. SCROPHULARIA. FIGWORT

Coarse perennial herbs; stems tall, erect or nearly so, leafy; leaves opposite, petioled, the blades ovate to lanceolate, serrate or lacinate; flowers numerous, small, in ample loose terminal panicles; corolla greenish or dull red, short and broad, short-lobed; capsule 2-valved; seeds many.

Key to the species

1. Leaf blades (at least the lower ones) prevailing triangular-ovate and cordate at base, coarsely and irregularly, often doubly, dentate or lacinate.

1. *S. CALIFORNICA*.

1. Leaf blades prevailing lanceolate to ovate-lanceolate, mostly truncate, cuneate, or subcordate at base, usually more evenly and shallowly serrate-dentate or crenate----- 2. *S. PARVIFLORA*.

1. *Scrophularia californica* Cham., *Linnaea* 2: 585. 1827.

Pinal Mountains, Gila County, about 4,000 feet (*Harrison* 2090), June. Central Arizona, Oregon, and California.

Although from far outside the main area of this species, the specimen cited closely resembles many from California and Oregon.

2. *Scrophularia parviflora* Woot. and Standl., *Contrib. U. S. Natl. Herbarium* 16: 173. 1913.

Scrophularia glabrata Davidson, *South. Calif. Acad. Sci. Bul.* 1: 26. 1902. Not of Aiton, 1789.

Scrophularia davidsonii Pennell, *Notul. Nat. Acad. Nat. Sci. Phila.* 43: 8. 1940.

Southern Coconino County and Hualpai Mountain (Mohave County), to Cochise and Pima Counties, 5,000 to 8,000 feet, common in rich soil in coniferous forests, July to October, type of *S. glabrata* from Metcalf, Greenlee County (*Davidson* in 1902). Western New Mexico and Arizona.

The stems reach a height of 1.2 m. (4 feet) or more. This species apparently intergrades, in Arizona, with *S. californica* Cham., which it resembles in its relatively lax inflorescence, but is more like *S. lanceolata* Pursh in the shape of the leaves. The type of *S. glabrata*, as compared with the type of *S. parviflora*, has the herbage more finely puberulent, the leaves thinner and more coarsely toothed, and the flowers smaller (barely 5 mm. long).

8. PENSTEMON. BEARDTONGUE

Contributed by DAVID D. KECK

Perennial herbs or shrubs; leaves opposite, the upper ones sessile; flowers showy, paniculate; calyx 5-parted; corolla tubular, usually somewhat ventricose, 2-lipped, the upper lip 2-lobed, the lower lip 3-cleft; fertile stamens 4, paired, with arching filaments; sterile filament (staminode) attached to the upper side of the corolla at the junction of the tube and the throat, extending downward and forward; anthers 2-celled, the cells often confluent; capsule septicial; seeds numerous, angled.

These plants mostly flower in spring or early summer and are often very showy. One may expect them in light, dry, neutral soils in eroded or mountainous regions throughout the State and at all elevations, although few species are found on the deserts. Some use has been made of them for ornamental plantings, which, on account of the wide range of growth habits and colors available, offer greater opportunities than have been realized thus far. Otherwise, the species are of insignificant economic importance, although many of them are browsed, especially the shrubby, evergreen *P. microphyllus*. The name of the genus is usually spelled *Pentstemon*.

Key to the species

1. Corolla scarlet, carmine, yellow, or (in *P. parryi*) rose magenta (2).
2. Corolla sulphur yellow, strongly bilabiate, 10 mm. wide; fertile filaments strongly pubescent at base; shrub up to 2 m. high; leaf blades less than 2 cm. long, usually elliptic; staminode densely long-bearded.
 1. *P. MICROPHYLLUS*.
2. Corolla scarlet to carmine, rarely orange or rose; fertile filaments glabrous (3).
3. Calyces and pedicels obviously glandular-pubescent; corolla strongly bilabiate (4).
 4. Leaves filiform, 1 mm. wide, crowded; anthers dehiscent throughout, explanate; plant woody below; corolla scarlet. 2. *P. PINIFOLIUS*.
 4. Leaves much wider, not crowded; anthers not explanate (5).
 5. Anther sacs broad, dehiscent from apex to base; leaves linear-attenuate; stems more or less densely puberulent below the inflorescence, entirely herbaceous; corolla orange to dull red.
 3. *P. LANCEOLATUS*.
 5. Anther sacs narrow, dehiscent across their contiguous apices for less than half their length, the lower portion saccate; leaves linear-ob lanceolate; stems glabrous below the inflorescence, often slightly woody near the base; corolla bright red.
 4. *P. BRIDGESII*.
3. Calyces and pedicels glabrous or puberulent, at most very obscurely glandular; plants strictly herbaceous (6).
 6. Corolla strongly bilabiate, the prominent lower lip reflexed, the upper lip projecting, scarlet; stems tall, virgate. 5. *P. BARBATUS*.
 6. Corolla obscurely bilabiate, the lips about equally erect or spreading (7).
 7. Anther sacs dehiscent only part way from the free tips, not explanate; corolla glabrous, scarlet; herbage not at all glaucous.
 6. *P. EATONI*.
 7. Anther sacs dehiscent throughout and explanate (8).
 8. Corolla glabrous throughout, narrowly tubular, the limb very narrow, scarlet; herbage green or glaucescent; cauline leaves linear-lanceolate. 7. *P. SUBULATUS*.
 8. Corolla glandular externally and internally, the limb broad and flaring; herbage glaucous (9).
 9. Glands on the corolla sessile; throat tubular; staminode glabrous (rarely obsoletely bearded); corolla carmine; cauline leaves lance-oblong; northern Arizona.
 8. *P. UTAHENSIS*.

9. Glands on the corolla stalked; throat somewhat ampliate; staminode bearded; southern Arizona (10).
10. Corolla 15 to 20 mm. long, rose magenta, rather broadly funnellform; cauline leaves narrowly lanceolate to lance-oblong, not blackening on drying.
9. *P. PARRYI*.
10. Corolla 20 to 25 mm. long, carmine to scarlet, narrowly funnellform; cauline leaves broadly ovate to oblong-ovate, large, blackening on drying. 10. *P. SUPERBUS*.
1. Corolla whitish, pink, lavender, blue, or blue purple (never scarlet, carmine, or yellow) or, if reddish, then the leaves toothed (11).
11. Leaves, at least a few of them, toothed, sometimes (in *P. jamesii*) very obscurely so; corolla glandular externally (12).
12. Blades obscurely denticulate, none perfoliate; plants not glaucous, less than 60 cm. high; calyx lobes lance-oblong to attenuate, 7 to 12 mm. long; inflorescence glandular-pubescent; corolla purple or blue purple (13).
13. Corolla villous but not glandular within, the lower lip projecting, exceeding the upper lip; staminode bearded only apically; anther sacs dehiscent throughout but not explanate through the connective.
11. *P. WHIPPLEANUS*.
13. Corolla glandular within, the lower lip reflexed, about equaling the upper lip; staminode bearded most of its length; anther sacs peltately explanate (14).
14. Leaves large, ovate, obviously toothed; corolla more than 35 mm. long, the throat abruptly much inflated, not villous within.
12. *P. COBAEA*.
14. Leaves smaller, linear-oblong, some of them obscurely toothed, usually many of them entire; corolla up to 22 mm. long, the inflated throat villous within. 13. *P. JAMESII*.
12. Blades conspicuously toothed, the uppermost leaves connate-perfoliate; plants glaucous or glaucescent (often green in one subspecies of *P. pseudospectabilis*), 60 to 140 cm. high; calyx lobes mostly ovate, 4 to 6 mm. long (15).
15. Corolla abruptly inflated from a tube not longer than the calyx, strongly bilabiate, 10 to 20 mm. wide, white tinged with pink; staminode long-bearded, exserted, uncinata. 14. *P. PALMERI*.
15. Corolla gradually inflated from a tube twice longer than the calyx, nearly regular, narrower, deep pink to rose purple; staminode included or barely exserted, straight (16).
16. Throat of the corolla definitely ventricose, 9 to 12 mm. wide; inflorescence usually leafy below, frequently interrupted by long internodes. 15. *P. CLUTEI*.
16. Throat of the corolla moderately ampliate, 6 to 9 mm. wide; inflorescence not leafy, rarely interrupted (17).
17. Staminode glabrous; throat not villous at the lower lip; anther sacs scarcely as long as wide. 16. *P. PSEUDOSPECTABILIS*.
17. Staminode bearded; throat sparsely villous at the lower lip; anther sacs longer than wide. 17. *P. BICOLOR*.
11. Leaves always entire (18).
18. Herbage blue glaucous or obviously glaucescent, glabrous; leaves coriaceous, lanceolate or wider; staminode bearded (19).
19. Corolla strongly bilabiate, lavender, the throat about 10 mm. wide, pilose at the orifice; inflorescence paniculate with long internodes, the divergent peduncles 1 to 3 cm. long. 18. *P. NUDIFLORUS*.
19. Corolla nearly regular, the throat 4 to 7 mm. wide; inflorescence an interrupted thyrse of verticillasters, the peduncles erect and very short, or suppressed (20).
20. Corolla nearly tubular, blue; verticillasters few-flowered and rather open, all very short-bracteate, the inflorescence appearing bare.
19. *P. FENDLERI*.
20. Corolla more or less ampliate; verticillasters dense, the lower ones prominently bracteate (21).
21. Staminode bearded most of its length with long fine pale-yellow hairs, not dilated; corolla deep blue purple, nearly glabrous at the orifice; calyx lobes acute, scarious-margined nearly throughout; cauline leaves mostly obtuse or rounded at apex.
20. *P. PACHYPHYLLUS*.

21. Staminode bearded only at and near the apex with relatively short coarse deep-yellow hairs, dilated apically (22).
22. Corolla pinkish lavender, glabrous throughout; calyx lobes acuminate, scarious-margined only at base; cauline leaves acuminate----- 21. *P. ANGUSTIFOLIUS*.
22. Corolla bright blue, slightly pilose at the orifice; calyx lobes acute to short-acuminate, scarious-margined nearly to the apex; cauline leaves obtuse or rounded, mucronate.
22. *P. LENTUS*.
18. Herbage green or, if pubescent, then often grayish (more or less glaucescent in *P. comarrhenus*); leaves mostly thin, relatively narrow (23).
23. Throat of the corolla 2-ridged within ventrally, the ridges densely hairy about the orifice; corolla relatively narrow (24).
24. Plants strongly caespitose, not more than 10 cm. high, cinereous-puberulent; leaves up to 2 cm. long, mucronate; corolla narrowly funnelliform, lavender purple (25).
25. Stems scarcely creeping; leaves cinereous-whitened with closely appressed hairs, oblanceolate, spatulate-oblong, or obovate; herbage of the inflorescence very obscurely viscid.
23. *P. THOMPSONIAE*.
25. Stems widely creeping; leaves greenish with spreading hairs, in Arizona linear-ob lanceolate to lance-obovate, smaller; herbage of the inflorescence more obviously viscid.
24. *P. CAESPITOSUS*.
24. Plants not caespitose, more than 10 cm. high, not cinereous; leaves (at least the basal ones) more than 2 cm. long, not mucronate (26).
26. Calyx and corolla glandular-puberulent, the latter pale blue, much paler on the strongly 2-ridged ventral portion, the lower lip exceeding the upper lip----- 25. *P. OLIGANTHUS*.
26. Calyx and corolla essentially glabrous, the latter moderately 2-ridged ventrally, the upper and lower lips subequal (27).
27. Leaves and calyx lobes prominently white-margined, thick; inflorescence conspicuously leafy; corolla pinkish, moderately ampliate; staminode glabrous--- 26. *P. ALBOMARGINATUS*.
27. Leaves not prominently white-margined, thin; calyx lobes more or less hyaline-margined; inflorescence scarcely leafy; corolla blue purple, tubular; staminode densely bearded (28).
28. Stems terminating rootstocks, arising from a basal rosette of leaves; verticillasters dense, the peduncles and pedicels obscure; calyx lobes oblong, caudate-tipped, rather prominently erose, 3.5 to 5.5 mm. long; corolla densely golden-bearded at the palate----- 27. *P. RYDBERGHII*.
28. Stems densely tufted from a subligneous caudex, leafy throughout but with no definite rosette at base; verticillasters looser, the peduncles and pedicels more obvious; calyx lobes ovate or obovate to rotund, very short-tipped, slightly erose, 2 to 3.5 mm. long; corolla lightly white-bearded at the palate----- 28. *P. WATSONI*.
23. Throat of the corolla rounded ventrally, lightly if at all hairy at the orifice (29).
29. Plants shrubby or decidedly suffrutescent (sometimes nearly herbaceous in *P. linarioides*); leaves crowded, narrowly linear, mucronate (30).
30. Staminode bearded; corolla viscid-puberulent externally, the limb moderately expanded (31).
31. Corolla 14 to 24 mm. long, blue purple; leaves 8 to 20 (or 30) mm. long, not fleshy, grayish or greenish on both faces.
29. *P. LINARIOIDES*.
31. Corolla 10 mm. long, white tinged with lavender; leaves 5 to 8 (or 10) mm. long, fleshy, white-puberulent on the flat upper face, deep green and glabrous on the rounded lower face.
30. *P. DISCOLOR*.
30. Staminode glabrous; corolla glabrous externally, the limb much expanded (32).
32. Corolla blue purple (rarely pinkish) throughout, funnelliform, 10 to 12 mm. long, the limb pubescent only at base of the lower lip, scarcely oblique, the throat not curved but ventricose; stamens exerted----- 31. *P. THURBERII*.

32. Corolla pink, salverform, 14 to 16 mm. long, the limb white within, densely puberulent on all sides at the orifice, set obliquely on the curved throat; stamens included.
32. *P. AMBIGUUS*.
29. Plants strictly herbaceous; leaves not crowded or mucronate; corolla large, funnellform, strongly bilabiate (33).
33. Inflorescence glandular-pubescent; leaves all linear-attenuate; anther sacs obviously spinose-dentate along the suture; staminode glabrous (34).
34. Herbage cinereous throughout; inflorescence densely glandular-pubescent, strict, racemose, the mostly 1-flowered peduncles erect; calyx lobes oblong or oblong-lanceolate, with entire, narrowly or obsoletely scarios margins; flowering mainly in spring ----- 33. *P. DASYPHYLLUS*.
34. Herbage glabrate; inflorescence very lightly glandular-puberulent, open, paniculate, the commonly 2- or 3-flowered peduncles divaricate; calyx lobes broadly ovate, with broad erose scarios margins; flowering in late summer.
34. *P. STENOPHYLLUS*.
33. Inflorescence not at all glandular; anther sacs microscopically denticulate or glabrous along the suture (35).
35. Anther sacs glabrous or finely scabrid on the sides; inflorescence strict, secund (36).
35. Sacs of the anthers opening throughout, straight, opposite; staminode glabrous (except in the subspecies); lower lip bearded; leaves mostly linear in the Arizona plants (except in the subspecies) ----- 35. *P. VIRGATUS*.
35. Sacs of the anthers opening partially, curved, divaricate; staminode bearded; lower lip glabrous; leaves lanceolate.
36. *P. LAEVIS*.
35. Anther sacs villous on the sides (37).
37. Corolla pale blue, the tube nearly as long as the throat; lower peduncles divergent, bearing elongate pedicels; anthers usually nearly hidden by hairs. --- 37. *P. COMARBHENUS*.
37. Corolla deep blue, the tube much shorter than the throat; peduncles and pedicels appressed and short, the strict panicle secund; anthers less densely villous.
38. *P. STRICTUS*.

1. **Penstemon microphyllus** A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 119. 1857.

Penstemon plummerae Abrams, Torrey Bot. Club Bul. 33: 445. 1906.

Gila and northern Pinal Counties to Mohave County, 1,800 to 5,000 feet, desert mountain ranges, often with junipers, April and May, type from Williams River (*Bigelow* in 1853-4), type of *P. plummerae* from Mineral Park, Mohave County (*Lemmon* in 1884). Southern and western Arizona, southern California, and northern Baja California.

2. **Penstemon pinifolius** Greene, Bot. Gaz. 6: 218. 1881.

Known in Arizona only from the Clifton area (Greenlee County) and the Chiricahua and Swisshelm Mountains (Cochise County), rocky summits above 5,000 feet, summer, type from near Clifton (*Greene* in 1880). Southwestern New Mexico, southeastern Arizona, and adjacent Mexico.

3. **Penstemon lanceolatus** Benth., Pl. Hartw. 22. 1839.

Mountains of Greenlee, Graham, and Cochise Counties, 5,000 to 6,000 feet, occasional, usually in rocky canyons, May and June. Southwestern New Mexico, southeastern Arizona, and northern Mexico.

4. **Penstemon bridgesii** A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 379. 1868.

Kaibab Plateau (Coconino County), south to the Sierra Ancha (Gila County), westward to Mohave and Yavapai Counties, 4,500 to 7,500 feet, occasional in the mountains among pinyons and yellow pine, May to September. Southwestern Colorado and western New Mexico to California.

5. **Penstemon barbatus** (Cav.) Roth, Cat. Bot. 3: 49. 1806.

Chelone barbata Cav., Icon. Pl. 3: 22. 1794.

Penstemon barbatus var. *puberulus* A. Gray in Torr., U. S. and Mex. Bound. Bot. 114. 1859.

Kaibab Plateau (Coconino County), southward to the Mexican border, 4,000 to 10,000 feet, common in the mountains in coniferous or in oak woods, June to September. Southern Colorado and Utah to the central highlands of Mexico.

The typical form, which is the prevalent one in Arizona, has the lower lip of the corolla bearded. The form with a glabrous lower lip, subsp. *torreyi* (Benth.) Keck (*P. torreyi* Benth.), is much less frequent than in Colorado and New Mexico. In northern Apache County one occasionally finds subsp. *trichander* (A. Gray) Keck (*P. barbatus* var. *trichander* A. Gray, *P. trichander* Rydb.), which differs only in having villous anthers. The species as a whole is variable as to the presence or absence of puberulence on the herbage, all gradations being found at random. Therefore var. *puberulus* A. Gray, founded on a collection from Guadalupe Canyon, Cochise County (*Thurber* in 1851), is not retained.

6. **Penstemon eatoni** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 395. 1872.

Northern Arizona southward to Gila and northern Pinal Counties, 2,000 to 7,000 feet, common on mesas, in fields, and at roadsides, sandy or clay soils, March to June. Southwestern Colorado to central Arizona and California.

Typical *P. eatoni*, glabrous throughout, is present only in the northernmost tier of counties but is abundant in Utah. The 2 more abundant forms in Arizona are marked by puberulent stems and leaves. One of these, subsp. *undosus* (M. E. Jones) Keck (*P. eatoni* var. *undosus* M. E. Jones, *P. coccinatus* Rydb., type from the Grand Canyon, *MacDougal* 173), in which the stamens are included within the corolla or barely exerted, is frequent in southern Utah and northern Arizona, occasional in Gila and Pinal Counties. Southward, particularly in Gila and Pinal Counties, the prevailing form is subsp. *exsertus* (A. Nels.) Keck (*P. exsertus* A. Nels., type from along Salt River, *Nelson* 10624, *P. amplius* A. Nels., type from Oak Creek Canyon, near Sedona, *A. and R. Nelson* 2075), in which the stamens are long-exserted. A hybrid between *P. eatoni* subsp. *exsertus* and *P. palmeri* subsp. *typicus*, collected in Oak Creek Canyon, near Sedona (*A. and R. Nelson* 2076), has been named *P. mirus* A. Nels.

7. **Penstemon subulatus** M. E. Jones, Contrib. West. Bot. 12: 63. 1908.

Central Mohave County and Yavapai County to Graham, Pinal, and Maricopa Counties, 1,700 to 4,500 feet, stony hillsides, canyons,

and mesas, nowhere abundant, March to May, type from Hackberry, Mohave County (*Jones* in 1903). Known only from central Arizona.

This is the Arizona counterpart of the well-known scarlet-bugler (*P. centranthifolius* Benth.) of coastal California. It has the most slender corolla tube of all scarlet penstemons excepting the very distinct and shrubby *P. pinifolius*.

8. *Penstemon utahensis* Eastw., *Zoe* 4: 124. 1893.

Navajo, Coconino, and Mohave Counties, 4,000 to 6,500 feet, uncommon, canyons and mesas, March to May. Southern Utah and northern Arizona to eastern California.

9. *Penstemon parryi* A. Gray, *Syn. Fl.* 2¹: 264. 1878.

Penstemon puniceus A. Gray var. *parryi* A. Gray in Torr., U. S. and Mex. Bound. Bot. 113. 1859.

Penstemon shantzii A. Nels., *Amer. Jour. Bot.* 23: 270. 1936.

Penstemon shantzii var. *incognitus* A. Nels., *ibid.* 25: 116. 1938.

Pinal, Cochise, Santa Cruz, and Pima Counties, 1,500 to 5,000 feet, mountain canyons and well-drained slopes, spring, type from the Gila River (*Parry* in 1852). Southern Arizona and Sonora.

In favorable situations and seasons this plant produces from the base many erect stems up to 4 feet in length, bearing very showy flowers. The species is not uncommon, but the individuals are usually well scattered.

10. *Penstemon superbus* A. Nels., *Biol. Soc. Wash. Proc.* 17: 100. 1904.

Penstemon puniceus A. Gray in Torr., U. S. and Mex. Bound. Bot. 113. 1859. Not *Lilja*, 1843.

Greenlee, Graham, and Cochise Counties, 4,000 to 5,200 feet, uncommon, rocky canyons and along washes, sandy or gravelly soils, April to May. New Mexico, southeastern Arizona, and Chihuahua.

In habit very similar to *P. parryi*, with which it apparently intergrades.

11. *Penstemon whippleanus* A. Gray, *Amer. Acad. Arts and Sci. Proc.* 6: 73. 1862.

Penstemon arizonicus Heller, *Torrey Bot. Club Bul.* 26: 591. 1899.

Penstemon stenosepalus (A. Gray) Howell, *Fl. Northw. Amer.* 1: 514. 1901.

Penstemon metcalfei Woot. and Standl., *Torrey* 9: 145. 1909.

San Francisco Peaks (Coconino County), 10,400 to 11,500 feet, July and August, type of *P. arizonicus* from the crater of the San Francisco Peaks (*MacDougal* in 1898). Idaho to New Mexico and northern Arizona.

The flower color of Arizona specimens is of the purple phase rather than lemon yellow or whitish, as it is occasionally elsewhere within the range of the species.

12. **Penstemon cobaea** Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 182. 1837.

Penstemon hansonii A. Nels., Wyo. Univ. Pubs. Bot. 1: 129. 1926.

Flagstaff (Coconino County), apparently escaped from cultivation or introduced (*Hanson* 709, the type of *P. hansonii*). Southeastern Nebraska to southern Texas.

A showy plant, known in Texas as "foxglove," a name properly applied to the Old World *Digitalis purpurea*.

13. **Penstemon jamesii** Benth. in DC., Prodr. 10: 325. 1846.

Apache County to Mohave and Yavapai Counties, 4,500 to 7,000 feet, frequent in sandy soils, in the pinyon-juniper and yellow-pine associations, May and June. Southwestern Colorado, southern Utah, western New Mexico, and northern Arizona.

Typical *P. jamesii* occurs east of the Continental Divide, in New Mexico and western Texas. The staminode in this species is conspicuously bearded and exerted. The Arizona form is subsp. *ophianthus* (Pennell) Keck (*P. ophianthus* Pennell, *P. pilosigulatus* A. Nels., type of the latter from Flagstaff, *Hanson* 554). The corolla is lavender, veined with darker purple. Subsp. *breviculus* Keck, of northwestern New Mexico and adjacent Colorado, may be looked for in the northeastern corner of the State. It lacks glandular pubescence within the corolla, which is only 14 to 16 mm. long and scarcely inflated.

Penstemon pulchellus Lindl. is to be expected in Cochise County, being found in southwestern New Mexico. It has thin, finely serrate, lanceolate, nonperfoliate, essentially glabrous leaves, and abruptly much inflated, showy corollas.

14. **Penstemon palmeri** A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 379. 1868.

Coconino, Mohave, and Yavapai Counties, 3,500 to 6,500 feet, frequent in washes and at roadsides in the sagebrush and pinyon regions, May and June, type from Skull Valley, Yavapai County (*Coues* and *Palmer* 228). Utah and Arizona to California.

This is one of the handsomest species of *Penstemon* and is additionally notable for its delicate fragrance. The common form is subsp. *typicus* Keck, with calyces, pedicels, and peduncles glandular-pubescent; but in northernmost Mohave and Coconino Counties and adjacent Utah is found the subsp. *eglandulosus* Keck, in which these parts are glabrous (pl. 28).

Penstemon petiolatus T. S. Brandeg. is to be looked for in the northwestern corner of the State. It is a rare plant of the Beaver Dam Mountains, Washington County, Utah, and of southern Nevada, of low, shrubby habit (10 to 20 cm. high), and with dentate pruinose-puberulent leaves only 10 to 25 mm. long.

15. **Penstemon clutei** A. Nels., Amer. Bot. 33: 109. 1927.

Coconino County, about 7,000 feet, very local in the region about Sunset Crater, northeast of Flagstaff, in volcanic cinders, June and July, type collected by W. N. Clute in 1923. Known only from Arizona.

16. **Penstemon pseudospectabilis** M. E. Jones, Contrib. West. Bot. 12: 66. 1908.

Southern Coconino and Mohave Counties, southward and eastward to Cochise, Pima, and Yuma Counties, 2,000 to 6,500 feet, open land,



Palmer penstemon (*Penstemon palmeri*). Near Mingus Mountain, Yavapai County, altitude 5,600 feet. One of the handsomest of Arizona penstemons, with pale pink flowers.

spring and summer, type from near Chemehuevi, Mohave County (Jones in 1903). Southwestern New Mexico to eastern California.

A common and beautiful species, separable into western and eastern subspecies on the presence or absence of glands on the calyces and pedicels. In Mohave, Yuma, and western Pima Counties, and in California, is found subsp. *typicus* Keck, with the glands and with glaucous herbage. To the eastward grows the much more abundant, greener, and eglandular subsp. *connatifolius* (A. Nels.) Keck (*P. connatifolius* A. Nels., *P. spectabilis* Woot. and Standl., not of Thurb.). The type of the latter subspecies was collected on the Apache Trail, Gila or Maricopa County (A. Nelson 10314). A beautiful form, apparently a first generation hybrid between subsp. *connatifolius* and *P. eatoni* subsp. *exsertus*, collected near Superior (A. Nelson 11262), has received the name *P. crideri* A. Nels.

17. *Penstemon bicolor* (T. S. Brandeg.) Clokey and Keck, South. Calif. Acad. Sci. Bul. 38: 12. 1939.

Penstemon palmeri var. *bicolor* T. S. Brandeg., Univ. Calif. Pubs. Bot. 6: 360. 1916.

Portland Mine to Chloride, Mohave County, 2,400 feet (Kearney and Peebles 13163), spring, very rare. Southern Nevada and northwestern Arizona.

The Arizona form is subsp. *roseus* Clokey and Keck. The typical form of the species has essentially white flowers and has been found only in Clark County, Nevada. The species as a whole is found associated with the creosotebush on outwash fans and plains.

18. *Penstemon nudiflorus* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 306. 1885.

Coconino, Mohave, and Yavapai Counties, mountainous regions south of the Grand Canyon, 4,700 to 7,000 feet, dry slopes in yellow pine forests, uncommon, summer, type from near Flagstaff (Lemmon in 1884). Known only from north-central Arizona.

19. *Penstemon fendleri* Torr. and Gray, U. S. Rpt. Expl. Miss. Pacif. 2^d: 168. 1855.

Cochise County, 4,000 to 5,000 feet, not common, April to June. Oklahoma and Texas to southeastern Arizona and Chihuahua.

20. *Penstemon pachyphyllus* A. Gray ex Rydb., Fl. Rocky Mount. 770, 1066. 1917.

Coconino and Mohave Counties, from the Kaibab Plateau south to Williams, 5,000 to 7,000 feet, dry slopes among yellow pine, pinyon, or juniper, May and June. Utah, Nevada, and northern Arizona.

The species is represented in Arizona by subsp. *congestus* (M. E. Jones) Keck (*P. congestus* Pennell). Typical *P. pachyphyllus*, from the Uintah Basin, northern Utah, differs from this subspecies in having a very broad flaring corolla limb. In subsp. *congestus* there is variation in the amount of pubescence on the orifice, in the color of the beard on the staminode, and in the size of the calyx lobes.

21. *Penstemon angustifolius* Nutt. ex Pursh, Fl. Amer. Sept. 738. 1814.

Apache, Navajo, and Coconino Counties, 5,000 to 6,500 feet, mesas and sandy grasslands, frequently on dunes, May and June. North

Dakota and eastern Montana to Kansas, New Mexico, and northern Arizona.

The Arizona form is subsp. *venosus* Keck, type from 12 miles north-east of Tuba, Coconino County (*Peebles* and *Fulton* 11877), found also in southern Utah and northwestern New Mexico. This is the westernmost representative of the variable *P. angustifolius*, which, in typical form, grows on the high plains east of the Continental Divide. This is replaced in southeastern Colorado, Kansas, and northern New Mexico by subsp. *caudatus* (Heller) Keck (*P. caudatus* Heller), which intergrades completely with typical *P. angustifolius*. The Arizona form, subsp. *venosus*, is closely related to subsp. *caudatus* but is distinguished by pinkish-lavender instead of blue flowers, herbage not darkening appreciably in drying, and bracts of the inflorescence more prominently venose on both sides. The Hopi Indians are reputed to make a medicine of the roots and call the plant "tei-eq-pi," meaning snake plant.

22. *Penstemon lentus* Pennell, Contrib. U. S. Natl. Herbarium 20: 359. 1920.

Apache County, in the Lukachukai Mountains (*Goodman* and *Payson* 2882) and at Fort Defiance (*E. Palmer* 100), 6,000 to 8,700 feet, very rare, dry hills and mesas, usually in sandy soil, June. Southwestern Colorado, southeastern Utah, and northeastern Arizona.

23. *Penstemon thompsoniae* (A. Gray) Rydb., Torrey Bot. Club Bul. 36: 690. 1909.

Penstemon pumilus Nutt. var. *thompsoniae* A. Gray, Syn. Fl. 2¹: 269. 1878.

Kaibab Plateau and southward (Navajo, Coconino, Mohave, and Yavapai Counties), 4,800 to 7,000 feet, light soils with pinyon and juniper, May to June. Southern Utah, southeastern Nevada, and northern Arizona.

24. *Penstemon caespitosus* Nutt. ex. A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 66. 1862.

Painted Desert and Grand Canyon regions (Navajo and Coconino Counties), 4,500 to 7,000 feet, sometimes on limestone soils, June to August. Wyoming, Colorado, Utah, and northern Arizona.

This variable species, which comprises some of the smallest known plants in the genus, is represented in Arizona by subsp. *desertipicti* (A. Nels.) Keck (*P. desertipicti* A. Nels., type from near Cameron, Coconino County, *Hanson* A177).

25. *Penstemon oliganthus* Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 172. 1913.

White Mountains (Apache County), 8,000 to 9,000 feet, loamy soil, July and August. Colorado, New Mexico, and eastern Arizona.

A low herb with few stems arising from small rosettes, the flowers often somewhat declined.

26. *Penstemon albomarginatus* M. E. Jones, Contrib. West. Bot. 12: 61. 1908.

Near Yucca (Mohave County), 1,500 to 1,800 feet, rare, April and May. Southern Nevada, western Arizona, and eastern California.

This singular species grows in drifting sand, into which many stems penetrate to connect with the long fleshy root.

27. *Penstemon rydbergii* A. Nels., Torrey Bot. Club Bul. 25: 281. 1898.

North rim of the Grand Canyon, Coconino County (*Purchase* 2902), moist soil, very rare, July, also in the Tunitcha Mountains, San Juan County, New Mexico, so probably in the same range in Apache County, Arizona. Southern Wyoming, Colorado, New Mexico, and northern Arizona.

The calyx in Arizona specimens is not glabrous as in the typical form but puberulent as in *P. aggregatus* Pennell, a common plant in Utah. The calyx lobes are likewise more like those of *P. aggregatus*, but otherwise the Arizona collection must be referred to *P. rydbergii*. The Arizona locality is distant from the main area of either species.

28. *Penstemon watsoni* A. Gray, Syn. Fl. 2¹: 267. 1878.

Mokiak Pass, northern Mohave County (*E. Palmer* 377), rare in Arizona. Common in the sagebrush and pinyon belts of Colorado, Utah, and Nevada.

The plant is herbaceous throughout, with several moderately tall stems arising directly from a crownlike base without forming a basal rosette. The sepals are remarkably small, seldom exceeding 3 mm. in length.

29. *Penstemon linarioides* A. Gray in Torr., U. S. and Mex. Bound. Bot. 112. 1859.

Apache County to Mohave County, south to Cochise, Gila, and Yavapai Counties, 5,000 to 9,000 feet, often on calcareous soil, June to August. Colorado, Utah, New Mexico, and Arizona.

Key to the subspecies and variety

1. Leaves principally oblanceolate----- subsp. *MAGUIREI*.
1. Leaves essentially linear (2).
2. Leaves glabrous----- *VAR. VIRIDIS*.
2. Leaves densely puberulent (3).
3. Hairs of the leaf fine, erect or retrorsely spreading----- subsp. *SILERI*.
3. Hairs of the leaf flattened, closely appressed (4).
4. Staminode sparsely bearded apically----- subsp. *COLORADOENSIS*.
4. Staminode more densely bearded, with longer hairs, for most of its length (5).
5. Stems ascending from a decumbent rootstock; leaves closely overlapping, heathlike, mostly 1 cm. long.- subsp. *COMPACTIFOLIUS*.
5. Stems strictly erect from a compact caudex; leaves more remote, longer----- subsp. *TYPICUS*.

Arizona is the center of greatest diversity in this variable species, which comprises many subspecies that are both geographically and morphologically separable, but intergrade at their points of contact. Subsp. *typicus* Keck is found from Apache and Navajo Counties southward to Cochise County and east to New Mexico. Subsp. *maguirei* Keck is local in the Gila River Valley (Greenlee County) and in adjacent New Mexico. Subsp. *compactifolius* Keck is locally common in the Flagstaff region. Subsp. *coloradoensis* (A. Nels.) Keck grows at high elevations in the northeastern corner of the State, at Marsh Pass, Navajo County (*Harvey* in 1937) and in the

Lukachukai Mountains, Apache County (*Goodman and Payson* 2848), but is much more abundant in adjacent New Mexico and Colorado. Subsp. *sileri* (A. Gray) Keck is common from the Kaibab Plateau region (Coconino and Mohave Counties) to Yavapai County, and is occasional southeastward to Cochise County, also common in southern Utah. The var. *viridis* Keck is less frequent than subsp. *sileri*, but occupies the same range as far south as Gila County.

30. *Penstemon discolor* Keck, Torrey Bot. Club Bul. 64: 379. 1937.

Known only from the type locality, Bear Canyon, Santa Catalina Mountains (Pima County), 6,100 to 7,000 feet, June and July, the type collected by Forrest Shreve (No. 5319).

31. *Penstemon thurberi* Torr., U. S. Rpt. Expl. Miss. Pacif. 7³: 15. 1856.

Leiostemon thurberi Greene, Leaflets 1: 223. 1906.

Penstemon scoparius A. Nels., Wyo. Univ. Pubs. Bot. 1: 132. 1926.

Mohave and Yavapai Counties, southeastward to Pima and Cochise Counties, 2,000 to 4,000 feet, open sandy or stony slopes, March to June, type of *P. scoparius* from West Wells (*Goodding* 1037). New Mexico, Arizona, California, and Baja California.

This species is ordinarily distinctly set off from the next, but there is some evidence of their mixing in west-central New Mexico.

32. *Penstemon ambiguus* Torr., Ann. Lyc. N. Y. 2: 228. 1828.

Navajo and Coconino Counties, 4,500 to 6,500 feet, open sandy mesas and grassland, rather common in the Painted Desert, summer. Kansas and Texas to Nevada and northern Arizona.

The typical form of the species, with puberulent herbage, occurs farther east. The glabrous Arizona form, subsp. *laevissimus* Keck, ranges from southwestern Texas to Utah and Nevada. In the Hopi country it has been called "cow-tobacco."

33. *Penstemon dasyphyllus* A. Gray in Torr., U. S. and Mex. Bound. Bot. 112. 1859.

Cochise, Santa Cruz, and Pima Counties, 3,600 to 5,000 feet, open gravelly slopes, April and May and again in late summer. Western Texas to southeastern Arizona and Chihuahua.

34. *Penstemon stenophyllus* A. Gray in Torr., U. S. and Mex. Bound. Bot. 112. 1859.

Penstemon rubescens A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 92. 1883.

Huachuca and Patagonia Mountains (Cochise and Santa Cruz Counties), 4,000 to 5,500 feet, open canyons and slopes, August and September. Southeastern Arizona, Sonora, and Chihuahua.

The type of the species came from Sonora. The type of *P. rubescens* came from near Fort Huachuca, Cochise County (*Lemmon*) and was blue-flowered, although Gray mistook the color for red. The flowers of this and the preceding species are a rich violet blue when fresh.

35. *Penstemon virgatus* A. Gray in Torr., U. S. and Mex. Bound. Bot. 113. 1859.

Penstemon putus A. Nels., Wyo. Univ. Pubs. Bot. 1: 131. 1926.

Navajo, Coconino, Yavapai, Graham, and Gila Counties, 5,000 to 11,000 feet, pine woodlands and mountain meadows, summer. New Mexico and Arizona.

The corolla is marked with deep-purple guide lines within the throat and is usually pale violet; but throughout the range of the species occasional plants are found with white flowers. This color variation was the basis of *P. putus*, type from Black River, White Mountains (Goodding 1100). *P. virgatus* is a highly variable species as to leaf width, shape of the calyx lobes, presence or absence of puberulence, and size of the corolla, but only one geographic variant is significant, namely, *P. virgatus* subsp. *arizonicus* (A. Gray) Keck (*P. hallii* var. *arizonicus* A. Gray). This form occurs in the White and Pinaleno Mountains, 9,000 to 10,000 feet, and differs from the species in having the staminode bearded, the leaves somewhat broader and oblong-spatulate instead of merely linear-lanceolate, and the calyx lobes broadly scarious-margined and crose. Intergrades occur between this form and the species.

36. *Penstemon laevis Pennell, Contrib. U. S. Natl. Herbarium 20: 347. 1920.

Not rare just over the State line in Utah, e. g., in Kanab Canyon, and likely to be found in Coconino and Mohave Counties, May and June.

This species has blue-purple flowers marked with guide lines as in *P. virgatus*, but its thyrus is somewhat broader and more compact.

Penstemon leiophyllus Pennell, very closely related to *P. laevis* but distinguished by a finely glandular-puberulent inflorescence and a usually glabrous staminode, may also be expected in Mohave and Coconino Counties, having been found in Utah within 10 miles of the Arizona State line.

37. *Penstemon comarrhenus* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 81. 1876.

Betatakin Canyon, Navajo County (*Wetherill* 412), Laguna Canyon, Painted Desert (*Clute* in 1920), apparently very rare. Western Colorado, Utah, and northeastern Arizona.

38. *Penstemon strictus* Benth. in DC., Prodr. 10: 324. 1846.

Lukachukai Mountains, Skeleton Mesa, Segi Canyon, north of Marsh Pass (Apache and Navajo Counties), about 8,000 feet, uncommon, June and July. Southern Wyoming to northern New Mexico, northeastern Arizona, and Utah.

The Arizona specimens are slightly puberulent, instead of glabrous, at the very base of the stem and so may be referable to subsp. *angustus* Pennell. From the Coconino National Forest north of Flagstaff came a single collection (*Stone* 363) of subsp. *strictiformis* (Rydb.) Keck (*P. strictiformis* Rydb.), a form otherwise limited to southwestern Colorado, characterized by lanceolate scarious-margined sepals up to 10 mm. long, and broadly lanceolate upper cauline leaves.

9. MIMULUS.⁴² MONKEYFLOWER

Plants herbaceous, annual or perennial; stems leafy or scapose; leaves opposite or basal, sessile or petioled, the blades entire or dentate; flowers in leafy terminal racemes, or axillary and solitary, often showy; calyx tubular or campanulate, 5-angled, sometimes bilabiate; corolla bilabiate or nearly regular, with a pair of longitudinal ridges on the lower side of the throat; stigma 2-lobed, the lobes separate or united; capsule usually longitudinally dehiscent (2-valved); seeds numerous.

Many of the species have showy, handsome flowers, and some of them are in cultivation. Most of the Arizona species grow in wet soil.

Key to the species

1. Corolla normally scarlet or carmine, 3 to 5.5 cm. long, bilabiate, the upper lip erect; plants perennial, with creeping rootstocks, loosely villous and somewhat viscid with flaccid hairs; leaf blades sessile with a somewhat clasping base, sharply dentate or serrate; pedicels nearly as long as to much longer than the subtending leaves; calyx tubular-obconic, the teeth nearly equal; stamens exerted (2).
2. Plant stoloniferous; stems not more than 20 cm. long, procumbent or prostrate; leaf blades commonly obovate; corolla tube moderately to greatly surpassing the calyx.----- 1. *M. EASTWOODIAE*.
2. Plant not stoloniferous; stems usually at least 30 cm. long, erect or ascending; leaf blades commonly oblong, oblong-ovate, or rhombic-elliptic.----- 2. *M. CARDINALIS*.
1. Corolla not scarlet or carmine, less than 3 cm. long or, if longer, then bright yellow and usually spotted with red (3).
3. Pedicels not more than one-third as long as the calyx; plants annual; stems not more than 25 cm. long, erect or ascending, usually branching from the base; leaf blades entire or nearly so; corolla 15 to 25 mm. long, with a narrow tube and throat and a spreading limb; stamens included; plants of dry, gravelly slopes (4).
4. Corolla distinctly bilabiate, yellow, sometimes tinged or spotted with reddish purple; plant glandular-puberulent; leaf blades lanceolate, oblanceolate, or narrowly elliptic; anthers glabrous.----- 3. *M. PARRYI*.
4. Corolla nearly regular, mallow pink, with a yellow tube and usually a bright yellow patch in the throat; plant villous, usually viscid; leaf blades lanceolate to broadly ovate or obovate; anthers usually hispidulous.----- 4. *M. BIGELOVII*.
3. Pedicels nearly as long as, to much longer than, the calyx; plants of moist soil (5).
5. Fruiting calyx strongly asymmetric, the upper tooth much longer than the others; corolla distinctly bilabiate, yellow, the throat often spotted with red (6).
6. Fruiting calyx open; plants perennial; stems glabrous or very nearly so, strongly decumbent to creeping and rooting at the nodes; corolla 7 to 15 mm. long (7).
7. Stems slender, less than 10 cm. long, closely matted; leaf blades pilose with white, subappressed hairs, less than 10 mm. long, flabelliform or suborbicular, usually shallowly crenate or dentate; corolla lobes denticulate or somewhat lacinate.----- 5. *M. DENTILIBUS*.
7. Stems relatively stout, commonly more than 10 cm. long, not matted or very loosely so; leaf blades glabrous or sparsely pilose, 10 to 40 mm. long; corolla lobes mostly entire.----- 6. *M. GLABRATUS*.
6. Fruiting calyx more or less closed by the connivent teeth; stems usually erect or ascending; stems and leaves more or less pubescent in the inflorescence, commonly glabrous or glabrate below; leaf blades mostly denticulate to sharply and coarsely dentate (8).

⁴² Reference: GRANT, ADELE L. A MONOGRAPH OF THE GENUS MIMULUS. Mo. Bot. Gard. Ann. 11: 99-388. 1924.

8. Plant usually perennial, with a rootstock or stolons, or with the flowering stems rooting at the lower nodes; fruiting calyx only partly closed by the infolding of the lower teeth, the upper tooth commonly less than 3 times as long as the others, usually slightly ascending; corolla seldom less than 2 and up to 4 cm. long.
7. *M. GUTTATUS.*
8. Plant usually annual; fruiting calyx almost completely closed, the upper tooth 3 or more times as long as the others, horizontal or nearly so; corolla commonly less than 2 cm. long. 8. *M. NASUTUS.*
5. Fruiting calyx not strongly a-symmetric, the upper tooth not or barely longer than the others; corolla only slightly bilabiate, not more than 20 mm. long (9).
9. Calyx becoming much inflated, not strongly prismatic, campanulate in fruit; plant annual, viscid-villous; leaves mostly distinctly petioled, much shorter than the internodes, the blades broadly ovate, dentate or denticulate; corolla 7 to 15 mm. long, narrowly funnelliform, yellow, the throat dotted or streaked with red, sometimes obscurely so. 9. *M. FLORIBUNDUS.*
9. Calyx not becoming much inflated (except as distended by the enlarging capsule), strongly prismatic, narrowly obconic in fruit, often with conspicuous, dark-colored ribs; leaves sessile or nearly so, the blades entire or shallowly dentate; corolla lobes usually emarginate or orbiculate (10).
10. Plant perennial, with filiform stolons or underground rootstocks and bulbils, scapose to subcaulescent with very short internodes (the stems up to 10 cm. long and bearing none to several pairs of leaves), glabrous or sparsely (seldom copiously) viscid-villous; flowers solitary on erect filiform pedicels much surpassing the leaves; leaf blades elliptic, oblanceolate, or obovate; corolla 8 to 20 mm. long, broadly funnelliform, yellow, sometimes spotted with reddish brown on the lobes and throat. 10. *M. PRIMULOIDES.*
10. Plants annual, caulescent, glandular-puberulent; stems commonly much-branched from the base, with well-developed internodes; leaf blades lanceolate, oblanceolate, or narrowly oblong; corolla 5 to 10 mm. long (11).
11. Stems up to 7 cm. long; leaves crowded, nearly as long as to much longer than the internodes; pedicels 3 to 9 mm. long; calyx teeth not ciliate; corolla yellow; stigma lobes unequal.
11. *M. SUKSDORFII.*
11. Stems up to 20 cm. long; leaves not crowded, much shorter than the internodes; pedicels 6 to 20 mm. long; calyx teeth usually ciliate; corolla yellow, or with a pink limb; stigma lobes equal. 12. *M. RUBELLUS.*
1. *Mimulus eastwoodiae* Rydb., Torrey Bot. Club Bul. 40: 483. 1913.

Navajo Indian Reservation (Apache and Navajo Counties), 6,000 to 7,000 feet, wet caves and recesses in rock walls. Southeastern Utah and northeastern Arizona.

Insufficiently known, perhaps only a variety of *M. cardinalis*.

2. *Mimulus cardinalis* Dougl. ex Benth., Scroph. Indic. 28. 1835.

Grand Canyon (Coconino County) and Mohave County, south to Cochise and Pima Counties, 1,800 to 8,000 feet, along streams usually in shade, April to October. Utah to Oregon, south to northwestern Mexico.

Crimson monkeyflower. The large bright orange-red or scarlet flowers are very conspicuous. The var. *verbenaceus* (Greene) Kearney and Peebles (*M. verbenaceus* Greene) with the corolla tube nearly twice as long as the calyx (only moderately exerted in the typical form) occupies the same range as the latter in Arizona and is about equally common. A yellow-flowered specimen was collected near Lake Mead, Mohave County (*Clover* 4273).

3. *Mimulus parryi* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 97. 1876.

Eunanus parryi Greene, Calif. Acad. Sci. Bul. 1: 104. 1885.

Near Littlefield, northwestern Mohave County, about 2,000 feet (*Maguire* 5003, 5005). Virgin River region, southwestern Utah and northwestern corner of Arizona.

4. *Mimulus bigelovii* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 96. 1876.

Eunanus bigelovii A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 121. 1856.

Mohave County, from Fort Mohave to Boulder Dam, 500 to 2,300 feet, open sandy places, February to April. Nevada, northwestern Arizona, and southern California.

This small plant, with its disproportionately large, beautifully colored flowers, is well worth cultivating.

5. *Mimulus dentilobus* Robins. and Fern., Amer. Acad. Arts and Sci. Proc. 30: 120. 1895.

Mimulus parvulus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 171. 1913.

Santa Rita Mountains, Pima County, 4,500 feet (*Thornber* 505, etc.). Southern New Mexico, southern Arizona, and Sonora.

Thornber's specimens correspond to the descriptions of *M. dentilobus* in the character of the pubescence, but seem otherwise more like *M. glabratus*.

6. *Mimulus glabratus* H. B. K., Nov. Gen. et Sp. 2: 370. 1818.

Sacaton (Pinal County), Chiricahua Mountains, and near Bisbee (Cochise County), 1,300 to 5,500 feet; June. Michigan to Manitoba, south to Texas, Arizona, and Central America; South America.

Most of the Arizona specimens belong to var. *fremontii* (Benth.) Grant (*M. geyeri* Torr.), distinguished from the typical form by having nearly orbicular leaf blades, these cuneate to subcordate at base, with the margin entire or merely denticulate. The specimen collected at Sacaton doubtless grew from seed brought down the Gila River from farther east.

7. *Mimulus guttatus* DC., Cat. Hort. Monsp. 127. 1813.

Mimulus prionophyllus Greene, Leaflets 1: 190. 1905.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 1,300 to 8,000 feet, abundant in springy places and along brooks, March to September, type of *M. prionophyllus* from Willow Spring, Apache County (*Palmer* 527). Montana to Alaska, south to northern Mexico.

A conspicuous plant with showy yellow flowers, sometimes used for salad and greens.

Several forms, closely related to *M. guttatus* and represented by specimens collected in Arizona, are regarded by Pennell as specifically distinct (see footnote 39, p. 799, Pennell, pp. 4-6). These are: *M. unimaculatus* Pennell, type from Sierra Ancha, Gila County (*Harrison* 7892); *M. cordatus* Greene, from the Chiricahua Mountains and from near Tucson; *M. puberulus* Greene, from the Lukachukai Mountains,

Apache County; and *M. maguirei* Pennell, type from near Williams, Coconino County (*Maguire et al.* 12214).

8. *Mimulus nasutus* Greene, Calif. Acad. Sci. Bul. 1: 112. 1885.

Graham, Pinal, Cochise, and Pima Counties, 3,000 to 9,000 feet, wet soil, March to September. Idaho to British Columbia, south to Chihuahua, Arizona, and Baja California.

9. *Mimulus floribundus* Dougl. ex. Lindl., Bot. Reg. 13: pl. 1125-1828.

Coconino County to Graham and Pima Counties, 2,800 to 7,000 feet, wet soil, April to September. Wyoming to British Columbia, south to northern Mexico and California.

10. *Mimulus primuloides* Benth., Scroph. Indic. 29. 1835.

Kaibab Plateau (Coconino County), White Mountains (Apache County), 8,000 to 9,000 feet, wet soil about springs, etc., July and August. Idaho to Arizona and southern California.

Plants tending to form mats, with stems rooting at the nodes.

11. *Mimulus suksdorfii* A. Gray, Syn. Fl. ed. 2, 2¹: 450. 1886.

A collection in "northern Arizona" (*Lemmon* 3270) is cited by Grant (*ibid.* p. 265). British Columbia to California, Colorado, and Arizona.

12. *Mimulus rubellus* A. Gray in Torr., U. S. and Mex. Bound. Bot. 116. 1859.

Coconino and Mohave Counties to Graham and Pima Counties, 4,000 to 7,500 feet, frequent in sandy soil along streams, March to May (sometimes September). Wyoming to New Mexico, Arizona, and southern California.

10. STEMODIA

Plant herbaceous, glandular-pubescent; stems erect, leafy, simple or sparingly branched; leaves opposite, sessile, with a somewhat clasping base, the blades serrate, lanceolate, elliptic, or somewhat obovate; flowers in terminal spikelike racemes or thyrsoid panicles; calyx 5-parted, with narrow lobes; corolla with a narrow tube and a bilabiate, violet-purple limb, the lower lip 3-cleft; stamens 4, all of them anther-bearing; capsule appearing 4-valved (the valves 2-parted).

1. *Stemodia durantifolia* (L.) Swartz, Observ. Bot. 240. 1791.

Capraria durantifolia L., Syst. Nat. ed. 10, 1116. 1759.

Gila, Maricopa, Pinal, and Pima Counties, 1,000 to 3,000 feet, wet soil along streams, April to September. Southern Texas, southern Arizona, and southern California, to tropical America.

F. W. Pennell (see footnote 39, p. 799, Pennell, p. 3), regarding the *Stemodia* of southern Arizona and adjacent territory as specifically distinct from the tropical American form, has published the former as *S. arizonica* Pennell.

11. GRATIOLA

A low, glandular-pubescent herb; leaves opposite, sessile, denticulate; flowers axillary, solitary, on long slender pedicels; calyx 5-parted, with narrow divisions; corolla tubular-funnelform, nearly regular, the limb whitish, shallowly 5-lobed, the tube yellow; sterile stamens rudi-

mentary; capsule 4-valved; seeds many, striate and transversely reticulate.

1. *Gratiola neglecta* Torr., Cat. Pl. N. Y. 89. 1819.

Coconino County, near Flagstaff (*Leemmon* in 1884), and near Williams (*Kearney* and *Peebles* 14005), about 7,000 feet, mud flats, July and August. Almost throughout the United States.

12. CONOBEA

Plant small, annual, glandular-pubescent; leaves opposite, petioled, pinnatifid, the divisions wedge-shaped, usually toothed; flowers axillary, short-peduncled, small; calyx 5-parted, the divisions narrow; corolla obscurely bilabiate, the tube yellowish, the limb violet; stigma 2-lobed; capsule longitudinally dehiscent, appearing 4-valved; seeds numerous.

1. *Conohea intermedia* A. Gray in Torr., U. S. and Mex. Bound. Bot. 117. 1859.

Schistophragma intermedia Pennell, Notul. Nat. Acad. Nat. Sci. Phila. 43: 2. 1940.

Mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, grassy or wooded slopes, mostly in loose soil, July to September. Southern New Mexico and Arizona, and northern Mexico.

13. PAGESIA

Small, glabrous, perennial herb; leaves opposite, short-petioled or nearly sessile, the blades lanceolate, ovate, or obovate, crenate or dentate; flowers axillary, solitary, on long slender peduncles; corolla funnellform, slightly bilabiate, yellow with dark veins.

1. *Pagesia vandellioides* (H. B. K.) Pennell, Notul. Nat. Acad. Nat. Sci. Phila. 43: 2. 1940.

Herpestis vandellioides H. B. K., Nov. Gen. et Sp. 2: 367. 1818.

Cochise, Santa Cruz, and Pima Counties, 2,800 to 4,500 feet, wet sandy soil along streams, March and April (sometimes flowering also in autumn). Southeastern Arizona and Mexico.

14. MIMETANTHE

Plant small, annual, viscid-villous with long, slender, white hairs; stems erect, much-branched, leafy; leaves opposite, sessile or nearly so, the blades lanceolate or oblong, entire; flowers axillary, solitary, slender-peduncled; calyx campanulate; corolla tubular-funnelform, obscurely bilabiate, the lower lip usually with 2 red-brown or purple spots; stigma dilated at apex.

1. *Mimetanthe pilosa* (Benth.) Greene, Calif. Acad. Sci. Bul. 1: 181. 1885.

Herpestis pilosa Benth., Compend. Bot. Mag. 2: 57. 1836.

Mimulus pilosus S. Wats. in King, Geol. Expl. 40th Par. 5: 225. 1871.

Graham, Gila, Pinal, Maricopa, and Pima Counties, 1,000 to 4,500 feet, moist sandy soil along streams, April to July. Nevada and Oregon to Arizona and southern California.

15. LIMOSELLA. MUDWORT

Small, subscapose, glabrous or nearly glabrous annuals, with slender runners; leaves on long slender petioles, the blades entire, slightly fleshy; flowers very small, solitary, on long slender peduncles, the corolla white or purplish; style short, the stigma capitate; capsule 2-celled only at base; seeds many, cross-ribbed.

Key to the species

1. Leaf blades elliptic or oval, cuneate at base; corolla lobes acute, glabrous or very nearly so; capsules obovoid; seeds much longer than wide.
 1. L. AQUATICA.
 1. Leaf blades oblanceolate, attenuate at base; corolla lobes obtuse, puberulent; capsules globose-ovoid; seeds little longer than wide.
 2. L. PUBIFLORA.
1. **Limosella aquatica** L., Sp. Pl. 631. 1753.

Near Flagstaff, Coconino County, 7,500 feet (*Lemmon* in 1884), wet soil, August. Almost throughout North America; Eurasia.

2. **Limosella pubiflora** Pennell, Notul. Nat. Acad. Nat. Sci. Phila. 43: 7. 1940.

Known only from the type collection in the Chiricahua Mountains, Cochise County (*Peebles* and *Loomis* 5420).

16. VERONICA.⁴³ SPEEDWELL

Plants herbaceous, annual or perennial, terrestrial or aquatic; leaves opposite or the upper alternate, sessile or short-petioled; flowers small, slightly irregular, axillary, or in terminal racemes; corolla rotate or broadly campanulate; capsule compressed, often notched at apex.

Key to the species

1. Plants annual, glandular, puberulent, or short-pilose; flowers solitary in the axils; capsules commonly wider than long (2).
 2. Corolla whitish, shorter than the calyx, about 2 mm. wide; style very short, not or scarcely surpassing the notch of the capsule; stems erect; leaves alternate or the lower ones opposite, the blades oblong, linear, or oblanceolate, entire or sparingly dentate; pedicels shorter than the subtending leaves; capsules orbicular-obovate, the lobes not divergent.
 1. V. PEREGRINA.
 2. Corolla blue, longer than the calyx, about 10 mm. wide; style slender, surpassing the notch; stems decumbent or prostrate; leaves alternate, the blades broadly ovate, coarsely crenate-dentate; pedicels much longer than the subtending leaves; capsules broadly obovate, the lobes divergent.
 2. V. PERSICA.
1. Plants perennial, with creeping rootstocks; flowers in racemes, the corolla blue or bluish; style elongate, much surpassing the notch of the capsule (3).
 3. Racemes terminal; capsules flat, not orbicular; plants not aquatic (4).
 4. Stems decumbent, much-branched at base, appressed-puberulent; lower leaves opposite, short-petioled, the upper ones alternate, the blades round-oval to oblong; racemes elongate, loose; corolla little surpassing the calyx; capsules wider than long, deeply notched.
 3. V. SERPYLLIFOLIA.
 4. Stems erect, simple, these and the inflorescence villous; leaves opposite except in the inflorescence, all sessile, the blades ovate to oblong; racemes short, rather dense; corolla sky blue, much surpassing the calyx; capsules much longer than wide, shallowly notched.
 4. V. WORMSKJOLDII.

⁴³ Reference: PENNELL, FRANCIS W. "VERONICA" IN NORTH AND SOUTH AMERICA. *Rhodora* 23: 1-22, 29-41. 1921.

3. Racemes axillary; capsules somewhat turgid, orbicular or nearly so; plants aquatic or semiaquatic (5).
 5. Leaves all short-petioled, the blades elliptic, oblong, or ovate, serrate or serrulate; capsules wider than long.----- 5. *V. AMERICANA*.
 5. Leaves all sessile and cordate-clasping, or the lowest ones short-petioled (6).
 6. Sepals acute to acuminate; pedicels ascending; corolla bluish lilac; capsules suborbicular, mostly shorter than the sepals, not or barely notched at apex.----- 6. *V. ANAGALLIS-AQUATICA*.
 6. Sepals obtuse to acutish; pedicels divaricate; corolla white or pinkish; capsules round-reniform or obcordate, mostly longer than the sepals, distinctly notched.----- 7. *V. SALINA*.

1. *Veronica peregrina* L., Sp. Pl. 14. 1753.

Throughout the State, up to 8,600 feet but usually much lower, common along streams and washes, March to September. Widely distributed in North America; South America.

The form that occurs in Arizona is var. *xalapensis* (H. B. K.) Pennell (*V. xalapensis* H. B. K.), with glandular pubescence.

2. *Veronica persica* Poir. in Lam., Encycl. 8: 542. 1808.

Tempe, Maricopa County, lawns and parkways (*McLellan* and *Stitt* 1371), apparently well established, March. Introduced from Europe.

3. *Veronica serpyllifolia* L., Sp. Pl. 12. 1753.

Black River, White Mountains (*Goodding* 579), Pinaleno Mountains, Graham County (*Peebles* et al. 4498), about 8,000 feet, July. Throughout most of North America; Eurasia.

The species is represented in Arizona by var. *humifusa* (Dickson) Vahl (*V. humifusa* Dickson), a pubescent, relatively large-flowered form.

4. *Veronica wormskjoldii* Roem. and Schult., Syst. Veg. 1: 101. 1817.

Baldy Peak (Apache County), San Francisco Peaks (Coconino County), 9,600 to 12,000 feet, July and August. Greenland to Alaska, south in the mountains to New Hampshire, New Mexico, and Arizona.

5. *Veronica americana* Schwein. ex Benth. in DC., Prodr. 10: 468. 1846.

Apache County to Coconino, Gila, and Pinal Counties, 1,300 to 9,000 feet, in and around springs and streams, June to August. Widely distributed in North America.

American brooklime.

6. *Veronica anagallis-aquatica* L., Sp. Pl. 12. 1753.

Apache, Yavapai, and Pinal Counties (doubtless elsewhere), 1,300 to 5,200 feet, habitat similar to that of *V. americana*, March to June. Widely distributed in the Northern Hemisphere; South America.

Water speedwell.

7. *Veronica salina* Schur, Enum. Pl. Transsil. 492. 1866.

Veronica connata Pennell, 1935. Probably not Raf., 1830.

A collection in "Arizona" (*Palmer* in 1869), and one cited by Pennell from Beaver Creek, Yavapai County (*Rusby*) are the basis for including this species in the flora of Arizona. The species is widely distributed in the Northern Hemisphere.

17. BESSEYA⁴⁴

Plants herbaceous, perennial, subscapose; stem leaves bractlike, much smaller than the large basal leaves; inflorescence terminal, very dense, spikelike, conspicuously bracted; corolla whitish or purplish, the upper lip entire, the lower lip 3-lobed.

Key to the species

1. Corolla 5 mm. long or longer, conspicuously exerted; capsules emarginate at apex, 5 to 6 mm. long; leaf blades commonly subciliate at base, up to 20 cm. long.----- 1. *B. PLANTAGINEA*.
 1. Corolla not more (usually less) than 5 mm. long, moderately exerted; capsules rounded to acutish at apex, not more (usually less) than 5 mm. long; leaf blades rounded or subcordate at base, not more than 8 cm. long.----- 2. *B. ARIZONICA*.

1. *Besseyia plantaginea* (Benth.) Rydb., Torrey Bot. Club Bul. 30: 280. 1903.

Synthyris plantaginea Benth. in DC., Prodr. 10: 455. 1846.

Besseyia gooddingii Pennell, Acad. Nat. Sci. Phila. Proc. 85: 101. 1933.

White Mountains (Apache and Greenlee Counties), about 9,500 feet, moist meadows, July and August, type of *B. gooddingii* from Sitgreaves Camp, White River (*Goodding* 1119). Wyoming to New Mexico and eastern Arizona.

The Arizona form (*B. gooddingii*) has exceptionally elongate, glabrate leaves.

2. *Besseyia arizonica* Pennell, Acad. Nat. Sci. Phila. Proc. 85: 103. 1933.

White Mountains (Apache County), San Francisco Peaks and vicinity (Coconino County), 7,200 to 8,500 feet, moist meadows and coniferous forests, May to August, type from the San Francisco Peaks (*Leiberg* 5537). Known only from northern Arizona.

18. GERARDIA

Plant perennial with a large woody caudex, probably a root parasite; herbage retrorsely hispidulous; leaves opposite or nearly so, or in whorls of 3, narrowly linear, entire, often revolute; flowers long-pedicelled, in loose leafy racemes; corolla large, brownish yellow or orange yellow, with a short tube scarcely surpassing the calyx, and a large ventricose throat.

1. *Gerardia wrightii* A. Gray in Torr., U. S. and Mex. Bound. Bot. 118. 1859.

Brachystigma wrightii Pennell, Acad. Nat. Sci. Phila. Proc. 80: 433. 1928.

Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,500 feet, dry slopes and mesas, often among live oaks, August and September, type from between Babocomari, Cochise County, Arizona, and Santa Cruz, Sonora (*Wright*).

Southwestern New Mexico, southern Arizona, and northern Mexico.

⁴⁴ Reference: PENNELL, FRANCIS W. A REVISION OF SYNTHYRIS AND BESSEYA. Acad. Nat. Sci. Phila. Proc. 85: 77-106. 1933.

19. BUCHNERA. BLUEHEARTS

Perennial, probably root-parasitic; herbage hispid, the hairs pustulate at base; stem erect, wandlike; leaves mostly opposite, the basal leaves obovate or oblong, larger than the lanceolate or linear stem leaves, usually sparingly dentate; flowers subsessile, in a slender elongate small-bracted spike; corolla dark violet.

1. *Buchnera arizonica* (A. Gray) Pennell, Notul. Nat. Acad. Nat. Sci. Phila. 43: 8. 1940.

Buchnera pilosa Benth. var. *arizonica* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 92. 1883.

Huachuca Mountains (*Lemmon* 2830, the type collection), August. Southeastern Arizona and Mexico.

20. CASTILLEJA.⁴⁵ PAINTBRUSH

Plants annual or perennial, herbaceous or barely suffrutescent, often partially root-parasitic; stems leafy, mostly erect; leaves alternate, sessile, the blades entire to pinnatifid; flowers very irregular, in conspicuously bracted terminal spikes, the bracts usually colored otherwise than green; calyx tubular, cleft above and below; corolla long and narrow, with a long upper lip (galea), the very short lower lip often reduced to teeth or callosities.

Most of the species have bright-red floral bracts that are more conspicuous than the flowers. Where abundant these plants contribute to the forage value of the range for livestock, although it has been discovered that *C. chromosa* takes up large quantities of selenium from certain soils. Plants of this genus are reported to be used medicinally and ceremonially by the Hopi Indians, who ate the flowers of *C. linariaefolia*.

Key to the species

1. Plants usually annual, somewhat viscid; stems tall and often unbranched; leaves and bracts entire, the latter scarlet, at least at the tip; corolla yellowish (except sometimes the lip), the lip well developed, much shorter than the galea, thin (not callous), deeply cleft; plants of marshy places (2).
2. Stems usually very slender, sparsely villous or glabrate, at least below; leaf blades lance-linear; lip colored differently from the rest of the corolla, bright red----- 1. *C. MINOR*.
2. Stems usually rather stout, copiously villous nearly to the base; leaf blades lanceolate; lip not differently colored----- 2. *C. EXILIS*.
1. Plants perennial (3).
3. Bracts and flowers not highly colored, never bright red; galea from slightly more to considerably less than 3 times as long as the lip, the latter thin (not callous), deeply cleft, with linear or narrowly lanceolate lobes; bracts (and often some of the stem leaves) pinnatifid, with narrow lobes (4).
4. Corolla much longer than the calyx, falcate, 35 to 50 mm. long, ochroleucous or purplish, as are sometimes the bracts and the calyx; lip conspicuous, cleft nearly to the base; pubescence short or somewhat appressed, scarcely lanate (except sometimes on the stems below the inflorescence)----- 3. *C. SESSILIFLORA*.
4. Corolla not longer than the calyx, not noticeably falcate, not more than 20 mm. long, greenish or yellowish, as are also the bracts and the calyx; whole plant conspicuously but loosely lanate----- 4. *C. LINEATA*.
3. Bracts wholly or partly bright red, (except in *C. flava*); galea much more than 3 times as long as the thick, more or less callous, green lip (5).

⁴⁵ Reference: EASTWOOD, ALICE. THE MEXICAN SPECIES OF CASTILLEJA. Amer. Acad. Arts and Sci. Proc. 44: 563-591. 1909.

5. Calyx very asymmetric, cleft much deeper before (opposite the lip of the corolla) than behind (6).
6. Bracts, some or all of them (and often the upper stem leaves) deeply cleft, with very narrow lateral lobes; stems puberulent or short-pilose with mostly retrorse hairs, often glabrate below the inflorescence (7).
7. Upper lip of the calyx 4-toothed, the teeth subulate, very acute; stem leaves mostly entire, if cleft then with not more than 2 lateral lobes; galea about equaling the tube of the corolla.
5. *C. LINARIAEFOLIA*.
7. Upper lip of the calyx 2-lobed, the lobes lanceolate or broader, obtuse or obtusish, sometimes dentate; stem leaves mostly cleft, often with more than 2 lateral lobes; galea usually considerably longer than the tube of the corolla. 6. *C. PATRIOTICA*.
6. Bracts and stem leaves all entire; stems villous-hirsute with stiff hairs (8).
8. Leaves thin, lax, usually spreading or somewhat reflexed, only the midrib prominent; corolla well-exserted (longer than the calyx), 30 to 40 mm. long. 7. *C. LAXA*.
8. Leaves thick, rather rigid, erect or ascending, prominently 3-ribbed; corolla not exserted, slightly shorter than the calyx, about 20 mm. long. 8. *C. CRUENTA*.
5. Calyx more nearly symmetric, not cleft much more deeply before than behind (9).
9. Stem tomentose-canescens or lanate, the hairs appressed or subappressed (10).
10. Leaf blades glabrous or glabrate above, entire; bracts normally all entire but occasionally some of them shallowly cleft toward the apex with rather broad, erect teeth; stems tomentose-canescens or somewhat lanate, with subappressed hairs; calyx teeth rather long and narrow, acute. 9. *C. INTEGRATA*.
10. Leaf blades about equally and persistently pubescent on both faces, at least some of the upper ones nearly always deeply pinnately cleft, with narrow, divergent lobes; bracts similarly cleft; stems densely, closely, and conspicuously white-lanate, at least when young, sometimes slightly woody toward the base; calyx teeth short, broad, obtuse or rounded. 10. *C. LANATA*.
9. Stem puberulent or short-pilose to villous-hirsute, scarcely tomentose or lanate, some of the hairs usually spreading, others shorter and more or less retrorse (11).
11. Leaves pilose or villous-hirsute, the herbage usually grayish; stems noticeably and usually copiously pubescent to the base with both short and long hairs; blades of the stem leaves (some or most of them), pinnatifid, with 1 or more narrow, divergent, lateral lobes; bracts similarly cleft. 11. *C. CHROMOSA*.
11. Leaves nearly glabrous, puberulent, or sparsely short-pilose; blades of the stem leaves normally entire (12).
12. Bracts entire or shallowly cleft near the apex; stem leaves all entire. 12. *C. AUSTROMONTANA*.
12. Bracts deeply cleft, with often more than 1 pair of lateral lobes; some of the stem leaves occasionally pinnately cleft (13).
13. Leaves lanceolate or oblong-lanceolate; bracts partly or wholly bright red; corolla 25 to 30 mm. long. 13. *C. CONFUSA*.
13. Leaves linear-lanceolate; bracts normally yellowish to salmon color; corolla usually less than 25 mm. long. 14. *C. FLAVA*.

1. Castilleja minor A. Gray, Bot. Calif. 1: 573. 1876.

Navajo and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,600 feet, moist soil around springs and along brooks, April to August. New Mexico, Arizona, and northern Mexico.

Although normally annual, the plant is reported to be sometimes perennial.

2. Castilleja exilis A. Nels., Biol. Soc. Wash. Proc. 17: 100. 1904.

Near Tuba, Coconino County, 5,000 feet (*Kearney* and *Peebles* 12860) at edge of a marsh, September. Montana to Washington, south to northwestern New Mexico, northern Arizona, and Nevada.

3. *Castilleja sessiliflora* Pursh, Fl. Amer. Sept. 738. 1814.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, grassy plains, sometimes with *Dasyllirion* and *Agave*, May. Illinois to Saskatchewan, south to Missouri, Texas, and southern Arizona.

The corolla varies in color at the same station from ochroleucous to purple. The Arizona specimens seem to approach *C. mexicana* (Hemsl.) A. Gray.

4. *Castilleja lineata* Greene, Pittonia 4: 151. 1900.

North of Hannigan, Apache or Greenlee County, 8,600 feet (*Kearney* and *Peebles* 12422), along a brook, August. Colorado, New Mexico, and eastern Arizona.

5. *Castilleja linariaefolia* Benth. in DC., Prodr. 10: 532. 1846.

Apache County to Hualpai Mountain (Mohave County), south to Cochise and Pima Counties, 5,000 to 10,000 feet, common in pine and spruce-fir forests, May to September. Wyoming to Arizona, California, and Mexico.

6. *Castilleja patriotica* Fernald, Amer. Acad. Arts and Sci. Proc. 40: 56. 1904.

Castilleja galeata A. Nels., Amer. Jour. Bot. 18: 439. 1931.

Chiricahua and Huachuca Mountains, Cochise County, about 8,000 feet, openings in pine forests, August and September, type of *C. galeata* from the Huachuca Mountains (*Goodding* 1354). South-eastern Arizona and northern Mexico.

The var. *blumeri* (Standl.) *Kearney* and *Peebles* (*C. blumeri* Standl.) apparently differs only in its smaller flowers, with corolla less than 3 cm. long (3.5 to 4.5 cm. in typical *C. patriotica*). The type of *C. blumeri* was collected in the Chiricahua Mountains (*Blumer* 143).

7. *Castilleja laxa* A. Gray in Torr., U. S. and Mex. Bound. Bot. 119. 1859.

Castilleja retrorsa Standl., Muhlenbergia 5: 81. 1909.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, chaparral and rock ledges, March to October, type of *C. retrorsa* from the Chiricahua Mountains (*Blumer* 2132). Southern Arizona and northern Mexico.

Closely related to *C. laxa* is *C. setosa* Pennell (see footnote 39, p. 799, Pennell, p. 8), described as having more hispid herbage, more stiffly erect stems, and a hirsute calyx more closely investing the corolla. Collections from the Santa Rita and Santa Catalina Mountains (Pima County) are cited.

8. *Castilleja cruenta* Standl., Muhlenbergia 5: 82. 1909.

Known definitely only from the type collection in the Chiricahua Mountains (*Blumer* 2133), but a specimen supposed to have been collected between Fort Huachuca and the San Pedro River (*Mearns* 1539) may belong here. Known only from southeastern Arizona.

The writers have seen no good flowering specimens, but the vegetative characters are very distinctive.

9. *Castilleja integra* A. Gray in Torr., U. S. and Mex. Bound. Bot. 119. 1859.

Apache, Navajo, and Coconino Counties, south to Cochise and Pima Counties, 3,000 to 7,500 feet, mostly among oaks and pines,

March to September. Colorado, New Mexico, Arizona, and northern Mexico.

The var. *gloriosa* (Britton) Cockerell (*C. gloriosa* Britton) is a form with extraordinarily large bracts and flowers (corolla up to 4.5 cm. long), suggesting a polyploid variation. The type of *C. gloriosa* was collected at Fort Verde, Yavapai County (Mearns 208).

10. *Castilleja lanata* A. Gray in Torr., U. S. and Mex. Bound. Bot. 118. 1859.

Graham and Cochise Counties to the Sierra Estrella (Maricopa County) and the Baboquivari Mountains (Pima County), 2,500 to 7,000 feet, arid granitic or limestone slopes, February to October. Western Texas to southern Arizona and northern Mexico.

11. *Castilleja chromosa* A. Nels., Torrey Bot. Club Bul. 26: 245. 1899.

Castilleja angustifolia of authors. Not of G. Don.

Castilleja eremophila Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 171. 1913.

Apache County to Mohave County, south to Gila, Pinal, and Maricopa Counties, 3,000 to 7,000 feet, common in chaparral and among pines, March to June, type of *C. eremophila* from the Carrizo Mountains, Apache County (Standley 7464). Colorado to British Columbia, south to New Mexico, Arizona, and southern California.

The distinction of this widely distributed species from *C. angustifolia* (Nutt.) G. Don, to which most of the Arizona specimens have been referred previously, was pointed out recently by F. W. Pennell.⁴⁶

12. *Castilleja austromontana* Standl. and Blumer, Muhlenbergia 7: 44. 1911.

White Mountains (Greenlee County) to Cochise County, west to the Santa Catalina Mountains (Pima County), 7,500 to 9,500 feet, pine forests, July to September. Southern New Mexico, southeastern Arizona, and northeastern Sonora.

This species resembles *C. confusa*, but the plant is less rigid and of softer texture. The ranges of these species apparently do not overlap.

13. *Castilleja confusa* Greene, Pittonia 4: 1. 1899.

Apache County to Coconino County, on both sides of the Grand Canyon, 7,000 to 10,000 feet, common in yellow-pine forests, June to August. Colorado, northern New Mexico, and northern Arizona.

14. *Castilleja flava* S. Wats. in King, Geol. Expl. 40th Par. 5: 230. 1871.

De Motte Park, Kaibab Plateau, 8,500 to 9,000 feet, August, grassy-sedgy meadows (Kearney and Peebles 13725, Collom in 1940). Montana to British Columbia, south to Colorado and northern Arizona.

21. CORDYLANTHUS.⁴⁷ CLUBFLOWER

Plants annual, probably partially root-parasitic; stems leafy, mostly erect and much branched; leaves alternate, entire to pinnatifid; in-

⁴⁶ PENNELL, FRANCIS W. CASTILLEJA IN THE CHARLESTON MOUNTAINS, NEVADA. Acad. Nat. Sci. Phila. Proc. 89: 419-424. 1937.

⁴⁷ Reference: FERRIS, ROXANA S. TAXONOMY AND DISTRIBUTION OF ADENOSTEGIA. Torrey Bot. Club Bul. 45: 399-423. 1918.

florescence various; bracts entire or parted; calyx with a tubular base and a spathe-like lobe, this often opposed by a more or less similar bract, giving the appearance of a 2-lobed calyx; corolla narrow, bilabiate, the lips equal or unequal, the upper lip enclosing the stamens and pistil; capsule compressed.

Plants sometimes called birdsbeak, from the peculiar shape of the corolla. *C. wrightii* is reported to be used by the Hopi Indians for bleaching the skin.

Key to the species

1. Flowers in terminal capitate or short-spicate inflorescences, or sometimes solitary at the ends of the branches; pubescence of the herbage not or obscurely glandular; corolla lips nearly equal; seed coats alveolate (2).
2. Leaves and bracts entire; corolla 15 to 20 mm. long; anthers of the longer stamens 2-celled, of the others 1-celled; herbage loosely villous.
 1. *C. CANESCENS.*
2. Leaves and outer bracts 3- to 7-parted, the divisions nearly filiform; corolla 20 to 30 mm. long, purple or yellow; anthers all 2-celled; herbage short-pilose to glabrate.
 2. *C. WRIGHTII.*
1. Flowers scattered along the branches, 10 to 18 mm. long; outer bracts 3-cleft (3).
3. Corolla bright yellow (drying purplish), cleft to the middle, the lower lip half to two-thirds as long as the upper; herbage hirsute below, villous often slightly glandular above; anthers commonly 1-celled.
 3. *C. LAXIFLORUS.*
3. Corolla mainly pink or lavender, not cleft to the middle, the lower lip more than two-thirds as long as the upper one (4).
 4. Tips of the outer bracts (and of the leaf lobes) dilated and whitish-callous; anthers 1-celled; herbage hirsute or pilose, with few gland-tipped hairs; corolla not yellow-tipped.
 4. *C. NEVINII.*
 4. Tips of the outer bracts not dilated or callous; anthers mostly 2-celled; herbage copiously glandular-pilose; tip of the corolla yellow.
 5. *C. PARVIFLORUS.*

*1. *Cordylanthus canescens* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 383. 1868.

Adenostegia canescens Greene, Pittonia 2: 181. 1891.

No Arizona specimens have been seen by the writers, but the species occurs at St. George, Utah, not far from the northern border. Utah to California.

2. *Cordylanthus wrightii* A. Gray in Torr., U. S. and Mex. Bound. Bot. 120. 1859.

Adenostegia wrightii Greene, Pittonia 2: 180. 1891.

Apache, Navajo, and Coconino Counties to Cochise and Pima Counties, 5,000 to 7,000 feet, mostly in open pine forests, July to October. Western Texas to Arizona and northern Mexico.

A form with flowers solitary or 2 in the cluster, and with glabrate or obscurely glandular-puberulent herbage, var. *pauciflorus* Kearney and Peebles, is rather common on sandy plains in Apache and Coconino Counties. The type of the variety was collected near Tuba, Coconino County (Kearney and Peebles 12884).

C. tenuifolius Pennell (see footnote 39, p. 799, Pennell, p. 9) is related to *C. wrightii*, but is described as having the apex of the floriferous bracts 3- to 5-parted, rather than entire. The species was founded upon a collection at the Grand Canyon (Eggleston 15677a).

3. *Cordylanthus laxiflorus* A. Gray in Torr., U. S. and Mex. Bound. Bot. 120. 1859.

Adenostegia laxiflora Greene, Pittonia 2: 181. 1891.

Navajo, Coconino, Yavapai, and Gila Counties, 4,000 to 6,000 feet, dry slopes and mesas, sometimes with *Cupressus glabra*, August to October. Known only from central Arizona.

4. *Cordylanthus nevinii* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 229. 1882.

Hualpai Mountain, Mohave County (*Goldman* 2995, *Kearney* and *Peebles* 12699), about 6,500 feet, among yellow pines, September. Western Arizona and southern California.

5. *Cordylanthus parviflorus* (Ferris) Wiggins, Contrib. Dudley Herbarium Stanford Univ. 1: 174. 1933.

Adenostegia parviflora Ferris, Torrey Bot. Club Bul. 45: 409. 1918.

Coconino and Mohave Counties, from the northern border of the State to 80 miles southeast of Kingman, 2,600 to 7,000 feet, dry stony slopes and mesas, often with juniper, August and September, type from the Grand Canyon (*Knowlton* 270). Known only from north-western Arizona.

22. ORTHOCARPUS. OWLCLOVER

Plants annual; stems leafy, mostly erect; leaves alternate, sessile or nearly so, entire to pinnately parted; inflorescence spicate, usually dense, leafy-bracted, the bracts green or purple; calyx narrowly campanulate; corolla bilabiate, the lips approximately equal, the lower lip entire to tri-sacculate at apex.

Key to the species

1. Leaf blades and bracts pinnately parted, the divisions narrowly linear or filiform; tips of the bracts and calyx lobes purplish pink, as is the corolla; lower lip of the corolla trisacculate at apex, much wider than the galea; stigma large, much wider than the style, depressed-capitate; herbage villous-hirsute, not scabrous..... 1. *O. PURPURASCENS*.
1. Leaf blades entire or 3-cleft; tips of the bracts and calyx lobes green; lower lip of the corolla entire or rather obscurely tridentate, not sacculate, at apex; stigma small, scarcely wider than the style; leaves scabrous-puberulent (2).
2. Inflorescence many-flowered, usually dense; leaf blades mostly entire, linear or lanceolate; corolla yellow; tip of the galea obtuse, not inflexed; lower lip about as long as and not much wider than the galea.
 2. *O. LUTEUS*.
2. Inflorescence few-flowered, loose; leaf blades mostly 3-cleft, with filiform lobes; corolla purple and white; tip of the galea mucroniform, inflexed; lower lip somewhat shorter and much wider than the galea.
 3. *O. PURPUREO-ALBUS*.

1. *Orthocarpus purpurascens* Benth., Scroph. Indic. 13. 1835.

Mohave County to Graham, Gila, Maricopa, Pinal, and Pima Counties, 1,500 to 3,500 feet, open mesas and slopes, March to May. Western and southern Arizona, California, and Baja California.

Escobita. In favorable seasons, extensive areas are bright purple with the flowers of this owlclover, which is grazed by cattle and sheep.

The Arizona form is var. *palmeri* Gray, distinguished from the typical form of the species by having the tip of the lower lip purple like the rest of the corolla, and often with 1 or more deeper colored spots, instead of yellow or white.

2. *Orthocarpus luteus* Nutt., Gen. Pl. 2: 57. 1818.

Apache County to Coconino County, on both sides of the Grand Canyon, 7,000 to 9,000 feet, mostly in yellow-pine forests, August and September. Canada to Nebraska, New Mexico, Arizona, and Nevada.

3. *Orthocarpus purpureo-albus* A. Gray in King, Geol. Expl. 40th Par. 5: 458. 1871.

Navajo, Coconino, and Gila Counties, 5,500 to 9,000 feet, coniferous forests, July to September. Colorado to Idaho, New Mexico, and Arizona.

23. RHINANTHUS. YELLOW-RATTLE

Plant annual, possibly a root parasite; stems strictly erect, leafy, 4-angled; leaves opposite, sessile, thickish, rigid, scabrous, lanceolate, sharply serrate; flowers in a rather dense, leafy-bracted, spikelike raceme; corolla yellow, bilabiate, the upper lip arched, the lower lip 3-lobed; anthers hairy; capsule compressed, orbicular; seeds winged.

The plants have been used as an insecticide.

1. *Rhinanthus rigidus* Chabert, Herb. Boissier Bul. 7: 516. 1899.

White Mountains, Apache County, at Greer (*Eggleston* 17083) and on Baldy Peak (*Peebles* and *Smith* 12493), 8,800 to 9,600 feet, August. Canada and Alaska to Colorado, eastern Arizona, and Washington.

24. PEDICULARIS. WOODBETONY

Plants partially root-parasitic, perennial, herbaceous, caulescent or subcaulescent; leaves alternate or basal, toothed to bipinnatifid; flowers in bracted spikes; corolla strongly bilabiate, narrow, the upper lip compressed on the sides, arched and often beaked at the apex, the lower lip 3-lobed, the middle lobe smaller; capsule oblique, compressed.

Some of the species are known also as duckbill and fernleaf.

Key to the species

1. Galea prolonged into a filiform, recurved beak (curved outward and upward), this as long as or longer than the rest of the corolla; herbage glabrous; stems strictly erect, moderately leafy; leaf blades deeply and incisely pinnatifid or bipinnatifid; inflorescence spiciform, cylindrical, many-flowered; corolla bright pink to claret red..... 1. *P. GROENLANDICA*.
1. Galea not beaked or, if so, then the beak straight or incurved (curved downward), much shorter than the rest of the corolla (2).
2. Leaf blades merely crenate or crenate-dentate, often doubly so, linear or linear-lanceolate; beak of the galea strongly incurved, 4 to 5 mm. long; lower lip of the corolla nearly equaling the galea; stems commonly 30 cm. long or longer, very leafy; herbage glabrous or sparsely pubescent; flowers few, in loose, leafy racemes; corolla 12 to 20 mm. long, white..... 2. *P. RACEMOSA*.
2. Leaf blades pinnatifid or bipinnatifid (3).
3. Galea falcate, the beak short, stout, conic, straight or slightly incurved; corolla 10 to 15 mm. long, ochroleucous; stems stout, strict, moderately leafy, up to 50 cm. long; leaf blades bipinnatifid, with numerous narrow divisions; racemes elongate-spiciform, usually dense, with numerous or many flowers..... 3. *P. PARRYI*.

3. Galea strongly cucullate at apex, not beaked; corolla 25 mm. long or longer (4).
4. Plant subacaulescent; herbage glabrous below the inflorescence, the latter sparsely villous, few-flowered, not surpassing the leaves; leaf blades pinnatifid, with broad, mostly obtuse, crenate-dentate lobes, the teeth conspicuously white-mucronate; corolla purple; anther cells conspicuously aristate at base, the awns projecting like teeth from the hood of the galea ----- 4. *P. CENTRANTHERA*.
4. Plant strongly caulescent, the stems stout, very leafy, up to 1.5 m. long; herbage more or less pubescent below the inflorescence, the latter copiously villous, many-flowered, elongate, greatly surpassing the leaves; leaf blades pinnate, the primary divisions pinnatifid, lanceolate, acute, the secondary lobes serrate, with setose-tipped teeth; corolla greenish yellow; anther cells not aristate.
5. *P. GRAYI*.

1. *Pedicularis groenlandica* Retz, Fl. Scand. Prodr., ed. 2, 145. 1795.

Elephantella groenlandica Rydb., N. Y. Bot. Gard. Mem. 1: 363. 1900.

Baldy Peak, White Mountains, Apache County (*Peebles* and *Smith* 12503), 9,900 feet, August. Greenland to Alaska, south in the mountains to New Mexico, eastern Arizona, and California.

Elephanthead. The Arizona specimens are of the large-flowered form, *P. surrecta* Benth., with the galea more than twice as long as the calyx.

2. *Pedicularis racemosa* Dougl. ex Hook., Fl. Bor. Amer. 2: 108. 1838.

Baldy Peak, White Mountains, Apache County (*Goodding* 613, *Peebles* and *Smith* 12498), 9,600 to 11,000 feet, common in deep coniferous forest, July and August. Canada to New Mexico, eastern Arizona, and California.

3. *Pedicularis parryi* A. Gray, Amer. Jour. Sci. ser. 2, 34: 250. 1862.

Apache, Greenlee, and Coconino Counties, especially in the White Mountains and on the San Francisco Peaks, 7,500 to 12,000 feet, moist mountain meadows, July to September. Wyoming to Montana, south to northern New Mexico and northern Arizona.

4. *Pedicularis centranthera* A. Gray in Torr., U. S. and Mex. Bound. Bot. 120. 1859.

Coconino, northern Mohave, and Gila Counties, probably also in the Santa Catalina Mountains (Pima County), 5,000 to 7,500 feet, common in pine forests, April to June. Colorado, Utah, New Mexico, and Arizona.

5. *Pedicularis grayi* A. Nels., Biol. Soc. Wash. Proc. 17: 100. 1904.

Pedicularis procera A. Gray, Amer. Jour. Sci. ser. 2, 34: 251. 1862. Not Adams, 1823.

White Mountains (Greenlee County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), 8,000 to 10,000 feet, rich soil in coniferous forests, July and August. Wyoming to New Mexico and eastern Arizona.

This tall-stemmed species is sometimes cultivated as an ornamental.

111. BIGNONIACEAE. BIGNONIA FAMILY

Shrubs or small trees; leaves mostly opposite, simple or compound; flowers large and showy, in terminal racemes or panicles; corolla

bilabiate; stamens 5, only 4 of them anther-bearing; ovary superior, 2-celled; stigma bilabiate; fruit an elongate 2-valved capsule; seeds many, winged or comose.

Key to the genera

1. Leaves simple; seeds comose----- 1. CHILOPSIS.
1. Leaves pinnate; seeds with hyaline wings----- 2. TECOMA.

1. CHILOPSIS. DESERTWILLOW

Small tree or large shrub, up to 9 m. (30 feet) high; leaves alternate or the lower ones opposite, simple, linear or linear-lanceolate, entire, elongate; corolla white, often tinged, streaked, or spotted with purple; wing of the seed dissected into hairs.

1. *Chilopsis linearis* (Cav.) Sweet, Hort. Brit. 283. 1827.

Bignonia linearis Cav., Icon. Pl. 3: 35. 1794.

Coconino and Mohave Counties to Greenlee, Cochise, Santa Cruz, Pima, and Yuma Counties, up to 4,000 (rarely 6,000) feet but usually lower, mostly along washes in the deserts and foothills, April to August. Western Texas to southern Nevada, Arizona, southern California, and northern Mexico.

The desertwillow is sometimes cultivated as an ornamental for the sake of its attractive catalpalike flowers. It probably would be useful for planting to control soil erosion. It is browsed only where more palatable forage is scarce. The common form in Arizona is var. *arcuata* Fosberg, with the sterile branchlets nearly or quite glabrous and leaf veins not prominent, but Fosberg⁴⁸ mentions also Arizona specimens approaching var. *glutinosa* (Engelm.) Fosberg, which he distinguishes from var. *arcuata* by the glutinous herbage.

2. TECOMA. TRUMPETBUSH

Shrub; leaves opposite, pinnate, the leaflets 5 or more, lanceolate, long-acuminate, deeply serrate or laciniate; corolla funnellform-campanulate, bright yellow; seeds flat, with a thin entire wing.

1. *Tecoma stans* (L.) H. B. K., Nov. Gen. et Sp. 3: 144. 1818.

Bignonia stans L., Sp. Pl. ed. 2, 871. 1763.

Stenolobium incisum Rose and Standl., Contrib. U. S. Natl. Herbarium 16: 174. 1913.

Pinal, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, dry stony or gravelly slopes, May to September. Southern New Mexico and Arizona, southward into tropical America.

The plant is much cultivated as an ornamental in the warmer parts of the United States. It is stated that the roots are used in Mexico medicinally and for making a sort of beer. The Arizona form, var. *angustatum* Rehder, seldom exceeds a height of 2.5 m. (8 feet).

⁴⁸ FOSBERG, F. RAYMOND. VARIETIES OF THE DESERTWILLOW, CHILOPSIS LINEARIS. Madroño 3: 362-366. 1936.

112. MARTYNIACEAE. UNICORNPLANT FAMILY

1. MARTYNIA.⁴⁹ UNICORNPLANT

Coarse viscid-pubescent annual herbs; leaves petioled, the lower ones mostly opposite, the blades large, entire to shallowly lobed; flowers few, large and showy, in terminal racemes; calyx somewhat inflated, subtended by 1 or 2 bractlets; corolla somewhat bilabiate; stamens 4, all perfect or 2 of them sterile; anthers gland-tipped, the cells divaricate; pods large, somewhat fleshy, ending in a long, incurved, hooked, dehiscent beak.

These plants are usually known in Arizona as devilsclaw. The young pods are sometimes eaten as a vegetable. The black designs in the baskets made by the Pima and other Arizona Indians are woven with the split mature pods of *M. parviflora*. The plants are regarded as somewhat of a pest on sheep ranges because the hooked beaks of the pods become entangled in the fleece.

Key to the species

1. Corolla reddish purple to nearly white, often dotted or blotched with red purple and streaked with yellow, the limb about 2.5 cm. wide, the tube only slightly ventricose; leaf blades usually longer than wide, nearly entire to shallowly sinuate-lobed..... 1. *M. PARVIFLORA*.
1. Corolla yellow or copper-colored, often dotted or spotted with red or brown, the limb 3 to 4 cm. wide; leaf blades usually wider than long (2).
2. Leaf blades distinctly lobed; bracts elliptic to broadly oblong; calyx with lobes nearly as long as the tube; corolla tube strongly ventricose..... 2. *M. ARENARIA*.
2. Leaf blades nearly entire to shallowly, sinuately lobed; bracts ovate to suborbicular; calyx with lobes much shorter than the tube; corolla tube scarcely ventricose..... 3. *M. ALTHEAEFOLIA*.

1. *Martynia parviflora* Wooton, Torrey Bot. Club Bul. 25: 453. 1898.

Proboscidea parviflora Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 602. 1915.

Gila and Yavapai Counties to Cochise and Pima Counties, 1,200 to 5,000 feet, plains, mesas, and roadsides, April to October. Western Texas to southern Nevada, Arizona, and northern Mexico.

A collection near Sacaton, Pinal County (*Peebles* et al. 75) differs from the characterization in the key in having leaf blades considerably wider than long and the corolla tube strongly ventricose. These are characters of *M. fragrans* Lindl. but the corolla is too small for that species as described (see footnote 49, Van Eseltine, p. 21). The specimen cited has the horns of the fruit exceptionally long, both absolutely and relatively, being nearly 30 cm. long and nearly 3 times as long as the body of the fruit.

2. *Martynia arenaria* Engelm. in Wisliz., Mem. North. Mex. 100. 1848.

Proboscidea arenaria Decne., Ann. Sci. Nat. ser. 5, 3: 326. 1865.

Pinal, Cochise, and Pima Counties (probably elsewhere), plains and mesas, July to September. Western Texas to southern Arizona

⁴⁹ Reference: VAN ESELTIME, G. P. A PRELIMINARY STUDY OF THE UNICORN PLANTS. N. Y. Agr. Expt. Sta. Tech. Bul. 149. 1929.

and northern Mexico. Corolla copper-colored outside, yellow within, the throat spotted with purple, the limb streaked with orange, the upper lobes spreading.

3. *Martynia altheaefolia* Benth., Bot. Voy. Sulph. 37. 1844.

Proboscidea altheaefolia Decne., Ann. Sci. Nat. Bot. ser. 5, 3: 324. 1865.

Yuma, Yuma County (*H. Brown* in 1905). Western Texas to southeastern California and northern Mexico.

Brown's specimen corresponds with the characterization of *M. altheaefolia* (see footnote 49, p. 835, Van Eseltine, pp. 13, 19), except that the calyx lobes are rather more than one-half as long as the tube. Another collection near Yuma (*Peebles* et al. 4956) seems to be intermediate between this species and *M. arenaria*. It is somewhat doubtful that the latter is specifically distinct from *M. altheaefolia*.

113. OROBANCHACEAE. BROOMRAPE FAMILY

Plants herbaceous, without chlorophyll, root-parasitic; stems fleshy; leaves alternate, reduced to scales; corolla irregular, bilabiate, the tube narrow, the lower lip 3-lobed; stamens commonly 4, in pairs; capsule 1-celled, 2-valved; seeds many, very small.

Key to the genera

1. Calyx very irregular, spathe-like, deeply cleft on the lower side, several-toothed on the upper side; upper lip of the corolla deeply concave.
 1. CONOPHOLIS.
1. Calyx nearly regular, the lobes or teeth almost equal; upper lip of the corolla not deeply concave..... 2. OROBANCHE.

1. CONOPHOLIS. SQUAWROOT

Plant yellowish; stems clustered, covered with imbricate scales; inflorescence spikelike, elongate, not branched, dense, conspicuously bracted, the flowers in several rows; corolla strongly bilabiate, the upper lip arched, emarginate.

1. *Conopholis mexicana* A. Gray, Amer. Acad. Arts and Sci. Proc. 18: 131. 1883.

Southern Apache County and northern Gila County to Cochise County, 5,000 to 6,000 feet, May and June. New Mexico, Arizona, and Mexico.

The plant grows with, and is presumably parasitic on, species of *Pinus*, *Cupressus*, *Juglans*, and *Quercus*. The plant resembles a cluster of slender pine cones, reaching a length of about 25 cm. in fruit.

2. OROBANCHE.⁵⁰ BROOMRAPE

Plants glandular-pilose, purplish or yellowish brown; inflorescences loosely fasciculate or densely spikelike; calyx 5-cleft; corolla more or less curved, the upper lip 2-lobed.

These plants are sometimes called cancer-root, in reference to their reputed efficacy in treatment of ulcers, by application of the stems to

⁵⁰ References: MUNZ, P. A. THE NORTH AMERICAN SPECIES OF OROBANCHE, SECTION MYZORRHIZA. Torrey Bot. Club Bul. 57: 611-624. 1930. ACHEY, D. M. A REVISION OF THE SECTION GYMNOCAULIS OF THE GENUS OROBANCHE. Torrey Bot. Club Bul. 60: 441-451. 1933.

the sore. The Navajo Indians are reported to use a decoction of the plant for this purpose. The entire plant, or the underground parts only, were eaten by the southwestern Indians. Some of the Old World species are parasitic on clover and other cultivated plants.

Key to the species

1. Flowers not subtended by bractlets, few, in loose fasciculate inflorescences; pedicels commonly much longer than the flowers; corolla somewhat falcate; Section *Gymnocaulis*----- 1. *O. FASCICULATA*.
1. Flowers subtended by bractlets, many, in dense, spikelike inflorescences, these sometimes branched below; pedicels none or shorter than the flowers; corolla straight or nearly so, brownish purple and white: Section *Myzorrhiza* (2).
2. Corolla lobes rounded----- 2. *O. MULTIFLORA*.
2. Corolla lobes narrowed toward the acute or acutish apex.----- 3. *O. LUDOVICIANA*.

1. *Orobanche fasciculata* Nutt., Gen. Pl. 2: 519. 1818.

Navajo, Coconino, and Mohave Counties to Cochise and Pima Counties, 4,000 to 8,000 feet, mostly in chaparral and in coniferous forests, May to August. Michigan to British Columbia, south to Texas, Arizona, and southern California.

Both the typical form, with the plant and the corolla brownish purple, and var. *lutea* (Parry) Achey (*Phelipaea lutea* Parry), with the plant and the corolla dull yellow, sometimes tinged with pink, occur in Arizona, the latter being the commoner form. Arizona specimens with exceptionally large corollas, therein approaching var. *franciscana* Achey, are not infrequent. The plants are parasitic on *Artemisia tridentata*, *Eriogonum wrightii*, and other plants.

2. *Orobanche multiflora* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 179. 1848.

Apache, Navajo, and Pima Counties (doubtless elsewhere), 5,000 to 6,000 feet, sandy soil, April to July. Wyoming to Washington, south to northern Mexico and southern California.

Most of the Arizona specimens belong to var. *arenosa* (Suksdorf) Munz, with corolla lips not more than 5 mm. long. A collection in the Santa Catalina Mountains (*Pringle* in 1884) with lips 6 to 7 mm. long represents var. *pringlei* Munz, heretofore reported only from Chihuahua.

3. *Orobanche ludoviciana* Nutt., Gen. Pl. 2: 58. 1818.

Navajo and Coconino Counties to Pima, Santa Cruz, and Yuma Counties, 500 to 7,000 feet, March to July. Southern Utah and Nevada to western Texas, Arizona, southeastern California, and northwestern Mexico.

Two intergrading forms occur in Arizona. These are: (1) var. *cooperi* (A. Gray) G. Beck (*O. cooperi* A. Gray), with lips of the corolla 3 to 6 mm. long and lobes of the lower lip lanceolate, tapering gradually to an acute tip; (2) var. *latiloba* Munz, with lips of the corolla 6 to 9 mm. long and lobes of the lower lip oblong or oblong-ovate, narrowed abruptly at apex. The latter form occurs only in the southern part of the State. The plants are normally parasitic on *Franseria* and other Compositae, but specimens of var. *cooperi* collected near Flagstaff showed attachment to roots of cacti (*Opuntia*, *Echinocactus*).

114. ACANTHACEAE. ACANTHUS FAMILY

Plants perennial, herbaceous or shrubby; stems commonly quadrangular; leaves opposite, simple, entire; inflorescences usually bracteate, cymose, racemose, spicate, or the flowers solitary; corolla more or less irregular; anther-bearing stamens 2, or 4 in unequal pairs; ovary superior, borne on a disk; fruit a 2-celled, elastically dehiscent capsule.

Many plants of this family are cultivated as ornamentals, notably the European *Acanthus mollis* and the South African climber, *Thunbergia alata*.

Key to the genera

1. Flowers in dense terminal spikes, closely subtended by imbricate bracts, these cuspidate or aristate at apex; plants herbaceous; stamens 2 (2).
2. Plant subcaulescent, with all of the well-developed leaves basal or nearly so and short lived; floral bracts obscurely veined (only the midrib at all conspicuous), with scarious margins prolonged into 2 winglike teeth on each side of the terminal awn; corolla limb purple. --- 1. ELYTRARIA.
2. Plant caulescent, the stems with several pairs of well-developed leaves; floral bracts prominently 3-ribbed and often with 2 smaller additional veins, not scarious-margined; corolla limb pale yellow, often tinged or spotted with purple. ----- 7. TETRAMERIUM.
1. Flowers not in dense spikes, or not closely subtended by imbricate bracts (3).
3. Bracts subtending each flower in pairs, thin, valvelike, closely compressed, nearly orbicular, very different from the foliage leaves. 8. DICLIPTERA.
3. Bracts not in valvelike pairs and not very different from the foliage leaves except in size (4).
4. Corolla convolute in the bud, only slightly irregular; stamens 4, the filaments much longer than the 2-celled anthers; stigma linear; plants herbaceous (5).
5. Flowers axillary, solitary or in few-flowered clusters, sessile or nearly so; corolla less than 3 cm. long; anthers acutish, mucronulate.
 2. DYSCHORISTE.
5. Flowers in loose terminal panicles, mostly distinctly pedicelled; corolla more than 3 cm. long; anthers obtuse, mucinous. --- 3. RUELLIA.
4. Corolla imbricate in the bud, strongly irregular, bilabiate (6).
6. Stamens 4, the anthers 1-celled, pubescent, as long as or longer than the filaments; stigma somewhat funnellform, small. --- 4. BERGINIA.
6. Stamens 2, the anthers 2-celled, much shorter than the filaments; stigma minute, capitate or somewhat flattened (7).
7. Anther cells inserted at the same height or very nearly so, parallel, contiguous, mucinous; plants shrubby or suffruticose (8).
8. Corolla very open, 1 to 1.5 cm. long, the lobes about twice as long as the tube. ----- 5. CARLOWRIGHTIA.
8. Corolla tubular-funnelform, more than 2 cm. long, the lobes shorter than the tube. ----- 6. ANISACANTHUS.
7. Anther cells inserted at different heights (9).
9. Corolla white, the tube very slender, 3 cm. long or longer; plant herbaceous or suffruticose; leaf blades lanceolate.
 9. SIPHONOGLOSSA.
9. Corolla red; plants shrubby; leaf blades oval or ovate (10).
10. Lower cell of the anther without a conspicuous basal callus, merely mucronulate. ----- 10. JACOBINIA.
10. Lower cell of the anther with a conspicuous whitish basal callus.
 11. BELOPERONE.

1. ELYTRARIA

Plant herbaceous; scapes numerous, decumbent or spreading, entirely covered with closely imbricate, glumelike bracts; floral bracts like those of the scapes but larger, ciliate with short soft hairs, otherwise glabrous, bluish green; calyx 4-parted; corolla imbricate in the bud, narrowly funnellform.

1. Elytraria imbricata (Vahl) Pers., Syn. Pl. 1: 23. 1805.*Justicia imbricata* Vahl, Eclog. Amer. 1: 1. 1796.

Cochise, Santa Cruz, and Pima Counties, 3,600 to 5,000 feet, mesas and slopes among rocks, April to September. Western Texas to southern Arizona, southward to tropical America.

2. DYSCHORISTE

Plant herbaceous, canescent-puberulent; stems decumbent or prostrate; leaves sessile, the blades oblanceolate or obovate; corolla violet or violet purple, moderately irregular, convolute in the bud; stamens 4, the 2 pairs somewhat unequal in length; capsule narrowly oblong; seeds 2 to 4.

1. Dyschoriste decumbens (A. Gray) Kuntze, Rev. Gen. Pl. 2: 486. 1891.*Calophanes decumbens* A. Gray, Syn. Fl., ed. 2, 2¹: 325. 1886.

Cochise, Santa Cruz, and Pima Counties, 4,800 to 5,500 feet, plains, mesas, and foothills, in the open or with oaks, junipers, etc., April to October. Western Texas, southern Arizona, and Mexico.

3. RUELLIA

Plants herbaceous, glandular-pilose in the inflorescence; stems mostly erect or ascending, branched; leaves petioled, the blades ovate; calyx deeply 5-cleft or 5-parted; corolla violet, moderately irregular, convolute in the bud; stamens 4, the 2 pairs somewhat unequal in length; capsule narrow, often subclavate; seeds 6 or more.

1. Ruellia nudiflora (Engelm. and Gray) Urban, Symb. Ant. 7: 382. 1912.*Dipteracanthus nudiflorus* Engelm. and Gray, Boston Jour. Nat. Hist. 5: 229. 1845.

Cochise, Santa Cruz, and Pima Counties, 2,300 to 4,000 feet, canyons and foothills, usually among rocks, May to August. Southern Texas, southern Arizona, and Mexico.

The var. *glabrata* Leonard is commoner in Arizona than the typical, more pubescent form. *R. nudiflora* is worth cultivating as an ornamental because of its large, richly colored flowers.

4. BERGINIA

A low shrub with whitish branches; leaf blades narrowly lanceolate, entire; flowers subtended by 2 bractlets, in interrupted leafy-bracted spikes; bractlets and calyx lobes narrow, acute, rigid; corolla about 1 cm. long, pink, the limb bilabiate.

***1. Berginia virgata** Harv. ex Benth. and Hook., Gen. Pl. 2: 1097. 1873.

The writers have seen no specimens from Arizona, but the plant has been collected near Altar, Sonora, not far from the southern boundary of the State.

5. CARLOWRIGHTIA

Plants straggling undershrubs with slender branches; leaf blades entire, linear to ovate-lanceolate; flowers few, in spikes, racemes, or panicles; corolla imbricate in the bud, purple, or white streaked with purple, the tube narrow, the limb 4-cleft; stamens 2; capsule flattened, acuminate at apex, stalked; seeds flat.

Key to the species

1. Leaf blades narrowly linear; flowers in narrow racemelike panicles; corolla purple, the lobes 5 to 7 mm. long; filaments hirsutulous; anthers sagittate; herbage puberulent. ----- 1. *C. LINEARIFOLIA*.
1. Leaf blades lanceolate or ovate-lanceolate; flowers in interrupted spikes, these often forming a very open, few-flowered, leafy panicle; corolla white, the upper (posterior) lobe with a median yellow spot bordered by purple, the lobes 8 to 12 mm. long; filaments glabrous; anthers not sagittate, at most subcordate at base; herbage finely canescent or hirsutulous. ----- 2. *C. ARIZONICA*.

1. **Carlowrightia linearifolia** (Torr.) A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 364. 1877.

Schaueria linearifolia Torr., U. S. and Mex. Bound. Bot. 123. 1859.

Graham County, near Safford and Matthews, 2,500 to 3,000 feet, mesas and washes, August and September. Western Texas to south-eastern Arizona.

2. **Carlowrightia arizonica** A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 364. 1877.

Maricopa, Cochise, Santa Cruz, Pima, and Yuma Counties, 2,500 to 4,000 feet, rather common on dry stony slopes, April and May, type from Camp Grant, Graham County (*Palmer* in 1867). Southern Arizona and northwestern Mexico.

The plant is browsed by cattle and sheep. There is much variation in appearance in different seasons or at different stages of growth. Typically the flowers are in slender, elongate, interrupted spikes, with the floral leaves reduced to small bracts, but there also occurs a more compact form with flowers scattered in the axils of well-developed leaves.

6. ANISACANTHUS

A shrub, up to 2.5 m. (8 feet) high, with rather stout branches and whitish exfoliating bark; leaves short-petioled, the blades lanceolate or ovate-lanceolate; corolla normally brick red, sometimes yellow or orange, the tube long and slender, the limb bilabiate, the lower lip 3-parted; capsule flattened, long-stalked.

1. **Anisacanthus thurberi** (Torr.) A. Gray, Syn. Fl. 2¹: 328. 1878.

Drejera thurberi Torr., U. S. and Mex. Bound. Bot. 124. 1859.

Greenlee County to Yavapai County, south to Cochise, Santa Cruz, Pima, and Yuma Counties, 2,500 to 5,200 feet, mostly in canyons and along washes, flowering almost throughout the year but chiefly in spring. Southwestern New Mexico, Arizona, and northern Mexico.

Known as chuparosa and desert-honeysuckle. The plant is browsed by cattle and sheep, especially when other forage is scarce.

7. TETRAMERIUM

Plant herbaceous or suffrutescent; stems several, erect or decumbent, leafy, the old bark exfoliating; foliage leaves and bracts bright green, conspicuously ciliate with long stiff hairs and usually sparsely hirsute on the veins, often also puberulent; spikes 4-rowed; corolla slightly bilabiate, the tube longer than the limb, the upper lip entire, the lower lip 3-parted.

1. *Tetramerium hispidum* Nees in DC., Prodr. 11: 468. 1847.

Santa Cruz and Pima Counties, 3,000 to 5,000 feet, among rocks and shrubs, usually in partial shade, April to October. Southern Arizona and Mexico.

This plant is reported to be very palatable to livestock.

8. DICLIPTERA

Plants herbaceous; stems erect or decumbent, branched, leafy; flowers each subtended by a pair of valvelike bractlets, solitary in the axils or in few-flowered cymes, the whole inflorescence a loose leafy panicle; corolla rose purple, deeply bilabiate, the lips entire to shallowly lobed; stamens 2.

Key to the species

1. Bractlets cordate, subcordate, or slightly cuneate at base, separate or very nearly so; cymes mostly on peduncles surpassing the leaves.
 1. *D. RESUPINATA*.
1. Bractlets truncate and abruptly cuneate at base, united the length of the wedge-shaped portion; cymes shorter than the leaves, sessile or subsessile.
 2. *D. PSEUDOVERTICILLARIS*.

1. *Dicliptera resupinata* Juss., Paris Mus. Hist. Nat. Ann. 9: 268. 1807.

Dicliptera torreyi A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 309. 1885.

Diapedium torreyi Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 598. 1915.

Pima County, 3,000 to 4,000 feet, rocky slopes and canyons, April to September. Southwestern New Mexico, southern Arizona, and Mexico.

2. *Dicliptera pseudoverticillaris* A. Gray, Amer. Acad. Arts and Sci. Proc. 20: 308. 1885.

Pima County, south of Tucson (*Thornber* 5351, 5512) and in the Baboquivari Mountains (*Loomis* and *King* 3255). Southern Arizona and northwestern Mexico.

The Arizona specimens referred to this species, as compared with the type from Altar Valley, Sonora (*Pringle* in 1884), are less extreme in their characters, approaching *D. resupinata*.

9. SIPHONOGLOSSA

Plant herbaceous or nearly so; stems clustered, usually decumbent, commonly puberulent; leaves short-petioled, the blades lanceolate; flowers clustered in the axils; corolla white, the tube very long and slender, the limb short, the lower lip spreading, deeply 3-lobed.

1. *Siphonoglossa longiflora* (Torr.) A. Gray, Syn. Fl. ed. 2, 2¹: 328. 1886.

Adhatoda (?) *longiflora* Torr., U.S. and Mex. Bound. Bot. 125. 1859.

Pinal and Pima Counties, 3,000 to 4,000 feet, rocky slopes and canyons, April to October, type from "southern Arizona." Apparently known only from southern Arizona but doubtless also in Sonora.

Domestic and various wild animals feed upon this plant, especially in times of drought, and it is able to withstand close browsing. The white flowers are vespertine, slightly fragrant, and ephemeral.

10. JACOBINIA

Plant shrubby, up to 1.5 m. (5 feet) high, much branched, the herbage soft-villous; leaves petioled, the blades ovate; flowers in dense, sessile or subsessile, axillary clusters; corolla broadly funnel-form, brilliant red, the lower lip deeply 3-lobed; stamens 2, the anther cells unequal.

1. *Jacobinia candicans* (Nees) Benth. and Hook. ex Hook. and Jackson, Index Kew. 1: 1246. 1893.

Adhatoda candicans Nees in DC., Prodr. 11: 396. 1847.

Vicinity of Canyon Lake (eastern Maricopa County), Ajo Mountains (western Pima County), 1,700 to 2,000 feet, rocky slopes, April and May. Southern Arizona and Mexico.

11. BELOPERONE

A shrub, up to 2 m. high, with spreading brittle branches and canescent-puberulent herbage; leaves petioled, the blades ovate; flowers in naked racemes; corolla tubular-funnel-form, rather dull red, strongly bilabiate, the lower lip shallowly lobed or toothed; stamens 2, exerted, the anther cells unequal.

1. *Beloperone californica* Benth., Bot. Voy. Sulph. 38. 1844.

Pinal, Maricopa, Pima, and Yuma Counties, 1,300 to 3,500 feet, frequent on dry rocky slopes, December to May. Southern Arizona, southeastern California, and northwestern Mexico.

Called chuparosa in Sonora. The plant is browsed to some extent by livestock. The flowers are very attractive to hummingbirds, and it is reported that they were eaten by the Papago Indians. The name "honeysuckle" is sometimes used locally for this plant.

115. PLANTAGINACEAE. PLANTAIN FAMILY

1. PLANTAGO,⁵¹ PLANTAIN, INDIANWHEAT

Scapose herbs with the foliage leaves all basal; flowers small, perfect or unisexual, regular, in terminal, long-peduncled, bracted spikes; calyx and corolla 4-divided or 4-lobed, persistent, usually scarious or scarious-margined; stamens 2 or 4, separately attached to the corolla; fruit a circumscissile capsule.

⁵¹ References: POE, IONE. A REVISION OF THE PLANTAGO PATAGONICA GROUP OF THE UNITED STATES AND CANADA. Torrey Bot. Club Bul. 55: 406-420. 1928.

WHEELER, LOUIS C. NOTES ON PLANTAGO IN THE PACIFIC STATES. Amer. Midland Nat. 20: 331-333. 1938.

Some of the native species afford excellent forage for sheep and cattle. The seeds become mucilaginous when wet and are produced in such quantity where the plants are abundant as to cement the sand grains after rain, forming a thin crust on the surface of the soil. Seeds of the Arizona species that are known as Indianwheat (*P. fastigiata*, *P. purshii*) are sometimes gathered and used as a substitute for the psyllium seeds of commerce, which are obtained from an Old World species, *Plantago psyllium*.

Key to the species

1. Flowers more or less dioecious or polygamous, many of them cleistogamous (the corolla remaining closed and its lobes erect or connivent), other flowers with spreading corolla lobes and exerted stamens; plants annual or biennial; leaf blades often coarsely dentate or cleft (2).
2. Leaves and scapes inconspicuously pubescent or glabrate, the hairs short, mostly appressed; leaf blades filiform or linear, less than 5 mm. wide; spikes loosely flowered, often interrupted below; calyx glabrous; corolla white or pale straw-colored; capsule with 8 or more seeds.
 1. *P. HETEROPHYLLA*.
2. Leaves and scapes copiously villous or subhirsute; leaf blades elliptic or oblong-oblancoleate, seldom less than 8 mm. wide; spikes usually densely flowered; calyx villous or subhirsute; corolla buff or orange-colored; capsule 2- to 4- seeded (3).
 3. Capsule 3-seeded; plant flowering in late summer----- 2. *P. HIRTELLA*.
 3. Capsule usually 2-seeded; plants flowering in spring (4).
 4. Bracts and sepals obtuse; fruiting calyx less than 3 mm. long; mature seeds yellowish brown, less than 2 mm. long, deeply concave on the ventral face----- 3. *P. VIRGINICA*.
 4. Bracts and sepals acute or apiculate; fruiting calyx 3 to 4 mm. long; mature seeds dark red, 2.5 to 3 mm. long, flat to slightly concave on the ventral face----- 4. *P. RHODOSPERMA*.
1. Flowers not dioecious, all perfect, none cleistogamous; corolla lobes permanently spreading or reflexed (5).
 5. Leaf blades broadly lanceolate, oblanceolate, or broader, seldom less than 10 mm. wide; plants glabrous or loosely pubescent, not sericeous or lanate, usually perennial, with a thick caudex (6).
 6. Spikes short-conic, becoming oblong, very dense, 1 to 6 cm. long at maturity; leaf blades lanceolate or oblong-lanceolate, entire or denticulate; seeds 2, concave on the ventral face----- 5. *P. LANCEOLATA*.
 6. Spikes cylindric, moderately dense or rather loose, usually 6 cm. long or longer at maturity (7).
 7. Leaf blades broadly ovate, abruptly contracted at base; scapes seldom woolly at base; seeds several or numerous, not more than 1 mm. long, angulate, finely reticulate, not concave ventrally. 6. *P. MAJOR*.
 7. Leaf blades lanceolate, oblanceolate, or elliptic, tapering at base; scapes usually woolly at base; seeds not more than 4, 2 to 3 mm. long, rounded on the back, somewhat concave ventrally. 7. *P. ERIOPODA*.
 5. Leaf blades linear or lanceolate, commonly much less than 10 mm. wide; plants copiously silky-villous, sericeous, or lanate (except in *P. wrightiana*), annual or winter annual; spikes cylindric at maturity; seeds 2, deeply concave on the ventral face (8).
 8. Bracts subulate or narrowly lanceolate, not or very indistinctly scarious-margined, at least the lower ones commonly longer than the calyx.
 8. *P. PURSHII*.
 8. Bracts broadly lanceolate to nearly orbicular, conspicuously scarious-margined, none longer than the calyx (9).
 9. Leaves not at all rigid, conspicuously whitish sericeous or lanate, not noticeably discolored in drying; spikes at maturity 1 to 4 cm. long, seldom more than 4 times as long as wide; lowest bracts much like the sepals, broadly ovate or nearly orbicular, broadly scarious-margined to the apex, the scarious portion forming more than one-half of the area of the bract; seeds reddish brown, somewhat shiny.
 9. *P. FASTIGIATA*.

9. Leaves somewhat rigid, turning dark in drying; spikes at maturity commonly 3 to 6 cm. long and more than 4 times as long as wide; lowest bracts unlike the sepals, broadly lanceolate to broadly deltoid, not scarious-margined to the apex, the scarious portion forming less than one-half of the area of the bract; seeds not shiny (10).
 10. Herbage glabrous or sparsely villous; bracts triangular-lanceolate or deltoid; seeds olive brown at maturity----- 10. *P. WRIGHTIANA*.
 10. Herbage copiously villous or sericeous; bracts ovate-lanceolate; seeds black, or nearly so, at maturity----- 11. *P. ARGYRAEA*.

1. ***Plantago heterophylla*** Nutt., Amer. Phil. Soc. Trans. ser. 2, 5: 177. 1837.

Near Casa Grande, Pinal County, 1,400 feet (*Peebles* 936), in a stream bed, February. New Jersey to Florida, Texas, southern Arizona, and southern California.

2. ***Plantago hirtella*** Kunth in H. B. K., Nov. Gen. et Sp. 2: 187. 1817.

Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), 5,500 to 8,000 feet, springy or boggy places along streams, July to September. Southern Arizona to tropical America.

The species is represented in Arizona by var. *mollior* Pilger.

3. ***Plantago virginica*** L., Sp. Pl. 113. 1753.

Coconino and Pima Counties (doubtless elsewhere), 3,000 to 7,000 feet, commonly in moist soil, February to April (in southern Arizona). Connecticut to Michigan and Missouri, south to Florida, Arizona, and southern California.

4. ***Plantago rhodosperma*** Decne. in DC., Prodr. 13¹: 722. 1852.

Gila, Maricopa, Pinal, and Pima Counties, 1,200 to 5,000 feet, mostly along streams, March to May. Mississippi and Oklahoma to Texas and Arizona.

5. ***Plantago lanceolata*** L., Sp. Pl. 113. 1753.

Navajo, Coconino, Pinal, and Pima Counties, rare in Arizona, lawns and meadows, April to July. Widely distributed in the United States; naturalized from Europe.

Commonly known as ribwort or buckhorn plantain.

6. ***Plantago major*** L., Sp. Pl. 112. 1753.

Navajo and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 1,000 to 7,000 feet, moist soil along streams, March to October. Widely distributed in the United States; naturalized from Europe.

Common plantain.

7. ***Plantago eriopoda*** Torr., Ann. Lyc. N. Y. 2: 237. 1828.

Kaibab Plateau, Coconino County, 8,700 feet (*Kearney* and *Peebles* 13739), moist meadow, August. Canada to New Mexico, northern Arizona, and California.

The collection cited is not typical, being relatively narrow-leaved, with loosely villous herbage and very little "wool" about the crown.

8. ***Plantago purshii*** Roem. and Schult., Syst. Veg. 3: 120. 1818.

Apache County to Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 1,000 to 7,000 feet, dry slopes and mesas, February to July. Canada to Texas, Arizona, and southern California.

There occur in Arizona both the typical form of the species, with

the basal bracts of the spike not more, usually less, than twice as long as the calyx, and var. *picta* (Morris) Pilger (*P. picta* Morris, *P. xerodea* Morris, *P. ignota* Morris), with the basal bracts 2 to 3 times as long as the calyx. The latter is the more common form in the southern part of the State.

9. ***Plantago fastigiata*** Morris, Torrey Bot. Club Bul. 27: 116. 1900.

Plantago insularis Eastw. var. *fastigiata* Jepson, Man. Fl. Pl. Calif. 956. 1925.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 3,000 feet or lower, abundant, dry plains and mesas, January to May (occasionally in autumn), type from Tucson (*Toumey* 335a). Southern Utah and Nevada, Arizona, and southern California.

10. ***Plantago wrightiana*** Decne. in DC., Prodr. 13¹: 712. 1852.

Plantago hookeriana Fisch. and Mey. var. *nuda* (A. Gray) Poe, Torrey Bot. Club Bul. 55: 416. 1928.

Near Prescott (Yavapai County), Pinal Mountains (Gila County), about 5,000 feet, openings in pine woods, May to July. Western Texas to central Arizona, Oregon, and California.

11. ***Plantago argyraea*** Morris, Torrey Bot. Club Bul. 27: 111. 1900.

Plantago purshii var. *argyraea* Poe, *ibid.* 55: 414. 1928.

Navajo, Coconino, and Yavapai Counties, 6,000 to 7,500 feet, mostly in pine forest, June to August, type from Castle Creek, Yavapai County (*Toumey* 355c). Western New Mexico and Arizona.

116. RUBIACEAE. MADDER FAMILY

Plants annual or perennial, herbaceous or shrubby; leaves opposite or appearing verticillate, usually with stipules, simple, entire; flowers mostly perfect, regular or very nearly so, 4- or 5-merous; calyx with the tube completely adnate to the ovary and the limb reduced to teeth or lobes, or obsolete; fruit a capsule, or achenelike, or separating at maturity into 2 to 4 usually indehiscent carpels.

A very large, mainly tropical family. Its best-known members are the coffeetree (*Coffea arabica*), the trees from whose bark quinine is obtained (*Cinchona* spp.), and the formerly important dye plant, madder (*Rubia tinctoria*). The Arizona representatives are of almost no economic importance.

Key to the genera

1. Ovules and seeds several in each carpel; fruits capsular, 2-celled; flowers 4-merous (2).
2. Plant large, suffruticose; leaf blades lanceolate to ovate; corolla tubular, scarlet ----- 3. BOUVARDIA.
2. Plants small, herbaceous or barely suffruticose; leaf blades linear, narrowly lanceolate, or spatulate; corolla salverform, pink or white (3).
3. Capsule wholly adnate to the calyx tube; seeds angled -- 1. OLDENLANDIA.
3. Capsule mostly free from the calyx; seeds saucer-shaped - 2. HOUSTONIA.
1. Ovule solitary in each carpel (4).
4. Plant a shrub; flowers in dense globose heads ----- 4. CEPHALANTHUS.
4. Plants herbaceous or (in a few species of *Galium*) suffruticose or suffruticose; flowers not in globose heads (5).
5. Stipules similar to and nearly as large as the blades, the leaves thus appearing to be in whorls of 4 or more; corolla rotate ---- 9. GALIUM.
5. Stipules unlike the blades and much smaller; leaves opposite, the floral ones sometimes appearing whorled; corolla salverform or funnelliform (6).

6. Flowers on long slender divaricate pedicels; fruits hispid with hooked hairs, didymous; stipules small, interpetiolar (not forming a sheath around the stem), entire or few-toothed..... 5. *KELLOGGIA*.
6. Flowers sessile or nearly so, in axillary or terminal cymules (rarely solitary in the leaf axils); fruits not hispid with hooked hairs; stipules connate, forming a sheath around the stem, cuspidate or setose (7).
7. Fruit circumscissile, the upper part falling off with the calyx limb; seeds about as wide as long, 4-lobed..... 8. *MITRACARPUS*.
7. Fruit not circumscissile, the carpels separating partly or completely by longitudinal cleavage; seeds elongate, not lobed (8).
8. Calyx limb with the teeth united at base, deciduous at or before the separation of the carpels..... 6. *CRUSEA*.
8. Calyx limb of separate or nearly separate teeth, these persistent even after the carpels separate..... 7. *DIODIA*.

1. OLDENLANDIA

Plant annual, small, glabrous; stems slender, erect, often diffusely branched; leaves opposite, the blades narrow; flowers small, all alike, in terminal cymes or solitary in the forks; calyx teeth subulate; corolla whitish, salverform; capsule hemispheric and somewhat quadrangular

1. *Oldenlandia greenei* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 77. 1883.

Cochise, Santa Cruz, and Pima Counties, 5,000 to 6,000 feet, rich soil in woods, August and September. Southern New Mexico and Arizona (doubtless also in northern Mexico).

2. HOUSTONIA

Plants perennial, caespitose, herbaceous or barely suffrutescent; stems short, diffuse or procumbent; leaves opposite, or appearing fascicled due to the shortening of the internodes; flowers dimorphic in the relative length of the stamens and the style, some of them cleistogamous; corolla white to deep pink, salverform; peduncles recurved in fruit; capsules didymous.

Key to the species

1. Plant rather densely caespitose, subcaulescent; leaves mostly basal or nearly so, erect; corolla bright pink, tubular-salverform, the tube very slender, 10 to 24 mm. long, about 3 times as long as the lobes..... 1. *H. RUBRA*.
1. Plant loosely caespitose, caulescent, the stems leafy, up to 20 cm. long; leaves spreading or ascending; corolla white or pinkish, funnellform-salverform, the tube 3 to 4 mm. long, not more than one and one-half times as long as the lobes..... 2. *H. WRIGHTII*.

1. *Houstonia rubra* Cav., Icon. Pl. 5: 48. 1799.

Navajo, Cochise, and Santa Cruz Counties (doubtless elsewhere), 4,000 to 6,000 feet, mesas and dry rocky hills, often in sandy soil, May to July. New Mexico, Arizona, and Mexico.

2. *Houstonia wrightii* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 202. 1882.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,000 to 7,500 feet, dry mesas and slopes, among chaparral shrubs, oaks, or pines, common, June to September. Western Texas to Arizona and Mexico.

3. BOUVARDIA

Plant suffrutescent or shrubby, glabrous, 1 m. high or less; stems branched, the old bark whitish brown; leaves mostly in whorls of 3, the blades lanceolate or ovate-lanceolate, up to 8 cm. long; flowers dimorphic in the length of the stamens and the style, in mostly terminal cymes; calyx lobes subulate, persistent; corolla slender, 2 to 3 cm. long; capsules didymous, subglobose; seeds flat, peltate, winged.

A handsome shrub, worthy of cultivation, with neat foliage and clusters of bright red (occasionally pink or white) honeysucklelike flowers.

1. **Bouvardia glaberrima** Engelm. in Wisliz., Mem. North. Mex. 106. 1849.

Bouvardia ovata A. Gray, Pl. Wright. 2: 67. 1853.

Southern Apache County to Cochise, Santa Cruz, and Pima Counties, 4,500 to 6,500 feet, canyons and slopes, preferring partial shade, May to September, type of *B. ovata* from between the San Pedro River and Santa Cruz, perhaps in Arizona (*Wright* 1117). Southern New Mexico and Arizona, and northern Mexico.

4. CEPHALANTHUS. BUTTONBUSH

Shrub, up to 2.5 m. (8 feet) high; leaves large, opposite or in whorls of 3, the blades broadly lanceolate to oblong-ovate; flowers small, very numerous, in dense globose, long-peduncled heads, 4-merous; corolla tubular-funnelform, whitish; fruits achenelike, obpyramidal, 2-celled, 1- or 2-seeded.

1. **Cephalanthus occidentalis** L., Sp. Pl. 95. 1753.

Apache, Gila, Maricopa, Pinal, and Pima Counties, 1,200 to 5,000 feet, wet soil along streams, June to September. Throughout most of temperate North America.

The Arizona form is var. *californicus* Benth., with shorter-petioled, narrower leaves more often in 3's than in the typical form of the eastern United States. The plant is not palatable to livestock and is reputed poisonous, containing glucosides (cephalanthine, etc.). The bark has been used medicinally. The flowers are attractive to bees.

5. KELLOGGIA

Plant herbaceous, perennial, with slender rootstocks, with the aspect of *Galium*; leaves opposite, sessile, the blades lanceolate; flowers in very open cymose panicles, small; calyx with an obovate tube and minute teeth; corolla funnelform-salverform, whitish; stamens inserted in the throat of the corolla; stigmas clavate.

1. **Kelloggia galioides** Torr. in Wilkes, U. S. Expl. Exped. 17: 332. 1874.

San Francisco Peaks, Bill Williams Mountain, both sides of the Grand Canyon (Coconino County), Betatakin (Navajo County), 7,000 to 8,000 feet, rich soil in coniferous forests, June to August. Wyoming to Washington, northern Arizona, and California.

6. CRUSEA

Plants small, annual; stems slender, erect or ascending, simple or sparingly branched; leaf blades oblong-lanceolate to subulate; flowers small, in terminal or axillary glomerules; calyx lobes 2 to 4, often conspicuously unequal; corolla white or purple, salverform or nearly so; fruit of 2 to 4 obovoid or globose carpels, these separating at maturity from the persistent axis.

Key to the species

1. Herbage sparsely hirsute; leaf blades oblong-lanceolate, up to 10 mm. wide, conspicuously several-veined; glomerules of flowers mostly solitary at the ends of the main stem and branches, capitate; calyx lobes attenuate-subulate, more or less unequal in length but not conspicuously different in texture; corolla rose purple.----- 1. *C. WRIGHTII*.
1. Herbage glabrous or (commonly) sparsely hispidulous; leaf blades linear-lanceolate or subulate, not more than 3 mm. wide, with only the midvein apparent; glomerules several, axillary and terminal; calyx lobes very unequal, some of them lanceolate and foliaceous, the others reduced to setaceous, scarios teeth; corolla whitish.----- 2. *C. SUBULATA*.

1. *Crusea wrightii* A. Gray, Pl. Wright. 2: 68. 1853.

Huachuca Mountains, Cochise County (*Lemmon* 2724), Sycamore Canyon near Ruby, Santa Cruz County, 3,600 feet (*Kearney* and *Pebbles* 14447), August and September. Southeastern Arizona and northern Mexico.

2. *Crusea subulata* (Pavon) A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 78. 1883.

Spermacoce subulata Pavon ex DC., Prodr. 4: 543. 1830.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), 5,000 to 6,000 feet, in woods or in the open, August and September. Southern New Mexico and Arizona; Mexico.

7. DIODIA. BUTTONWEED

Plant annual; stems erect or diffuse; leaf blades narrowly lanceolate; stipules fringed with long, stiff bristles; flowers small, in axillary glomerules; corolla funnellform-salverform, pink; fruit obovoid-turbinate, crowned by the persistent calyx lobes.

1. *Diodia teres* Walt., Fl. Carol. 87. 1788.

Gila, Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, dry mesas and slopes, often in sandy soil, August and September. Connecticut to Missouri and Arizona, south to Florida and Panama.

The common form in Arizona is var. *angustata* Gray, with erect, simple or sparingly branched stems. The typical form, with spreading or procumbent, freely branched stems, also occurs in the State.

8. MITRACARPUS

Plant annual; stems erect, simple or sparingly branched; leaves opposite, the blades lanceolate; stipules setose; flowers small, in few, very dense, terminal and axillary clusters; calyx with the 2 pairs of lobes very unlike in size and texture, the larger ones equaling or surpassing the whitish corolla; capsule didymous, 2-celled

1. *Mitracarpus breviflorus* A. Gray, Pl. Wright. 2: 68. 1853.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, dry plains and mesas, August and September. Southern Texas, southern Arizona, and Mexico.

9. GALIUM. BEDSTRAW

Plants annual or perennial, herbaceous or suffrutescent; stems angled, often winged, usually weak and reclining or supported on other plants; herbage often retrorsely hispid; leaves appearing whorled, usually narrow; flowers small, perfect or unisexual, in axillary or terminal cymes or glomerules, these often paniced, or the flowers solitary in the axils; fruits didymous (paired), smooth, tuberculate, or covered with straight hairs or hooked bristles, indehiscent; seeds with a deeply concave face.

The plants have been used as remedies for various diseases, but their medicinal value is questionable.

Key to the species

1. Flowers involucrate (closely subtended by leaflike bracts), sessile or nearly so, solitary in each involucre; fruit slightly fleshy at maturity, granulate or tuberculate, not hairy; plant glabrous or nearly so; stems deeply grooved, with thick, whitish angles; leaves apparently 4 in the whorl, the blades somewhat rigid, thickish, shiny, mostly narrowly linear, sharply cuspidate, the midrib and margin thick, whitish----- 1. *G. MICROPHYLLUM*.
1. Flowers not involucrate, usually distinctly pedicellate; fruit not fleshy at maturity (2).
 2. Fruit not long-hairy; plants perennial; stems herbaceous above ground (3).
 3. Stems stout, very rough to the touch; leaves apparently 5 or more in the whorl, the lower ones commonly more than 15 mm. long, with narrowly elliptic, lanceolate, or oblanceolate blades; pedicels less than 5 mm. long; fruit tuberculate or minutely hispidulous-- 2. *G. ASPERRIMUM*.
 3. Stems slender, not or barely rough to the touch; leaves commonly appearing to be 4 in the whorl, less than 15 mm. long; pedicels (some of them) usually more than 5 mm. long; fruit smooth, glabrate (4).
 4. Herbage glabrous or very nearly so; stems commonly less than 20 cm. long, matted----- 3. *G. BRANDEGEL*.
 4. Herbage sparsely and minutely hispidulous (exceptionally glabrous); stems commonly more than 20 cm. long, not forming mats.
 4. *G. TRIFIDUM*.
 2. Fruit conspicuously hairy (sometimes glabrate at maturity in *G. boreale*), the hairs usually nearly as long as to longer than the transverse diameter of the carpel (5).
 5. Hairs of the fruit straight, soft, white; plants perennial, more or less woody at base; leaves apparently in whorls of 4, or fewer (6).
 6. Corolla purplish to dark brown purple; flowers not dioecious; plants suffrutescent; leaf blades linear, narrowly lanceolate, or somewhat oblanceolate (7).
 7. Stems and leaves hirtellous, at least near the base of the plant; leaves often somewhat flaccid----- 5. *G. WRIGHTII*.
 7. Stems and leaves glabrous or puberulent; leaves rigid.
 6. *G. ROTHROCKII*.
 6. Corolla white, yellowish, or greenish (rarely purplish); flowers dioecious (8).
 8. Leaf blades obtuse or acutish at apex, thin, not rigid, linear or narrowly lanceolate, often reflexed, the midrib slender, not very prominent, the lateral veins obsolete; plant scarcely woody above ground, hirtellous-puberulent to nearly glabrous, scarcely rough to the touch----- 7. *G. FENDLERI*.

8. Leaf blades acute or acuminate and sharply cuspidate at apex, the midrib very prominent beneath; plants usually distinctly woody above ground; bark of the older stems pale, exfoliating (9).
9. Plant very rough to the touch, hispid or hispidulous, usually suffruticose; leaf blades lanceolate or ovate-lanceolate, thick, rigid, the lateral veins obsolete..... 8. *G. STELLATUM*.
9. Plants scarcely rough to the touch, glabrous or obscurely hispidulous (rarely hispid), suffruticose; leaf blades thin or only moderately thick, scarcely rigid (10).
10. Leaf blades lanceolate or lance-ovate, 6 to 15 mm. long, 4 to 7 mm. wide, the lateral veins (1 or more) usually perceptible but often very short..... 9. *G. WATSONI*.
10. Leaf blades linear, 10 to 25 mm. long, 2 to 3 mm. wide, the lateral veins obsolete..... 10. *G. COLORADOENSE*.
5. Hairs of the fruit curved or uncinat; stems entirely herbaceous above ground (11).
11. Leaves apparently 5 or more in the whorl; stems long, weak, commonly reclining (12).
12. Plant annual, without a rootstock; stems rough to the touch, retrorsely hispid with pricklelike hairs; leaf blades linear, lanceolate, or oblanceolate; fruit mostly 3 to 4 mm. in transverse diameter at maturity, the hairs stiff, triangular-tuberculate at base, shorter than the transverse diameter of the carpel.
11. *G. APARINE*.
12. Plant perennial, with slender, elongate, branched rootstocks; stems not or very slightly rough to the touch, hispidulous, pilose, or nearly glabrous; leaf blades elliptic-lanceolate, broadly oblanceolate, or oblong-ovate, conspicuously setose-cuspidate; fruit less than 3 mm. in transverse diameter at maturity, the hairs not stiff, scarcely enlarged at base, about as long as the transverse diameter of the carpel..... 12. *G. TRIFLORUM*.
11. Leaves apparently not more than 4 in the whorl (13).
13. Flowers in elongate, many-flowered, often rather dense, not very leafy terminal panicles; corolla bright white; plant perennial, puberulent or glabrate; stems erect; leaf blades linear to broadly lanceolate, distinctly 3-nerved; fruit often glabrate in age.
13. *G. BOREALE*.
13. Flowers in axillary or terminal, few-flowered, leafy cymes or, if more numerous and aggregated in terminal panicles, these very loose and very leafy; corolla yellowish or brownish; fruit permanently pubescent (14).
14. Plant annual, hispidulous or glabrate; leaf blades 1-nerved, seldom more than 1 cm. long; pedicels curved, usually shorter than the fruit..... 14. *G. PROLIFERUM*.
14. Plant perennial, puberulent, soft-pilose, or villous; leaf blades usually indistinctly several-veined, the larger ones commonly more than 1 cm. long; pedicels straight, usually much longer than the fruit..... 15. *G. PILOSUM*.

1. *Galium microphyllum* A. Gray, Pl. Wright. 1: 80. 1852.

Relbunium microphyllum Hemsl., Biol. Cent. Amer. Bot. 2: 63. 1881.

Coconino County to Greenlee County, south to Cochise, Santa Cruz, and Pima Counties, 1,500 to 7,000 feet, mostly along streams, common, April to October. Western Texas to Arizona and Mexico.

Several leading authorities recognize *Relbunium* as a genus distinct from *Galium*.

2. *Galium asperrimum* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 60. 1849.

Greenlee, Graham, Gila, Cochise, Santa Cruz, and Pima Counties, 4,000 to 9,500 feet, common in coniferous forests in rich soil, July to September. New Mexico, Arizona, and Mexico.

3. *Galium brandegei* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 58. 1876.

Given for Arizona by K. Wiegand (Torrey Bot. Club Bul. 24: 398. 1897), but no specimens are cited. A collection on the Kaibab Plateau, Coconino County (Grand Canyon Herb. 994) may belong here. Wyoming to New Mexico and southern California.

4. *Galium trifidum* L., Sp. Pl. 105. 1753.

Willow Spring, southern Apache County (Palmer 514), Prescott, Yavapai County (McLellan and Stitt 1347), apparently very rare in Arizona. Labrador to Alaska, south to New York, Colorado, Arizona, and southern California.

5. *Galium wrightii* A. Gray, Pl. Wright. 1: 80. 1852.

Apache County to Coconino County, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 8,500 feet, June to September. Western Texas to Arizona and northern Mexico.

6. *Galium rothrockii* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 203. 1882.

Coconino County (both sides of the Grand Canyon) to Cochise, Santa Cruz, and Pima Counties, 3,000 to 8,000 feet, rocky slopes, canyons, etc., common, July to September, type from Camp Crittenden, Santa Cruz County (Rothrock 675). Southern New Mexico to southeastern California and Mexico.

Intergrades or hybridizes with the nearly related *G. wrightii*.

7. *Galium fendleri* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 60. 1849.

Greenlee, Graham, and Cochise Counties, 8,000 to 9,500 feet, coniferous forests, July and August. New Mexico and southeastern Arizona.

8. *Galium stellatum* Kellogg, Calif. Acad. Sci. Proc. 2: 97. 1863.

Mohave, Yavapai, Gila, Pinal, Pima, and Yuma Counties, 3,000 feet or lower, dry rocky slopes, common, January to May. Southern Utah and Nevada, central and western Arizona, southern California, and Baja California.

The species is represented in Arizona by var. *eremicum* Hilend and Howell.

9. *Galium watsoni* (A. Gray) Heller, Torrey Bot. Club Bul. 25: 627. 1898.

Galium multiflorum Kellogg var. *watsoni* A. Gray, Syn. Fl. ed. 2, 1²: 40. 1886.

Both sides of the Grand Canyon (Coconino County), apparently common, 5,000 to 7,000 feet, also (?) Fossil Creek, Gila County (Collom 596), crevices of rocks on dry slopes, May to July. Idaho and Oregon to northern Arizona.

Mrs. Collom's specimen, and specimens collected on the north wall of the Grand Canyon (Eastwood and Howell 1008, 1008A), seem to approach *G. munzii* Hilend and Howell in their rough-hirsute or hispid pubescence.

10. *Galium coloradoense* W. F. Wight, Zoe 5: 54. 1900.

Carrizo Mountains, Apache County (*Standley* 7353). Southwestern Colorado, southeastern Utah, and northeastern Arizona.

Standley's specimen has hispidulous stems and leaf margins.

11. *Galium aparine* L., Sp. Pl. 108. 1753.

Navajo County to northern Mohave County, south to Pima County, 2,500 to 6,000 feet, mostly along streams, early spring. Widely distributed in the United States, presumably naturalized from Europe.

Goosegrass bedstraw. A small-fruited form, var. *vaillantii* (DC.) Koch (*G. vaillantii* DC.), has been reported as occurring in Arizona.

12. *Galium triflorum* Michx., Fl. Bor. Amer. 1: 80. 1803.

White Mountains, Apache County (*Griffiths* 5342), Baker Butte and Upper Oak Creek, Coconino County (*Toumey* 166a, *Fulton* 7330), 6,000 to 8,000 feet, moist shady places, July to September. Canada and Alaska to Alabama, Arizona, and California.

Sweet-scented bedstraw. The herbage is very fragrant in drying.

13. *Galium boreale* L., Sp. Pl. 108. 1753.

Lukachukai Pass, Apache County (*Eastwood* and *Howell* 6789), Lakeside, Navajo County (*Thornber* 8901), 6,000 to 7,000 feet, July to August. Canada to Pennsylvania, Texas, eastern Arizona, and California; Eurasia.

Northern bedstraw.

14. *Galium proliferum* A. Gray, Pl. Wright. 2: 67. 1853

Greenlee, Pinal, Maricopa, and Pima Counties, 2,000 to 4,000 feet, canyons and rocky slopes, March to May. Western Texas to southern Utah, Arizona, and northern Mexico.

15. *Galium pilosum* Ait., Hort. Kew. 1: 145. 1789.

Pinaleno Mountains, Graham County, about 7,000 feet (*Peebles* et al. 4504), rich soil in shade, growing with *Circaea*, July. Massachusetts to Indiana, south to Florida and central Texas, and in southeastern Arizona.

The Arizona station is far to the west of the main area occupied by this species.

117. CAPRIFOLIACEAE. HONEYSUCKLE FAMILY

Plants almost entirely herbaceous, or shrubby, or arborescent; leaves opposite, simple or compound; flowers perfect, regular or irregular; calyx with the tube wholly adnate to the ovary, the limb represented by 3 to 5 teeth or lobes; corolla funnelliform or rotate; stamens 4 or 5, attached separately to the corolla; fruit berrylike, drupelike, or achenelike.

This family includes numerous plants that are cultivated as ornamentals, notably the bush honeysuckles and climbing honeysuckles (*Lonicera* spp.).

Key to the genera

1. Leaves pinnately compound; flowers small, very numerous; corolla rotate or saucer-shaped..... 1. *SAMBUCUS*.
1. Leaves simple; flowers relatively large, not very numerous; corolla tubular to funnelliform-campanulate (2).
2. Plant low, only slightly woody, with prostrate creeping stems; flowers in pairs on an elongate, slender, erect peduncle..... 3. *LINNAEA*.

2. Plant shrubby, with erect, climbing, or trailing stems; flowers in short spikes or axillary clusters (3).
3. Corolla regular or very nearly so, funnellform, funnellform-campanulate, or salverform, the tube not gibbous or swollen near the base; ovary 4-celled; berry commonly white, 1- or 2-seeded. — 2. SYMPHORICARPOS.
3. Corolla more or less irregular, with a slightly or pronouncedly bilabiate limb, the tube more or less gibbous or swollen on one side near the base; ovary 2- or 3-celled (the partitions sometimes incomplete); berry not white, often containing more than 2 seeds. — 4. LONICERA.

1. SAMBUCUS. ELDER

Large shrubs or small trees; stems pithy; leaves large, pinnate, the leaflets lanceolate to ovate; flowers in broad compound cymes, or pyramidal cymose panicles; corolla rotate, cream-colored or yellowish; fruits berrylike.

The foliage is browsed by domestic animals and deer. The fruits are edible (except those of the red-fruited *S. racemosa*) and are very attractive to birds. They are sometimes used for making jelly and wine. It has been reported, however, that the fruits, as well as the flowers, bark, and roots, when eaten raw, may poison animals. All parts of the plants are reputed to have medicinal virtues, but these are probably largely imaginary, although the flowers are stated to be diuretic. The Mexican elder (*S. mexicana*), Arizona's most treelike species, is sometimes planted as an ornamental in the southern part of the State.

Key to the species

1. Inflorescence broadly short-pyramidal, with the axis extended beyond the lowest branches; leaflets lanceolate to oblong-ovate, sharply serrate; berries not glaucous (2).
 2. Berries bright red at maturity; branchlets and leaves glabrous or glabrate; leaflets commonly 7; corolla yellowish. — 1. *S. RACEMOSA*.
 2. Berries black at maturity; branchlets and the lower face of the leaves usually scurfy-puberulent or sparsely villous; leaflets commonly 5; corolla whitish. — 2. *S. MELANOCARPA*.
1. Inflorescence flat-topped, with elongate, compound rays, the axis not or seldom extended beyond the lowest branches; berries dark blue, commonly glaucous (3).
 3. Leaflets gradually long-acuminate, thin, commonly 5 or 7, lanceolate or oblong-lanceolate, the larger ones seldom less than 8 cm. long; inflorescence very open, 10 to 30 cm. wide, the primary branches usually horizontally divergent. — 3. *S. NEOMEXICANA*.
 3. Leaflets short-acuminate, usually thickish, commonly less than 8 cm. long; inflorescence somewhat dense, seldom more than 15 cm. wide, the primary branches usually ascending (4).
 4. Branchlets and the lower face of the leaflets finely pubescent, the branchlets densely so; leaves deciduous; leaflets ovate or ovate-oblong. — 4. *S. VELUTINA*.
 4. Branchlets and leaves glabrous or sparsely pubescent, rarely copiously so (5).
 5. Leaves persistent; leaflets 3 to 5 (seldom with a small additional basal pair), oblong-lanceolate to ovate or somewhat obovate, rather abruptly acuminate, finely and closely serrate; berries moderately glaucous; plant usually a tree, up to 10 m. high. — 5. *S. MEXICANA*.
 5. Leaves deciduous; leaflets 5 to 9 (rarely only 3), lanceolate or oblong-lanceolate, gradually acuminate, sharply and often rather deeply serrate; berries very glaucous; plant commonly a large shrub; branchlets and leaves glabrous or very nearly so. — 6. *S. COERULEA*.

1. *Sambucus racemosa* L., Sp. Pl. 1: 270. 1753.

White Mountains (Apache and Greenlee Counties), both sides of the Grand Canyon (Coconino County), 7,500 to 10,000 feet, moist

forests, June and July. Throughout the cooler parts of North America; Eurasia.

The Arizona form is var. *microbotrys* (Rydb.) Kearney and Peebles (*S. microbotrys* Rydb., *S. acuminata* Greene), with the leaves and branchlets glabrous or nearly so. The herbage is strong-scented, and the fruits are reputed to be poisonous. The type of *S. acuminata* came from Mount Agassiz (*Pearson* 330).

2. ***Sambucus melanocarpa*** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 76. 1883.

White Mountains (Apache County), Santa Catalina Mountains (Pima County), reported also from the Kaibab Plateau (Coconino County), 7,500 feet and probably higher, May to July. Alberta and British Columbia to New Mexico, Arizona, and California.

3. ***Sambucus neomexicana*** Wooton, Torrey Bot. Club Bul. 25: 309. 1898.

Coconino County to Cochise and Pima Counties, 5,500 to 9,500 feet, mostly along streams, July and August. New Mexico and Arizona.

This shrub attains a height of 2.5 m. (8 feet) and has been reported to reach 6.5 m. (21 feet). Both the typical form, with the branchlets and leaves glabrous or nearly so, and var. *vestita* (Woot. and Standl.) Kearney and Peebles (*S. vestita* Woot. and Standl.), with the branchlets and leaves persistently puberulent or tomentulose, are found in Arizona. The variety has been collected in the Pinal, Santa Catalina, and Santa Rita Mountains.

4. ***Sambucus velutina*** Dur. and Hilg., U. S. Rpt. Expl. Miss. Pacif. 5: 8. 1855.

Hualpai Mountain, Mohave County (*Goldman* 2980, *Kearney* and *Peebles* 12725), 7,000 to 8,000 feet, yellow pine forest. Western Arizona and California.

5. ***Sambucus mexicana*** Presl in DC., Prodr. 4: 322. 1830.

Sambucus coerulea Raf. var. *arizonica* Sarg., Man. Trees North Amer. ed. 2, 885. 1922.

Gila, Yavapai, and Mohave Counties to Cochise, Santa Cruz, and Pima Counties, 1,200 to 4,000 feet, frequent along streams and ditches, April to June. Southern New Mexico to southern California and northern Mexico.

Mexican elder (pl. 29). The tree attains a height of 9 m. (30 feet) and a trunk diameter of 45 cm. (18 inches). It is the only nonmontane species in the State.

6. ***Sambucus coerulea*** Raf., Alsogr. Amer. 48. 1838.

Both sides of the Grand Canyon (Coconino County), near Prescott (Yavapai County), Chiricahua Mountains (Cochise County), 6,500 to 8,000 feet, coniferous forests, June to August. Alberta and British Columbia to Arizona and southern California.

Usually a many-stemmed shrub, up to 6 m. (20 feet) high, sprouting freely from the root.



Mexican elder (*Sambucus mexicana*), near Patagonia, Santa Cruz County, altitude 4,000 feet. Tree about 20 feet high, in flower.



2. SYMPHORICARPOS.⁵² SNOWBERRY

Shrubs with the older bark exfoliating; leaves opposite, simple, without stipules, the blades entire to sinuately lobed; flowers regular or nearly so, the corolla campanulate, funnellform, or salverform, 4- or 5-lobed, pink or white, often pubescent within, with 1 to 5 nectaries at base; ovary 4-celled, 2 of the cells containing 1 large fertile pendulous ovule, the other cells containing several small abortive ovules; berry ovoid, ellipsoid, or subglobose; nutlets normally 2, more or less compressed.

The plants afford valuable browse for livestock and deer. They contain saponin but in such small quantity that poisoning rarely occurs. The plants are often cultivated for their long-persistent, very ornamental, waxy-looking white fruits, which are eaten by many kinds of birds. The species are difficult to identify in the absence of flowers.

Key to the species

1. Corolla salverform, 11 to 13 mm. long, with only 1 small basal nectary, glabrous within; style 5 to 7 mm. long, usually pilose above the middle; anthers sessile; leaves oblanceolate, glaucous, 6 to 15 mm. long, 2 to 5 mm. wide.
 1. *S. LONGIFLORUS*.
1. Corolla long-campanulate or tubular-funnelform, 6 to 13 mm. long, with 5 basal nectaries; style 3 to 5 mm. long, usually glabrous; anthers equaling or somewhat shorter than the free portion of the filaments (2).
 2. Young twigs completely glabrous (3).
 3. Corolla long-campanulate, 6 to 7 mm. long, the tube pilose within; leaf buds lanceolate in outline, acuminate; leaves normally very glaucous beneath, pilosulous, rarely glabrous; plant low, spreading.
 2. *S. PARISHII*.
 3. Corolla tubular-funnelform, 11 to 13 mm. long, the tube sparsely pilose to nearly glabrous within; leaf buds ovate in outline, acute; leaves almost always entirely glabrous; plant erect----- 3. *S. OREOPHILUS*.
 2. Young twigs puberulent or pubescent; corolla pilose within (4).
 4. Pubescence of the young twigs dense, of straight spreading hairs; corolla tubular-funnelform, 8 to 10 mm. long; anthers reaching only to the base of the corolla lobes; leaves roundish oval, dark green, obtuse or obtusish, softly pubescent on both faces, 1 to 3 cm. long, 6 to 18 mm. wide----- 4. *S. ROTUNDFOLIUS*.
 4. Pubescence of the young twigs not dense or, if so, then the hairs short and curved (5).
 5. Corolla funnellform-campanulate, 6 to 7 mm. long; young twigs loosely pilosulous, the internodes occasionally glabrous; a low spreading shrub; leaves glaucous, pilosulous----- 2. *S. PARISHII*.
 5. Corolla tubular-funnelform, 8 to 12 mm. long; young twigs tomentulose-puberulent with short curved hairs (6).
 6. Plant erect; leaves puberulent, scarcely paler beneath, the principal veins prominent on the upper surface in dried specimens, the petioles 2 to 4 mm. long; nutlets lanceolate in outline or fusiform, acute or apiculate at base, 5 to 7 mm. long-- 5. *S. UTAHENSIS*.
 6. Plant trailing; leaves short-pilosulous, paler beneath, the veins obscure on the upper surface, the petioles 1 to 2 mm. long; nutlets elliptic in outline, flattened, acutish at base, 4 to 5 mm. long.
 6. *S. PALMERI*.

1. *Symphoricarpos longiflorus* A. Gray, Linn. Soc. London Jour. Bot. 14: 12. 1873.

Kaibab Plateau and Grand Canyon (Coconino County), Wolf Hole, Pagumpa Springs, and Peach Springs (Mohave County), 4,000

⁵² Reference: JONES, GEORGE NEVILLE. A MONOGRAPH OF THE GENUS SYMPHORICARPOS. Arnold Arboretum Jour. 21: 231-252. 1943.

to 8,000 feet, foothills, canyons, and pine forests, April to June. Western Colorado and western Texas to Oregon and eastern California.

2. *Symphoricarpos parishii* Rydb., Torrey Bot. Club Bul. 26: 545. 1899.

Grand Canyon, Flagstaff, etc. (Coconino County), 5,000 to 9,000 feet, dry hills, in the open or in chaparral, April to July. Nevada, northern Arizona, and southern California.

Specimens labeled as from Fort Mohave (*Lemmon* in 1884) doubtless were collected at a more elevated station.

3. *Symphoricarpos oreophilus* A. Gray, Linn. Soc. London Jour. Bot. 14: 12. 1873.

Apache, Navajo, and Coconino Counties, south to the mountains of Cochise and Pima Counties, 5,500 to 9,000 feet, mostly in pine forests, May to August. Colorado and western Texas to eastern Nevada, Arizona, and northern Sonora.

4. *Symphoricarpos rotundifolius* A. Gray, Pl. Wright. 2: 66. 1853.

Apache, Coconino, Yavapai, and Gila Counties, 4,000 to 10,000 feet, rocky slopes, May and June. Southern Colorado, New Mexico, and Arizona.

5. *Symphoricarpos utahensis* Rydb., Torrey Bot. Club Bul. 26: 544. 1899.

Carrizo Mountains, Apache County (*Standley* 7384), Navajo Mountain, Coconino County (*Peebles* and *Smith* 13960), near Pine, Gila County (*MacDougal* 702), 6,000 to 8,000 feet, canyons and slopes, June and July. Wyoming, Colorado, Utah, and Arizona.

6. *Symphoricarpos palmeri* G. N. Jones, Arnold Arboretum Jour. 21: 243. 1940.

White Mountains (Apache County), Keam Canyon (Navajo County), Chiricahua Mountains (Cochise County), 7,000 to 8,200 feet, moist slopes and swales, May to July. Southern Colorado and western Texas to eastern Arizona.

3. LINNAEA. TWINFLOWER

Plant evergreen, nearly herbaceous; stems slender, creeping, forming loose mats; leaf blades thickish, obovate or nearly orbicular, crenulate; flowers nodding; corolla nearly regular, broadly funnel-form, 5-lobed, white tinged with pink; stamens 4, unequal in length; ovary 3-celled; fruit 1-seeded, dry, indehiscent.

1. *Linnaea borealis* L., Sp. Pl. 631. 1753.

White Mountains, Apache County (*Zuck* in 1907, *Goodding* 1162), Kaibab Plateau, Coconino County (Grand Canyon Herb. 678), deep coniferous forests, June and July. Greenland to Alaska, south to New Jersey, Michigan, New Mexico, northern Arizona, and California; Eurasia.

The name of this beautiful little plant, very rare in Arizona, commemorates the great botanist Linnaeus. The Arizona form is var. *americana* (Forbes) Rehder (*L. americana* Forbes).

4. LONICERA.⁵³ HONEYSUCKLE

Plants shrubby; stems erect, trailing, or twining; leaf blades broad, normally entire; flowers in 2's or 3's on axillary peduncles, or in axillary or terminal whorls, these often forming interrupted spikelike inflorescences; corolla nearly regular to strongly bilabiate; fruit berrylike.

It is stated that the fruits contain saponin and have emetic and cathartic effects. The plants are mostly unpalatable, but some species are browsed. They are, however, regarded with suspicion by stockmen. The fruits are eaten by birds and chipmunks. *L. arizonica*, which resembles the trumpet or coral honeysuckle of the eastern United States (*L. sempervirens* L.), is worthy of cultivation as an ornamental climber.

Key to the species

1. Flowers in pairs on more or less elongate axillary peduncles; stems erect or ascending; branches with solid pith; leaves all petioled, never connate-perfoliate; tube of the corolla gibbous or saccate on one side at base, the limb nearly regular (2).
2. Fruits at maturity black, closely enveloped by the glandular-ciliate, broadly ovate bractlets, these becoming enlarged and rose red to reddish brown; leaf blades ovate or oblong, acuminate at apex, paler but green beneath; corolla slightly gibbous, yellow, less than 15 mm. long.
 1. *L. INVOLUCRATA*.
2. Fruits at maturity orange yellow to bright red (rarely dark blue), not closely enveloped by the small, glabrous, subulate, green bracts; leaf blades oblong, elliptic, ovate, or slightly obovate, obtuse or rounded at apex, whitish beneath; corolla strongly gibbous (almost spurred), yellowish white, usually more than 15 mm. long.
 2. *L. UTAHENSIS*.
1. Flowers several or numerous in axillary or terminal, whorllike, compound cymes, these sometimes aggregated in spikelike inflorescences; stems straggling or clambering (seldom twining in the Arizona species); branches hollow; uppermost pair or pairs of leaves usually sessile and connate-perfoliate, the blades broadly oval, ovate, or nearly orbicular, whitish beneath; fruits red at maturity (3).
3. Corolla coral red outside (often drying purplish), orange within, the limb short, only slightly bilabiate, one-fifth to one-fourth as long as the tube, the latter slightly swollen on one side well above the base; stamens inserted deep in the corolla tube; leaf blades ciliate, up to 7 cm. long; whorl of flowers single, or the whorls crowded together in a subcapitate spike, this usually distinctly stalked and not closely subtended by the uppermost pair of leaves; style glabrous or very nearly so.
 3. *L. ARIZONICA*.
3. Corolla whitish or pale yellow, deeply 2-lipped, the lips nearly as long as the tube, the lower lip spreading or reflexed; stamens inserted near the summit of the corolla tube (4).
4. Bracts more than one-half as long as the ovary; corolla 10 to 15 mm. long, the tube as long as the limb; stems herbaceous above; leaves persistent, the blades commonly glabrous, sometimes pubescent beneath; whorls of flowers several, well separated, forming elongate, interrupted, small-bracted spikes, these terminating the axis and the somewhat elongate branchlets.
 4. *L. INTERRUPTA*.
4. Bracts less than one-half as long as the ovary; corolla usually more than 15 mm. long, the tube usually longer than the limb; stems woody almost throughout; leaf blades pubescent, at least beneath; whorl of flowers single (if more than one, the whorls so closely crowded as to appear one), borne at the ends of the short branchlets and closely subtended by the uppermost pair of leaves.
 5. *L. ALBIFLORA*.

⁵³ Reference: REHDER, ALFRED. SYNOPSIS OF THE GENUS LONICERA. Mo. Bot. Gard. Ann. Rpt. 14: 27-232. 1903.

1. **Lonicera involucrata** (Richards.) Spreng., Syst. Veg. 1: 759. 1825.

Xylosteum involucratum Richards., Bot. App. Frankl. Journey 733. 1823.

Apache, Coconino, Greenlee, Graham, and Cochise Counties, especially on the White Mountains, San Francisco Peaks, Pinaleno Mountains, and Chiricahua Mountains, 7,500 to 10,500 feet, open coniferous forests, often along streams, June and July. Canada and Alaska to Michigan, Arizona, California, and northern Mexico.

Bearberry honeysuckle, inkberry, pigeonbush, twinberry. Suckers freely and tends to form thickets. The flowers attract hummingbirds.

2. **Lonicera utahensis** S. Wats. in King, Geol. Expl. 40th Par. 5: 133. 1871.

Xylosteon utahense Howell, Fl. Northwest. Amer. 282. 1900.

White Mountains (Apache and Greenlee Counties), 9,500 to 11,000 feet, open coniferous forests, gregarious, July. Montana to British Columbia, south to New Mexico, Arizona, and northern California.

3. **Lonicera arizonica** Rehder, Trees and Shrubs 1: 45. 1902.

Apache County and Coconino County (both sides of the Grand Canyon), to Cochise and Pima Counties, 6,000 to 9,000 feet, open coniferous forests, June and July, type from the Rincon Mountains, Pima County (*Pringle* in 1884). Utah, New Mexico, and Arizona.

Arizona honeysuckle. Closely related to *L. ciliosa* Poir., and some of the Arizona specimens (e. g. *Rusby* in 1883) appear to be intermediate.

4. **Lonicera interrupta** Benth., Pl. Hartw. 313. 1839.

Gila and Pima Counties, in the Pinal, Sierra Ancha, and Santa Catalina Mountains, 4,000 to 6,000 feet, chaparral, usually near streams, May and June. South-central Arizona and California.

Chaparral honeysuckle.

5. **Lonicera albiflora** Torr. and Gray, Fl. North Amer. 2: 6. 1841.

Southern Apache County and Gila County to Cochise and Santa Cruz Counties, 3,500 to 6,000 feet, along streams, April to June. Arkansas to southern Arizona and northern Mexico.

The species is represented in Arizona by var. *dumosa* (A. Gray) Rehder (*L. dumosa* A. Gray).

118. VALERIANACEAE. VALERIAN FAMILY

Plants herbaceous, annual or perennial; leaves opposite, without stipules; flowers perfect or unisexual, somewhat irregular, in cymose panicles; calyx with the tube wholly adnate to the ovary and with the limb represented by pappuslike bristles, or obsolete; corolla salverform; stamens commonly 3, borne on the corolla; ovary 3-celled, with 2 of the cells empty; fruit achenelike, 1-seeded.

Key to the genera

1. Limb of the calyx obsolete; corolla with a long pendent spur at base of the throat..... 1. PLECTRITIS.
1. Limb of the calyx represented by a circle of setiform lobes, these at maturity elongating and becoming a pappuslike ring of plumose bristles surmounting the fruit; corolla not spurred, the tube sometimes gibbous or slightly saccate..... 2. VALERIANA.

1. PLECTRITIS

Plant annual, glabrous; stems seldom more than 20 cm. long, erect, sparingly branched; leaves (except the lowest ones) sessile, the blades all entire, those of the upper leaves oblong, those of the lower leaves spatulate or obovate; flowers small, in dense terminal or subterminal clusters; corolla 2-lipped, pink; fruit commonly short-pilose, keeled dorsally, broadly winged.

1. *Plectritis macrocera* Torr. and Gray, Fl. North Amer. 2: 50. 1841.

Valerianella macrocera A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 83. 1883.

Gila, Yavapai, and Pima Counties (doubtless elsewhere), 3,000 to 5,000 feet, moist usually shaded soil along streams, March and April. Nevada and Washington to Arizona and California.

2. VALERIANA. VALERIAN, TOBACCO-ROOT

Plants perennial, with rootstocks or tubers; leaves mostly pinnate or pinnately parted; flowers perfect or unisexual; calyx limb of pappuslike bristles, these elongate and spreading in fruit; corolla with the limb nearly regular, the tube swollen on one side; fruit achenelike, glabrous or puberulent.

The dried plants have a strong, unpleasant, very characteristic odor, which persists for years in herbaria. The roots of *V. edulis* and perhaps of other species were boiled and eaten by the Indians. *V. acutiloba* is reported to have some value as forage.

Key to the species

1. Stems from a large vertical caudex, up to 1 m. long, stout, erect; leaves thickish, with several conspicuous veins nearly parallel with the midvein, the basal leaves oblanceolate or spatulate, long-petioled, entire or pinnately parted with few divisions, the stem leaves sessile or nearly so, usually pinnately parted with few elongate, linear, lanceolate, or spatulate divisions; flowers dioecious or polygamous, in an elongate very open panicle; corolla of the staminate flowers yellowish, less than 3 mm. long, the tube not or scarcely longer than the limb; fruits glabrous or puberulent..... 1. *V. EDULIS*.
1. Stems not from a large vertical caudex; leaves thin, with inconspicuous or spreading lateral veins; corolla pink or whitish (2).
 2. Rootstock short, tuberlike, usually vertical; leaves very thin and flaccid, pinnate with 3 or more leaflets (some of the basal ones rarely simple and coarsely toothed), all petioled (the petioles of the uppermost leaves sometimes very short), the leaflets broadly ovate to oblong-lanceolate, coarsely serrate or lacinate with numerous teeth; inflorescence an open elongate panicle of loosely flowered cymes; flowers monoecious; corolla 1 to 2 mm. long; fruits strigose-puberulent..... 2. *V. SORBIFOLIA*.
 2. Rootstock elongate, usually horizontal; leaves firm, the basal ones petioled, mostly simple and entire, oblanceolate or obovate, the upper stem leaves sessile or subsessile, pinnately cleft or pinnate with very few narrow mostly entire divisions or leaflets; inflorescence at anthesis short and compact, often subcapitate, in fruit more open and elongate; flowers perfect; corolla at least 4 mm. long; fruits mostly glabrous (3).
 3. Corolla 4 to 6 mm. long, the tube much shorter than the throat and limb; blades of the basal leaves attenuate at base, elliptic, oblanceolate, or obovate, commonly 5 cm. long or longer..... 3. *V. ACUTILOBA*.
 3. Corolla 8 to 12 mm. long, the tube nearly as long as to much longer than the throat and limb; blades of the basal leaves rounded or short-cuneate at base, ovate, seldom more than 4 cm. long.
 4. *V. ARIZONICA*.

1. *Valeriana edulis* Nutt. ex Torr. and Gray, Fl. North Amer. 2: 48. 1841.

Valeriana trachycarpa Rydb., Torrey Bot. Club Bul. 31: 645. 1904.

Apache County to Coconino County and the mountains of Cochise County, 7,000 to 9,500 feet, rich moist soil usually in open coniferous forests, June to September. Montana and Idaho to New Mexico and Arizona.

The prevailing form in Arizona, with glabrous fruits, is *V. trachycarpa* Rydb.

2. *Valeriana sorbifolia* H. B. K., Nov. Gen. et Sp. 3: 332. 1819.

Mountains of Cochise, Santa Cruz, and Pima Counties, 5,500 to 7,000(?) feet, rich soil in coniferous forests, July to October. Southern Arizona to Central America.

3. *Valeriana acutiloba* Rydb., Torrey Bot. Club Bul. 28: 24. 1901.

Apache County to Coconino County, 7,000 to 9,000 feet, mountain meadows, June and July. Wyoming to New Mexico and northern Arizona.

V. acutiloba is perhaps not specifically distinct from *V. sylvatica* Banks.

4. *Valeriana arizonica* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 81. 1883.

Apache and Coconino Counties, south to the mountains of Pima County, 6,000 to 8,000 feet, rich moist soil in coniferous forests, May and June, type from near Prescott (*Palmer*). Apparently known only from Arizona.

119. CUCURBITACEAE. GOURD FAMILY

Plants herbaceous, annual or perennial; stems with tendrils, trailing or climbing; leaves simple or compound; flowers mostly unisexual, regular or nearly so, solitary or in racemose or corymbose clusters; calyx tube wholly adnate to the ovary; corolla gamopetalous, or of separate petals; stamens commonly 3 and more or less united, free from the corolla or nearly so; fruits various.

This family comprises numerous valuable plants such as the melons, squashes, pumpkin, cucumber, and gourds. None of the species native to Arizona is of much economic importance, although some of them seem worth cultivating as ornamental climbers.

Key to the genera

1. Fruits gourdlike, hard-shelled, not spiny, at maturity 4 cm. in diameter or larger, many-seeded; stems prostrate or trailing, with short, relatively stout, few-coiled tendrils; leaves large; corolla yellow (2).
2. Leaf blades reniform, wider than long, very shallowly lobed or with merely undulate, dentate margins; staminate flowers in racemes or corymbs; calyx tube cylindric, about as long as the corolla. --- 1. *Apodanthera*.
2. Leaf blades not reniform, longer than wide, or else palmately dissected; staminate flowers solitary; calyx tube campanulate, much shorter than the corolla. ----- 4. *Cucurbita*.

1. Fruit not gourdlike or hard-shelled, at maturity not more than 3 cm. in diameter; stems climbing, with long, filiform, many-coiled tendrils; flowers monoecious (except in *Ibervillea*); corolla whitish or pale yellow (3).
3. Hypanthium (at least in the pistillate flowers) long and narrowly cylindrical; fruits globose, berrylike, smooth, several-seeded (4).
4. Thickened root single; flowers dioecious, the staminate ones with a short campanulate hypanthium; seeds rounded at the large end.
 2. **IBERVILLEA.**
 4. Thickened roots clustered, often forked; flowers monoecious, the staminate ones with a long, slender-cylindric hypanthium; seeds truncate at the large end.----- 3. **TUMAMOCA.**
 3. Hypanthium short-campanulate or, if elongate-cylindric (in the pistillate flowers of genus *Brandegea*), then the fruit asymmetric, long-beaked, 1-celled and 1-seeded; fruits not globose and berrylike or, if so, then spiny; corolla of the staminate flowers rotate, whitish (5).
 5. Ovule and seed solitary; ovary 1-celled; corolla of the staminate flowers not more than 6 mm. in diameter (6).
 6. Fruit very asymmetric, narrowly obovoid, with a long slender beak; plant perennial.----- 8. **BRANDEGEA.**
 6. Fruit symmetric or nearly so, ovoid, not long-beaked; plants annual (7).
 7. Pistillate flowers in short-stalked, subcapitate or subumbellate clusters, not hidden by the bracts; fruit spiny; corolla lobes not bicuspidate.----- 9. **SICYOS.**
 7. Pistillate flowers solitary or in pairs in the leaf axils, each enveloped and hidden by an infolded, leaflike, 3-lobed and dentate bract; fruit smooth; corolla lobes bicuspidate.----- 10. **SICYOSPERMA.**
 5. Ovules and seeds several, on 3 or more placentas; fruit spiny; pistillate flowers solitary (8).
 8. Anthers completely fused and appearing as a horizontal ring opening all around; leaf blades pedately parted or divided.----- 11. **CYCLANTHERA.**
 8. Anthers evidently more than one, opening longitudinally; leaf blades not parted or divided, but sometimes deeply cleft (9).
 9. Plant perennial; fruit globose; seeds round and turgid.----- 7. **MARAH.**
 9. Plants annual; fruit ovoid; seeds flat (10).
 10. Fruit regularly dehiscent (operculate), the acuminate apical portion coming away as a lid, the spines glandular-hirsute.----- 5. **ECHINOPEPON.**
 10. Fruit bursting irregularly at the rounded apex (not operculate), the spines not hirsute.----- 6. **ECHINOCYSTIS.**

1. APODANTHERA. MELON-LOCQ

Plant perennial, coarse, with a large thick root, the herbage harshly appressed-pubescent; flowers few, unisexual (monoecious); calyx with the tube (hypanthium) 1.5 to 2.5 cm. long and the teeth subulate; corolla yellow, the lobes separate or very nearly so; stamens 3, one with a 1-celled anther and two with the anthers 2-celled, the anthers separate, sessile; fruit oval, longitudinally ridged.

1. *Apodanthera undulata* A. Gray, Pl. Wright. 2: 60. 1853.

Pinal, Cochise, Santa Cruz, and Pima Counties, 1,500 to 5,500 feet, dry plains and mesas, sometimes on limestone slopes, June to September. Western Texas to southern Arizona and Mexico.

The plant has a disagreeable odor.

2. IBERVILLEA

Plant perennial, glabrous or nearly so; stems slender, from a thick nearly globose root; leaves pedately parted or divided; flowers small, dioecious, the staminate ones in short racemes or corymbs, the pistillate flowers solitary, axillary; fruit a red globose berry.

1. *Ibervillea tenuisecta* (A. Gray) Small, Fl. Southeast. U. S. 1136. 1903.

Sicydium lindheimeri A. Gray var. *tenuisecta* A. Gray, Pl. Wright. 1: 75. 1852.

The writers have seen no specimens from Arizona, but the plant is reported to occur in Guadalupe Canyon (Cochise County) in the extreme southeastern corner of the State. Western Texas to southeastern Arizona and northern Mexico.

3. TUMAMOCA

A slender-stemmed glabrous perennial with a cluster of thick tuber-like roots; leaves thin, pedately 3-parted, the divisions deeply cleft or parted into narrow segments; flowers monoecious, the staminate ones in short racemes, the pistillate flowers solitary; calyx tube slender; corolla pale yellow, the lobes narrow; fruit a globose several-seeded berry, red or yellow at maturity.

1. *Tumamoca macdougalii* Rose, Contrib. U. S. Natl. Herbarium 16: 21. 1912.

Known in Arizona only from the type locality, Tumamoc Hill, near Tucson (Pima County), about 2,500 feet, dry soil among rocks, climbing over bushes. Southern Arizona and Sonora.

Ira L. Wiggins, who discovered the Sonoran station for this very rare plant, near Carbo, wrote (personal communication): "Root tuberous, each tuber 5 to 12 cm. long; flowers greenish; plants trailing on the ground or climbing 1 to 1.5 m. in a tangled mass in bushes. The tubers smell like decaying cabbage when bruised."

4. CUCURBITA

Coarse perennial herbs with trailing stems from a large thick root, the herbage harshly appressed-pubescent; flowers few, unisexual (monoecious); corolla yellow, 3 cm. long or longer, the tube campanulate, much longer than the lobes; stamens with separate filaments and connate anthers; fruit globose, smooth, gourdlike.

Key to the species

1. Leaf blades triangular-ovate, longer than wide, at most shallowly angulate-lobed, acuminate, up to at least 30 cm. long, the upper face uniformly pubescent.----- 1. *C. FOETIDISSIMA*.
1. Leaf blades palmately 5-cleft or 5-parted, the lobes or divisions entire or angulately few-toothed, the upper face conspicuously more pubescent along the veins than elsewhere, the lower face uniformly pubescent (2).
 2. Blades up to 25 cm. long, cleft very nearly to the base, with lanceolate, often very narrow lobes, the upper face dark green, with conspicuous broad bands of white pubescence along the veins, otherwise nearly glabrous.----- 2. *C. DIGITATA*.
 2. Blades not more than 10 cm. long, cleft not nearly to the base, with deltoid lobes, the upper face light green, with pubescence less restricted to the veins.----- 3. *C. PALMATA*.

1. *Cucurbita foetidissima* H. B. K., Nov. Gen. et Sp. 2: 123. 1817.

Navajo and Coconino Counties to Cochise and Maricopa Counties, 1,000 to 7,000 feet, mostly in alluvial soil, often at roadsides, May to August. Missouri and Nebraska to Texas, Arizona, southern California, and Mexico.

Buffalo-gourd, calabazilla. A conspicuous, rank-growing, ill-smelling plant with numerous stems up to 6 m. (20 feet) long, and striped gourdlike fruits about 10 cm. (4 inches) in diameter. The fruits were eaten by the Indians of Arizona cooked, or dried for winter use, and the seeds were eaten in the form of mush. This plant should be useful as a ground cover.

2. Cucurbita digitata A. Gray, Pl. Wright. 2: 60. 1853.

Graham County to Maricopa County, south to Cochise, Santa Cruz, Pima (and doubtless Yuma) Counties, 5,000 feet or lower, dry plains and mesas, June to October. Southwestern New Mexico to southeastern California and northern Mexico.

Fruit at maturity pale yellow, striped longitudinally.

3. Cucurbita palmata S. Wats., Amer. Acad. Arts and Sci. Proc. 11: 137. 1876.

Near Boulder Dam, Mohave County (*Clover* 4196), Yuma County, 1,000 feet or lower, sandy soil of plains and mesas, July (?) to September. Southwestern Arizona, southern California, and Baja California.

Sometimes called coyote-melon.

5. ECHINOPEPON

Plant annual, with slender climbing stems; leaves shallowly lobed, cordate at base; flowers monoecious, the staminate ones in long racemes, the pistillate flowers solitary; corolla of the staminate flowers 7 to 8 mm. in diameter, glandular-punctate, the lobes triangular; fruit ovoid, not more than 1.5 cm. in diameter, spiny, opening by an apical lid, commonly 3-celled.

1. Echinopepon wrightii (A. Gray) S. Wats., Torrey Bot. Club Bul. 13: 158. 1887.

Elaterium (?) *wrightii* A. Gray, Pl. Wright. 2: 61. 1853.

Santa Cruz and Pima (doubtless also Cochise) Counties, 3,000 to 4,000 feet, along streams, climbing over shrubs, August and September. Southwestern New Mexico, southern Arizona, and Mexico.

6. ECHINOCYSTIS. MOCK-CUCUMBER

Stems slender, climbing, from an annual root; leaf blades thin, deeply lobed; flowers monoecious, those of both sexes from the same axils, the staminate ones numerous in long compound racemes, the pistillate flowers few or solitary; corolla not punctate, the lobes ligulate-lanceolate; fruit ovoid, up to 2.5 cm. in diameter, armed with soft spines, irregularly dehiscent.

1. Echinocystis lobata (Michx.) Torr. and Gray, Fl. North. Amer. 1: 542. 1840.

Sicyos lobata Michx., Fl. Bor. Amer. 2: 217. 1803.

Flagstaff, Coconino County, alluvial soil (*Thorner* 8579). New Brunswick to Manitoba and southern Idaho, south to Pennsylvania, Texas, and northern New Mexico and Arizona.

The plant is ornamental, and its occurrence at Flagstaff may be attributable to escape from cultivation. In this case, it is doubtful that it has become established in Arizona.

7. MARAH.⁵⁴ BIGROOT, WILD-CUCUMBER

Plant perennial with a very large tuberlike root; stems climbing; leaves deeply cleft, the lobes triangular or oblong-lanceolate; corolla of the staminate flowers 6 to 10 mm. in diameter, whitish; fruit 2 to 3 cm. in diameter, somewhat fleshy, with stout smooth spines, bursting irregularly.

The root of a related species, *M. fabacea* (Naud.) Greene, contains 2 glucosides, one cathartic, the other with the property of dilating the pupil of the eye. It is not known whether these constituents are present in the Arizona species.

1. *Marah gilensis* Greene, Leaflets 2: 36. 1910.

Greenlee County to Mohave County, south to Pinal and Pima Counties, 4,500 feet or lower, common, mostly in thickets along streams, February to April. Southwestern New Mexico and Arizona.

"This wild cucumber sends up succulent shoots or stems very early, sometimes in early March. These shoots grow very rapidly, but in spite of their early appearance appear to be very susceptible to cold. I have known two sets of shoots to be killed down by freezing temperatures in early spring, and the third set to come to perfection later on." (Collom, ms.)

8. BRANDEGEA

Stems slender, from a thick root, clambering over low shrubs; leaf blades conspicuously pustulate above, deeply cleft, the lobes narrow, entire or sparingly dentate; staminate flowers in racemes, the pistillate flowers solitary; corolla rotate, deeply 5-lobed, yellowish white; fruit obovoid, long-beaked, sparsely echinate with short stout spines.

1. *Brandegea bigelovii* (S. Wats.) Cogn., Calif. Acad. Sci. Proc. ser. 2, 3: 58. 1890.

Elatarium bigelovii S. Wats., Amer. Acad. Arts and Sci. Proc. 12: 252. 1877.

Western Maricopa, western Pima, and Yuma Counties, 1,000 feet or lower, not infrequent in sandy soil along washes, March, type from "the Lower Colorado Valley" (*Bigelow*). Southwestern Arizona, southeastern California, and northwestern Mexico.

9. SICYOS. ONE-SEEDED BUR-CUCUMBER

Plants annual; stems climbing; leaf blades angulate to deeply cleft; staminate and pistillate inflorescences mostly from the same axils, long-peduncled, the staminate ones loose, the pistillate ones dense; corolla of the staminate flowers rotate, whitish; anthers 2 to 5, separate or united, the filaments united; fruit not fleshy, ovoid, armed with slender, minutely and retrorsely barbed, deciduous spines.

⁵⁴ Reference: DUNN, S. T. THE GENUS MARAH. Kew Roy. Bot. Gard. Bul. Misc. Inform. 1913: 145-153. 1913.

Key to the species

1. Leaf blades cleft to the middle or deeper, the lobes oblong, more or less lobulate..... 1. *S. LACINIATUS*.
 1. Leaf blades not cleft to the middle, angulate or very shallowly lobed, the lobes broadly triangular, merely dentate..... 2. *S. AMPELOPHYLLUS*.

1. *Sicyos laciniatus* L., Sp. Pl. 1013. 1753.

Huachuca Mountains, Cochise County (*Lemmon* in 1882), September. Southeastern Arizona and Mexico.

The Arizona form is var. *genuina* Cogn.

2. *Sicyos ampelophyllus* Woot. and Standl., Torrey Bot. Club Bul. 36: 111. 1909.

Sicyos laciniatus var. *subintegrus* Cogn. in DC., Monog. Phan. Cucurb. 880. 1881.

Yavapai, Cochise, and Pima Counties (probably elsewhere), 4,000 to 5,500 feet, in shade along streams, August and September. New Mexico and Arizona.

10. SICYOSPERMA

Plant annual; stems slender, climbing; leaf blades thin, angulate, or shallowly lobed with broad triangular lobes; flowers monoecious, the inflorescences few-flowered, axillary, the pistillate flowers conspicuously bracteate; staminate corolla rotate, whitish; fruit small, dry, without spines.

1. *Sicyosperma gracile* A. Gray, Pl. Wright. 2: 62. 1853.

Gila, Cochise, Santa Cruz, and Pima Counties, 3,600 to 5,500 feet, along streams in partial shade, August and September. Southern Arizona and northern Mexico.

11. CYCLANTHERA

Plant annual, glabrous; stems slender, climbing; leaves mostly pedately compound, the divisions stalked; flowers of both sexes from the same axils, the staminate flowers in small racemes or panicles, the pistillate flowers solitary; corolla rotate, whitish; fruit dry, narrowly ovoid, somewhat asymmetric, acuminate, 2 to 3 cm. long, armed with long slender smooth spines, bursting irregularly.

1. *Cyclanthera dissecta* (Torr. and Gray) Arn., London Jour. Bot. 3: 280. 1841.

Discanthera dissecta Torr. and Gray, Fl. North Amer. 1: 697. 1840.

Santa Rita and Baboquivari Mountains (Pima County), 4,000 (to 5,000?) feet, along streams, September and October. Kansas to Louisiana, Texas, southern Arizona, and Mexico.

120. CAMPANULACEAE. BELLFLOWER FAMILY

Contributed by ROGERS McVAUGH

Plants herbaceous or rarely suffrutescent, the juice usually milky; leaves simple, alternate, exstipulate; flowers normally 5-merous (the carpels 2 to 5, in *Specularia* the calyx lobes 3 to 5); corolla sympetalous; style 1; ovary usually inferior or partly so; fruit a capsule; seeds numerous, minute.

Key to the genera

1. Corolla regular; anthers and filaments distinct; capsule opening by lateral pores formed by the uplifting of small lids: Subfamily Campanuloidae (2).
 2. Flowers terminal or axillary, on long pedicels; corolla campanulate, relatively deep; plants perennial----- 1. CAMPANULA.
 2. Flowers axillary, sessile; corolla rotate, relatively shallow; plants annual.----- 2. SPECULARIA.
1. Corolla irregular, usually strongly so; filaments united into a tube; anthers distinct or united; capsule opening apically, by valves or somewhat irregularly: subfamily Lobelioideae (3).
 3. Anthers distinct, all alike; flowers minute, 5 mm. long or less; leaves in a basal rosette; plants of deserts and semideserts, annual--- 3. NEMAFLADUS.
 3. Anthers united into a tube, 3 of them longer than the other 2; flowers 10 mm. long or more; leaves mostly cauline; plants of moist situations (4).
 4. Corolla tube slit down one side nearly to the base----- 4. LOBELIA.
 4. Corolla tube entire, not slit down one side----- 5. PORTERELLA.

1. CAMPANULA. BELLFLOWER

Plants glabrous or nearly so; upper leaves linear or linear-lanceolate, the basal and lower leaves oblanceolate, spatulate, or ovate, petiolate, sometimes cordate; flowers blue or violet, showy; hypanthium turbinate-obconic; ovary and capsule trilocular.

Several species of this very attractive genus are cultivated as ornamentals.

Key to the species

1. Calyx lobes entire; mature capsule nodding, the valves at the very base.----- 1. C. ROTUNDFOLIA.
1. Calyx lobes normally with 1 or more callose teeth on each side; mature capsule erect, the valves distinctly above the middle, usually two-thirds to three-fourths of the distance from base to apex----- 2. C. PARRYI.

1. *Campanula rotundifolia* L., Sp. Pl. 163. 1753.

White Mountains (Apache and Greenlee Counties), Pinaleno Mountains (Graham County), 9,000 feet or higher, meadows and rocky slopes, June to September. Boreal regions of North America and Eurasia, south in western North America, in the mountains, to Coahuila, eastern Arizona, and northern California.

Harebell, bluebell. An exceedingly widespread and variable species. Numerous segregates have been proposed, but at the present time the most conservative course appears to be to regard them all as phases of one polymorphic species.

2. *Campanula parryi* A. Gray, Syn. Fl. ed. 2, 2¹: 395. 1886.

Kaibab Plateau, San Francisco Peaks, near Flagstaff, Clark Valley (Coconino County), 7,000 to 10,000 feet, mountain meadows, July to September. Wyoming and central Utah to northern New Mexico and northern Arizona.

2. SPECULARIA. VENUS-LOOKINGGLASS

Plants somewhat hairy; leaves ovate to oblong or suborbicular, sessile or clasping; flowers dimorphic, the earlier ones small and cleistogamous, the later flowers petaliferous, showy, purple or violet; hypanthium short-cylindric or elliptic; ovary and capsule regularly trilocular, or sometimes bilocular.

Key to the species

1. Valves of the capsule near the summit; leaves sessile, ovate or the upper ones narrower..... 1. *S. BIFLORA*.
 1. Valves of the capsule at or below the middle; leaves strongly cordate-clasping, or the lower ones merely sessile..... 2. *S. PERFOLIATA*.

1. ***Specularia biflora*** (Ruiz and Pavon) Fisch. et Mey., Index Sem. Hort. Petrop. 1: 17. 1835.

Campanula biflora Ruiz and Pavon, Fl. Peruv. Chil. 2: 55. 1799.

Gila County and southward, 5,300 feet or lower, April to June. Southern Virginia to Arkansas, southern Arizona, coastal California, and southward; South America.

2. ***Specularia perfoliata*** (L.) A. DC., Monog. Campan. 351. 1830.

Campanula perfoliata L., Sp. Pl. 169. 1753.

Coconino County and southward, 7,500 feet or lower, spring and summer. Southern Ontario to southern British Columbia, south to the West Indies, southern Mexico, Arizona, and northern California.

3. NEMACLADUS

Plants diffusely branched, with delicate slender stems, 5 to 30 cm. high; cauline leaves reduced to subulate or linear bracts; flowers loosely racemose on all the branches; corolla white or purplish tinged, more or less bilabiate; ovary and capsule bilocular, or sometimes becoming unilocular.

Key to the species

1. Capsule 2.3 to 5 mm. long, free from the calyx its entire length; corolla tube 2 to 3 mm. long, usually exceeding the calyx lobes; corolla (in the Arizona variety) 3 to 3.5 mm. long..... 1. *N. LONGIFLORUS*.
 1. Capsule 1.0 to 2.0 (rarely 2.5) mm. long, free from the calyx about half its length; corolla tube not more than 1.5 mm. long, usually exceeded by the calyx lobes (2).
 2. Anthers 0.4 to 0.8 mm. long; lower part of the stem silvery-gray, shining; corolla lobes united at the very base only, the lobes much longer than the tube..... 3. *N. RUBESCENS*.
 2. Anthers 0.1 to 0.3 (rarely 0.4) mm. long; lower part of the stem purplish or brownish, lacking a silvery-gray sheen (3).
 3. Seeds pitted, the pits in about 10 rows of 10 to 12 each; pedicels usually spreading in a graceful double curve; corolla tubular, the tube equaling the lobes or nearly so..... 2. *N. GRACILIS*.
 3. Seeds with distinct, somewhat flattened, longitudinal ridges separated by sharply impressed lines, each ridge divided by 15 to 20 fine transverse lines; pedicels usually somewhat ascending, distinctly stiff; corolla deeply divided, the lobes longer than the tube..... 4. *N. GLANDULIFERUS*.

1. ***Nemacladus longiflorus*** A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 60. 1876.

Represented in Arizona by var. *breviflorus* McVaugh, of which the type (*Peebles* et al., 3754) was collected between Tucson and Sells (Pima County), about 2,300 feet, sandy soil. This is the only known Arizona locality.

The variety, as well as the typical form of the species, occurs most abundantly in the deserts and desert mountains of southern California. The typical form of the species, with corolla 5.0 to 8.0 mm. long, has not been reported from Arizona.

2. *Nemacladus gracilis* Eastw., Torrey Bot. Club Bul. 30: 500. 1903.

Nemacladus ramosissimus Nutt. var. *gracilis* Munz, Amer. Jour. Bot. 11: 240. 1924.

This species is included in the flora of Arizona by virtue of a specimen, now in the herbarium of the Academy of Natural Sciences of Philadelphia, labeled "Central Arizona" (Palmer 300). The range of the species lies west of the Mohave and Colorado Deserts for the most part, and, although it is known from Clark County, Nevada, and eastern San Bernardino County, Calif., there are no authentic modern records of its occurrence in Arizona.

3. *Nemacladus rubescens* Greene, Calif. Acad. Sci. Bul. 1: 197. 1885.

Nemacladus rigidus Curran var. *rubescens* Munz, Amer. Jour. Bot. 11: 245. 1924 (in part).

Western Mohave and Yuma Counties, 1,800 feet or lower, dry gravelly or rocky soil in desert regions, mostly April to May. Nevada, western Arizona, southern California, and Baja California.

A well-marked species, easily distinguished from all others by the silvery-gray stems and the smooth, yellowish-green, nearly entire leaves.

4. *Nemacladus glanduliferus* Jepson, Man. Fl. Pl. Calif. 975. 1925.

Nemacladus rigidus var. *rubescens* Munz, Amer. Jour. Bot. 11: 245. 1924 (in part).

Throughout Arizona except the northeastern part (absent in Coconino, Navajo, and Apache Counties), up to 5,000 feet, sandy deserts and desert mountains, March to May. Southwestern Utah to southern California, south to Sonora and Baja California.

Represented in Arizona by var. *orientalis* McVaugh. This variety is more widely distributed than any other member of the genus.

4. LOBELIA

Plants erect, more or less strict; inflorescence a single terminal raceme (occasionally with subordinate lateral inflorescences); corolla showy, strongly bilabiate; flowers inverted in anthesis, the pedicel twisted.

Many species of *Lobelia* have beautiful flowers and several of them are grown as ornamentals.

Key to the species

1. Corolla normally blue; flower, when straightened, not more than 23 mm. long; filament tube 1.5 to 5.0 mm. long (2).
2. Plant annual or biennial; filament tube 1.5 to 2.3 mm. long, the anthers all densely white-tufted at tip; corolla tube with slits in the sides in addition to the dorsal slit; leaves sharply serrate, broad and often clasping at base..... 1. *L. FENESTRALIS*.
2. Plant with a perennial rootstock; filament tube 3.5 to 5.0 mm. long, the 2 smaller anthers white-tufted at tip, the 3 larger ones smooth or nearly so; corolla tube entire except for the dorsal slit; cauline leaves shallowly dentate or subentire, narrowed at base, never clasping.
 2. *L. ANATINA*.
1. Corolla normally red, or red and yellow; flower when straightened 25 mm. long, or longer; filament tube 18 to 35 mm. long (3).
3. Pedicels elongate, 3 to 10 cm. long in fruit; anther tube 5 to 9 mm. long.
 3. *L. LAXIFLORA*
3. Pedicels short, seldom more than 1.5 cm. long in fruit; anther tube 3 to 4 mm. long..... 4. *L. CARDINALIS*.

1. *Lobelia fenestralis* Cav., Icon. Pl. 6: 8. 1801.

Chiricahua and Huachuca Mountains (Cochise County), near Patagonia (Santa Cruz County), also a collection by Lemmon labeled as from Oak Creek (Coconino County), 5,000 to 6,000 feet, meadows and swales, August to November. Western Texas to Arizona and southward to Oaxaca.

2. *Lobelia anatina* Wimmer, Repert. Spec. Novarum Regni Veg. 19: 385. 1924.

Apache County to Coconino County, south to the mountains of Cochise and Pima Counties, 5,600 to 8,600 feet, meadows, marshy places, and stream banks, July to October. Southern New Mexico and Arizona, and southward to Durango.

A species quite distinct from *L. grivina* Cav., to which most of the United States material has previously been referred.

3. *Lobelia laxiflora* H. B. K., Nov. Gen. et Sp. 3: 311. 1819.

Sycamore Canyon, near Ruby, Santa Cruz County, about 4,000 feet (*Goodding* in 1936), the only known locality in the State. Southern Arizona and throughout most of Mexico and Central America.

A polymorphic species. Many so-called species have been segregated from it, but the better course appears to be to regard them all as varieties of the original *L. laxiflora*, the typical form of which is found in the region of Vera Cruz and southward. The plant of Arizona, at least for the present, is best referred to var. *angustifolia* A. DC.

4. *Lobelia cardinalis* L., Sp. Pl. 930. 1753.

Throughout most of the State, 4,000 to 7,000 feet, frequent in moist soil, especially along streams, July to October. Widely distributed in the United States, Mexico, and Central America.

Cardinalflower. Represented in Arizona by subsp. *graminea* (Lam.) McVaugh. Plants of this subspecies have previously been reported as *L. splendens* Willd. or *L. fulgens* Willd.

5. PORTERELLA

Plant annual, diffuse, weak-stemmed; leaves lanceolate to linear, entire or essentially so, the lower leaves often submersed and early deciduous; corolla blue with a yellow eye, showy; flowers inverted in anthesis.

1. *Porterella carnosula* (Hook. and Arn.) Torr. in Hayden, Geol. Survey Mont. Rpt. 488. 1872.

Lobelia carnosula Hook. and Arn., Bot. Beech. Voy. 362. 1840.

Fort Valley, Coconino County, about 7,500 feet (*Fulton* 4373), the only known Arizona locality, muddy pools and margins of streams and ponds. Northern Wyoming to Oregon, south to northern Arizona and northern California.

121. COMPOSITAE. SUNFLOWER FAMILY

Contributed by S. F. BLAKE

Herbs or shrubs; leaves opposite or alternate, rarely whorled, entire to dissected, never truly compound; flowers borne in a head (this rarely 1-flowered) on a receptacle, surrounded by an involucre of

phyllaries (bracts), hermaphrodite, or pistillate, or hermaphrodite with a more or less abortive pistil and functionally staminate, or neutral (with an ovary but lacking a style and a stigma); corolla gamopetalous, either regular, tubular, and 5-toothed (rarely 2- to 4-toothed), or bilabiate, or ligulate (flattened, strap-shaped, and usually 2- to 5-toothed), the corolla rarely wanting in the pistillate flowers; stamens (in the hermaphrodite or staminate flowers) almost always 5, united by the anthers or rarely only by the filaments, inserted on the corolla; ovary inferior, 1-celled, with an erect anatropous ovule; style normally 2-branched, the branches stigmatiferous inside, often bearing sterile appendages at apex, the style in functionally staminate flowers often undivided; fruit an achene, with a single erect exalbuminous seed, usually bearing a pappus of bristles, of awns, or of scales (paleae or squamellae).

The family comprises several well-known vegetables, notably lettuce (*Lactuca sativa*), artichoke (*Cynara scolymus*), salsify (*Tragopogon porrifolius*), endive (*Cichorium endivia*), and Jerusalem-artichoke (*Helianthus tuberosus*). Species of goldenrod (*Solidago*), rabbitbrush (*Chrysothamnus*), and "Colorado rubber plant" (*Actinea*) contain appreciable quantities of rubber, but commercial exploitation of these plants has not yet been found practicable. Guayule (*Parthenium argentatum*) has been exploited extensively in the wild state in Mexico and grown to a limited extent in the United States as a source of rubber. The family is rich in oils, resins, and bitter principles, and many species are used in medicine. The well-known insecticide, pyrethrum, is furnished by the powdered flowers of a few species of *Chrysanthemum*. Many of the family are browsed by grazing animals, but their palatability is generally low, because of their resinous or acrid properties. A few species are known to be poisonous to livestock. The ragweeds (*Ambrosia* spp.) are notable, because their wind-borne pollen is one of the most frequent causes of hay fever. Goldenrod, although popularly regarded as an important source of hay fever, is now considered to be of little if any importance in this respect.

The flower heads are frequently showy, often beautiful, and many Compositae are in cultivation as ornamentals, notably in the genera: *Ageratum*, *Anthemis*, *Arctotis*, *Aster*, *Bellis*, *Boltonia*, *Calendula*, *Callistephus* (China-aster), *Centaurea*, *Chrysanthemum*, *Coreopsis*, *Cosmos*, *Dahlia*, *Dimorphotheca*, *Echinops* (globethistle), *Erigeron*, *Felicia*, *Gaillardia*, *Gazania*, *Gerbera*, *Helenium*, *Helianthus* (sunflower), *Helichrysum* (everlasting, strawflower), *Heliopsis*, *Inula*, *Jurinea*, *Krigia*, *Liatris* (blazing-star), *Ligularia*, *Matricaria*, *Notonia*, *Olearia*, *Onopordon*, *Piqueria*, *Rudbeckia*, *Santolina*, *Sanvitalia*, *Senecio*, *Solidago*, *Stokesia*, *Tagetes*, *Tanacetum*, *Tithonia*, *Ursinia*, *Vernonia*, *Waitzia*, *Xanthisma*, *Xeranthemum*, *Zinnia*.

Key to the principal divisions

1. Corollas of some or all of the flowers distinctly bilabiate----- A.
1. Corollas not or obscurely bilabiate (2).
2. Flowers all hermaphrodite (perfect) and with strap-shaped 5-toothed corollas----- B.
2. Flowers, when hermaphrodite, with the corolla tubular and regular or nearly so; marginal flowers of the head often pistillate or neutral and often with strap-shaped, 2- or 3-toothed corollas (3).
3. Rays (strap-shaped corollas) none or the ligule vestigial (4).

- 4. Pappus none or vestigial..... C.
- 4. Pappus evident on some or all of the achenes (5).
 - 5. Achenes with a pappus of awns or scales (paleae, squamellae) or both, these sometimes united into a low chaffy crown..... D.
 - 5. Achenes with a pappus of capillary bristles, rarely with additional outer scales..... E.
- 3. Rays present but sometimes small (6).
 - 6. Pappus of capillary bristles, rarely with a few short outer scales.... F.
 - 6. Pappus none, or of awns or scales (7).
 - 7. Achenes without pappus, or the pappus vestigial..... G.
 - 7. Achenes (some or all of them) with a pappus of awns, or scales, or both, these separate or united into a crown..... H.

Key to the genera

A. Corollas of some or all of the flowers bilabiate.

- 1. Flowers at the margin of the head pistillate and with strap-shaped 3-toothed corollas, the other flowers perfect and with bilabiate corollas; plants scapose..... 121. CHAPTALIA.
- 1. Flowers all perfect and with bilabiate corollas; stems leafy (2).
 - 2. Plants herbaceous; corollas pink or whitish; involucre strongly graduated. 122. PEREZIA.
 - 2. Plant shrubby; corollas yellow; involucre in only 2 distinct series. 123. TRIXIS.

B. Flowers all hermaphrodite and with strap-shaped 5-toothed corollas.

- 1. Achenes without pappus..... 125. ATRICHOSERIS.
- 1. Achenes with pappus (2).
 - 2. Pappus, at least in part, of plumose bristles (3).
 - 3. Phyllaries in several strongly graduated series, very obtuse, broadly scarious-margined; receptacle chaffy; flowers yellow. 128. ANISOCOMA.
 - 3. Phyllaries not in several graduated series but often with a much shorter outer series, not, or narrowly, scarious-margined; receptacle naked (4).
 - 4. Achenes truncate at apex; plants more or less rushlike; corollas pink. 130. STEPHANOMERIA.
 - 4. Achenes tapering or beaked at apex (5).
 - 5. Plant scapose; leaves hispid; corollas yellow.... 129. LEONTODON.
 - 5. Plants leafy-stemmed; leaves not hispid (6).
 - 6. Leaves pinnatifid; corollas white or pinkish; involucre with an outer series of short bractlets..... 131. NEMOSERIS.
 - 6. Leaves grasslike, entire; corollas yellow or violet purple; involucre without short outer bractlets..... 132. TRAGOPOGON.
- 2. Pappus of nonplumose bristles or of awns or scales (7).
 - 7. Pappus, at least in part, of awns or scales (8).
 - 8. Corollas blue; plant with leafy branched stems..... 124. CICHORIUM.
 - 8. Corollas yellow or orange (9).
 - 9. Plants scapose or subscapose; pappus simple, of bifid paleae tipped with a bristle..... 126. MICROSERIS.
 - 9. Plants caulescent, the stems few-leaved; pappus double, the outer series of thin short scales, the inner series of much longer bristles. 127. KRIGIA.
 - 7. Pappus of capillary bristles only (10).
 - 10. Achenes more or less flattened; stems leafy; heads in panicles (11).
 - 11. Involucre campanulate or hemispheric; achenes not beaked. 138. SONCHUS.
 - 11. Involucre cylindrical or ovoid-cylindrical; achenes beaked. 139. LACTUCA.
- 10. Achenes not flattened (12).
 - 12. Achenes not beaked (13).
 - 13. Pappus quickly deciduous, or with 1 to 8 stiff persistent bristles; plants annual..... 134. MALACOTHRIX.
 - 13. Pappus persistent (14).
 - 14. Plants rushlike or spinescent; corollas pink. 140. LYGOESMIA.

14. Plants not rushlike or spinescent; corollas yellow, rarely white or flesh-colored (15).
15. Phyllaries somewhat thickened at base or on the midrib; pappus white..... 143. CREPIS.
15. Phyllaries not thickened; pappus dingy or brownish, or sometimes white..... 144. HIERACTUM.
12. Achenes beaked (16).
16. Pappus soon deciduous (17).
17. Leaves not crustaceous-margined; plants conspicuously stipitate-glandular above; achenes tapering into the beak, not transversely rugulose..... 135. CALYCOSERIS.
17. Leaves crustaceous-margined; plants not stipitate-glandular; achenes abruptly beaked, transversely rugulose between the ribs..... 136. GLYPTOPLEURA.
16. Pappus persistent (18).
18. Achenes 10- to 15-ribbed or -nerved, not spinulose-muricate; phyllaries imbricate in several graduated series (19).
19. Corollas rosy or whitish; phyllaries with conspicuous blackish or brownish, scarios tips; pappus brownish.
133. PINAROPAPPUS.
19. Corollas yellow or orange, sometimes turning purplish in age; phyllaries without dark scarios tips; pappus white or whitish..... 141. AGOSERIS.
18. Achenes 4- or 5-ribbed, spinulose-muricate above; phyllaries in 2 unequal series, the outer ones much shorter (20).
20. Plants scapose, the scapes naked, 1-headed; pappus whitish, without a woolly ring at base..... 137. TARAXACUM.
20. Plants caulescent, the stems more or less leafy and branched; pappus brownish, with a woolly ring at base.
142. PYRRHOPAPPUS.
- C. Hermaphrodite flowers with a tubular, regular or nearly regular corolla; rays and pappus none or vestigial.
1. Heads unisexual, monoecious; pistillate heads with 1 to 4 flowers enclosed in a nutlike or burlike involucre, only the style tips exerted (2).
2. Phyllaries of the staminate heads separate; fruiting involucre burlike, covered with hooked prickles..... 51. XANTHIUM.
2. Phyllaries of the staminate heads united (3).
3. Pistillate involucre with several transverse scarios wings; leaves or their lobes linear-filiform..... 48. HYMENOCLEA.
3. Pistillate involucre without transverse wings; leaves and their lobes not linear-filiform (4).
4. Fruiting involucre unarmed or with a few teeth or tubercles in a single series below the beak..... 49. AMBROSIA.
4. Fruiting involucre with several or many spines in more than one series.
50. FRANSERIA.
1. Heads not unisexual; involucre not nutlike or burlike (5).
5. Flowers all hermaphrodite (6).
6. Heads 1- or 2-flowered, aggregated in dense glomerules (7).
7. Phyllaries of the individual heads connate into a toothed tube; leaves ovate, petioled..... 38. LAGASCEA.
7. Phyllaries of the individual heads separate; leaves lanceolate, sessile or subsessile..... 87. FLAVERIA.
6. Heads many-flowered, not in glomerules (8).
8. Receptacle chaffy (9).
9. Inner phyllaries united at base into a cup; achenes thickish, papillate..... 74. THELESPERMA.
9. Inner phyllaries not united; achenes strongly compressed, very flat, not papillate (10).
10. Achenes strongly ciliate on the margin..... 64. ENCELIA.
10. Achenes not evidently ciliate..... 65. SIMSIA.
8. Receptacle not chaffy (11).
11. Achenes strongly compressed..... 84. LAPHAMIA.
11. Achenes plump (12).
12. Phyllaries with conspicuous whitish or yellow tips and margins; achenes strongly 4- or 5-angled, usually hirsute on the angles.
90. HYMENOPAPPUS.

12. Phyllaries not with conspicuous whitish or yellowish tips and margins; achenes otherwise (13).
 13. Heads solitary or cymose----- 108. MATRICARIA.
 13. Heads in spikes or racemes, these often paniced.
 110. ARTEMISIA.
5. Flowers not all hermaphrodite, the outer ones pistillate and fertile, the inner ones hermaphrodite but often sterile (14).
14. Plants woolly, annual, dwarf (15).
 15. Bracts subtending the pistillate flowers completely enclosing them, and tipped with a hyaline appendage----- 32. STYLOCLINE.
 15. Bracts subtending the pistillate flowers more or less open, not completely enclosing the flowers (16).
 16. Pales of the receptacle flattish----- 33. EVAX.
 16. Pales of the receptacle, at least the outer ones, boat-shaped.
 34. FILAGO.
14. Plants not woolly or, if so, then perennial (17).
 17. Receptacle not chaffy----- 110. ARTEMISIA.
 17. Receptacle chaffy, at least toward the margin (18).
 18. Achenes densely long-villous; leaves or their lobes linear-filiform.
 46. OXYTENIA.
 18. Achenes not long-villous; leaves or their lobes not linear-filiform (19).
 19. Achenes with pectinate or toothed wings----- 47. DICORIA.
 19. Achenes not with pectinate or toothed wings (20).
 20. Pistillate flowers 6 to 8; achenes with an acute margin and a terminal apiculation, falling away at maturity with the pales of the opposed disk flowers----- 44. PARTHENICE.
 20. Pistillate flowers 5; achenes otherwise----- 45. IVA.
- D. Hermaphrodite flowers with a tubular, regular or nearly regular corolla; rays none or vestigial; pappus present, of awns or scales or both, these sometimes united into a low chaffy crown.
1. Receptacle chaffy (2).
 2. Pappus of about 15 plumose awns----- 77. BEBBIA.
 2. Pappus not of plumose awns (3).
 3. Pappus of numerous flattened bristles----- 30. BACCHARIS.
 3. Pappus of 1 to 4 teeth, squamellae, awns, or paleae (4).
 4. Achenes with pectinate or toothed wings----- 47. DICORIA.
 4. Achenes not with pectinate or toothed wings (5).
 5. Awns or teeth not retrorsely barbed; plants shrubby (6).
 6. Achenes somewhat thickened, not notably ciliate on the margin.
 63. FLOURENSIA.
 6. Achenes very flat, conspicuously ciliate on the margin.
 64. ENCELIA.
 5. Awns or teeth retrorsely barbed; plants herbaceous (7).
 7. Inner phyllaries united about to the middle, forming a cup.
 74. THELESERMA.
 7. Inner phyllaries not united----- 75. BIDENS.
1. Receptacle not chaffy, sometimes setose or fimbriate (8).
 8. Heads 1-flowered, crowded in dense glomerules; involucre of the individual heads tubular, 5- or 6-toothed at tip----- 38. LAGASCEA.
 8. Heads several- or many-flowered (9).
 9. Plants strictly dioecious, the heads on some plants entirely pistillate, on others with hermaphrodite but sterile and functionally staminate flowers----- 30. BACCHARIS.
 9. Plants not dioecious (10).
 10. Receptacle densely setose all over; thistlelike herbs (11).
 11. Pappus of numerous slender plumose paleae, united at base and deciduous in a ring----- 118. CYNARA.
 11. Pappus of numerous setae or paleae, not united at base, separately deciduous----- 120. CENTAUREA.
10. Receptacle naked, fimbriate, or sparsely setose; plants not thistlelike (12).
 12. Pappus of 2 to 8 caducous awns; plants usually strongly glutinous.
 10. GRINDELIA.
 12. Pappus otherwise (13).
 13. Pappus of numerous graduated bristles, the inner ones somewhat flattened and paleaceous; low shrub, with crowded, subterete, impressed-punctate leaves----- 112. PEUCEPHYLLUM.

13. Pappus otherwise (14).
 14. Leaves and involucre conspicuously punctate with translucent oil glands (15).
 15. Pappus of 3 to 6 entire paleae; phyllaries strictly 1-seriate, united essentially to the apex into a toothed cup or tube.
 102. TAGETES.
 15. Pappus of paleae dissected into bristles, or else of 10 paleae or squamellae; phyllaries more or less distinctly 2-seriate.
 103. DYSSODIA.
 14. Leaves and involucre sometimes impressed-punctate, but not with translucent oil glands (16).
 16. Pappus of 12 or more paleae, these nearly or quite as long as the achene (17).
 17. Herbs; involucre not conspicuously graduated.
 91. HYMENOTHRIX.
 17. Shrubs; involucre conspicuously graduated (18).
 18. Leaves opposite; corollas purple-tinged.
 5. CARPHOCHAETE.
 18. Leaves alternate; corollas yellow (19).
 19. Plant very viscid; paleae of the pappus 12 to 16, essentially equal..... 11. VANCELVEA.
 19. Plant not viscid; paleae and bristles of the pappus more numerous, distinctly graduated.
 14. ACAMPTOPAPPUS.
 16. Pappus of fewer than 12 paleae or squamellae, or else these much shorter than the achene (20).
 20. Heads 5-flowered; pappus of 3 to 5 awns, with or without as many short squamellae, or reduced to a toothed crown.
 1. STEVIA.
 20. Heads with more numerous flowers, or else the pappus otherwise (21).
 21. Achenes strongly compressed; pappus of 1 or 2 slender awns and often a crown of squamellae, or of a crown of lacerate squamellae only (22).
 22. Achenes not evidently ciliate; pappus of 1 or 2 awns.
 84. LAPHAMIA.
 22. Achenes strongly ciliate on the margin; pappus of a crown of squamellae and often 1 or 2 awns (23).
 23. Heads radiate; leaves not hastate-triangular or caudate-acuminate..... 83. PERITYLE.
 23. Heads discoid; leaves hastate-triangular, caudate-acuminate..... 85. PERICOME.
 21. Achenes not compressed, or else the pappus otherwise (24).
 24. Pappus a low entire crown; low annual herb, pineapple-scented..... 108. MATRICARIA.
 24. Pappus otherwise; plants not pineapple-scented (25).
 25. Heads mostly 4- to 6-flowered, about 2.5 cm. high.
 5. CARPHOCHAETE.
 25. Heads with more numerous flowers, or else much smaller (26).
 26. Pappus a crown of short dissected squamellae, or of 5 paleae dissected into bristles (27).
 27. Glabrous annual; phyllaries chartaceous, green-tipped; pappus a low dissected crown.
 22. GREENELLA.
 27. Woolly annual; phyllaries not chartaceous; pappus of 5 paleae dissected into numerous bristles..... 97. TRICHOPTILUM.
 26. Pappus otherwise (28).
 28. Phyllaries with a thin, scarious, white, yellow, or purplish margin and tip (29).
 29. Plants tomentose; pappus of 10 or more paleae or squamellae.
 90. HYMENOPAPPUS.

29. Plants not tomentose; pappus of 8 paleae or squamellae (30).
30. Heads with fewer than 10 flowers; achenes strongly quadrangular.
89. SCHKUHRIA.
30. Heads with more than 10 flowers; achenes not strongly quadrangular.
96. BAHIA.
28. Phyllaries not with a scarious colored margin and tip (31).
31. Leaves decurrent; corollas fuscous; pappus squamellae about 5, obtuse, much shorter than the achene----- 99. HELENIUM.
31. Leaves not decurrent; corollas not fuscous; pappus paleae or squamellae usually more numerous or longer (32).
32. Corollas yellow----- 93. ERIOPHYLLUM.
32. Corollas white, flesh-colored, or purplish (33).
33. Plant scapose, with roundish entire or crenate leaves.
95. CHAMAEECHAENACTIS.
33. Plants leafy-stemmed; leaves not roundish and entire or subentire (34).
34. Pappus paleae with a strong midrib; leaves lanceolate or linear, entire.
92. PALAFOXIA.
34. Pappus paleae nerveless or essentially so; leaves, at least in part, toothed to pinnatifid---- 94. CHAENACTIS.
- E. Hermaphrodite flowers with a tubular, regular or nearly regular corolla; rays none or vestigial; pappus present, of capillary bristles, rarely with additional outer scales.
1. Receptacle densely bristly (2).
2. Leaf margins neither prickly nor spiny; pappus bristles not united at base nor deciduous in a ring----- 120. CENTAUREA.
2. Leaf margins prickly or spiny; pappus bristles united at base and deciduous in a ring (3).
3. Pappus bristles flattish, barbellate; leaves blotched with white along the veins----- 119. SILYBUM.
3. Pappus bristles slender, plumose; leaves not blotched with white (4).
4. Phyllaries comparatively narrow, at least the outer ones spine-tipped.
117. CIRSIUM.
4. Phyllaries broad (about 1 cm. wide), not spine-tipped-- 118. CYNARA.
1. Receptacle naked or chaffy (5).
5. Phyllaries scarious or hyaline, or in genera *Baccharis* and *Pluchea* only partly so (6).
6. Heads unisexual; plants dioecious (7).
7. Plants large, not tomentose, shrubby, at least at base; heads numerous, in panicles; phyllaries chartaceous, scarious-margined.
30. BACCHARIS.
7. Plants small, tomentose, strictly herbaceous; heads few, in short racemes or corymbs, these sometimes paniced, or the heads rarely solitary; phyllaries strictly scarious (8).
8. Heads strictly dioecious; plants low, the basal leaves in a rosette, the stem leaves reduced----- 35. ANTENNARIA.
8. Heads subdioecious, the pistillate ones usually with a few hermaphrodite flowers in the center; plant usually at least 30 cm. high, without a basal rosette----- 36. ANAPHALIS.
6. Heads with the marginal flowers pistillate, the central flowers perfect (9).
9. Receptacle chaffy except in the center; plants small, woolly.
34. FILAGO.
9. Receptacle naked (10).
10. Phyllaries subscarious; corollas purplish; plants not tomentose.
31. PLUCHEA.

10. Phyllaries scarious; corollas rarely purplish; plants tomentose (11).
 11. Heads subdioecious, the pistillate ones usually with a few central hermaphrodite flowers----- 36. ANAPHALIS.
 11. Heads all alike and heterogamous----- 37. GNAPHALIUM.
5. Phyllaries herbaceous, at least in the center (12).
 12. Heads unisexual; plants dioecious----- 30. BACCHARIS.
 12. Heads not unisexual (13).
 13. Plants low, depressed, scurfy-pubescent, winter-annual; leaf blades broadly ovate or suborbicular----- 113. PSATHYROTES.
13. Plants perennial or, if annual, then not low and scurfy-pubescent (14).
 14. Phyllaries and leaves bearing conspicuous translucent oil glands (15).
 15. Phyllaries relatively numerous, usually in more than 1 series and with some bractlets at base; pappus bristles basally united in groups----- 103. DYSSODIA.
 15. Phyllaries few (5 to 8), free, equal, strictly 1-seriate; pappus bristles free, numerous----- 104. POROPHYLLUM.
14. Phyllaries and leaves sometimes impressed-glandular but not with translucent oil glands (16).
 16. Phyllaries proper 4 to 7, in a single series, of equal length (17).
 17. Plant herbaceous; leaves very large, decompound.----- 114. CACALIA.
 17. Plant shrubby; leaves narrow, entire----- 115. TETRADYMIA.
16. Phyllaries more than 7 (18).
 18. Pappus bristles plumose (19).
 19. Annual herb, with deltoid-ovate leaves and cylindric heads, these in a slender leafless virgate panicle.----- 3. CARMINATIA.
19. Perennial herbs or shrubs; leaves and inflorescence otherwise (20).
 20. Intricately branched shrub; corollas yellow-- 77. BEBBIA.
 20. Perennial herbs, or shrubby at base, not much branched; corollas whitish (21).
 21. Leaves lanceolate or ovate, 3-nerved; heads 9- to 12-flowered----- 6. BRICKELLIA.
 21. Leaves narrowly linear or linear-lanceolate, 1-nerved; heads many-flowered----- 7. KUHNIA.
18. Pappus bristles not plumose (22).
 22. Plants shrubby; leaves of the branches reduced to scales; involucre strongly graduated, the phyllaries not in vertical ranks (23).
 23. Phyllaries lanceolate, acute; achenes silky-pubescent.----- 27. ASTER.
 23. Phyllaries ovate to oblong, obtuse; achenes glabrous.----- 110a. LEPIDOSPARTUM.
22. Plants otherwise in habit and foliage, or else the phyllaries in distinct vertical ranks (24).
 24. Shrub; leaves crowded, linear-filiform, subterete, impressed-punctate; involucral bracts nearly in 1 series and of equal length, subulate, herbaceous.----- 112. PEUCEPHYLLUM.
24. Herbs or, if shrubby and with subterete impressed-punctate leaves, then the involucral bracts not equal, nor subulate, nor herbaceous (25).
 25. Pappus double, the outer series of short scales, the inner series of capillary bristles; white-barked shrub with small leaves, the petioles much longer than the blades.----- 2. HOFMEISTERIA.
25. Pappus simple or else the plants herbaceous (26).
 26. Heads with the outer flowers pistillate and the central flowers hermaphrodite (27).
 27. Phyllaries subequal; corollas whitish-- 29. CONYZA.
 27. Phyllaries distinctly graduated; corollas purplish.----- 31. PLUCHEA.
26. Heads with all of the flowers hermaphrodite (28).
 28. Pappus of 2 to 8 caducous bristlelike awns; herbs, more or less viscid----- 10. GRNDELIA.

28. Pappus bristles more numerous, not caducous (29).
29. Achenes 5-angled or 5-ribbed; corollas white, pink, blue, or purple; leaves often opposite.⁵⁵
4. EUPATORIUM.
29. Achenes not 5-angled or 5-ribbed, or else the corollas yellow (30).
30. Pappus of 5 paleae dissected above into bristles.
97. TRICHOPTILUM.
30. Pappus otherwise (31).
31. Outer corollas enlarged and palmate; low annual, tomentose below, glandular above.
20. LESSINGIA.
31. Outer corollas not enlarged (32).
32. Achenes 10-ribbed; involucre usually strongly graduate, the phyllaries striate; leaves often opposite; corollas not yellow.
6. BRICKELLIA.
32. Achenes not 10-ribbed; phyllaries not striate; leaves alternate; corollas nearly always yellow (33).
33. Phyllaries in a single series of equal length, or with a few much shorter outer bractlets; style tips truncate.
116. SENECIO.
33. Phyllaries more or less unequal and imbricate, in more than 1 principal series; style tips not truncate (34).
34. Phyllaries in more or less distinct vertical ranks-- 19. CHRYSOTHAMNUS.
34. Phyllaries not in vertical ranks (35).
35. Plants woody or else the leaves spinulose-toothed; phyllaries in 2 or more graduated series, often closely imbricate.
18. APLOPAPPUS.
35. Plants herbaceous, the leaves not spinulose-toothed; phyllaries usually subequal, scarcely imbricate----- 28. ERIGERON.
- F. Hermaphrodite flowers with a tubular, regular or nearly regular corolla; rays evident but sometimes small; pappus of bristles, these mostly capillary, rarely with a few short outer scales.
1. Rays white, pink, purple, or violet (2).
2. Leaves and involucre marked with translucent oil glands-- 103. DYSSODIA.
2. Leaves and involucre without translucent oil glands (3).
3. Pappus of 1 or 2 bristlelike awns, these not plumose----- 84. LAPHAMIA.
3. Pappus bristles more numerous, or else single and plumose (4).
4. Ray achenes enveloped by the subtending phyllaries; pappus of the disk achenes of 10 stout hairy bristles, the hairs on their outer side straight, on the inner side entangled into a woolly mass-- 80. LAYIA.
4. Ray achenes not enveloped by the subtending phyllaries; pappus otherwise (5).
5. Ray flowers with pappus none or vestigial----- 24. PSILACTIS.
5. Ray flowers with evident pappus (6).
6. Plants dwarf hispid-hirsute winter annuals; upper leaves closely subtending the heads; pappus of a single plumose bristle and a scarious cup, or of numerous unequal bristles or narrow paleae.
25. MONOPTILON.
6. Plants otherwise in habit, or in the pappus (7).
7. Style tips lanceolate or subulate, acute or acuminate; phyllaries usually strongly graduated, often partly herbaceous; rays mostly relatively broad----- 27. ASTER.
7. Style tips deltoid, obtuse or rounded; phyllaries usually equal or little graduated; rays mostly very narrow-- 28. ERIGERON.

⁵⁵ *Brickellia floribunda*, which might also run down to this point in the key, may be distinguished from any native species of *Eupatorium* by its combination of rather large heads (9 to 12 mm. high) and strongly graduated involucre of obtuse or obtusish phyllaries.

1. Rays yellow or orange (8).
8. Pappus of squamellae or paleae dissected into bristles above, but entire at base (9).
 9. Plant floccose-woolly, annual----- 88. SYNTRICHOPAPPUS.
 9. Plants not floccose-woolly----- 103. DYSSODIA.
8. Pappus otherwise (10).
 10. Leaves opposite, at least below (11).
 11. Involucre and leaves with translucent oil glands; leaf margins with a few stiff bristles near the base----- 105. PECTIS.
 11. Involucre and leaves without translucent oil glands; leaves not bristly at base (12).
 12. Heads large; pappus of numerous bristles----- 111. ARNICA.
 12. Heads small; pappus of 1 or 2 bristlelike awns, or wanting.
 84. LAPHAMIA.
 10. Leaves alternate (13).
 13. Pappus of 2 to 8 caducous bristlelike awns; plants glutinous.
 10. GRINDELIA.
 13. Pappus bristles more numerous or persistent, or else the plants not glutinous (14).
 14. Pappus wholly of numerous simple and similar capillary bristles (15).
 15. Phyllaries proper 1-seriate, equal, sometimes with some short outer bractlets; style tips truncate----- 116. SENECIO.
 15. Phyllaries in more than 1 series, usually more or less unequal and graduated; style tips not truncate (16).
 16. Heads usually small and very numerous, paniced or cymose; phyllaries rarely distinctly herbaceous at apex; plants always herbaceous----- 17. SOLIDAGO.
 16. Heads usually few and relatively large, if small and paniced, then the plants shrubby; phyllaries often distinctly herbaceous at apex----- 18. APLOPAPPUS.
 14. Pappus not wholly of numerous simple and similar capillary bristles (17).
 17. Shrub; heads small, few-flowered, crowded in small rounded terminal clusters; rays 1 or 2, small----- 13. AMPHIPAPPUS.
 17. Herbs; inflorescence otherwise; rays more numerous, conspicuous (18).
 18. Achenes dissimilar, those of the rays essentially glabrous and epappose, the disk achenes hairy, their pappus double, the inner series of capillary bristles, the outer series of short bristles or squamellae----- 15. HETEROTHECA.
 18. Achenes all similar and with a similar (double) pappus.
 16. CHRYSOPSIS.
- G. Hermaphrodite flowers with a tubular, regular or nearly regular corolla; rays evident but sometimes small; pappus none or vestigial.
 1. Rays white, sometimes with a yellow base (2).
 2. Receptacle naked (3).
 3. Receptacle broad and flattish; phyllaries with a dark-brown submarginal line----- 109. CHRYSANTHEMUM.
 3. Receptacle convex, conic, or hemispheric; phyllaries not with a dark-brown submarginal line (4).
 4. Achenes oblique, ribbed only on the inner side; leaves dissected into linear-filiform lobes; phyllaries oblong or oval... 108. MATRICARIA.
 4. Achenes prismatic or subterete, ribbed on all sides, or somewhat flattened and 2-nerved; leaves entire to pinnatifid; phyllaries lanceolate (5).
 5. Achenes prismatic or subterete, ribbed on all sides.
 21. APHANOSTEPHUS.
 5. Achenes somewhat flattened, 2-nerved----- 23. ACHAETOGERON.
 2. Receptacle paleaceous (6).
 6. Rays sessile, persistent on the achenes, becoming indurated (7).
 7. Involucre strongly graduated; pales of the receptacle not cuspidate.
 52. ZINNIA.
 7. Involucre not distinctly graduated; pales of the receptacle cuspidate.
 53. SANVITALIA.

6. Rays not sessile and persistent on the achenes (8).
8. Leaves opposite (9).
9. Ray achenes tightly and completely enclosed by the subtending pales.
40. MELAMPODIUM.
9. Ray achenes not tightly and completely enclosed by the subtending pales (10).
10. Rays 1 to 5; leaves roundish-ovate; anthers green.
39. GUARDIOLA.
10. Rays very numerous, small; leaves lanceolate; anthers blackish.
55. ECLIPTA.
8. Leaves alternate (11).
11. Heads very small, numerous, in dense flattish or rounded cymose panicles..... 107. ACHILLEA.
11. Heads relatively large, solitary or few (12).
12. Receptacle conic, bearing stiff narrow acuminate pales above, naked below..... 106. ANTHEMIS.
12. Receptacle convex, with broad blunt membranous pales throughout..... 107a. LEUCAMPYX.
1. Rays yellow, sometimes partly purple or maroon (13).
13. Receptacle not chaffy (14).
14. Phyllaries graduated in several unequal series, closely imbricate (15).
15. Rays 9 or fewer; heads small, very numerous, in dense rounded terminal clusters; involucre ovoid or oblong..... 8. SELLOA.
15. Rays 12 or more; heads relatively large and few, scattered at the ends of the branchlets; involucre campanulate or hemispheric (16).
16. Leaves entire; phyllaries with narrow herbaceous tips.
9. XANTHOCEPHALUM.
16. Leaves pinnately dissected; phyllaries with broad scarious tips.
109. CHRYSANTHEMUM.
14. Phyllaries in 1 or 2 series or, if pluriseriate, not graduated in length (17).
17. Phyllaries of the outer series about 4, united to the middle or higher into a cup; heads small, numerous, in terminal cymose panicles.
101. PLUMMERA.
17. Phyllaries separate or essentially so (18).
18. Heads 1- or 2-flowered, in dense glomerate clusters, these sessile in the forks of the stem, or terminal and leafy-involucrate.
87. FLAVERIA.
18. Heads several- to many-flowered, solitary on terminal peduncles (19).
19. Plants woolly (20).
20. Rays persistent, becoming papery..... 82. BAILEYA.
20. Rays not persistent..... 93. ERIOPHYLLUM.
19. Plants not woolly (21).
21. Involucre and leaves with translucent oil glands..... 105. PECTIS.
21. Involucre and leaves not with translucent oil glands (22).
22. Leaves linear, entire; receptacle conic..... 86. BAERIA.
22. Leaves broad, dissected; receptacle flat..... 96. BAHIA.
13. Receptacle chaffy, at least toward the margin (23).
23. Rays pistillate and fertile; disk flowers hermaphrodite but sterile, with a nearly or quite undivided style and an abortive ovary (24).
24. Leaves with spinescent lobes and tip, alternate; heads involucre by spinescent bracts..... 79. HEMIZONIA.
24. Leaves not with spinescent lobes or tip; heads not involucre by spinescent bracts (25).
25. Ray achenes closely and completely enwrapped by the subtending phyllaries; leaves opposite..... 40. MELAMPODIUM.
25. Ray achenes not enwrapped by the subtending phyllaries, but falling in connection with them and with the pales of the opposed outer disk flowers; leaves alternate..... 41. BERLANDIERA.
23. Rays and disk flowers all fertile (26).
26. Rays sessile and persistent on their achenes, becoming papery (27).
27. Achenes very strongly flattened; phyllaries dry, strongly graduated.
52. ZINNIA.
27. Achenes plump; phyllaries herbaceous at tip, scarcely or not graduated..... 54. HELIOPSIS.

26. Rays not sessile, nor persistent, nor becoming papery (28).
28. Involucre distinctly double, the outer phyllaries herbaceous, the inner ones broader, longer, membranous (29).
29. Inner phyllaries free----- 71. COREOPSIS.
29. Inner phyllaries connate about to the middle, or higher. 74. THELESPERMA.
28. Involucre not double (30).
30. Plant a scapose perennial, with broad silvery-pubescent entire leaves and very large solitary heads----- 67. ENCELIOPSIS.
30. Plants leafy-stemmed; leaves and heads otherwise (31).
31. Achenes conspicuously ciliate on the margin, notched at apex, very flat; plants shrubby----- 64. ENCELIA.
31. Achenes not conspicuously ciliate on the margin (32).
32. Achenes 2-winged----- 70. VERBESINA.
32. Achenes not 2-winged, sometimes acutely margined (33).
33. Leaves pinnately parted or dissected-- 57. RATIBIDA.
33. Leaves entire to merely toothed or 3-lobed (34).
34. Achenes very flat, notched at apex----- 65. SIMSIA.
34. Achenes more or less thickened, not notched at apex (35).
35. Leaves alternate, ovate, often 3-lobed; rays pistillate. 58. ZALUZANIA.
35. Leaves opposite at least below, lance-ovate to linear; rays neutral----- 61. VIGUIERA.
- H. Hermaphrodite flowers with a tubular, regular or nearly regular corolla; rays evident but sometimes small; pappus present, of awns, squamellae, or paleae, these sometimes united into a crown.
1. Receptacle paleaceous (2).
2. Rays white, pink, or purple (3).
3. Rays fertile, the disk flowers sterile; achenes with a narrow callous margin, this adnate at base to the pales of the 2 opposed disk flowers and to the subtending phyllary, at length tearing away from the achene below but remaining attached at apex----- 43. PARTHENIUM.
3. Rays and disk flowers all fertile (4).
4. Pappus of 10 bristlelike hairy awns, the hairs on their outer side straight, on the inner side entangled into a woolly mass---- 80. LAYIA.
4. Pappus otherwise (5).
5. Rays sessile and persistent on their achenes (6).
6. Involucre strongly graduated; pales of the receptacle not cuspidate. 52. ZINNIA.
6. Involucre not distinctly graduated; pales of the receptacle cuspidate. 53. SANVITALIA.
5. Rays not sessile and persistent on their achenes (7).
7. Leaves merely toothed (8).
8. Rays numerous and very narrow; leaves sessile or subsessile. 55. ECLIPTA.
8. Rays 5 or fewer, short and broad; leaves petioled. 78. GALINSOGA.
7. Leaves dissected (9).
9. Achenes beaked; plant glabrous----- 76. COSMOS.
9. Achenes not beaked; plant more or less woolly. 107a. LEUCAMPYX.
2. Rays yellow, or partly purple brown (10).
10. Rays fertile, the disk flowers sterile; achenes of the rays adnate at base to the subtending phyllary and to the pales of the opposed outer disk flowers, the whole falling away together---- 42. ENGELMANNIA.
10. Rays and disk flowers all or mostly fertile, or the rays infertile, or else (genus *Hemizonia*) the achenes of the rays not as in genus *Engelmannia* (11).
11. Rays persistent on their achenes, becoming papery-- 52. ZINNIA.
11. Rays not persistent or papery (12).
12. Involucre distinctly double, the outer phyllaries narrow, herbaceous, the inner ones broader, membranous (13).
13. Inner phyllaries connate to the middle, or higher. 74. THELESPERMA.
13. Inner phyllaries free essentially to the base (14).
14. Pappus not of retrorsely hispid awns----- 71. COREOPSIS.
14. Pappus of retrorsely hispid awns (15).

15. Achenes dimorphous, the outer ones with a winged or callous margin, the inner ones narrower, wingless, somewhat beaked; leaves pinnately parted into 3 to 7 entire or few-parted linear lobes----- 73. HETEROSPERMA.
15. Achenes not dimorphous, neither winged nor truly beaked. 75. BIDENS.
12. Involucre otherwise (16).
16. Achenes dorso-ventrally compressed, with a pectinate wing. 72. COREOCARPUS.
16. Achenes laterally if at all compressed, not with a pectinate wing (17).
17. Plant scapose, perennial, with broad entire densely silvery-pubescent leaves----- 67. ENCELIOPSIS.
17. Plants not scapose; leaves not silvery-pubescent (18).
18. Pales of the receptacle in a single series inside the rays, united into a toothed cup----- 79. HEMIZONIA.
18. Receptacle paleaceous throughout, the pales not united (19).
19. Leaves, at least the lower ones, parted or pinnately divided (20).
20. Pappus a short chaffy crown; upper leaves entire or 3-lobed----- 56. RUDBECKIA.
20. Pappus of 1 or 2 short awns or teeth and sometimes also with squamellae; leaves, even the upper ones, pinnatifid----- 57. RATIBIDA.
19. Leaves entire or merely toothed (21).
21. Rays pistillate (22).
22. Pappus a conspicuous, more or less divided, chaffy crown, often with 1 or 2 awns; leaves alternate. 59. WYETHIA.
22. Pappus of 1 or 2 awns and sometimes with a very short crown of more or less united squamellae; leaves usually opposite (23).
23. Pappus of 2 awns and several short, more or less united, intermediate squamellae, or the latter obsolete; perennial herb. with opposite ovate subsessile leaves; achenes not with broad white wings----- 69. ZEXMENIA.
23. Pappus of 1 or 2 awns, without squamellae; leaves not opposite and subsessile, or else the achenes with broad white wings----- 70. VERBESINA.
21. Rays neutral (24).
24. Achenes more or less thickened (25).
25. Pappus of caducous awns or paleae (usually 2, sometimes many); achenes pubescent. 62. HELIANTHUS.
25. Pappus of persistent awns and squamellae, or if wanting, then the achenes glabrous (26).
26. Peduncle noticeably thickened below the head; plant annual, with broad ovate leaves. 60. TIFHONIA.
26. Peduncle not thickened below the head; plants, if annual, with narrow leaves- 61. VIGUIERA.
24. Achenes strongly compressed, very flat (27).
27. Achenes with 2 white wings; leaves opposite, at least the lower ones----- 70. VERBESINA.
27. Achenes not winged but sometimes narrowly white-margined; leaves usually alternate (28).
28. Achenes not conspicuously ciliate on the margin; plants herbaceous perennials. 68. HELIANTHELLA.
28. Achenes conspicuously long-ciliate on the margin; plants not herbaceous perennials (29).
29. Shrubs; achenes with a narrow white margin, no crown, and 1 or 2 weak awns. 64. ENCELIA.
29. Annual; achenes with a conspicuous white margin and crown, and 2 strong awns. 66. GERAEA.

1. Receptacle naked or rarely fimbriate, not paleaceous (30).
30. Involucre and leaves with translucent oil glands (31).
31. Phyllaries 1-seriate, united almost to the apex into a toothed cup or tube; pappus of 5 or 6 unequal paleae..... 102. TAGETES.
31. Phyllaries more or less 2-seriate, or else quite free; pappus otherwise (32).
32. Leaves without stiff spreading bristles at base; phyllaries more or less 2-seriate, often partly united, often with bractlets at base.
103. DYSSODIA.
32. Leaves with a few stiff spreading bristles at base; phyllaries 1-seriate, free, without bractlets at base..... 105. PECTIS.
30. Involucre and leaves without translucent oil glands (33).
33. Rays white, pink, blue, or purple (34).
34. Achenes compressed, 2-edged or 2-nerved (35).
35. Pappus, at least in the disk flowers, of several or many paleae or flattened bristles; phyllaries with scarious margin and tip.
26. TOWNSENDIA.
35. Pappus of only 1 or 2 bristlelike awns, or a crown of squamellae, or both; phyllaries not scarious-margined (36).
36. Pappus of a minute setulose crown only; leaves entire, alternate.
23. ACHAETOGERON.
36. Pappus of 1 or 2 weak awns, with or without a crown of squamellae; leaves usually toothed, lobed, or dissected, at least the lower ones opposite (37).
37. Pappus of 1 or 2 awns and a crown of squamellae; achenes usually callous-margined and ciliate..... 83. PERITYLE.
37. Pappus of 1 or 2 awns, without squamellae; achenes not callous-margined, not ciliate..... 84. LAPHAMIA.
34. Achenes more or less thickened, 4- or 5-angled (38).
38. Pappus a low dissected or ciliolate crown only (39).
39. Leaves toothed to pinnatifid, or the upper ones entire; phyllaries green-centered, scarious-margined..... 21. APHANOSTEPHUS.
39. Leaves entire; phyllaries whitish, thick, chartaceous, with a scarious margin and a green tip..... 22. GREENELLA.
38. Pappus of distinct awns or paleae, sometimes also with a low crown (40).
40. Phyllaries with a conspicuous scarious whitish or yellowish margin and tip; plants perennial or biennial... 90. HYMENOPAPPUS.
40. Phyllaries without a conspicuous scarious margin and tip; plants annual (41).
41. Herbage hispid-pilose; upper leaves subtending the heads.
25. MONOPTILON.
41. Herbage woolly; heads not subtended by the upper leaves.
93. ERIOPHYLLUM.
33. Rays yellow (42).
42. Phyllaries distinctly graduated, in several series (43).
43. Pappus of 2 to 8 slender caducous awns..... 10. GRINDELIA.
43. Pappus otherwise (44).
44. Annual herbs; rays 12 to 50..... 9. XANTHOCEPHALUM.
44. Perennial herbs or shrubs; rays 12 or fewer, except in genus *Acamplopappus* (45).
45. Heads comparatively large, solitary; pappus of numerous, narrowly linear awns and bristles, several-seriate.
14. ACAMPTOPAPPUS.
45. Heads small or very small, clustered (46).
46. Disk achenes with a pappus of several straight paleae or squamellae in a single series; involucre not compressed; leaves chiefly linear..... 12. GUTIERREZIA.
46. Disk achenes with a pappus of numerous more or less twisted, flattened bristles or narrow paleae; involucre compressed; leaves obovate or elliptic..... 13. AMPHIPAPPUS.
42. Phyllaries equal or subequal or in 2 unequal series, not distinctly graduated (47).
47. Rays persistent on the achenes, becoming papery (48).
48. Rays 3 to 5, about as wide as long; achenes linear, slightly angled, essentially glabrous..... 81. PSILOSTROPHE.

48. Rays 10 or more, much longer than wide; achenes obpyramidal, 5-angled, hirsute----- 98. ACTINEA.
47. Rays not persistent on the achenes (49).
49. Achenes strongly flattened, 2-edged; pappus of 1 or 2 bristlelike awns and sometimes with a crown of squamellae (50).
50. Pappus of 1 or 2 awns and with a crown of squamellae; achenes usually callous-margined and ciliate----- 83. PERITYLE.
50. Pappus of 1 or 2 awns, without squamellae; achenes not callous-margined, not ciliate----- 84. LAPHAMIA.
49. Achenes not flattened or 2-edged; pappus awns or squamellae more numerous (51).
51. Pappus squamellae dissected into numerous bristles, these united at base (52).
52. Heads short-peduncled, solitary; rays conspicuous. 88. SYNTRICHOPAPPUS.
52. Heads essentially sessile, clustered; rays inconspicuous. 93. ERIOPHYLLUM.
51. Pappus squamellae not dissected into bristles (53).
53. Phyllaries spreading or reflexed, herbaceous (54).
54. Receptacle naked; pappus usually much shorter than the achene----- 99. HELENIUM.
54. Receptacle fimbriate; pappus usually as long as the achene or longer----- 100. GAILLARDIA.
53. Phyllaries erect (55).
55. Plant a low annual, not woolly; leaves opposite, linear, entire; pappus of 2 to 5 lanceolate awns-- 86. BAERIA.
55. Plants perennial, or woolly, or with more numerous awns or paleae in the pappus (56).
56. Achene obpyramidal, strongly 4-angled; ray 1; pappus of 8 scarious paleae or squamellae; slender annuals, with leaves entire or pinnately divided into filiform lobes. 89. SCHKUHRIA.
56. Achene not obpyramidal and 4-angled; rays more than 1 (57).
57. Rays (2 to 5) fertile, disk flowers (6 to 7) sterile; leaves dissected into filiform lobes; heads very small, very numerous, crowded in dense cymose panicles. 101. PLUMMERA.
57. Both rays and disk flowers fertile, more numerous (58).
58. Pappus of 12 or more lanceolate awn-tipped paleae; plant nearly glabrous, with dissected leaves; involucre not double----- 91. HYMENOTHRIX.
58. Pappus paleae fewer, or else the plant tomentose, or the leaves not dissected, or the involucre double, of 2 more or less distinct sets of phyllaries (59).
59. Achenes obpyramidal, 5-angled, only 2 or 3 times as long as wide----- 98. ACTINEA.
59. Achenes narrowly obpyramidal, several times as long as wide (60).
60. Phyllaries concave, partly enclosing the ray achenes; plants woolly_ 93. ERIOPHYLLUM.
60. Phyllaries flat, not at all enclosing the ray achenes; plants not woolly---- 96. BAHIA.

1. STEVIA⁵⁶

Herbs or shrubby plants; leaves alternate or opposite; heads small, 5-flowered; phyllaries 5 or 6, equal, firm; corollas tubular, 5-toothed, white to purple; achenes slender; pappus of awns or squamellae or both, or reduced to a toothed crown.

⁵⁶ Reference: ROBINSON, B. L. THE STEVIAS OF NORTH AMERICA. Gray Herbarium Contrib. 90: 90-159. 1930.

Key to the species

1. Annual; leaves membranaceous, ovate, more than half as wide as long, serrate; pappus of 3 awns and 3 very short intermediate squamellae; heads rather loosely cymose; corollas whitish..... 1. *S. MICRANTHA*.
1. Perennial; leaves usually firm, linear to elliptic, much less than half as wide as long (2).
 2. Heads definitely pedicellate, loosely cymose-panicled; corollas purple; leaves alternate, linear, entire or bluntly toothed..... 2. *S. VISCIDA*.
 2. Heads subsessile, in dense fastigate cymose panicles; corollas white or rose color (3).
 3. Leaves entire, linear-elliptic or lanceolate, opposite, 3-nerved but not strongly veiny; plant suffrutescent or shrubby; pappus a very short, toothed crown..... 3. *S. LEMMONI*.
 3. Leaves serrate, linear to lance-oblong or oblong, often alternate or veiny; plants herbaceous (4).
 4. Leaves mostly opposite, not very numerous, strongly veiny beneath, elliptic to elliptic-oblong or lance-oblong, the larger leaves 10 to 18 mm. wide; pappus of squamellae only..... 4. *S. PLUMMERAE*.
 4. Leaves mostly alternate, usually very numerous and crowded, narrowly linear-oblancoolate to spatulate-oblancoolate, cuneate, or oval, 3 to 10 (rarely 15) mm. wide; pappus normally of awns and squamellae.
 5. *S. SERRATA*.

1. *Stevia micrantha* Lag., Gen. et Sp. Pl. 27. 1816.

Stevia macella A. Gray, Pl. Wright. 2: 70. 1853.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita and Baboquivari Mountains (Pima County), 5,000 to 6,500 feet, rich moist soil in canyons, August to October. Southwestern New Mexico, southern Arizona, and Mexico.

2. *Stevia viscida* H. B. K., Nov. Gen. et Sp. 4: 140. 1820.

Stevia amabilis Lemmon ex A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 1. 1883.

Plains near the Huachuca Mountains, Cochise County (*Lemmon* 2729, the type of *S. amabilis*), September. Southeastern Arizona and Mexico.

3. *Stevia lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 204. 1882.

Oro Blanco Mountains (Santa Cruz County), Santa Catalina Mountains (Pima County), rocky canyons, April, type from the Santa Catalina Mountains (*Lemmon*). Southern Arizona and northern Mexico.

4. *Stevia plummerae* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 204. 1882.

White Mountains (Apache County), Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina and Santa Rita Mountains (Pima County), 6,000 to 7,600 feet, rich soil in canyons, April to October, type from Rucker Valley, Chiricahua Mountains (*Mrs. Lemmon*). New Mexico, Arizona, and northern Mexico.

The flowers are fragrant. The var. *alba* A. Gray is a form with white flowers.

5. *Stevia serrata* Cav., Icon. Pl. 4: 33. 1797.

Mountains of southern Apache, Graham, Cochise, Santa Cruz, and Pima Counties, 4,500 to 9,000 feet, chiefly in pine forest, April to

October. Western Texas to southern Arizona, southward into Mexico.

The typical form has oblanceolate to spatulate leaves. The less common var. *ivaefolia* (Willd.) Robinson has broader, lanceolate to oblong-oblanceolate or oval leaves.

2. HOFMEISTERIA. ARROWLEAF

Much-branched low shrub, glandular-puberulous; leaves opposite or alternate, the blades lanceolate or lance-ovate, 2 to 10 mm. long, very much shorter than the petioles; heads loosely paniced, white, discoid; involucre strongly graduate, of dry few-ribbed phyllaries, the outer ones with acuminate subherbaceous tips; pappus of about 12 bristles, alternating irregularly with much shorter narrow squamellae or bristles.

1. *Hofmeisteria pluriseta* A. Gray in Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 96. 1857.

Mountains of Yuma (and probably of Mohave) County, 2,500 feet or lower, dry granitic slopes, January to March (sometimes autumn), type from Williams River. Southern Utah and Nevada, western Arizona, southeastern California, and northern Baja California.

3. CARMINATIA

Low annual herb; leaves mostly opposite, deltoid-ovate, toothed, thin, slender-petioled; heads discoid, whitish, cylindrical, in a terminal leafless virgate panicle; involucre graduated, of thin few-striate phyllaries; achenes slender; pappus of long-plumose bristles.

1. *Carminatia tenuiflora* DC., Prodr. 7: 267. 1838.

Mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,500 feet, rich soil in canyons, August and September. Western Texas to southern Arizona, south to Central America.

4. EUPATORIUM. THOROUGHWORT

Herbs or low shrubs; leaves usually opposite; heads small or medium-sized, usually paniced, discoid, white to lavender, violet, or purple; involucre scarcely to strongly graduated; achenes 5-ribbed; pappus of numerous capillary bristles.

Key to the species

1. Leaves palmately 3- to 5-cleft, with toothed to pinnatifid divisions; receptacle convex; flowers violet..... 1. *E. GREGGII*.
1. Leaves entire to sharply serrate, not palmately cleft; receptacle flat or essentially so; flowers white to purple (2).
2. Heads 3- to 6-flowered, sessile or subsessile in small clusters at the tips of usually short branches, forming a thyrsoid panicle; leaves narrowly lanceolate or lance-ovate, not more than 18 mm. wide, very short-petioled, acuminate..... 2. *E. SOLIDAGINIFOLIUM*.
2. Heads 10- to 30-flowered, distinctly pedicellate, not thyrsoid-paniced; leaves usually broader (3).
3. Leaf blades obtuse, broadly ovate, usually not more than 15 mm. long and wide, entire or crenate-serrate, thickish, on petioles 5 mm. long or less; plant shrubby, low, puberulous; involucre 3 to 5 mm. high, scarcely half as long as the flowers..... 3. *E. WRIGHTII*.

3. Leaf blades normally acute to acuminate, larger, on usually longer petioles (4).
4. Involucre strongly graduated, the phyllaries in 3 to 5 lengths (5).
 5. Heads small, 5 mm. high or less (excluding the styles), in close clusters at the tips of the stem and branches, the pedicels mostly 4 mm. long or less; achenes 1.5 mm. long; involucre 4 mm. high or less, the inner phyllaries obtuse, the outer ones acute.
 4. E. PYCNOCEPHALUM.
 5. Heads larger, 8 to 15 mm. high, loosely cymose, on pedicels mostly 6 to 20 mm. long; achenes about 3 mm. long; involucre 6 to 10 mm. high, the phyllaries all acute or acuminate.
 5. E. BIGELOVII.
4. Involucre of subequal phyllaries, or obscurely graduated (6).
 6. Achenes glabrous, 1 to 1.3 mm. long; leaf blades narrowly lanceolate, 3 to 5 times as long as wide, long-acuminate; involucre 3 mm. high, the phyllaries acuminate, pubescent.
 6. E. PAUPERCULUM.
 6. Achenes pubescent, (1.5) 2 to 3 mm. long; leaf blades rhombic-ovate to broadly ovate, not more than about twice as long as wide; involucre 3 to 6 mm. high (7).
 7. Corolla lobes strongly hairy outside; involucre 5 to 6 mm. high; leaves oblong-ovate or rhombic-ovate, cuneate to rounded, rarely subcordate at base.
 7. E. ROTHROCKII.
 7. Corolla lobes glabrous; involucre 3 to 4 mm. high; leaves triangular-ovate to broadly ovate, usually subcordate or truncate at base.
 8. E. HERBACEUM.

1. **Eupatorium greggii** A. Gray, Syn. Fl. 1²: 102. 1884.

Chiricahua Mountains to the San Pedro River (Cochise County), 4,000 to 6,000 feet, plains and mesas, September and October. Western Texas to southeastern Arizona, southward to Zacatecas.

2. **Eupatorium solidaginifolium** A. Gray, Pl. Wright. 1: 87. 1852.

Santa Catalina, Baboquivari and Ajo Mountains (Pima County), 3,500 to 5,000 feet, rocky canyons, May to September. Western Texas to southern Arizona and northern Mexico.

3. **Eupatorium wrightii** A. Gray, Pl. Wright. 1: 87. 1852.

Chiricahua and Huachuca Mountains (Cochise County), 5,000 to 6,000 feet, limestone slopes, September to October. Western Texas to southeastern Arizona and northern Mexico.

Plant "very bushy, spreading" (Blumer, ms.).

4. **Eupatorium pycnocephalum** Less., Linnaea 6: 404. 1831.

Superstition Mountains (Pinal County), and mountains of Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,000 feet, rich soil along streams, May to October. Southern Arizona to South America.

Flowers pale blue or lavender.

5. **Eupatorium bigelovii** A. Gray in Torr., U. S. and Mex. Bound. Bot. 75. 1859.

Apparently known in Arizona only from the type collection on the Gila River (*Bigelow*). Northern Mexico, where it flowers March to October.

6. **Eupatorium pauperculum** A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 205. 1882.

Piptothrix arizonica A. Nels., Amer. Jour. Bot. 25: 117. 1938.

Santa Rita and Baboquivari Mountains (Pima County), 4,000 to 5,000 feet, by streams in canyons, March to May, type from the Santa Rita Mountains (*Pringle*), type of *Piptothrix arizonica* from the west side of the Baboquivari Mountains (*A. and R. Nelson* 1567). Southern Arizona and Sonora.

7. *Eupatorium rothrockii* A. Gray, Syn. Fl. 1²: 102. 1884.

Eupatorium rothrockii var. *shrevei* Robinson, Amer. Acad. Arts and Sci. Proc. 54: 256. 1918.

Mountains of southern Apache, Graham, Cochise, and Pima Counties, 6,500 to 7,500 feet, chiefly in pine forest, July to October, type from Mount Graham (*Rothrock* 740, 741), type of var. *shrevei* from Ramsey Canyon, Huachuca Mountains (*Shreve* 5017). Southern New Mexico and southeastern Arizona.

8. *Eupatorium herbaceum* (A. Gray) Greene, Pittonia 4: 279. 1901.

Eupatorium ageratifolium var. ? *herbaceum* A. Gray, Pl. Wright. 2: 74. 1853.

Eupatorium occidentale var. *arizonicum* A. Gray, Syn. Fl. 1²: 101. 1884.

Eupatorium arizonicum Greene, Pittonia 4: 280. 1901.

Near Holbrook (Navajo County), Kaibab Plateau (Coconino County), Hualpai Mountain (Mohave County), southward to the mountains of Cochise, Santa Cruz, and Pima Counties, 5,000 to 9,000 feet, mostly in open pine forest, June to October. Utah, New Mexico, Arizona, and northern Mexico.

Flowers white, the plant fragrant in drying.

Eupatorium texense (Torr. and Gray) Rydb., which is probably *E. havanense* H. B. K., was listed by Rydberg⁵⁷ as ranging from Colorado and Texas to Arizona. The Arizona record is apparently based on error, as Rydberg wrote (personal communication) that there is no specimen in the herbarium of the New York Botanical Garden and that he does not think the species is found in Arizona. Possibly a specimen of *E. herbaceum* was mistaken for it in the original record.

5. CARPHOCHAETE

Low branching shrub; leaves opposite, sessile, entire, punctate, linear-elliptic to spatulate-elliptic, 15 to 30 mm. long, with axillary fascicles; heads cylindric, about 25 mm. high, few-flowered, the corollas purplish tinged; phyllaries rather few, narrow, unequal, subherbaceous, acute to acuminate, densely glandular-punctate; achenes linear, 8- to 10-ribbed; pappus of about 12 narrowly scariosum-margined, linear-attenuate awns, barbellate above.

1. *Carphochaete bigelovii* A. Gray, Pl. Wright. 1: 89. 1852.

Mountains of southern Apache, Greenlee, Gila, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, rocky slopes and canyons, March to July. Western Texas to southern Arizona and Chihuahua.

The plant is browsed.

6. BRICKELLIA.⁵⁸ BRICKELLBUSH

Herbs or shrubs; leaves opposite or alternate; heads small to medium-sized, discoid, usually whitish, solitary or paniced; involucre usually definitely graduated, the phyllaries generally dryish and striate; achenes 10-ribbed (sometimes only 5-ribbed in *B. fendleri*); pappus of numerous capillary bristles (plumose only in *B. brachyphylla*).

⁵⁷ RYDBERG, P. A. FLORA OF THE ROCKY MOUNTAINS AND ADJACENT PLAINS. 1917. (See p. 841.)

⁵⁸ Reference: ROBINSON, B. L. A MONOGRAPH OF THE GENUS BRICKELLIA. Gray Herbarium Mem. 1: 1-151. 1917.

Key to the species

1. Heads 3- to 5-flowered (2).
 2. Leaves linear-lanceolate, elongate, 3 to 13 cm. long, 2 to 10 mm. wide.
 1. B. LONGIFOLIA.
 2. B. MULTIFLORA.
 2. Leaves lance-ovate, 12 to 28 mm. wide-----
1. Heads (6) 8- to 60-flowered (3).
 3. Plant with abundant very short budlike branchlets bearing minute, crowded, 4-ranked, scalelike leaves; stem leaves (mostly deciduous) narrowly linear, entire, 3 to 7 cm. long, 2 mm. wide or less--- 3. B. SQUAMULOSA.
 3. Plant without budlike branchlets bearing crowded scalelike leaves; stem leaves persistent, linear to broadly ovate, more than 2 mm. wide (4).
 4. Leaves linear to elliptic or lance-ovate, cuneate to rounded at base, sessile or on petioles 3 mm. long or less (5).
 5. Heads about 40- to 50-flowered, solitary, or few and cymose; leaves elliptic-ovate to lance-linear, usually entire--- 9. B. OBLONGIFOLIA.
 5. Heads 9- to 26-flowered, numerous, paniced (6).
 6. Leaf blades 5 to 12 mm. long, lanceolate to ovate; achenes finely hispidulous; heads mostly solitary at the tips of slender, minutely leafy peduncles, forming a long racemiform panicle.
 4. B. SCABRA.
 6. Leaf blades usually 20 to 60 mm. long; achenes densely pubescent; heads otherwise arranged (7).
 7. Pappus bristles plumose; leaves lanceolate or lance-ovate.
 5. B. BRACHYPHYLLA.
 7. Pappus bristles not at all plumose; leaves linear to oblong or lance-oblong, rarely lanceolate (8).
 8. Phyllaries few (about 14); heads about 10-flowered.
 6. B. LEMMONI.
 8. Phyllaries numerous (20 to 37); heads usually 19- to 26-flowered (9).
 9. Plant glandular-pubescent, especially above; leaves narrowly lanceolate, 12 to 15 mm. wide----- 13. B. AMPLEXICAULIS.
 9. Plant not glandular-pubescent (10).
 10. Heads slender-pedicelled, in a loose panicle; leaves linear or narrowly linear-oblong, 3 to 9 mm. wide.
 7. B. VENOSA.
 10. Heads sessile or subsessile, subspicate on the stem and branches; leaves elliptic, oblong, or lance-oblong, 8 to 20 mm. wide----- 8. B. PRINGLEI.
 4. Leaves definitely ovate or rhombic-ovate or, if lance-oblong, then with distinctly cordate-clasping base (11).
 11. Leaves coriaceous, bright green, spiny-toothed; outer phyllaries herbaceous or subcoriaceous, much broader than the inner and nearly as long; heads solitary at the tips of the branches, about 50-flowered.
 10. B. ATRACTYLOIDES.
 11. Leaves not coriaceous (except in *B. baccharidea*), not spiny-toothed; outer phyllaries not noticeably broader than the inner, much shorter; heads paniced, except in *B. simplex* and *B. incana* (12).
 12. Leaves (at least when young) and stem densely white-tomentose; leaves small, ovate, sessile; heads about 60-flowered, about 23 mm. high, solitary at tips of stem and branches.
 11. B. INCANA.
 12. Leaves and stem not densely white-tomentose, if grayish-tomentulous (*B. desertorum*), then the heads 8- to 12-flowered (13).
 13. Leaves lance-oblong to ovate, sessile or very short-petioled, strongly cordate at base (14).
 14. Leaves ovate or oblong-ovate, distinctly short-petioled; pedicels hispidulous or short-hirsute, not glandular.
 12. B. BETONICAEFOLIA.
 14. Leaves lance-oblong or ovate-oblong, sessile, strongly cordate-clasping; pedicels densely stipitate-glandular.
 13. B. AMPLEXICAULIS.
 13. Leaves ovate or rhombic-ovate, usually slender-petioled (15).
 15. Blades of the largest leaves 12 mm. long or less; leaves green; heads mostly solitary at the tips of the slender, minutely leafy branches, forming a long racemiform panicle.
 4. B. SCABRA.

15. Blades of the largest leaves much more than 12 mm. long, or else (*B. desertorum*) the leaves densely grayish-tomentellous, or (*B. coulteri*) the heads loosely cymose-panicled, on slender essentially naked pedicels (16).
16. Leaves sharply 1- to 3-hastate-toothed at base, deltoid- or rhombic-ovate; heads slender-pedicelled, loosely panicled, about 17-flowered----- 14. *B. COULTERI*.
16. Leaves not sharply and hastately few-toothed at base (17).
17. Leaf blades rhombic-ovate, coriaceous, repand-toothed, cuneate at base, 10 to 38 mm. long; phyllaries all rounded or obtuse, firm, stramineous, often resinous.
15. *B. BACCHARIDEA*.
17. Leaf blades ovate, not coriaceous, crenate to dentate, usually cordate or subcordate at base; phyllaries thin (18).
18. Heads solitary or few, about 60-flowered; leaves triangular-ovate, coarsely toothed; involucre about 13 mm. high----- 22. *B. SIMPLEX*.
18. Heads numerous, 8- to 38-flowered (19).
19. Outer phyllaries with loose caudate-attenuate herbaceous tips; leaves thin, triangular-ovate, acuminate, coarsely serrate or crenate-serrate; involucre about 11 mm. high----- 21. *B. GRANDIFLORA*.
19. Outer phyllaries not caudate-attenuate (20).
20. Pedicels densely stipitate-glandular; outermost phyllaries (a few of them) herbaceous, usually longer than the next inner series, sometimes surpassing the heads----- 20. *B. FLORIBUNDA*.
20. Pedicels not stipitate-glandular; outer phyllaries not herbaceous or elongate (21).
21. Heads 28- to 35-flowered; leaves mostly deltoid- or triangular-ovate, thin; heads slender-pedicelled, mostly nodding, in usually few-headed cymose panicles at the tips of the stem and branches----- 19. *B. FENDLERI*.
21. Heads 8- to 18-flowered (22).
22. Plant herbaceous; leaves 5 to 10 cm. long, acuminate; heads slender-pedicelled, the panicles rather loose----- 18. *B. RUSBYI*.
22. Plants shrubby; leaves not more than 5 cm. long, obtuse to acute; heads mostly sessile, clustered in the leaf axils, forming spikelike panicles (23).
23. Phyllaries puberulous on the back; leaf blades 3 to 13 mm. long and wide, densely grayish-tomentellous --- 16. *B. DESERTORUM*.
23. Phyllaries essentially glabrous; leaf blades 10 to 50 mm. long and wide, green.
17. *B. CALIFORNICA*.

1. *Brickellia longifolia* S. Wats., Amer. Nat. 7: 301. 1873.

Coleosanthus longifolius Kuntze, Rev. Gen. Pl. 1: 328. 1891.

North rim of the Grand Canyon and Havasu Canyon, Coconino County (*Eastwood* and *Howell* 7080, *Whiting* in 1940), 3,300 to 8,000 feet, September. Southeastern Utah to eastern California and northern Arizona.

2. *Brickellia multiflora* Kellogg, Calif. Acad. Sci. Proc. 7: 49. 1877.

Coleosanthus multiflorus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

North rim of the Grand Canyon, Coconino County (*Eastwood* and *Howell* 7106), September. Southern Nevada, eastern California, and northwestern Arizona.

3. **Brickellia squamulosa** A. Gray, Amer. Acad. Arts and Sci. Proc. 15: 30. 1879.

Coleosanthus squamulosus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Chiricahua and Huachuca Mountains (Cochise County), Santa Cruz River valley (Santa Cruz County), 4,000 to 6,000 feet, May to September. Southwestern New Mexico and southeastern Arizona, south to Mexico.

4. **Brickellia scabra** (A. Gray) A. Nels. ex Robinson, Gray Herbarium Mem. 1: 43. 1917.

Brickellia microphylla var. *scabra* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 74. 1876.

Apache, Navajo, Coconino, and Yuma Counties, 3,000 to 5,500 feet, July to October. Wyoming to New Mexico, Arizona, and southern Nevada.

Brickellia watsonii Robinson, of Utah, southeastern Nevada, and southeastern California, will probably be found in Arizona. It is similar to *B. scabra*, but the stem is finely lanulose or crisp-puberulous, whereas in *B. scabra* it is glandular-puberulous.

5. **Brickellia brachyphylla** A. Gray, Pl. Wright. 1: 84. 1852.

Clavigera brachyphylla A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 63. 1849.

Coleosanthus brachyphyllus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Ryan Ranch, southern Apache County (*Harrison* 4870), Baboquivari Mountains, Pima County (*Gilman* 187B), about 5,000 feet, September. Western Texas to southern Colorado and eastern Arizona.

6. **Brickellia lemmoni** A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 206. 1882.

Coleosanthus lemmoni Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Chiricahua Mountains, Cochise County, 6,000 feet (*Lemmon* 306, the type, *Blumer* 1786), September. Southeastern Arizona and Chihuahua.

7. **Brickellia venosa** (Woot. and Standl.) Robinson, Gray Herbarium Mem. 1: 50. 1917.

Coleosanthus venosus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 177. 1913.

Greenlee, Gila, Pinal, Cochise, and Pima Counties, 4,500 to 5,500 feet, September and October. Southern New Mexico and Arizona, and Chihuahua.

8. **Brickellia pringlei** A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 206. 1882.

Coleosanthus pringlei Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Huachuca Mountains (Cochise County), Santa Rita and Santa Catalina Mountains (Pima County), rich canyons, April and May, type from the Santa Catalina Mountains (*Pringle* in 1881). Southern Arizona, south to Mexico.

9. **Brickellia oblongifolia** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 288. 1840.

Coleosanthus oblongifolius Kuntze, Rev. Gen. Pl. 1: 328. 1891.

The species is represented in Arizona by var. *linifolia* (D. C. Eaton) Robinson. Apache County to eastern Mohave County, 4,500 to 6,500 feet, May and June (September). Colorado to New Mexico, west to Nevada and southeastern California.

10. **Brickellia atractyloides** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 290. 1870.

Coleosanthus atractyloides Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Grand Canyon (Coconino County), and Gila, Mohave, and Yuma Counties, up to 3,500 feet, March to May (September). Southern Utah and Nevada, southeastern California, and Arizona.

A small, much-branched shrub.

11. **Brickellia incana** A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 350. 1868.

Coleosanthus incanus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Western Mohave County, 1,600 to 3,500 feet, sandy washes, May to October. Southern California, southern Nevada, and western Arizona.

12. **Brickellia betonicaefolia** A. Gray, Pl. Wright. 2: 72. 1853.

Coleosanthus betonicaefolius Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Southern Navajo County and Yavapai County to Cochise and Pima Counties, 4,500 to 6,500 feet, June to October. New Mexico and central Arizona to Sonora and Chihuahua.

13. **Brickellia amplexicaulis** Robinson, Amer. Acad. Arts and Sci. Proc. 47: 199. 1911.

Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, September and October. Southern Arizona and northern Mexico.

The typical form has ovate-oblong leaves with a cordate-amplexicaul base. The var. *lanceolata* (A. Gray) Robinson, with narrowly lanceolate, scarcely clasping leaves, is known only from Greenlee County, where the type was collected near Clifton (Greene in 1880).

14. **Brickellia coulteri** A. Gray, Pl. Wright. 1: 86. 1852.

Coleosanthus coulteri Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Southern Yavapai County, western Gila County, and Maricopa, Pinal, Pima, and Yuma Counties, up to about 4,000 feet, dry rocky slopes and canyons, common, March to November. Arizona to central Mexico and Baja California.

15. **Brickellia baccharidea** A. Gray, Pl. Wright. 1: 87. 1852.

Coleosanthus baccharideus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Greenlee, Cochise, and Pima Counties, 3,500 to 5,000 feet, often on limestone, September to November. Western Texas to southeastern Arizona.

16. *Brickellia desertorum* Coville, Biol. Soc. Wash. Proc. 7: 68. 1892.
Coleosanthus desertorum Coville, Contrib. U. S. Natl. Herbarium
 4: 119. 1893.

Mohave County, near Pierce Ferry (*Jones* 5077), and near Oatman (*Kearney* and *Peebles* 12634), Yuma County, Kofa Mountains (*Kearney* and *Peebles* 10233), 1,700 to 3,500 feet, September. Southern California, southern Nevada, and northwestern Arizona.

A small, much-branched shrub.

17. *Brickellia californica* (Torr. and Gray) A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 64. 1849.

Bulbostylis californica Torr. and Gray, Fl. North Amer. 2: 79. 1841.

Brickellia wrightii A. Gray, Pl. Wright. 2: 72. 1853.

Brickellia tenera A. Gray, *ibid.*

Coleosanthus californicus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Brickellia californica var. *tenera* Robinson, Gray Herbarium Mem. 1: 70. 1917.

Throughout the State, 3,000 to 7,000 feet, very common, July to October. Colorado to western Texas, west to California, south to Sonora and Baja California.

Called "pachaba" by the Hopi Indians, who are reported to rub it on the head for headache.

18. *Brickellia rusbyi* A. Gray, Syn. Fl. 1²: 106. 1884.

Coleosanthus rusbyi Kuntze, Rev. Gen. Pl. 1: 328. 1891,
 as *C. rustyi*.

Southern Apache and Gila Counties to Cochise and Pima Counties, 6,000 to 8,300 feet, commonly in pine forest, August to October. New Mexico, southeastern Arizona, Sonora, and Chihuahua.

19. *Brickellia fendleri* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 63. 1849.

Coleosanthus fendleri Greene, Pittonia 4: 237. 1901.

Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), about 6,000 feet, September. New Mexico and southeastern Arizona.

This species is intermediate in achenial characters between *Eupatorium* and *Brickellia*, the achene being 5-angulate, with or without 1 to 5 intermediate secondary ribs.

20. *Brickellia floribunda* A. Gray, Pl. Wright. 2: 73. 1853.

Coleosanthus floribundus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Southern Navajo, Gila, Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 5,500 feet, rich soil in canyons, September and October. Southwestern New Mexico, southern Arizona, Sonora, and Chihuahua

21. *Brickellia grandiflora* (Hook.) Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 287. 1840.

Eupatorium (?) *grandiflorum* Hook., Fl. Bor. Amer. 2: 26. 1834.

Brickellia grandiflora var. *petiolaris* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 207. 1882.

Coleosanthus grandiflorus Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Coleosanthus umbellatus Greene, Pittonia 4: 238. 1901.

Grand Canyon to the mountains of Graham, Cochise, and Pima Counties, 5,000 to 9,000 feet, rich soil in coniferous forests, August to October, type of *C. umbellatus* from "the mountain districts of northern Arizona." Missouri and Arkansas to Montana and Washington, south to New Mexico, southern Arizona, California, and northern Baja California.

22. *Brickellia simplex* A. Gray, Pl. Wright. 2: 73. 1853.

Coleosanthus simplex Kuntze, Rev. Gen. Pl. 1: 328. 1891.

Chiricahua, Huachuca, and Patagonia Mountains (Cochise and Santa Cruz Counties), 5,000 to 7,000 feet, August and September. Southeastern Arizona, Sonora, and Chihuahua.

7. KUHNIA

Slender perennial herb; leaves mostly alternate, linear or linear-lanceolate, entire, usually revolute-margined, glandular-punctate; heads rather small, paniced, discoid, whitish; involucre more or less graduated, the phyllaries mostly linear, strongly few-ribbed, narrowly scarious-margined; achenes slender, 10- to 20-nerved; pappus a single series of plumose bristles, usually becoming tawny.

1. *Kuhnia rosmarinifolia* Vent., Descr. Pl. Jard. Cels pl. 91. 1800.

Kuhnia leptophylla Scheele, Linnaea 21: 598. 1848.

Navajo and Coconino Counties to Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,500 feet, mesas and slopes, May to October. Texas to Arizona, south to Mexico.

In the typical form the phyllaries are ciliate, nearly or quite glabrous on the back, not or only slightly graduated, the outer ones abruptly shorter than the inner ones. In the var. *chlorolepis* (Woot. and Standl.) Blake, known from Cochise and Pima Counties, 2,500 to 5,000 feet, the phyllaries are rather densely pilosulous or puberulous on the back and more regularly graduated.

Liatris punctata Hook. has been assigned a range extending to Arizona by Rydberg⁵⁹ and by Wooton and Standley.⁶⁰ There is no specimen from Arizona in the United States National Herbarium or in the herbarium of the New York Botanical Garden, and it seems best to omit the species until a definite specimen is forthcoming.

8. SELLOA

Suffrutescent, branched, glabrous and glutinous; leaves alternate, oblong-lanceolate to linear, entire, punctate; heads small, inconspicuous.

⁵⁹ RYDBERG, P. A. FLORA OF THE ROCKY MOUNTAINS AND ADJACENT PLAINS. 1917. (See p. 844.)

⁶⁰ WOOTON, E. O., and STANDLEY, P. C. FLORA OF NEW MEXICO. Contrib. U. S. Natl. Herbarium 19. 1915. (See p. 649.)

ously radiate, yellow, in dense rounded terminal clusters, these panicked; involucre graduated, the phyllaries chartaceous, with short green tips; achenes glabrous, 4- or 5-ribbed; pappus none.

1. *Selloa glutinosa* Spreng., Nov. Provent. Hort. Hal. 36. 1819.

Gymnosperma glutinosum Less., Syn. Gen. Compos. 194. 1832.

Gymnosperma corymbosum DC., Prodr. 5: 312. 1836.

Maricopa, Pinal, Cochise, Pima, and Yuma Counties, 2,000 to 6,000 feet, rocky canyons and slopes, August to October. Texas to southern Arizona, south to Central America.

The plant is used in Mexico in decoctions for treating diarrhea, and the gum is used externally in cases of rheumatism and ulcers.

9. XANTHOCEPHALUM

Annual herbs, nearly or quite glabrous, sometimes glutinous; leaves alternate, linear to lance-oblong; heads radiate, yellow, cymose-panicled or scattered; involucre broad, the phyllaries graduated, chartaceous, green-tipped; pappus of several unequal more or less united awns, or reduced to a setulose crown, sometimes none in the ray achenes.

Key to the species

1. Leaves chiefly lanceolate, 5 to 20 mm. wide; heads crowded in cymose panicles, the pedicels stipitate-glandular; rays 12 to 19; pappus in the ray achenes none or reduced to an obscure border, in the disk achenes of unequal, basally united squamellae or paleae..... 1. *X. GYMNOSPERMOIDES*.
 1. Leaves chiefly linear, 2 to 4 mm. wide; heads mostly solitary at the tips of cymosely arranged glabrous branches; rays about 30 to 50; pappus a short undulate crown..... 2. *X. WRIGHTII*.

1. *Xanthocephalum gymnospermoides* (A. Gray) Benth. and Hook. ex Rothr. in Wheeler, U. S. Survey West 100th Merid. Rpt. 6: 140. 1878.

Gutierrezia (?) *gymnospermoides* A. Gray, Pl. Wright. 2: 79. 1853.

Pinal, Cochise, Santa Cruz, and Pima Counties, 1,200 to 5,500 feet, locally abundant in alluvial, often saline soil, August to October. Southeastern Arizona to northern Mexico.

The plant attains a height of 6 feet or more.

2. *Xanthocephalum wrightii* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 632. 1873.

Gutierrezia wrightii A. Gray, Pl. Wright. 2: 78. 1853.

White Mountains (Apache County) to the mountains of Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,500 feet, openings in pine forest, August to October. New Mexico and Arizona.

10. GRINDELIA.⁶¹ GUMWEED

Herbs, more or less resinous-viscid; leaves alternate, entire, toothed, or rarely pinnatifid; heads medium-sized, yellow, radiate or discoid; involucre strongly graduated; achenes short, more or less thickened; pappus of 2 to 8 slender caducous paleaceous awns.

⁶¹ Reference: STEYERMARK, J. A. STUDIES IN GRINDELIA. II. A MONOGRAPH OF THE NORTH AMERICAN SPECIES OF THE GENUS GRINDELIA. Mo. Bot. Gard. Ann. 21: 433-608. 1934.

Some of the species (including *G. squarrosa*) are official drug plants, being antispasmodic and stomachic, administered in asthma, and externally to relieve the irritation caused by poison-ivy. The plants are suspected of being toxic to livestock but are rarely eaten.

Key to the species

- | | |
|---|---------------------------|
| 1. Heads discoid | 1. <i>G. APHANACTIS</i> . |
| 1. Heads radiate (2). | |
| 2. Phyllaries with strongly spreading or recurved subulate tips. | 2. <i>G. SQUARROSA</i> . |
| 2. Phyllaries with appressed or nearly erect triangular tips (3). | |
| 3. Leaves all or mostly laciniate-dentate or pinnatifid | 3. <i>G. LACINIATA</i> . |
| 3. Leaves merely serrulate | 4. <i>G. ARIZONICA</i> . |

1. *Grindelia aphanactis* Rydb., Torr. Bot. Club Bul. 31: 647. 1904.

Grindelia pinnatifida Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 178. 1913.

Apache, Navajo, Coconino, and Yavapai Counties, and in the Chiricahua Mountains (Cochise County), mostly 5,000 to 7,000 feet, June to September. Southeastern Utah and southern Colorado to western Texas, New Mexico, and eastern Arizona.

2. *Grindelia squarrosa* (Pursh) Dunal, Paris Mus. Hist. Nat. Mém. 5: 50. 1819.

Donia squarrosa Pursh, Fl. Amer. Sept. 559. 1814.

Represented in Arizona by var. *serrulata* (Rydb.) Steyermark. Tuba, Coconino County, about 5,000 feet (*Cottam* 2590). Wyoming to northwestern New Mexico and northeastern Arizona, also widely introduced east and west of this range.

3. *Grindelia laciniata* Rydb., Fl. Rocky Mount. 848. 1917.

Southwestern Coconino and northwestern Yavapai Counties, at Williams and Seligman, 5,200 to 6,700 feet, June to August. Southeastern Utah and northern Arizona.

4. *Grindelia arizonica* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 208. 1882.

Apache, Navajo, and Gila Counties, 3,500 to 7,500 feet, openings in pine forests, August to October. Southwestern New Mexico and eastern Arizona.

The var. *microphylla* Steyermark, with longer pappus awns (5 to 6.5 mm. long), is known only from north of Clifton, Greenlee County (*Davidson* 736, type).

11. VANCLEVEA

Slender branching shrub, white-barked, glabrous, glutinous; leaves alternate, linear-lanceolate, 3- to 5-nerved, entire or slightly toothed, often conduplicate, falcate-recurved; heads medium-sized, discoid, yellow, solitary or cymose; involucre graduated; achenes slender, about 5-ribbed; pappus of about 12 to 16 linear acuminate persistent awns.

1. *Vanclavea stylosa* (Eastw.) Greene, Pittonia 4: 51. 1899.

Grindelia stylosa Eastw., Calif. Acad. Sci. Proc. ser. 2, 6: 293. 1896.

Monument Valley, Navajo County, 5,000 to 6,000 feet, September (*Eastwood* and *Howell* 6660), also reported by Aven Nelson from Red Lake, eastern Coconino County. Southeastern Utah and north-eastern Arizona.

12. GUTIERREZIA. SNAKEWEED

Perennial herbs, sometimes suffrutescent, more or less glutinous; leaves alternate, linear to narrowly oblanceolate, entire; heads small, yellow, radiate, usually numerous and crowded; involucre cylindric to campanulate, the phyllaries chartaceous, scarious-margined, with small green tips; achenes small, oblong or obovoid; pappus of several squamellae or paleae, often shorter in the ray flowers.

Also known as matchweed, resinweed, broomweed, turpentine-weed. Plants of dry stony plains, mesas, and slopes. The snake-weeds are worthless plants that are not even of much value in retarding soil erosion. They are more or less poisonous to sheep and goats when eaten in quantity but are unpalatable and are seldom grazed. The carrying capacity of much southwestern grassland has been greatly reduced by encroachment of the snakeweeds.

Key to the species

1. Heads tiny, cylindric, about 1 mm. thick; rays 1 or 2; disk flowers 1 to 3 (2).
2. Heads sessile, in fasciculate glomerules of 2 to 5; ray 1 (very rarely 2); disk flowers 1 or 2..... 1. *G. LUCIDA*.
2. Heads often pedicelled, not fasciculate-glomerulate; rays 2; disk flowers 2 or 3..... 2. *G. LINOIDES*.
1. Heads larger, slender-turbinate to subglobose; rays 3 to 12; disk flowers 1 to 12 (3).
3. Heads subglobose to broadly turbinate; ray flowers 7 to 14; disk flowers 7 to 24..... 3. *G. CALIFORNICA*.
3. Heads turbinate; flowers of the rays and the disk each 3 to 8, or the disk flowers rarely only 1 or 2 (4).
4. Involucre very slenderly turbinate, 1 to 1.5 mm. thick; rays 4 or 5; disk flowers 1 to 3..... 4. *G. MICROCEPHALA*.
4. Involucre turbinate, usually 2 mm. thick or more; rays 3 to 8; disk flowers 3 to 8..... 5. *G. SAROTHRÆA*.

1. *Gutierrezia lucida* Greene, Fl. Francisc. 361. 1897.

Xanthocephalum lucidum Greene, Pittonia 2: 282. 1892.

Gutierrezia glomerella Greene, Pittonia 4: 54. 1899.

Almost throughout the State, 1,200 to 6,000 feet, June to October. Colorado to Texas, west to Nevada and California, south to Mexico.

2. *Gutierrezia linoides* Greene, Leaflets 2: 22. 1909.

Definitely known only from the Chiricahua Mountains, Cochise County (*Blumer* in 1907, the type). The status of this species is not clear.

3. *Gutierrezia californica* (DC.) Torr. and Gray, Fl. North Amer. 2: 193. 1842.

Brachyris californica DC., Prodr. 5: 313. 1836.

Gutierrezia serotina Greene, Pittonia 4: 57. 1899.

Gutierrezia polyantha A. Nels., Amer. Jour. Bot. 25: 117. 1938.

Yavapai, Pinal, Cochise, and Pima Counties, 1,200 to 4,200 feet, March to October, type of *G. serotina* from Tucson (*Toumey* in 1892),

type of *G. polyantha* from near Tucson (*A. and R. Nelson* 1638). Central coastal California to southern Arizona and Chihuahua.

4. *Gutierrezia microcephala* (DC.) A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 74. 1849.

Brachyris microcephala DC., Prodr. 5: 313. 1836.

Gutierrezia filifolia Greene, Pittonia 4: 55. 1899.

Navajo, Coconino, and eastern Mohave Counties, south and south-east to Cochise County, 3,500 to 6,000 feet, August to October. Texas to Idaho, south to Arizona and Coahuila.

5. *Gutierrezia sarothrae* (Pursh) Britt. and Rusby, N. Y. Acad. Sci. Trans. 7: 10. 1887.

Solidago sarothrae Pursh, Fl. Amer. Sept. 540. 1814.

Gutierrezia juncea Greene, Pittonia 4: 56. 1899.

Gutierrezia linearis Rydb., Torrey Bot. Club Bul. 31: 647. 1904.

Apache County to Mohave County, south to Cochise and Pima Counties, 2,800 to 7,000 feet, July to October. Saskatchewan to Kansas, south to northern Mexico and Baja California.

13. AMPHIPAPPUS. CHAFFBUSH

Low branching shrub, white-barked; leaves alternate, obovate or elliptic, small, entire; heads small, yellow, few-flowered, crowded in small rounded terminal clusters; involucre graduated, the phyllaries broad, blunt, dryish; rays 1 or 2, small; disk flowers 3 to 6; ray achenes hairy, their pappus of more or less united bristles, awns, or paleae; disk achenes glabrous, their pappus of twisted hispidulous bristles and narrow paleae.

1. *Amphipappus fremontii* Torr. and Gray, Boston Soc. Nat. Hist. Proc. 1: 211. 1845.

Amphiachyris fremontii A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 633. 1873.

Beaver Dam, and Chloride to Boulder Dam (Mohave County), 1,800 to 2,300 feet, April and May. Southwestern Utah and northwestern Arizona to eastern California.

14. ACAMPTOPAPPUS. GOLDENHEAD

Low branching shrub, white-barked; leaves alternate, spatulate to nearly linear, small, entire; heads medium-sized, discoid, yellow; involucre broad, graduated, the dry scarious-margined blunt phyllaries with a greenish subapical spot; achenes turbinate, densely villous; pappus of numerous narrowly linear paleae, some of the outer ones narrower and setiform.

1. *Acamptopappus sphaerocephalus* (Harv. and Gray) A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 634. 1873.

Aplopappus (Acamptopappus) sphaerocephalus Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 76. 1849.

Northern Mohave County to Graham, Gila, Maricopa, and Pima Counties, 900 to 4,500 feet, dry plains and mesas, April to October. Southern Utah to central Arizona and southern California.

The plant is browsed when better forage is unavailable.

Acamptopappus shockleyi A. Gray, of southern Nevada and Inyo County, California, may yet be found in northwestern Arizona. It has radiate heads solitary at the tips of the branches, whereas those of *A. sphaerocephalus* are discoid and are borne at the tips of cymosely arranged branchlets.

15. HETEROTHECA. TELEGRAPH-PLANT

Annual or biennial herbs, hirsute or hispid, glandular above; leaves alternate, the lower ones usually with a foliaceous stipuliform dilation at base of the petiole; heads yellow, medium-sized; involucre graduate, of numerous narrow phyllaries; ray achenes glabrous or slightly pubescent, essentially epappose; disk achenes densely hairy, their pappus double, the outer series of short bristles or setiform squamellae, the inner series of longer capillary bristles.

Large coarse plants, browsed by cattle.

Key to the species

1. Heads relatively small, the disk in fruit (including the pappus) 8 to 10 mm. high involucre 6 to 8 mm. high; ray achenes glabrous; appendages of the style branches two-thirds as long as the stigmatic region; upper leaves usually with cordate-clasping bases..... 1. *H. SUBAXILLARIS*.
1. Heads relatively large, the disk in fruit (including the pappus) 10 to 12 mm. high; involucre 7 to 10 mm. high; ray achenes pubescent at least on the angles; appendages of the style branches about half as long as the stigmatic region; upper leaves usually narrowed at base..... 2. *H. GRANDIFLORA*.

1. *Heterotheca subaxillaris* (Lam.) Britt. and Rusby, N. Y. Acad. Sci. Trans. 7: 10. 1887.

Inula subaxillaris Lam., Encycl. 3: 259. 1789.

Heterotheca lamarckii Cass., Dict. Sci. Nat. 21: 131. 1821.

Yavapai, Gila, Maricopa, Pinal, Cochise, and Pima Counties, 1,000 to 5,500 feet, abundant and conspicuous along roads and ditches, March to November. Delaware to Kansas, south to Florida, Texas, Arizona, and Mexico.

Sometimes known as camphor-weed, because of the odor of the plant.

2. *Heterotheca grandiflora* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 315. 1840.

Near Prescott (Yavapai County), Santa Rita and Baboquivari Mountains (Pima County), 2,500 to 4,500 feet, thickets and chaparral, September and October. California and Arizona.

16. CHRYSOPSIS. GOLDEN-ASTER

Low, pubescent, perennial herbs; leaves alternate, spatulate to oblong or obovate, entire; heads medium-sized, yellow, radiate, usually few and cymose; involucre graduated; achenes compressed; pappus double in both the ray and the disk flowers, the outer series of short squamellae or squamellate bristles, the inner series of much longer capillary bristles.

Key to the species

1. Whole plant silvery-silky; heads very large (disk in fruit 1 to 1.5 cm. high), leafy-bracted, the bracts surpassing the proper involucre and usually also the heads..... 1. *C. RUTTERI*.
1. Plant not silvery-silky, or else the heads smaller (disk in fruit 1 cm. high or less), or not leafy-bracted (2).

2. Involucre densely pubescent, its glands obscure or none; plants canescent or grayish green (3).
 3. Plant canescent; leaves elliptic to obovate, usually not distinctly petioled, subsericeous-canescensent..... 2. *C. FOLIOSA*.
 3. Plant grayish-green; leaves usually spatulate or spatulate-obovate and distinctly petioled..... 3. *C. VILLOSA*.
 2. Involucre distinctly glandular, the longer eglandular hairs usually few or none (4).
 4. Heads leafy-bracted; leaves mostly elliptic or oblong, sessile, green, the middle ones 2 to 4 cm. long, the lowest leaves obovate or oblanceolate; involucre glandular and hirsute..... 4. *C. FULCRATA*.
 4. Heads rarely leafy-bracted; leaves chiefly obovate or the lower ones spatulate-oblanceolate, narrowed to a petiolelike base, 2.5 cm. long or less (5).
 5. Stem and involucre sparsely glandular..... 5. *C. HISPIDA*.
 5. Stem and involucre densely glandular, with few long eglandular hairs. 6. *C. VISCIDA*.

1. **Chrysopsis rutteri** (Rothr.) Greene, *Erythea* 2: 96. 1894.

Chrysopsis villosa var. *rutteri* Rothr. in Wheeler, U. S. Survey West 100th Merid. Rpt. 6: 142. 1878.

Western Cochise and Santa Cruz Counties, about 5,000 feet, dry plains and mesas, August to October, type from the Sonoita Valley (*Rothrock* 662). Known only from southeastern Arizona.

2. **Chrysopsis foliosa** Nutt., *Amer. Phil. Soc. Trans.* ser. 2, 7: 316. 1840.

White Mountains (southern Apache and Navajo Counties), Pinaleno Mountains (Graham County), Pine Creek and Pinal Mountains (Gila County), 4,500 to 8,300 feet, plains and canyons, August to October. Minnesota to Washington, south to central Arizona.

3. **Chrysopsis villosa** (Pursh) Nutt. ex DC., *Prodr.* 5: 327. 1836.

Amellus villosus Pursh, *Fl. Amer. Sept.* 564. 1814.

Apache, Navajo, and Coconino Counties, south to Pima County, 1,700 to 7,000 feet, dry slopes, mesas, and plains, May to October. Minnesota to Saskatchewan, south to Texas and southern Arizona.

The Hopi Indians are said to use a decoction of the leaves and flowers to relieve pain in the chest.

4. **Chrysopsis fulcrata** Greene, *Torrey Bot. Club Bul.* 25: 119. 1898.

Chrysopsis resinolens A. Nels., *Torrey Bot. Club Bul.* 28: 232. 1901.

Coconino, Yavapai, Graham, and Pima Counties, 5,000 to 8,000 feet, usually among rocks, June to October. Montana to Texas, New Mexico, and Arizona.

5. **Chrysopsis hispida** (Hook.) DC., *Prodr.* 7: 279. 1838.

Diplopappus hispidus Hook., *Fl. Bor. Amer.* 2: 22. 1834.

Navajo and Coconino Counties to Cochise and Pima Counties, 2,000 to 7,000 feet, dry rocky slopes, April to October. Saskatchewan to British Columbia, south to southern Arizona and California.

6. **Chrysopsis viscida** (A. Gray) Greene, *Erythea* 2:105. 1894.

Chrysopsis villosa var. *viscida* A. Gray, *Syn. Fl.* 1²: 123. 1884.

Near Holbrook (Navajo County), Chiricahua Mountains (Cochise County), Santa Rita Mountains (Pima County), 5,000 to 8,500 feet,

dry ledges of cliffs, May to October. Colorado to Texas and southern Arizona.

17. SOLIDAGO. GOLDENROD

Perennial herbs; leaves alternate, usually narrow, entire or toothed; heads small, radiate, yellow, in usually racemiform or cymose panicles, often secund on the branches; involucre narrow, the phyllaries more or less graduate, usually thin and dry, sometimes with herbaceous tips; achenes short; pappus of capillary bristles.

Some of the species are reputed to be poisonous to livestock, especially to sheep. The leaves of *S. missouriensis* are reported to be eaten as a salad by the Indians of northern Arizona.

Key to the species

1. Heads in small rounded cymose clusters at tips of the branches and branchlets; rays small, inconspicuous, more numerous than the disk flowers; plant glabrous, rather tall, usually with numerous semierect branches, uniformly leafy; leaves linear or narrowly lance-linear, entire, 3-ribbed, not coriaceous.
 11. *S. OCCIDENTALIS*.
1. Heads otherwise arranged, or else the plants low and caespitose, with coriaceous leaves; rays fewer than the disk flowers (2).
 2. Heads subcylindric, in dense flattish fastigiata cymes; leaves coriaceous; stems low, caespitose from a branched caudex (3).
 3. Leaves 3-nerved and reticulate, the lower ones oblanceolate or linear-oblanceolate, 2.5 to 7 mm. wide.----- 9. *S. PETRADORIA*.
 3. Leaves 1-nerved, narrowly linear, the lower ones about 1 mm. wide.
 10. *S. GRAMINEA*.
 2. Heads not cylindric, racemose or paniced, sometimes few and glomerate or cymose, never in dense fastigiata cymes; leaves not definitely coriaceous; stems not caespitose from a branched caudex (4).
 4. Stem glabrous or sometimes loosely villous, never densely puberulous (5).
 5. Heads smaller (involucre 3 to 5 mm. high), secund on the spreading, recurving, or sometimes erect branches of the usually pyramidal panicle.----- 3. *S. MISSOURIENSIS*.
 5. Heads larger (involucre 4 to 6 mm. high), glomerate, racemose, or in a narrow thyse, not secund on the branches; high montane (6).
 6. Phyllaries linear-lanceolate to lanceolate, acuminate to acute, thin; leaves villous-ciliate especially toward the base. 1. *S. CILIOSA*.
 6. Phyllaries oblong, obtuse to acutish, firm; leaves not ciliate.
 2. *S. DECUMBENS*.
 4. Stem densely puberulous or glandular-puberulous, sometimes (in *S. sparsiflora*) sparsely incurved-puberulous (7).
 7. Leaves very numerous and nearly uniform, only gradually reduced above, lanceolate or linear-lanceolate, gradually acuminate, strongly triplinerved, usually sharply serrate, sometimes entire (8).
 8. Involucre 3 to 5 mm. high.----- 4. *S. ALTISSIMA*.
 8. Involucre 2 to 3 mm. high.----- 5. *S. CANADENSIS*.
 7. Leaves comparatively few and usually distinctly dimorphous (the basal leaves much larger than the middle and upper stem leaves and distinctly petioled) or, if numerous and nearly uniform, then blunt or merely acute, either feather-veined or triplinerved (9).
 9. Phyllaries, at least the outer ones, with definite herbaceous or sub-herbaceous tips, densely puberulous or stipitate-glandular; leaves nearly uniform, the middle and upper ones elliptic to ovate-elliptic, usually 1 to 2.5 cm. wide, feather-veined or obscurely triplinerved.----- 8. *S. WRIGHTII*.
 9. Phyllaries without definite herbaceous tips (sometimes obscurely greenish above), glabrous or rarely slightly puberulous; middle and upper stem leaves usually much smaller than the basal ones, mostly lanceolate to linear or spatulate, seldom as much as 1 cm. wide, usually triplinerved (10).

10. Phyllaries oblong or the outer ones ovate, very obtuse, firm and substramineous; involucre 4 to 6 mm. high; inflorescence thyrsoid, or with erect branches; plant cinereous-puberulous.

6. *S. NANA.*

10. Phyllaries chiefly linear to linear-oblong or the outer ones usually lanceolate, acute or acutish or the outer ones acuminate, thinner; involucre 3 to 5 mm. high; inflorescence when well developed pyramidal, the heads secund on the more or less recurved branches; plants greener.----- 7. *S. SPARSIFLORA.*

1. *Solidago ciliosa* Greene, Pittonia 3: 22. 1896.

Solidago multiradiata var. *scopulorum* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 191. 1882.

Solidago scopulorum A. Nels., Bot. Gaz. 37: 264. 1904.

San Francisco Peaks (Coconino County), the type locality, 10,500 to 12,000 feet, July to September. Alberta and British Columbia to northern Arizona and California.

2. *Solidago decumbens* Greene, Pittonia 3: 161. 1897.

San Francisco Peaks (Coconino County), White Mountains (northern Greenlee County), 8,000 to 9,500 feet, July and August. British Columbia to Oregon and Arizona.

3. *Solidago missouriensis* Nutt., Acad. Nat. Sci. Phila. Jour. 7: 32. 1834.

Solidago glaberrima Martens, Acad. Roy. Belg. Bul. Cl. Sci. 8: 68. 1841.

Solidago marshallii Rothr. in Wheeler, U. S. Survey West 100th Merid. Rpt. 6: 146. 1878.

Solidago tenuissima Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 182. 1913.

Flagstaff and Williams (Coconino County) and southern Apache County, southward to the mountains of Cochise and Pima Counties, 6,000 to 9,000 feet, open pine forest and along streams, June to August, type of *S. marshallii* from the Chiricahua Mountains (*Rothrock* 530). Michigan and Tennessee to British Columbia, Oregon, and Arizona.

4. *Solidago altissima* L., Sp. Pl. 878. 1753.

Solidago canadensis var. *arizonica* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 197. 1882.

Solidago arizonica Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 181. 1913.

Coconino, Yavapai, Cochise, and Pima Counties, 2,500 to 8,500 feet, August and September, type of *S. canadensis* var. *arizonica* from Boulder Creek, Yavapai(?) County (*Rothrock* 782). Atlantic Coast States to Wyoming and Arizona.

5. *Solidago canadensis* L., Sp. Pl. 878. 1753.

The species is represented in Arizona by var. *gilvocanescens* Rydb. (*S. gilvocanescens* Smyth). Western Gila and eastern Yavapai Counties, 3,000 to 4,000 feet, July and August. Minnesota to Kansas, westward to Montana, Nevada, and central Arizona.

The stems reach a height of 2.5 m.

6. *Solidago nana* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 327. 1840.

Solidago pulcherrima A. Nels., Torrey Bot. Club Bul. 25: 549. 1898.

Coconino County, from the Kaibab Plateau to Oak Creek, 6,500 to 9,000 feet, plains, canyons, and slopes, July to September. Alberta to Nebraska and northern Arizona.

7. *Solidago sparsiflora* A. Gray, Amer. Acad. Arts and Sci. Proc. 12: 58. 1877.

Solidago sparsiflora var. *subcinerea* A. Gray, Syn. Fl. 1²: 159. 1884.

Solidago trinervata Greene, Pittonia 3: 100. 1896.

Almost throughout the State, 2,000 to 8,000 feet, pine forest and chaparral, June to October, type of *S. sparsiflora* from Camp Lowell, Pima County (*Rothrock* 706), type of var. *subcinerea* from Rucker Canyon, Cochise County (*Leemmon*). South Dakota and Wyoming to Texas, New Mexico, and Arizona.

8. *Solidago wrightii* A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 80. 1880.

Solidago bigelovii A. Gray, *ibid.* 17: 190. 1882.

Coconino, Mohave, Yavapai, and Gila Counties (probably elsewhere), 4,500 to 9,500 feet, mostly in pine forest, August to October. Western Texas to Arizona.

The var. *adenophora* Blake (*S. subviscosa* Greene?) occurs farther southward, in the mountains of Graham, Cochise, and Pima Counties, type from the Santa Catalina Mountains (*Harrison* 3106). It is distinguished by the presence of stipitate glands on the involucre, pedicels, stem, and leaves.

9. *Solidago petradoria* Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 540. 1925.

Chrysoma pumila Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 325. 1840.

Solidago pumila Torr. and Gray, Fl. North Amer. 2: 210. 1842. Not *S. pumila* Crantz, 1766.

Petradoria pumila Greene, Erythea 3: 13. 1895.

Northeastern Apache County to the Kaibab Plateau (Coconino County), 5,500 to 7,500 feet, rocky slopes and canyons, locally common, June to August. Wyoming to Oregon (?), western Texas, northern Arizona, and southeastern California.

It is reported that the Hopi Indians use this plant to alleviate pain in the breast.

10. *Solidago graminea* (Woot. and Standl.) Blake, Wash. Acad. Sci. Jour. 21: 326. 1931.

Petradoria graminea Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 183. 1913.

Kaibab Plateau, Coconino County (*Marsh* in 1926, *Eastwood* and *Howell* 6386), dry hills and plains, June to September. Southern Utah, northwestern New Mexico, and northern Arizona.

11. *Solidago occidentalis* (Nutt.) Torr. and Gray, Fl. North Amer. 2: 226. 1842.

Euthamia occidentale Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 326. 1840.

Tuba, Coconino County (*Kearney* and *Peebles* 12864), 5,000 feet, September. Alberta to British Columbia, south to New Mexico, northern Arizona, and California.

18. APLOPAPPUS⁶²

Herbs or shrubs; leaves alternate, entire to bipinnatifid; heads small to large, usually radiate, yellow, or the rays rarely saffron color; involucre usually definitely graduated; achenes cylindrical to turbinate; pappus copious, of graduated capillary bristles.

Key to the species

1. Stems strictly herbaceous, but the plants sometimes with a woody caudex. (If the stems exceptionally herbaceous in normally woody species (*A. heterophyllus*, *A. drummondii*), then the heads discoid, turbinate, and the leaves usually entire) (2).
2. Heads discoid; leaves closely serrate, the teeth with white spinescent tips; heads campanulate or hemispheric, many-flowered; plant rarely more than 25 cm. high..... 1. *A. NUTTALLII*.
2. Heads radiate (3).
3. Leaves strongly 3-nerved and veiny, coriaceous, entire; plants with woody branched caudices; stems low, few-leaved; heads usually solitary (4).
4. Phyllaries very obtuse to barely acutish, strongly graduate..... 6. *A. ARMERIOIDES*.
4. Phyllaries acuminate to acute, usually little graduate..... 7. *A. ACAULIS*.
3. Leaves not 3-nerved and veiny; plants not with woody branched caudices (5).
5. Leaves entire or rarely with a few teeth, large, the basal ones lanceolate to obovate, rarely less than 1.5 cm. wide; phyllaries not spinescent-tipped (6).
6. Heads 1 to 3 per stem; disk 1.5 to 2.5 cm. thick; rays usually saffron color; stem loosely pilose above..... 4. *A. CROCEUS*.
6. Heads several or numerous; disk 1 cm. thick or less; rays yellow; stem hispidulous above..... 5. *A. PARRYI*.
5. Leaves sharply serrate to bipinnatifid, the teeth or lobes spinescent-tipped, the basal leaves not large; phyllaries spinescent-tipped (7).
7. Plant annual; involucre strigose or hirsute, obscurely if at all glandular..... 2. *A. GRACILIS*.
7. Plant perennial; involucre usually conspicuously glandular or tomentose..... 3. *A. SPINULOSUS*.
1. Plants shrubs or undershrubs or, if almost entirely herbaceous (rarely so in *A. heterophyllus* and *A. drummondii*), then the heads discoid and turbinate (8).
8. Heads solitary at the tips of the branches, definitely peduncled, radiate, large, the disk 1 cm. high or more; involucre broad, the phyllaries about 3-seriate, not strongly graduated; pappus bright white, about 6 mm. long..... 8. *A. LINEARIFOLIUS*.
8. Heads cymose or paniced or, if solitary, then not definitely peduncled; involucre usually narrow, often strongly graduated; pappus straw-colored or dull whitish or brownish (9).
9. Heads usually solitary, leafy-bracted, the proper phyllaries about 2-seriate, subequal, 8 to 11 mm. long; style appendages at least twice as long as the stigmatic portion, acuminate; rays 0 to 6; plant densely glandular..... 9. *A. SUFFRUTICOSUS*.

⁶² Reference: HALL, H. M. THE GENUS APLOPAPPUS. A PHYLOGENETIC STUDY IN THE COMPOSITAE. Carnegie Inst. Wash. Pub. 389: 1-391. 1928.

9. Heads cymose or panicle or, if solitary, then not leafy-bracted; involucre strongly graduated, or else much shorter; style appendages less than twice as long as the stigmatic portion, or else (in *A. scopulorum*) obtusish (10).
10. Leaves spatulate to broadly obovate, entire, obtuse or apiculate, 8 to 23 mm. long, 3 to 15 mm. wide; heads small, discoid, in small terminal cymes.----- 10. *A. CUNEATUS*.
10. Leaves linear to linear-lanceolate or cuneate or, if spatulate, then the heads radiate (11).
11. Heads radiate (12).
12. Leaves densely glandular-punctate, essentially linear, not more than 2 mm. wide; involucre 2- or 3-seriate, not strongly graduated, 3 to 5 mm. high.----- 11. *A. LARICIFOLIUS*.
12. Leaves obscurely if at all glandular-punctate, often stipitate-glandular or resinous, spatulate to obovate, 2 to 5 mm. wide, cuspidate-pointed; involucre several-seriate, strongly graduated (13).
13. Plant densely stipitate-glandular; leaves spatulate to oblanceolate, 15 to 20 mm. long, 2 to 3 mm. wide.----- 12. *A. WATSONI*.
13. Plant glabrous but often glutinous; leaves obovate or spatulate-obovate, 8 to 15 mm. long, 3 to 5 mm. wide.----- 13. *A. CERVINUS*.
11. Heads discoid (14).
14. Leaves linear-lanceolate, 3-ribbed, entire or with a minutely spinulose-denticulate margin; style appendages linear, much longer than the stigmatic region, sometimes twice as long; corolla teeth 1.5 to 2 mm. long (15).
15. Leaves densely impressed-punctate.----- 14. *A. SALICINUS*.
15. Leaves not impressed-punctate.----- 15. *A. SCOPULORUM*.
14. Leaves linear to cuneate or broader, 1-nerved, entire to toothed or pinnatifid; style appendages deltoid or triangular, shorter than the stigmatic region; corolla teeth not more than 1 mm. long (16).
16. Leaves pinnatifid, the lobes linear, several times as long as the breadth of the leaf rachis.----- 16. *A. TENUISECTUS*.
16. Leaves entire or sometimes with a few teeth, occasionally subpinnatifid, the lobes then scarcely longer than the breadth of the leaf rachis (17).
17. Phyllaries with a thickened apex bearing a large rounded gland; leaves entire to laciniate-pinnatifid.----- 17. *A. ACRADENTUS*.
17. Phyllaries scarcely thickened at apex, without a distinct gland; leaves usually entire (18).
18. Heads 7- to 15-flowered, smaller, the involucre 3.5 to 5 mm. high, the phyllaries obscurely if at all green-tipped.----- 18. *A. HETEROPHYLLUS*.
18. Heads 18- to 30-flowered, larger, the involucre 6 to 8 mm. high, the phyllaries definitely greenish-tipped.----- 19. *A. DRUMMONDII*.
- 1. *Aplopappus nuttallii* Torr. and Gray, Fl. North Amer. 2: 242. 1842.**
- Eriocarpum grindelioides* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 321. 1840. Not *Aplopappus grindelioides* DC., 1836.
- Sideranthus grindelioides* Britton in Rydb., Torrey Bot. Club Bul. 27: 620. 1900.

Apache, Navajo, and Coconino Counties, 5,500 to 8,000 feet, barren rocky hills and plains, June to August. Saskatchewan to Alberta, south to Nebraska, New Mexico, and northern Arizona.

The Hopi Indians make a tea from the roots, which they administer for coughs.

2. **Aplopappus gracilis** (Nutt.) A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 76. 1849.

Dieteria gracilis Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 177. 1848.

Throughout the State, up to 6,000 feet, dry plains, mesas, and rocky slopes, February to November. Colorado to Texas, Arizona, southeastern California, and Mexico.

3. **Aplopappus spinulosus** (Pursh) DC., Prodr. 5: 347. 1836.

Amellus spinulosus Pursh, Fl. Amer. Sept. 564. 1814.

Sideranthus spinulosus Sweet, Hort. Brit. 227. 1826.

Throughout the State, in various forms, March to October. Minnesota to Alberta, south to Texas, Arizona, southeastern California, and northern Mexico.

The typical form, with a tomentose involucre, apparently rare in Arizona, has been collected near Superior, Pinal County, about 2,900 feet (*Harrison* and *Peebles* 1692, *Gillespie* 5384). The most common form in Arizona is var. *turbinellus* (Rydb.) Blake (*Sideranthus turbinellus* Rydb., *Eriocarpum australe* Greene), characterized by a glandular involucre, short rays (8 mm. long or less), usually bipinnatifid lower leaves, and serrate to pinnatifid middle leaves 0.5 to 2.5 cm. long. It occurs from the northeastern corner to the southern boundary of the State, up to about 5,000 feet. The var. *gooddingii* (A. Nels.) Blake (*Sideranthus gooddingii* A. Nels.), characterized by a glandular involucre, longer rays (8 to 15 mm.), merely pinnatifid lower leaves, and middle leaves 2 to 4 cm. long, pinnatifid with remote narrow lobes, is the prevailing form in western Arizona, ranging from the Grand Canyon and northern Mohave County to western Gila, Maricopa, and Yuma Counties, 3,000 feet or lower.

Aplopappus junceus Greene, a closely related species, is known from southern California, Baja California, and Sonora, and may be found in Arizona. It is nearest *A. spinulosus* var. *turbinellus* but is taller (3 to 10 dm. high) with bright yellowish-green, very sparsely leafy stems, the upper leaves much reduced.

4. **Aplopappus croceus** A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 65. 1863.

The Arizona form is var. *genuflexus* (Greene) Blake (*Pyrracoma genuflexa* Greene, *P. adsurgens* Greene). San Francisco Peaks to the Mogollon Escarpment (Coconino County), White Mountains (Apache and northern Greenlee Counties), 6,000 to 9,000 feet, mountain meadows and openings in coniferous forest, July to October, type from near Flagstaff (*Toumey* in 1894), type of *P. adsurgens* from Flagstaff (*Rusby* 645). The typical form of the species ranges from Wyoming to New Mexico and eastern Utah.

5. **Aplopappus parryi** A. Gray, Amer. Jour. Sci. ser. 2, 33: 239. 1862.

Solidago parryi Greene, Erythea 2: 57. 1894.

Oreochrysum parryi Rydb., Torrey Bot. Club Bul. 33: 153. 1906.

Kaibab Plateau, San Francisco Peaks, and Bill Williams Mountain (Coconino County), White Mountains (Apache and northern Greenlee Counties), Pinaleno Mountains (Graham County), Chiricahua and

Huachuca Mountains (Cochise County), 8,000 to 11,500 feet, coniferous forests, July to September. Wyoming to New Mexico and Arizona.

6. **Aplopappus armerioides** (Nutt.) A. Gray in Ives, Colo. River Rpt. pt. 4: 16. 1860.

Stenotus armerioides Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 335. 1840.

Navajo and eastern Coconino Counties, about 6,000 feet, mesas, often with pinyon and juniper, May and June. Saskatchewan to Nebraska, New Mexico, and northeastern Arizona.

- *7. **Aplopappus acaulis** (Nutt.) A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 353. 1868.

Chrysopsis acaulis Nutt., Acad. Nat. Sci. Phila. Jour. 7: 33. 1834.

The glabrous form, var. *glabratus* D. C. Eaton (*Stenotus falcatus* Rydb., *Aplopappus falcatus* (Rydb.) Blake), has been reported from northern Arizona. Saskatchewan to Wyoming, Utah, Arizona (?), and California.

8. **Aplopappus linearifolius** DC., Prodr. 5: 347. 1836.

The species is represented in Arizona by var. *interior* (Coville) M. E. Jones (*A. interior* Coville). Northern Mohave County through Yavapai County to eastern Maricopa County, 3,000 to 5,000 feet, March to May. Utah, central and western Arizona, and southeastern California.

The handsomest species in Arizona, very showy in flower.

- *9. **Aplopappus suffruticosus** (Nutt.) A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 542. 1865.

Macronema suffruticosa Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 322. 1840.

Mountain ridges and slopes, Sierra Nevada of California to Montana, Wyoming, and Nevada (reported from Arizona), July to September.

10. **Aplopappus cuneatus** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 635. 1873.

The Arizona form is var. *spathulatus* (A. Gray) Blake. Union Pass (Mohave County), Prescott (Yavapai County), Pinaleno Mountains (Graham County), Mazatzal Mountains (Gila County), Baboquivari Mountains (Pima County), 3,500 to 5,000 feet, rock ledges, September and October. Arizona to southeastern California and Baja California.

11. **Aplopappus laricifolius** A. Gray, Pl. Wright. 2: 80. 1853.

Mohave, Yavapai, Gila, Pinal, Cochise, and Pima Counties, 3,000 to 6,000 feet, mesas, slopes, and canyons, August to November. Western Texas to Arizona and Chihuahua.

12. **Aplopappus watsoni** A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 79. 1880.

Grand Canyon, Coconino County (*Eastwood* in 1905, *Blake* 9815, 9818), about 7,000 feet, on rocks, October. Southern Utah, southern Nevada, and northern Arizona.

- *13. *Aplopappus cervinus* S. Wats., Amer. Nat. 7: 301. 1873, as *Haplopappus*.

Ericameria cervina Rydb., Fl. Rocky Mount. 853. 1917.

Canyons, Utah (and reported from adjacent Arizona).

14. *Aplopappus salicinus* Blake, Biol. Soc. Wash. Proc. 48: 171. 1935.

Known only from the type collection on Bright Angel Trail, Grand Canyon (*Eastwood* 10), in bud in October.

15. *Aplopappus scopulorum* (M. E. Jones) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 546. 1925.

Bigelovia menziesii var. *scopulorum* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 692. 1895.

Isocoma scopulorum Rydb., Fl. Rocky Mount. 859. 1917.

Both sides of the Grand Canyon, Coconino County (*Eastwood* 3586, *Eastwood* and *Howell* 7111), September. Southern Utah and northern Arizona.

In the typical form the stem and leaves are glabrous, except for the ciliolate leaf margin. The var. *hirtellus* Blake, with hirtellous young branches, peduncles, and leaves, has been collected in Waterlily Canyon, 35 miles north of Kayenta, Navajo County (*R. E. Burton* in 1934), and it occurs also in southeastern Utah.

16. *Aplopappus tenuisectus* (Greene) Blake in Benson, Amer. Jour. Bot. 27: 188. 1940.

Linosyris coronopifolia A. Gray, Pl. Wright. 1: 96. 1852.

Not *Aplopappus coronopifolius* DC., 1836.

Isocoma tenuisecta Greene, Leaflets 1: 169. 1906.

Isocoma fruticosa Rose and Standl., Contrib. U. S. Natl. Herbarium 16: 18. 1912.

Aplopappus fruticosus Blake in Standl., Contrib. U. S. Natl. Herbarium 23: 1493. 1926.

Western Cochise and Pima Counties, 2,000 to 4,000 feet, plains, August to October, type of *Isocoma tenuisecta* from Tucson (*Smart* in 1867). Southwestern Texas, southern Arizona, and Sonora.

17. *Aplopappus acradenius* (Greene) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 546. 1925.

Bigelovia acradenia Greene, Torrey Bot. Club Bul. 10: 126. 1883.

Grand Canyon (Coconino County), and Mohave, Gila, Maricopa, Pinal, Pima, and Yuma Counties, up to 4,000 feet, in various habitats, often in saline soil, August to October. Southern Utah to Arizona and southern California.

18. *Aplopappus heterophyllus* (A. Gray) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 546. 1925.

Linosyris heterophylla A. Gray, Pl. Wright. 1: 95. 1852.

Linosyris wrightii A. Gray, *ibid.*

Isocoma heterophylla Greene, Erythra 2: 111. 1894.

Isocoma wrightii Rydb., Torrey Bot. Club Bul. 33: 152. 1906.

Navajo, eastern Coconino, and Yavapai Counties, south to Cochise, Pima, and Yuma Counties, up to 5,000 feet, mesas and plains, often

in saline soil, June to September. Colorado to Texas, Arizona, and northern Mexico.

Jimmyweed, rayless-goldenrod. The plant often occupies overgrazed range land and is a common roadside weed in the irrigated districts. This, and doubtless some of the closely related species, are generally unpalatable, but when eaten in quantity by cattle cause the disease known as "milk sickness," or "trembles," which is transmissible through the milk to human beings.

19. *Aplopappus drummondii* (Torr. and Gray) Blake in Standl., Contrib. U. S. Natl. Herbarium 23: 1491. 1926.

Linosyris drummondii Torr. and Gray, Fl. North Amer. 2: 233. 1842.

Isocoma drummondii Greene, Erythraea 2: 111. 1894.

Isocoma rusbyi Greene, Leaflets 1: 170. 1906.

Apache, Navajo, and Coconino Counties, about 5,000 feet, July to November, type of *Isocoma rusbyi* from Holbrook (*Rusby* in 1883). Texas to northern Arizona, and northeastern Mexico.

19. CHRYSOTHAMNUS.⁶³ RABBITBRUSH

Shrubs; leaves alternate, linear to linear-filiform, sometimes dotted with impressed glands; heads small or medium-sized, discoid, yellow, 4- to 7-flowered, usually paniced; involucre several-seriate, graduated, the phyllaries chartaceous, sometimes herbaceous-tipped, in more or less definite vertical ranks; achenes pubescent or glabrous; pappus of numerous capillary bristles.

The latex of several species (*C. nauseosus*, *C. paniculatus*, *C. viscidiflorus*), contains rubber of fair quality, that of *C. nauseosus* being reported to yield 2.8 percent on the average and as much as 6.5 percent in selected individual plants. It has not proved practicable, as yet, to utilize this source of rubber commercially, notwithstanding the great abundance of the plants. The rubber content is reported to be highest in plants growing in saline soil. Several species are browsed to a limited extent, but the genus as a whole is of small forage value. The plants tend to increase on overgrazed land at the expense of more valuable species. Rabbitbrushes are used by the Hopi as one of the "kiva" fuels, and for making windbreaks, arrows, and wickerwork. A yellow dye is obtained from the flowers and a green dye from the inner bark.

Key to the species

1. Leaves conspicuously punctate with impressed glands, terete or slightly flattened; plants glabrous throughout (2).
 2. Phyllaries with the midrib often glandular-thickened for most of its length, but without a roundish terminal gland----- 1. *C. PANICULATUS*.
 2. Phyllaries with a large roundish terminal gland----- 2. *C. TERETIFOLIUS*.
1. Leaves not punctate with impressed glands (3).
 3. Stems covered with a dense, often matted tomentum (4).
 4. Heads in a leafy spikelike panicle, or in racemelike clusters; outer phyllaries acuminate, herbaceous-tipped----- 7. *C. PARRYI*.
 4. Heads cymose, terminal; phyllaries obtuse to acute, not herbaceous-tipped.
 8. *C. NAUSEOSUS*.

⁶³Reference: HALL, H. M. and CLEMENTS, F. E. THE PHYLOGENETIC METHOD IN TAXONOMY. THE NORTH AMERICAN SPECIES OF ARTEMISIA, CHRYSOTHAMNUS, AND ATRIFLEX. Carnegie Inst. Wash. Pub. 326: 157-324. 1923.

3. Stems glabrous to pubescent, but never tomentose (5).
 5. Involucre 9 to 13 mm. high, the phyllaries in very sharply defined vertical ranks, all very acute to cuspidate-acuminate; achenes glabrous to rather sparsely pubescent (6).
 6. Plant densely cinereous-pubescent, only 1 to 3 dm. high; leaves narrowly spatulate to oblanceolate or nearly linear----- 3. C. DEPRESSUS.
 6. Plant glabrous except for the ciliate leaf margins, taller; leaves linear.----- 4. C. PULCHELLUS.
 5. Involucre 5 to 9 mm. high, the phyllaries in less sharply defined vertical ranks, obtuse to merely acute or the outer ones acuminate; achenes densely pubescent, rarely merely glandular (7).
 7. Phyllaries obtuse to acute----- 5. C. VISCIDIFLORUS.
 7. Phyllaries, at least the outer ones, with slender acuminate and often cuspidate greenish tips----- 6. C. GREENEI.

1. *Chrysothamnus paniculatus* (A. Gray) H. M. Hall, Calif. Univ. Pub. Bot. 3: 58. 1917.

Bigelovia paniculata A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 644. 1873.

Ericameria paniculata Rydb., Fl. Rocky Mount. 853. 1917.

Kingman (Mohave County), Rye Creek, Gila County (*Harrison and Kearney* 8367), September to November. Utah, Arizona, southeastern California, and Sonora.

This species is reported to contain 2.5 percent or more of rubber.

2. *Chrysothamnus teretifolius* (Dur. and Hilgard) H. M. Hall, Calif. Univ. Pub. Bot. 3: 57. 1907.

Linosyris teretifolia Dur. and Hilgard, Acad. Nat. Sci. Phila. Jour. ser. 2, 3: 41. 1855.

Ericameria teretifolia Jepson, Man. Fl. Pl. Calif. 1024. 1925.

Union Pass, Mohave County, 3,600 feet (*Palmer* in 1870), September and October. Nevada, northwestern Arizona, and southern California.

3. *Chrysothamnus depressus* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 171. 1848.

Navajo and Coconino Counties to Hualpai Mountain (Mohave County), 5,000 to 7,000 feet, dry rocky slopes, May to October. Colorado to Nevada, New Mexico, Arizona, and southeastern California.

4. *Chrysothamnus pulchellus* (A. Gray) Greene, *Erythea* 3: 107. 1895.

Linosyris pulchella A. Gray, Pl. Wright. 1: 96. 1852.

Represented in Arizona by var. *baileyi* (Woot. and Standl.) Blake (*C. baileyi* Woot. and Standl.). Hopi Indian Reservation, Navajo County (*Whiting* 2784), 17 miles northeast of Tuba, Coconino County (*Kearney and Peebles* 12894), about 5,500 feet, sandy soil, September. Kansas to Texas, New Mexico, and northeastern Arizona.

5. *Chrysothamnus viscidiflorus* (Hook.) Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 324. 1840.

Crinitaria viscidiflora Hook., Fl. Bor. Amer. 2: 24. 1834.

Including its varieties, the species ranges from North Dakota to British Columbia, south to New Mexico, Arizona, and eastern California. The typical form, usually 5 dm. high or more, glabrous and with linear leaves 2 to 5 cm. long and 2 to 5 mm. wide, rare in Arizona,

is known from Navajo County (*Wetherill* 496), and from the Kaibab Plateau, Coconino County, 6,000 feet (*Jones* 6063g). The commonest form in Arizona is var. *stenophyllus* (A. Gray) H. M. Hall (*C. stenophyllus* (A. Gray) Greene), a low shrub 10 to 30 cm. high, glabrous and with narrowly linear leaves 1 mm. wide or less, known from Apache, Navajo, and Coconino Counties, 5,000 to 6,000 feet, dry mesas and slopes, August to October. The var. *elegans* (Greene) Blake (*C. elegans* Greene, *C. viscidiflorus* subsp. *elegans* Hall and Clements) is reported by Hall and Clements from the Grand Canyon, Coconino County (*Allen* in 1887). It is more or less hirtellous and is chiefly distinguished by the thickened green tips of the phyllaries. Collections from 20 miles west of Cameron, Coconino County, 6,300 feet (*Kearney* and *Peebles* 12813), and from Canaan ranch, Kaibab Plateau, 5,000 feet (*Jones* 6066d), appear to belong to it. The var. *molestus* Blake, evenly but not densely hispidulous with conical hairs, in part glandular-capitate, on the stem and leaves, with linear leaves 1 to 1.8 cm. long and about 1 mm. wide, and merely glandular achenes (these densely pubescent in all the other forms), is known only in the vicinity of the San Francisco Peaks, Coconino County (*Hall* 11199, type; *Hall* 11184; *A. D. Read* 165).

6. *Chrysothamnus greenei* (A. Gray) Greene, *Erythea* 3: 94. 1895.

Bigelovia greenei A. Gray, *Amer. Acad. Arts and Sci. Proc.* 11: 75. 1876.

Represented in Arizona by var. *filifolius* (Rydb.) Blake (*C. laricinus* Greene, *C. filifolius* Rydb., *C. greenei* subsp. *filifolius* Hall and Clements), with leaves less than 1 mm. wide and usually only 1 to 2 cm. long. Apache, Navajo, and Coconino Counties, 5,000 to 7,000 feet, sandy or stony plains and mesas, July to October, type of *C. laricinus* from the Hopi Reservation-Little Colorado River region (*Hough* 33). Colorado to Nevada, New Mexico, and northeastern Arizona.

7. *Chrysothamnus parryi* (A. Gray) Greene, *Erythea* 3: 113. 1895.

Linosyris parryi A. Gray, *Acad. Nat. Sci. Phila. Proc.* 1863: 66. 1863.

The species with its varieties ranges from Wyoming and Nebraska to New Mexico, Arizona, and California. The Arizona form is var. *nevadensis* (A. Gray) H. M. Hall (*C. nevadensis* (A. Gray) Greene). Known from the Kaibab Plateau to Coconino Wash, 9 miles south of the Grand Canyon (Coconino County), and Hopi Indian Reservation (Navajo County), 7,000 to 9,000 feet, in open yellow-pine forest, sometimes with sagebrush, August and September.

C. parryi subsp. *attenuatus* (M. E. Jones) Hall and Clements also is recorded from Arizona, on the basis of *Jones* 6052k from the "Buckskin Mountains," Kaibab Plateau (see footnote 63, p. 908, Hall and Clements, p. 201). This specimen, however, is quite indistinguishable from material referred by these authors to subsp. *nevadensis*.

8. *Chrysothamnus nauseosus* (Pall.) Britton in Britton and Brown, *Illus. Fl.* 3: 326. 1898.

Chrysocoma nauseosa Pallas ex Pursh, *Fl. Amer. Sept.* 517. 1814.

In one or another of its forms, this variable species ranges from Saskatchewan to British Columbia, south to western Texas, northern

Mexico, and Baja California. The following key to the Arizona forms is based on Hall and Clements' monograph (see footnote 63, p. 908).

Key to the varieties

1. Involucre glabrous, or the margins of the phyllaries sometimes ciliate (2).
 2. Achenes glabrous----- var. ABBREVIATUS.
 2. Achenes densely pubescent (3).
 3. Leaves linear, 1 to 2 mm. wide, persistent----- var. GRAVEOLENS.
 3. Leaves linear-filiform, less than 1 mm. wide, soon deciduous in var. *junceus* (4).
 4. Plant essentially leafless; phyllaries in very distinct vertical rows; corolla teeth thinly long-pilose, at least when young.
 - var. JUNCEUS.
 4. Plant leafy; phyllaries in less distinct vertical rows; corolla teeth glabrous.
 - var. CONSIMILIS.
1. Involucre more or less tomentose or tomentulose, at least on the outer phyllaries (5).
 5. Achenes glabrous (6).
 6. Phyllaries acute or subacuminate; corolla 9 to 10 mm. long.
 - var. BIGELOVIL.
 6. Phyllaries obtuse; corolla 10 to 12 mm. long----- var. GLAREOSUS.
 5. Achenes densely pubescent (7).
 7. Branches clothed with a dense, clear white tomentum; inner phyllaries obtuse, glabrous----- var. LATISQUAMEUS.
 7. Branches with a yellowish or dull white tomentum (8).
 8. Involucre 10 to 12 mm. high, the phyllaries obtuse, in very distinct vertical ranks; corolla 10 to 12 mm. long, the teeth villous.
 - var. TURBINATUS.
 8. Involucre 7 to 9 mm. high, the phyllaries acute, the vertical ranks not very sharply defined; corolla 7 to 9 mm. long, the teeth glabrous.
 - var. GNAPHALODES.

Var. *abbreviatus* (Jones) Blake (*C. leiospermus* (A. Gray) Greene, *C. nauseosus* var. *leiospermus* (A. Gray) H. M. Hall) occurs 19 miles west of Cameron and on the south side of the Grand Canyon, Coconino County (Kearney and Peebles 12816, Eastwood and Howell 7071), about 6,000 feet, dry slopes, September.

Var. *graveolens* (Nutt.) H. M. Hall (*C. graveolens* (Nutt.) Greene) ranges from Apache County to Hualpai Mountain (Mohave County), 2,000 to 7,000 feet, mesas and slopes, July to September.

Var. *junceus* (Greene) H. M. Hall (*C. junceus* Greene) is found from Cameron to the Grand Canyon (Coconino County), near Kingman (Mohave County), along the Gila River, eastern Greenlee County (Greene in 1880, the type collection), 3,500 to 5,500 feet, often on limestone bluffs, September and October. Known only from Arizona.

Var. *consimilis* (Greene) H. M. Hall (*C. consimilis* Greene) occurs in Navajo, Coconino, eastern Mohave, and Yavapai Counties, also in foothills of the Santa Rita Mountains (Pima County), 4,000 to 7,000 feet, valleys, plains, and mesas, often in saline soil, July to November, type from the base of the San Francisco Peaks (Greene in 1895).

Var. *bigelovii* (Gray) H. M. Hall (*C. bigelovii* (A. Gray) Greene, *C. moquianus* Greene) extends from northern Apache and northern Navajo Counties to the vicinity of Flagstaff (Coconino County), 4,500 to 7,000 feet, dry slopes and mesas, July to September, type of *C. moquianus* from the Hopi Indian Reservation (Zuck in 1897).

Var. *glareosus* (M. E. Jones) H. M. Hall (*C. glareosus* (M. E. Jones) Rydb.). A collection on the Little Colorado River (Thurber(?) in 1851) is cited by Hall.

Var. *latisquameus* (A. Gray) H. M. Hall (*C. latisquameus* (A. Gray)

Greene, *C. speciosus* var. (?) *arizonicus* Greene, *C. arizonicus* Greene) has been collected near Oraibi (northern Navajo County), and is apparently more common in Cochise, Santa Cruz, and eastern Pima Counties, 4,000 to 7,000 feet, chiefly along streams, September and October, type of *C. speciosus* var. *arizonicus* from the Santa Rita Mountains (*Brandegee*).

Var. *turbinatus* (Jones) Blake (*C. turbinatus* (M. E. Jones) Rydb.) is known from Adamana and Billings (Apache County), Canaan ranch, Kaibab Plateau (northern Coconino County), 5,000 to 5,500 feet, sandy saline soil, September and October, type from Canaan ranch (*Jones* 6066c).

Var. *gnaphalodes* (Greene) H. M. Hall (*C. speciosus* var. *gnaphalodes* Greene, *C. gnaphalodes* Greene) occurs near the Carrizo Mountains (northern Apache County), on the Kaibab Plateau and vicinity of Flagstaff (Coconino County), with a doubtful record from the Chiricahua Mountains, Cochise County (*Lemmon* in 1881), 6,000 to 7,000 feet, gravelly-sandy slopes and mesas, July to September. Some of the Arizona specimens have leaves up to 2.5 mm. wide and approach var. *speciosus* (Nutt.) Hall.

20. LESSINGIA⁶⁴

Low branching annual, tomentose below, glandular above; leaves alternate, oblong-obovate to linear, entire or toothed; heads small, solitary, yellow, discoid but with enlarged and palmate outer corollas; involucre graduated; achenes turbinate, silky; pappus of numerous unequal brown bristles.

*1. **Lessingia lemmonii** A. Gray, Amer. Acad. Arts and Sci. Proc. 21: 412. 1886.

Lessingia germanorum var. *lemmonii* J. T. Howell, Calif. Univ. Pub. Bot. 16: 25. 1929.

Ash Fork, Yavapai County, the type locality (*Lemmon* in 1884), Peach Springs, Mohave County (*Lemmon* in 1884), about 5,000 feet, June and July. Southern California and central Arizona.

This genus is known otherwise only from California, western Nevada, and northern Baja California. Because the data of locality on the labels of Lemmon's specimens are not always trustworthy, it must be regarded as questionable whether *Lessingia* is truly a component of the Arizona flora. The localities cited in the preceding paragraph have been visited repeatedly by other collectors, none of whom have found *L. lemmonii*.

21. APHANOSTEPHUS

Low somewhat cinereous-puberulous annual, branching; leaves linear to spatulate or obovate, the lower ones crenate-toothed or pinnatifid, the upper leaves often entire; heads rather small, solitary at the tips of the stem and branches, the rays white or purple-tinged, the disk yellow; involucre broad, the phyllaries about 3-seriate, somewhat graduated, lanceolate, green-centered with scarious margin and apex; achenes prismatic or subterete, about 10-ribbed; pappus a very short ciliolate-fringed crown.

⁶⁴ Reference: HOWELL, J. T. A SYSTEMATIC STUDY OF THE GENUS LESSINGIA CHAM. Calif. Univ. Pub. Bot. 16: 1-44. 1929.

1. **Aphanostephus humilis** (Benth.) A. Gray, Pl. Wright. 1: 93. 1852.

Leucopsidium humile Benth., Pl. Hartw. 18. 1839.

Aphanostephus arizonicus A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 81. 1880.

Near Winkelman, Sacaton, and Red Rock (Pinal County), Benson (Cochise County), 1,200 to 3,500 feet, river banks and plains, March to September, type of *A. arizonicus* collected on the Gila River (*Rothrock*). Texas to southern Arizona, south to Mexico.

22. GREENELLA

Low, slender, branching, glabrous, winter annuals; leaves alternate, linear to lanceolate, entire; heads small, scattered or somewhat corymbose, radiate or discoid, the rays when present white; involucre few-seriate, the phyllaries chartaceous, scarious-margined, green-tipped; achenes villous or glabrous; pappus a dissected hyaline crown.

Key to the species

1. Rays present, white; ovaries and achenes densely canescent-pilosulous. 1. G. ARIZONICA.
 1. Rays none; ovaries glabrous or minutely puberulous..... 2. G. DISCOIDEA.
 1. **Greenella arizonica** A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 81. 1880.

Pinal and Pima Counties, 1,400 to 4,000 feet, gravelly soil on mesas and plains, March to September, type from near Tucson (*Greene* in 1877). Southern Arizona and northern Mexico.

2. **Greenella discoidea** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 2. 1883.

Known only from the type collection in Tanner Canyon, Huachuca Mountains, Cochise County (*Lemmon*), September.

23. ACHAETOGERON

Plant annual (?); stems several, about 15 cm. high, ascending, leafy except toward the apex, 1- to few-headed, spreading-pilose below, ascending- or appressed-pilose above; leaves spatulate to linear, entire; heads medium-sized, the rays white, the disk yellow; involucre about 2-seriate, subequal, pilose, of thin lanceolate phyllaries with a greenish midline; achenes compressed, 2-nerved, puberulous; pappus a minute setulose crown.

1. **Achaetogeron chihuahuensis** Larsen in Blake, Wash. Acad. Sci. Jour. 30: 470. 1940.

White Mountains, southern Apache County (*Zuck* in 1907, *Goodding* 539). Eastern Arizona and Chihuahua.

24. PSILACTIS

Slender branching annuals, glandular at least above; leaves alternate, entire to pinnatifid; heads radiate, small, the rays white to purplish, the disk yellow; involucre few-seriate, graduated, the phyllaries herbaceous at least at tip; ray achenes epappose; disk achenes with a pappus of capillary bristles.

Key to the species

1. Plant 50 cm. high or more, erect, branched only above; stem below glabrous or hirsute; leaves mostly entire or merely toothed. 1. *P. ASTEROIDES*.
 1. Plant usually about 30 cm. high or less, diffusely branched from the base; stem glandular-hispidulous throughout, usually also somewhat pilose; leaves mostly laciniate-pinnatifid with spinescent-tipped lobes, sometimes merely toothed. 2. *P. COULTERI*.

1. ***Psilactis asteroides*** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 72. 1849.

Aster boltoniae Greene, Pittonia 3: 248. 1897.

Woodruff (Navajo County), Tuba (Coconino County), south to Cochise and Pinal Counties, 1,400 to 5,000 feet, river bottoms, marshes, and roadsides, June to October. Southwestern Texas to Arizona and central Mexico.

2. ***Psilactis coulteri*** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 72. 1849.

Pinal, Pima, and Yuma Counties, 200 to 2,400 feet, river bottoms and roadsides, February to October. Southern Arizona, southern Nevada, southeastern California, and Sonora.

25. MONOPTILON

Dwarf hispid-hirsute winter annuals, diffusely branched; leaves linear-spatulate, small, entire, the upper ones subtending the solitary heads; rays white or rose-tinged, often drying bluish; disk yellow; involucre broad, nearly 1-seriate, the phyllaries equal, subherbaceous, scarious-margined; achenes obovate-oblong, compressed, 2-nerved; pappus of numerous unequal bristles or narrow paleae, or of a scarious cup and a single subplumose bristle.

Key to the species

1. Pappus of numerous unequal bristles, or of bristles and short narrow paleae. 1. *M. BELLIOIDES*.
 1. Pappus of a scarious cup and a single subplumose bristle. 2. *M. BELLIDIFORME*.

1. ***Monoptilon bellioides*** (A. Gray) H. M. Hall, Calif. Univ. Pub. Bot. 3: 75. 1907.

Eremiastrum bellioides A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 321. 1854.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 200 to 3,500 feet, sandy or stony mesas and slopes, February to April. Southern Utah, Arizona, southern California, and Sonora.

2. ***Monoptilon bellidiforme*** Torr. and Gray in A. Gray, Boston Soc. Nat. Hist. Proc. 1: 210. 1845.

Fort Mohave, Mohave County (*Lemmon* in 1884, mixed with *M. bellioides*), 500 feet, April. Southwestern Utah to southeastern California and western Arizona.

26. TOWNSENDIA⁶⁵

Low perennial, or rarely annual or biennial herbs; leaves spatulate to nearly linear, entire; heads medium-sized or rather large, *Aster*-like,

⁶⁵ Reference: LARSEN, E. L. A REVISION OF THE GENUS TOWNSENDIA. Mo. Bot. Gard. Ann. 14: 1-46. 1927.

with white, rosy, or violet rays and a yellow disk; involucre graduated, the phyllaries mostly lanceolate, with a narrow-colored scarious margin; achenes of the disk compressed, usually thick-margined, pubescent with 2-forked or glochidiate hairs; pappus of several or many long awns or paleae, or sometimes of few awns and several squamellae, often reduced in the ray achenes.

Key to the species

1. Plants tall, usually 25 cm. high or more, simple-stemmed; pappus in both the ray and the disk flowers of a few squamellae not longer than the proper tube of the corolla----- 1. *T. FORMOSA*.
1. Plants usually dwarf, or, if nearly 25 cm. high, then much branched; pappus, at least in the disk flowers, much longer than the proper tube of the corolla (2).
2. Plant a pulvinate-cespitose perennial, strictly acaulescent; heads comparatively large, strictly sessile among the leaves or very rarely on a bracted peduncle up to 2 cm. long, usually much surpassed by the leaves; involucre (1) 1.5 to 2 cm. high----- 2. *T. EXSCAPA*.
2. Plants with evident leafy stems when fully developed, but the stems sometimes very short; heads smaller, usually pedunculate, normally exceeding the leaves; involucre rarely more than 1 cm. high (3).
3. Plant diffusely much branched from a slender, apparently annual or at most biennial root; pappus of the ray flowers of short scales, very much shorter than that of the disk----- 3. *T. STRIGOSA*.
3. Plants pulvinate-cespitose, from a much-branched perennial caudex; pappus of the ray flowers of awns, similar to that of the disk, but sometimes only one-third as long (4).
4. Pappus of the ray flowers nearly or quite as long as that of the disk; leaves relatively broad, obovate-spatulate; stems cinereous-pubescent----- 4. *T. ARIZONICA*.
4. Pappus of the ray flowers one-third to two-thirds as long as that of the disk; leaves narrowly spatulate; stems very densely white-pubescent.----- 5. *T. INCANA*.

1. *Townsendia formosa* Greene, Leaflets 1: 213. 1906.

White Mountains (Apache and northern Greenlee Counties), 7,500 to 9,500 feet, grassy slopes and meadows, June to September. South-western New Mexico and eastern Arizona.

2. *Townsendia exscapa* (Richards.) Porter, Torrey Bot. Club Mem. 5: 321. 1894.

Aster(?) exscapus Richards., Bot. App. Frankl. Journey 748. 1823.

Townsendia wilcoriana Wood, Torrey Bot. Club Bul. 6: 163. 1877.

Townsendia intermedia Rydb. in Britton, Manual 944. 1901.

Grand Canyon, Flagstaff, and Williams (Coconino County), Fort Apache (southern Navajo County), near Prescott (Yavapai County), near Pine, and in the Sierra Ancha (Gila County), Sonoita to Patagonia (Santa Cruz County), 5,000 to 7,000 feet, open slopes and mesas, April to August. Alberta and Saskatchewan to Texas, Arizona, and Chihuahua.

3. *Townsendia strigosa* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 306. 1840.

Townsendia fendleri A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4:70. 1849.

Apache, Navajo, Coconino, Yavapai, and Graham Counties, 4,000 to 5,200 feet, dry mesas and slopes, March to September. Wyoming to New Mexico and central Arizona.

4. *Townsendia arizonica* A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 85. 1880.

Navajo, Coconino, eastern Mohave, and northern Yavapai Counties, about 5,000 feet, dry plains and mesas, May to July, type material from "Arizona at Fort Trumbull, etc." (*E. Palmer*). Southwestern Colorado, southern Utah, and northern Arizona.

5. *Townsendia incana* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 305. 1840.

Apache County to eastern Mohave and northern Yavapai Counties, 5,000 to 6,700 feet, dry sandy or stony soil, May to September. Wyoming and Utah to New Mexico and central Arizona.

This species and the preceding one probably hybridize, as intermediate specimens occur.

27. ASTER

Perennial herbs, rarely annual or biennial herbs or shrubs; leaves alternate, entire to bipinnatifid; heads medium or large, often showy, the rays white, violet, or purple, very rarely wanting, the disk yellow or rarely white, sometimes turning purple in age; involucre usually definitely graduated, the phyllaries usually with herbaceous tips; achenes hairy or glabrous; pappus of subequal capillary bristles, very rarely with a short outer series of bristles.

Many of the Arizona asters are worthy of cultivation as ornamentals, notably the Mohave aster (*A. abatus*), characterized often by silvery foliage and large heads with lavender or violet rays, a plant well adapted to dry hot situations. *A. arenosus* and *A. tanacetifolius* are used medicinally by the Hopi Indians. *A. adscendens* and *A. commutatus* are reported to absorb selenium from the soil in quantity sufficient to make them toxic to livestock. The spiny aster or Mexican-devilweed (*A. spinosus*) is sometimes a troublesome weed on canal banks and in pastures, where the soil is saline, but its creeping rootstocks make it a useful plant for controlling soil erosion.

Key to the species

1. Leaves, at least the lower ones, once or twice pinnatifid (2).
2. Heads small, the disk 5 to 7 mm. high; green tips of the phyllaries rhombic or rhombic-lanceolate, usually shorter than the whitish chartaceous base.
 16. *A. PARVULUS*.
2. Heads larger, the disk 8 to 12 mm. high; green tips of the phyllaries subulate to lance-triangular, usually equaling or exceeding the whitish chartaceous base (3).
3. Green tips of the phyllaries usually erect, triangular or lance-triangular, sometimes rhombic-lanceolate, not or scarcely narrower than the whitish base.....
3. Green tips of the phyllaries usually spreading, narrowly subulate or linear-subulate, distinctly narrower than the whitish base.
 17. *A. TAGETINUS*.
 18. *A. TANACETIFOLIUS*.
1. Leaves entire or merely toothed (4).
4. Stems low, usually 10 cm. high or less, numerous from a branched woody caudex; leaves very small, less than 1 cm. long, linear or spatulate or the upper scalelike (5).
5. Leaves all strongly hispid-ciliate and at least on the upper surface densely glandular, the lower leaves spatulate, the upper ones linear or linear-spatulate, those of the sterile branches sometimes subulate.
 8. *A. HIRTIFOLIUS*.
5. Leaves rather densely strigose or strigillose, at least the upper ones not or only inconspicuously ciliate, mostly linear or subulate.
 9. *A. ARENOSUS*.

4. Stems taller, rarely from a branched caudex; leaves (except in *A. intricatus*, *A. spinosus*, and *A. riparius*) much larger (6).
6. Upper leaves tiny, scalelike, entire; stems suffrutescent (except in *A. riparius*, this annual); plants tall (except in *A. riparius*), essentially glabrous; heads medium-sized (7).
7. Heads discoid; stems intricately branched; achenes silky.
11. *A. INTRICATUS*.
7. Heads radiate (8).
8. Rays purple; plant annual, not spiny; achenes pubescent.
10. *A. RIPARIUS*.
8. Rays white; plant perennial, often spiny; achenes glabrous.
12. *A. SPINOSUS*.
6. Upper leaves not tiny and scalelike; stems strictly herbaceous or, if somewhat woody (*A. abatus*), then the heads very large (9).
9. Leaves spiny-toothed; heads very large, about 5 cm. wide or more; involucre 1.5 to 2.5 cm. high 13. *A. ABATUS*.
9. Leaves not spiny-toothed; heads smaller; involucre much shorter (10).
10. Phyllaries glabrous on the back, sometimes ciliate on the margin (11).
11. Plants annual (12).
12. Rays exceeding the not very copious pappus; phyllaries all linear or lance-linear, acuminate, with a scarios margin; heads loosely paniced 14. *A. EXILIS*.
12. Rays shorter than the very copious and soft mature pappus; outer phyllaries narrowly oblong or linear-spatulate, obtuse or merely acutish, herbaceous; heads usually numerous and crowded 15. *A. FRONDOSUS*.
11. Plants perennial (13).
13. Rays white (14).
14. Plant hairy, not from slender running rootstocks; stem leaves nearly uniform, linear, those of the branches bracteiform; heads numerous; phyllaries with a whitish chartaceous base and an abrupt green tip 2. *A. COMMUTATUS*.
14. Plant glabrous, from slender running rootstocks; lower leaves spatulate or oblanceolate, the upper ones linear, all entire; heads solitary or few; phyllaries lanceolate or lance-linear, with a green midline (at least above) and a scarios margin 6. *A. LEMMONI*.
13. Rays violet or purple rarely (in a form of *A. foliaceus*) white (15). (The typical form of 7. *A. glaucodes* received too late to permit remaking the key, would be sought here.)
15. Plants normally tall (50 cm. high or more) and much branched; outer phyllaries linear or lance-linear.
4. *A. COERULESCENS*.
15. Plants normally low (not more than 30 cm. high) and simple or little branched; outer phyllaries narrowly spatulate to oblong-obovate (16).
16. Outer phyllaries narrowly spatulate, about 1 mm. wide; leaves normally narrow (less than 1 cm. wide), not or scarcely clasping 3. *A. ADSCENDENS*.
16. Outer phyllaries broadly oblong-spatulate or oblong-obovate, 2.5 to 5 mm. wide; leaves usually more than 1 cm. wide and definitely clasping 5. *A. FOLIACEUS*.
10. Phyllaries more or less densely glandular or pubescent on the back (17).
17. Rays white; heads usually numerous and small, not more than 1.5 cm. wide, including the rays; phyllaries several-seriate, with a whitish coriaceous base and an abrupt, usually rhombic, green tip, normally cuspidate or mucronate, never glandular.
2. *A. COMMUTATUS*.
17. Rays lavender or purple; heads usually larger; phyllaries usually glandular (18).
18. Leaves grasslike, entire, elongate-linear or the lower leaves narrowly spatulate; involucre densely stipitate-glandular (without other pubescence), the phyllaries subherbaceous throughout or the inner ones with narrow scarios margins.
1. *A. PAUCIFLORUS*.
18. Leaves not grasslike, usually toothed; phyllaries not subherbaceous throughout (19).

19. Plants perennial; involucre not conspicuously many-ranked (20).
20. Leaves not glaucous; lower leaves much larger than the upper ones and petioled; involucre pubescent dorsally, not glandular..... 3. *A. ADSCENDENS*.
20. Leaves glaucous or glaucescent; stem uniformly leafy, the leaves lanceolate to linear-oblong, sessile; involucre and at least the upper part of the stem stipitate-glandular.
7. *A. GLAUCODES*.
19. Plants annual, biennial, or rarely perennial; involucre conspicuously many-ranked, the phyllaries with a whitish chartaceous base and an abrupt, often squarrose, herbaceous tip (21).
21. Herbaceous tips of the phyllaries comparatively short, usually appressed, rhombic or narrowly triangular, much shorter than the chartaceous whitish base (22).
22. Phyllaries canescent-puberulent, with few or no glandular hairs, their green tips usually narrow-triangular.
19. *A. CANESCENS*.
22. Phyllaries conspicuously glandular, their green tips usually rhombic..... 24. *A. CICHORIACEUS*.
21. Herbaceous tips of the phyllaries comparatively long, subulate, spreading, often as long as or longer than the chartaceous whitish base (23).
23. Phyllaries densely cinereous-puberulous, scarcely or not at all glandular..... 20. *A. TEPHRODES*.
23. Phyllaries more or less densely glandular, sometimes also pubescent with eglandular hairs (24).
24. Stem densely glandular-hispid and -hispidulous, essentially without eglandular hairs.
21. *A. BIGELOVII*.
24. Stem with abundant eglandular hairs, sometimes also glandular (25).
25. Plants relatively low (40 cm. high or less); leaves (except the lowest) linear or essentially so, those of the stem 3 mm. wide or less.
22. *A. ADENOLEPIS*.
25. Plants tall (60 cm. high or more); leaves mostly lanceolate or oblong-lanceolate.
23. *A. AQUIFOLIUS*.

1. *Aster pauciflorus* Nutt., Gen. Pl. 2: 154. 1818.

Aster hydrophilus Greene ex Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 187. 1913.

San Bernardino ranch and valley of the San Pedro River (Cochise County), Santa Cruz River valley (Pima County), 2,300 to 4,000 feet, alluvial soil, May to September. Saskatchewan to Texas, New Mexico, southeastern Arizona, and Mexico.

2. *Aster commutatus* (Torr. and Gray) A. Gray, Syn. Fl. 1²: 185. 1884.

Aster multiflorus var. *commutatus* Torr. and Gray, Fl. North Amer. 2: 125. 1841.

Widely distributed in Arizona, 5,000 to 8,000 feet, mostly in the pine belt, August to October. Minnesota to British Columbia, south to Texas, New Mexico, and Arizona.

The typical form, with stems appressed-pubescent and phyllaries subequal, has been collected at Flagstaff and Mormon Lake, Coconino County (*Fulton* 6371, *Collom* 806). The var. *polycephalus* (Rydb.) Blake (*A. polycephalus* Rydb.), with stems appressed-pubescent and involucre distinctly graduated, ranges from the Hopi Indian Reservation and the Grand Canyon to the mountains of Cochise and Pima

Counties. The var. *crassulus* (Rydb.) Blake (*A. crassulus* Rydb.), with stems hispid or hirsutulous with spreading or reflexed hairs, is the commonest form in Arizona, ranging from the Kaibab Plateau and southern Navajo County to Cochise and Santa Cruz Counties.

3. *Aster adscendens* Lindl. in DC., Prodr. 5: 231. 1836.

Kaibab Plateau, San Francisco Peaks, and Flagstaff (Coconino County), 6,500 to 8,500 feet, mountain meadows and openings in coniferous forests, August and September. Saskatchewan to Washington, south to Colorado and northern Arizona.

4. *Aster coerulescens* DC., Prodr. 5: 235. 1836.

Hopi Indian Reservation and White Mountains (Apache and Navajo Counties), and throughout Coconino County, south to the mountains of Cochise and Pima Counties, 4,500 to 7,500 feet, marshy places and along streams, August to October. Wisconsin to Alberta, south to Texas, Arizona, and California.

Includes material from Arizona which has been referred to *A. hesperius* A. Gray, *A. wootonii* Greene, and *A. foliaceus* var. *canbyi* A. Gray.

5. *Aster foliaceus* Lindl. in DC., Prodr. 5: 228. 1836.

The only form known from Arizona is var. *burkei* A. Gray (*A. burkei* (A. Gray) Howell). San Francisco Peaks and Buck Springs (Coconino County), Hannigan Meadow (northern Greenlee County), 7,500 to 9,500 feet, pine forest and mountain meadows, August and September. Wyoming to British Columbia, south to New Mexico and central Arizona.

6. *Aster lemmonii* A. Gray, Syn. Fl. 1²: 199. 1884.

Chiricahua and Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), 6,000 to 7,000 feet, mossy ledges, June to September, type from the Santa Rita Mountains (*Pringle*). Known only from southeastern Arizona.

7. *Aster glaucodes* Blake, Biol. Soc. Wash. Proc. 35: 174. 1922.

Eucephalus glaucus Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 299. 1840.

Aster glaucus Torr. and Gray, Fl. North Amer. 2: 159. 1841.
Not *A. glaucus* Nees, 1818.

The typical form, with glabrous stem and involucre, has been collected in Havasu Canyon, Coconino County, 3,200 feet (*Whiting* in 1940), and ranges from Wyoming, Colorado, and Utah to northern Arizona. The var. *pulcher* Blake, with stem and involucre stipitate-glandular, occurs on the north rim of the Grand Canyon and near Sunset Crater, about 8,000 feet, September (*Eastwood* and *Howell* 7098, 6954), and is known only from southern Utah and northern Arizona.

8. *Aster hirtifolius* Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 562. 1925.

Diplopappus ericoides var. *hirtella* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 69. 1849.

Leucelene hirtella Rydb., Torrey Bot. Club Bul. 33: 153. 1906.
Not *A. hirtellus* Lindl. 1836.

Apache, Navajo, Coconino, Yavapai, Greenlee, Gila, and Pima Counties, mostly 5,000 to 7,000 feet, dry slopes and mesas, sometimes

in pine woods, April to August. Wyoming to Nevada, south to Texas and Arizona.

This and the next are perhaps only forms of one species.

9. *Aster arenosus* (Heller) Blake, Wash. Acad. Sci. Jour. 30: 471. 1940.

Aster ericaefolius var. *tenuis* A. Gray, Syn. Fl. 1²: 198. 1884.

Leucelene ericoides var. *serotina* Greene, Pittonia 3: 149. 1896.

Leucelene arenosa Heller, Cat. North Amer. Pl. ed. 1, 8. 1898.

Leucelene serotina Rydb., Torrey Bot. Club Bul. 33: 153. 1906.

Apache, Navajo, Coconino, Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,500 feet, dry mesas and slopes, often on limestone, April to October. Colorado to Texas, Arizona, and Mexico.

10. *Aster riparius* H. B. K., Nov. Gen. et Sp. 4: 92. 1820.

Aster sonorae A. Gray, Pl. Wright. 2: 76. 1853.

West of the Chiricahua Mountains (*Wright* 1163, the type of *A. sonorae*). Southeastern Arizona and Mexico.

11. *Aster intricatus* (A. Gray) Blake, Wash. Acad. Sci. Jour. 27: 378. 1937.

Linosyris (?) *carnosa* A. Gray, Pl. Wright. 2: 80. 1853.

Aster carnosus A. Gray in Hemsl., Biol. Cent. Amer. Bot. 2: 120. 1881. Not *A. carnosus* Gilib., 1781.

Bigelovia intricata A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 208. 1882.

Leucosyris carnosus Greene, Fl. Francisc. 384. 1897.

Maricopa and Pinal Counties (probably elsewhere), 1,000 to 1,300 feet, moist saline soil, May to October. Nevada to south-central Arizona and southeastern California.

12. *Aster spinosus* Benth., Pl. Hartw. 20. 1839.

Leucosyris spinosa Greene, Pittonia 3: 244. 1897.

Maricopa, Pinal, and Yuma Counties (probably elsewhere), 250 to 1,300 feet, moist saline soil, May to October. Texas to Utah, Nevada, southern Arizona, and California, south to Costa Rica.

13. *Aster abatus* Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 562. 1925.

Aplopappus tortifolius Torr. and Gray, Boston Soc. Nat. Hist. Proc. 1: 212. 1845.

Aster tortifolius A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 353. 1868. Not *A. tortifolius* Michx. 1803.

Xylorhiza tortifolia Greene, Pittonia 3: 48. 1896.

Western Coconino, Mohave, and northern Yuma Counties, 2,000 to 3,500 feet, dry rocky slopes and mesas, March to May. Utah, Nevada, western Arizona, and southeastern California.

14. *Aster exilis* Ell., Bot. S. C. and Ga. 2: 344. 1823?

Eastern Yavapai, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 1,000 to 4,000 feet, moist soil along streams and ditches, September and October. South Carolina to Florida, west to California, south to tropical America.

15. **Aster frondosus** (Nutt.) Torr. and Gray, Fl. North Amer. 2: 165. 1841.

Tripolium frondosum Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 296. 1840.

Near Betatakin and Shato, northern Navajo County (Wetherill 490, Eastwood and Howell 6588), Tuba, eastern Coconino County, 5,000 to 7,000 feet, in a marsh (Kearney and Peebles 12865), September. Wyoming to Oregon, south to northern Arizona and California.

16. **Aster parvulus** Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 563. 1925.

Machaeranthera parviflora A. Gray, Pl. Wright. 1: 90. 1852.

Aster parviflorus A. Gray, Bot. Calif. 1: 322. 1876. Not *A. parviflorus* Nees, 1818.

Eastern Coconino County (reported as common around Tuba) and Maricopa, Cochise, and Pima Counties, 1,000 to 5,000 feet, mesas and plains, February to September. Utah, New Mexico, and Arizona.

Machaeranthera pygmaea (A. Gray) Woot. and Standl. does not seem specifically distinct from *A. parvulus*.

17. **Aster tagetinus** (Greene) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 563. 1925.

Machaeranthera tagetina Greene, Pittonia 4: 71. 1899.

Northern Mohave County to Cochise and Pima Counties, 1,800 to 4,200 feet, mesas and roadsides, common, April to October, type from Arizona without definite locality (Wilcox in 1891). Utah, New Mexico, and Arizona.

18. **Aster tanacetifolius** H. B. K., Nov. Gen. et Sp. 4: 95. 1820.

Machaeranthera tanacetifolia Nees, Gen. et Sp. Aster. 225. 1832.

Machaeranthera parthenium Greene, Pittonia 4: 99. 1899.

Northern Navajo County to Yavapai, Cochise, Santa Cruz, and Pima Counties, 1,200 to 6,000 (rarely 8,000) feet, roadsides and waste ground, June to October, type of *M. parthenium* from Davidson Canyon, Empire Mountains, eastern Pima County (Pringle in 1884). South Dakota to Alberta, south to Texas, Arizona, and Mexico.

19. **Aster canescens** Pursh, Fl. Amer. Sept. 547. 1814.

Machaeranthera canescens A. Gray, Pl. Wright. 1: 89. 1852.

Machaeranthera orylepis Greene, Pittonia 4: 25. 1899.

Machaeranthera verna A. Nels., Bot. Gaz. 37: 267. 1904.

Machaeranthera scoparia Greene, Leaflets 2: 227. 1912.

Northeastern Apache and northern Coconino Counties to Pima and Yuma Counties, 140 to 8,000 feet, dry soil in open pine forests, chaparral, and roadsides, common, August to November, type of *M. orylepis* from Apache Pass, Cochise County (Lemmon in 1881), type of *M. verna* from Big Bend, Virgin River, Mohave County (Goodling 757), type of *M. scoparia* from Turkey Tanks, Coconino County, 6,200 feet (Jardine and Hill in 1911). Colorado to British Columbia, south to Arizona and California.

20. *Aster tephrodes* (A. Gray) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 563. 1925.

Dieteria asteroides Torr. in Emory, Mil. Recon. 141. 1848.
Not *Aster asteroides* MacMillan, 1892.

Aster canescens var. *tephrodes* A. Gray, Syn. Fl. 1²: 206. 1884.

Machaeranthera asteroides Greene, Pittonia 3: 63. 1896.

Machaeranthera tephrodes Greene, Pittonia 4: 24. 1899.

Near Kingman (Mohave County) and southern Yavapai County, south to Graham, Cochise, Pima, and Yuma Counties, 140 to 5,500 feet, mostly in alluvial soil, March to October. New Mexico to Nevada and southern California.

21. *Aster bigelovii* A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 97. 1857.

Machaeranthera bigelovii Greene, Pittonia 3: 63. 1896.

Northern Mohave County and Graham, Gila, Pinal, and Pima Counties, 3,000 to 6,000 feet, canyons and slopes, March to October. Colorado, New Mexico, and Arizona.

This and the similar *A. tephrodes* are very showy and handsome. The plants are browsed freely.

22. *Aster adenolepis* Blake, Wash. Acad. Sci. Jour. 30: 471. 1940.

Machaeranthera mucronata Greene, Pittonia 4: 72. 1899. Not *Aster mucronatus* Sheldon, 1903.

Kaibab Plateau and north rim of the Grand Canyon (Coconino County), 8,000 to 8,500 feet, perhaps also on the south rim, 7,000 feet, August and September, type from Thompson Canyon (*Jones* 6056bl). Known only from northern Arizona.

23. *Aster aquifolius* (Greene) Blake, Wash. Acad. Sci. Jour. 30: 471. 1940.

Machaeranthera aquifolia Greene ex Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 188. 1913.

White Mountains (northern Greenlee County), Cameron to the Grand Canyon (Coconino County), near Ash Fork (Yavapai County), Hualpai Mountain (Mohave County), Mazatzal Mountains (Gila County), 3,200 to 9,500 feet, May to October. New Mexico and Arizona.

24. *Aster cichoriaceus* (Greene) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 563. 1925.

Machaeranthera rigida Greene, Pittonia 4: 25. 1899. Not *Aster rigidus* L., 1753.

Machaeranthera cichoriacea Greene, Leaflets 1: 148. 1905.

?*Machaeranthera hansonii* A. Nels., Wyo. Univ. Pub. Bot. 1: 134. 1926.

Apache, Navajo, and eastern Coconino Counties, 5,500 to 7,500 feet, dry slopes and mesas, June to October, type of *M. rigida* from Keam Canyon, Navajo County (*Zuck*), type of *M. hansonii* from "Mount Ellen" (Elden Mountain?), near Flagstaff, 7,500 feet (*Hanson* 814). Colorado, New Mexico, Utah, and Arizona.

28. ERIGERON. FLEABANE, WILD-DAISY

Herbs; leaves alternate, sometimes all basal, usually narrow, entire to pinnatifid; heads small or medium-sized, radiate or rarely discoid, the rays white, pink, or purple, the disk yellow; involucre usually only slightly or not at all graduated, the phyllaries not herbaceous-tipped, but sometimes subherbaceous throughout; achenes usually 2-nerved, sometimes 4- to 10-nerved; pappus usually sparse, of subequal capillary bristles, sometimes with an outer series of short squamellae or bristles; appendages of the style short, triangular, obtuse or rounded.

Many of the species have attractive daisylike heads, with blue, lavender, or white rays. An oil distilled from horseweed, *E. canadensis*, was formerly prescribed for diarrhea and dysentery. This plant is reported to cause irritation of the throat and dermatitis in susceptible persons. When eaten by livestock, it may cause colic, but in Arizona the species is not sufficiently abundant to be a serious pest.

Key to the species

1. Rays very short and inconspicuous, not or only slightly exceeding the pappus rarely wanting (2).
2. Plants perennial, dwarf, rarely more than 15 cm. high, often scapose, the scapes or stems 1- or few-headed (3).
 3. Lower leaves spatulate, ciliate, essentially glabrous on the faces; plant loosely pilose..... 1. *E. SIMPLEX*.
 3. Lower leaves narrowly linear-spatulate, hispid like the whole plant.
 9. *E. CONCINNUS*.
2. Plants annual, normally 30 cm. high or more, leafy-stemmed, several- or many-headed (4).
 4. Plant gray-tomentose, without stiff or glandular hairs; stem sparsely branched above, the branches nearly naked; lower leaves oblanceolate, toothed..... 27. *E. ERIOPHYLLUS*.
 4. Plant green, with stiff or glandular hairs or both (5).
 5. Plant loosely arachnoid-pilose, also glandular, especially on the leaves and heads; leaves lanceolate or oblong-lanceolate, sessile and somewhat clasping, few-toothed; heads medium-sized, about 6 mm. high, numerous, in a narrow leafy racemiform or spikelike panicle.
 28. *E. SCHIEDEANUS*.
 5. Plant hispid, hirsute, or strigose, not glandular; leaves not clasping; heads otherwise (6).
 6. Heads relatively large (6 to 8 mm. thick); involucre densely hirsutulous; plant relatively low (usually 40 cm. high or less), grayish green, densely hispid and hispidulous..... 29. *E. LINIFOLIUS*.
 6. Heads tiny (about 2 to 4 mm. thick, about 4 mm. high), usually very numerous, in an elongate panicle; involucre essentially glabrous or sparsely hispidulous; plant usually tall (1 m. or more), green, rather sparsely hispid to essentially glabrous (7).
 7. Phyllaries not with colored tips; plant usually hispid.
 30. *E. CANADENSIS*.
 7. Phyllaries with definite purplish tips; plant glabrous or practically so..... 31. *E. PUSILLUS*.
 1. Rays present and conspicuous, much exceeding the pappus (8).
 8. Stem leaves all deeply pinnatifid, with several pairs of linear lobes; plants perennial, normally 30 to 50 cm. high, leafy throughout; rays white or pinkish (9).
 9. Stem hispid or hirsute but not glandular-puberulous.
 25. *E. NEOMEXICANUS*.
 9. Stem glandular-puberulous as well as hispid or hirsute. 26. *E. OREOPHILUS*.
 8. Stem leaves entire or, if rarely pinnatifid, then the plant either low, or not leafy throughout, or annual or biennial (10).

10. Plants comparatively coarse, large-leaved, and large-headed; stems usually more than 30 cm. high; disk of the head more than 1 cm. wide; middle stem leaves usually more than 5 mm. wide (11).
11. Stem very leafy to the inflorescence, the upper leaves not much reduced; heads usually several, the peduncles not elongate (12).
12. Stem glabrous or sometimes sparsely pilose above, not glandular.
2. *E. MACRANTHUS*.
12. Stem densely and finely glandular-puberulent, at least above, often also spreading-hirsute (13).
13. Stem usually rather densely spreading-hirsute as well as glandular-puberulent; stem leaves usually densely ciliate. 3. *E. PATENS*.
13. Stem densely and finely glandular-puberulent, at least above the middle, essentially without long hairs; stem leaves not or only very sparsely ciliate..... 4. *E. SUPERBUS*.
11. Stem more or less naked above, the upper leaves strongly reduced; heads mostly 1 to 3, on comparatively long, mostly naked peduncles (14).
14. Rays violet or purple..... 8. *E. PECOSENSIS*.
14. Rays white or pink (15).
15. Plant very sparsely hairy or nearly glabrous (16).
16. Stem leaves not ciliate; stem densely and finely glandular-puberulent above, with very few long hairs or none.
4. *E. SUPERBUS*.
16. Stem leaves ciliate; stem near the apex (the peduncle) spreading-pilose, essentially without glandular hairs... 5. *E. KUSCHEI*.
15. Plant rather densely hairy (17).
17. Plant green, the pubescence usually appressed, at least on the upper part of the stem; pappus nearly simple, the outer series inconspicuous..... 6. *E. RUSBYI*.
17. Plant cinereous-pilose with spreading hairs; pappus distinctly double, the outer series setulose-squamulose.
7. *E. ARIZONICUS*.
10. Plants comparatively slender, small-leaved, and small-headed; stems usually less than 30 cm. high; disk of the head less than 1 cm. wide; middle stem leaves less than 5 mm. wide (18).
18. Leaves twice ternately divided into linear or spatulate lobes; plant essentially scapose, dwarf, 10 cm. high or less... 11. *E. COMPOSITUS*.
18. Leaves entire or rarely toothed, lobed, or pinnatifid, never ternately divided; stems usually leafy (19).
19. Stem pubescent with wide-spreading or sometimes deflexed hairs (20).
20. Stems diffuse; leaves (some of them, particularly on the sterile branches) often pinnatifid, with 1 to 3 pairs of lobes; peduncles short (usually 2.5 cm. long or less); leaves small, 2 cm. long or less, the entire ones spatulate to linear... 19. *E. LEMMONI*.
20. Stems (at least the first flowering stem) erect or suberect; leaves entire or sometimes toothed or pinnatifid (regularly so in *E. lobatus*, very rarely in *E. divergens* and *E. nudiflorus*), usually longer (21).
21. Plant scapose, dwarf, not more than 10 cm. high; leaves all basal, spatulate, ciliate, otherwise essentially glabrous; plant high-montane..... 1. *E. SIMPLEX*.
21. Plants leafy-stemmed, normally taller; leaves pubescent on the faces (22).
22. Flowering stems at first scapiform, eventually producing long, spreading, leafy, usually sterile branches from the lower axils..... 21. *E. NUDIFLORUS*.
22. Flowering stems usually leafy from the start, not producing long spreading leafy sterile branches from the lower axils (23).
23. Leaves (the lower and usually also the middle leaves) obovate in outline, pinnatifid with (3) 5 to 7 lobes; stem glandular-puberulous, at least above, as well as rather sparsely spreading-pilose.... 24. *E. LOBATUS*.

23. Leaves linear to narrowly oblanceolate, entire or, if a few of the lowest ones rarely few-toothed, then the stems not at all glandular-puberulous (24).
24. Plant definitely perennial; herbage hispid or coarsely hirsute.....9. *E. CONCINNUS*.
24. Plant annual or biennial; herbage puberulous or pilosulous. 23. *E. DIVERGENS*.
19. Stem pubescent with appressed or incurved hairs, rarely nearly or quite glabrous (25).
25. Plant (the first flowering stems) scapiform, eventually producing long spreading small-leaved usually sterile runners from the base or the lower axils.....20. *E. FLAGELLARIS*.
25. Plant without long spreading runners (26).
26. Leaves densely cinereous- or canescent-strigose, sometimes (in *E. utahensis*) only sparsely so (27).
27. Stems scapiform, naked except toward the base, 8 cm. high or lower, 1-headed; plant densely caespitose, often forming large mats; achenes 2-nerved, compressed, pilose-ciliate on the margin, glabrous on the sides.... 16. *E. COMPACTUS*.
27. Stems leafy at least to above the middle (28).
28. Achenes essentially glabrous, subterete, 8- to 10-nerved; plant 12 to 20 cm. high..... 14. *E. CANUS*.
28. Achenes pubescent, subquadrangular, 4-nerved; plant usually 30 cm. high or more..... 15. *E. UTAHENSIS*.
26. Leaves not densely strigose, but sometimes cinereous-pubescent with incurved hairs (29).
29. Stems glabrous, striate-angled, tall (about 60 cm. high), simple below the cymose heads; leaves linear or narrowly linear-oblanceolate, callous-pointed, hispidulous-ciliate, otherwise nearly glabrous..... 18. *E. OXYPHYLLUS*.
29. Stems more or less densely pubescent, or else the plants low, not more than 25 cm. high, and the stems 1-headed (30).
30. Plant annual, single-stemmed; stem rather densely incurved-puberulous..... 22. *E. BELLIDIASTRUM*.
30. Plants perennial, more or less densely caespitose (31).
31. Involucre glabrous; basal leaves linear-spatulate to obovate, some of them usually 3-toothed to pinnatifid, the stem leaves much narrower, linear, entire. 12. *E. PRINGLEI*.
31. Involucre more or less glandular (sometimes very minutely so) and often also pilose or hirsute; leaves all entire (32).
32. Plant entirely glabrous except for the very finely glandular involucre and apex of the peduncles; leaves 1-nerved..... 10. *E. PERGLABER*.
32. Plant more or less strigose-pubescent on the stems and leaves; lowest leaves usually 3-nerved (33).
33. Rays purple; basal leaves essentially glabrous except on the margin; peduncles glandular and spreading-pilose toward the apex.... 13. *E. URSINUS*.
33. Rays white or purplish-tinged; basal leaves strigose on the faces; peduncles strigose.. 17. *E. EATONI*.

1. *Erigeron simplex* Greene, Fl. Francisc. 387. 1897.

Alpine meadows, San Francisco Peaks, 12,000 feet (*Little* 4656, 4709, 4733, 4777), August and September. Montana to northern New Mexico, northern Arizona, and California.

Some of the material from Arizona is rayless or essentially so, but this feature is not constant even in the same colony.

2. *Erigeron macranthus* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 310. 1840.

Carrizo Mountains and Ryan Ranch (Apache County), near Flagstaff (Coconino County), about 7,000 feet, oak thickets, etc., July to

October. Alberta and British Columbia, south to New Mexico and Arizona.

3. *Erigeron patens* Greene, Leaflets 2: 194. 1912.

Erigeron foliosissimus Greene, Leaflets 2: 194. 1912.

Erigeron rudis Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 184. 1913.

San Francisco Peaks and vicinity (Coconino County), Hualpai Mountain (Mohave County), White Mountains (southern Apache County), south to the Pinaleno, Pinal, Chiricahua, Huachuca, and Rincon Mountains (Graham, Gila, Cochise, and Pima Counties), 4,000 to 8,800 feet, rich soil in coniferous forests, July to October, type of *E. patens* from Strawberry Valley, Gila County (*MacDougal* in 1891), type of *E. foliosissimus* from near Fort Huachuca (*Wilcox* 460). New Mexico and Arizona.

4. *Erigeron superbus* Greene ex Rydb., Fl. Colo. 361, 364. 1900.

Erigeron eldensis Greene, Leaflets 2: 196. 1912.

Erigeron apiculatus Greene, Leaflets 2: 217. 1912.

North rim of the Grand Canyon, San Francisco Peaks, and Bill Williams Mountain (Coconino County), Pinaleno Mountains (Graham County), 8,000 to 10,500 feet, coniferous forests, July to September, type of *E. eldensis* from Elden Mountain, Coconino County (*Leiberg* 5837), type of *E. apiculatus* from Mount Graham (*Rothrock* 736). Wyoming to Utah, New Mexico, and Arizona.

5. *Erigeron kuschei* Eastw., Calif. Acad. Sci. Proc. ser. 5, 20: 158. 1931.

Known only from Cave Creek, Chiricahua Mountains, Cochise County, 6,000 to 8,000 feet (*Kusche* in 1927, the type collection).

6. *Erigeron rusbyi* A. Gray, Syn. Fl. 1²: 217. 1884.

Pinaleno Mountains (Graham County), Chiricahua and Huachuca Mountains (Cochise County), Santa Catalina Mountains (Pima County), 7,000 to 10,500 feet, coniferous forests, July to October. New Mexico and southeastern Arizona.

Both *Erigeron rusbyi* and *E. kuschei* are perhaps only less pubescent forms of *E. arizonicus*. *E. kuschei*, except for its ciliate leaves, is also strongly suggestive of a dwarf form of *E. superbus*.

7. *Erigeron arizonicus* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 2. 1883.

Erigeron huachucanus Greene, Leaflets 2: 197. 1912.

Known only from the Huachuca Mountains (Cochise County), where the type of *E. arizonicus* was collected in Tanner Canyon (*Lemmon* 2751), and the type of *E. huachucanus* near Fort Huachuca (*Wilcox* 482).

8. *Erigeron pecosensis* Standl., Muhlenbergia 5: 29. 1909.

Erigeron gubielmi Greene, Leaflets 2: 195. 1912.

Erigeron subasper Greene, Leaflets 2: 195. 1912.

Erigeron scaberulus Greene, Leaflets 2: 212. 1912.

Throughout Coconino County, White Mountains (southern Apache and Navajo and northern Greenlee Counties), Pine (northwestern

Gila County), 5,500 to 10,500 feet, coniferous forests, July to September, type of *E. guilelmi* from Bill Williams Mountain (*Palmer* in 1869), type of *E. subasper* from the San Francisco Peaks (*Purpus* 8084), type of *E. scaberulus* from the White Mountains (*Griffiths* 5353). New Mexico and Arizona.

The pubescence of the involucre is extremely variable in this species. The type sheets of both *E. guilelmi* and *E. subasper* bear specimens essentially identical in other characters, of which some are densely hirsute or hirsutulous on the involucre, others densely glandular with very few or no long hairs; and the type sheet of *E. pecosensis* shows a similar but less extreme amount of variation. The species is one of the complex *E. glabellus* group, and a revisionary study might discover an earlier name for it.

9. *Erigeron concinnus* (Hook. and Arn.) Torr. and Gray, Fl. North Amer. 2: 174. 1841.

Distasis (?) *concinna* Hook. and Arn., Bot. Beechey Voy. 350. 1840.

Northern Apache County to northern and eastern Mohave County and northern Yavapai County, 4,000 to 8,000 feet, dry sandy or stony mesas and slopes, with pine and juniper, April to October. Montana to British Columbia, south to New Mexico, Arizona, and California.

The var. *aphanaectis* A. Gray, with rayless heads, has been collected in Apache County, at the north end of the Carrizo Mountains (*Standley* 7465) and near Rock Point (*Peebles* and *Smith* 13536). The var. *condensatus* D. C. Eaton, a dwarf subscapose form, occurs in Navajo County.

10. *Erigeron perglaber* Blake, Wash. Acad. Sci. Jour. 30: 471. 1940.

Known only from a collection from Arizona, without definite locality (*Palmer* in 1869).

The plant has the appearance of *Erigeron concinnus*, but is glabrous.

11. *Erigeron compositus* Pursh, Fl. Amer. Sept. 535. 1814.

The Arizona form is var. *multifidus* (Rydb.) Macbr. and Payson (*E. multifidus* Rydb.). San Francisco Peaks, Coconino County, 11,500 feet (*Little* 4750). Greenland to Alaska, south to Colorado, northern Arizona, and California.

12. *Erigeron pringlei* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 210. 1882.

Oak Creek Canyon (Coconino County), Natural Bridge, Pine, Sierra Ancha, Mazatzal Mountains (Gila County), Santa Rita Mountains (Pima County), 5,000 to 9,000 feet, ledges of cliffs and rock crevices in canyons, May to July, type from Mount Wrightson, Pima County (*Pringle* in 1881). Known only from central and southern Arizona.

13. *Erigeron ursinus* D. C. Eaton in King, Geol. Expl. 40th Par. 5: 148. 1871.

Kaibab Plateau, Coconino County, 8,500 to 9,000 feet (*Cottam* 2675, *Collom* in 1940). Montana and Idaho to Colorado, Utah, northern Arizona, and California.

14. **Erigeron canus** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 67. 1849.

Defiance Plateau (Apache County), Keam Canyon (Navajo County), Kaibab Plateau and vicinity of Flagstaff (Coconino County), 6,600 to 7,500 feet, mesas and open pine forest, June and July. South Dakota and Wyoming to Nebraska, New Mexico, and northern Arizona.

15. **Erigeron utahensis** A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 89. 1880.

Erigeron stenophyllus var. (?) *tetrapleurus* A. Gray, *ibid.* 8: 650. 1873.

Erigeron sparsifolius Eastw., Calif. Acad. Sci. Proc. ser. 2, 6: 297. 1896.

Carrizo Mountains (Apache County), Kayenta (Navajo County), Kaibab Plateau and Grand Canyon (Coconino County), 3,000 to 7,000 feet, dry rocky slopes, June to October. Southern Utah and northern Arizona.

16. **Erigeron compactus** Blake, Biol. Soc. Wash. Proc. 35: 78. 1922.

Erigeron pulvinatus Rydb., Fl. Rocky Mount. 911. 1917.
Not *E. pulvinatus* Wedd., 1857.

Northern Apache County (*Peebles* and *Smith* 13467, *Turner* in 1935), El Capitan and southeast of Kayenta, northern Navajo County (*Peebles* and *Fulton* 11921, 11971), 5,600 to 6,200 feet, barren rocky slopes and mesas, May and June. Utah, Nevada, and northeastern Arizona.

Plant forming compact mounds about 0.3 m. in diameter, attractive in flower, the rays pink.

17. **Erigeron eatoni** A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 91. 1880.

Betatakin Canyon (Navajo County), Navajo Mountain and rim of the Grand Canyon (Coconino County), 7,000 to 8,000 feet, rocky slopes, June. Wyoming to Oregon, northern Arizona, and California.

18. **Erigeron oxyphyllus** Greene, *Erythea* 3: 20. 1895.

Black Mountains and near Yucca (Mohave County), Sierra Estrella (Maricopa County), Picacho Mountain (Pinal County), 2,000 to 3,000 feet, dry rocky slopes, March to May, type from Yucca (*Jones* in 1884). Known only from western and southwestern Arizona.

Stems wandlike, many from a woody crown, the dead stems long-persistent.

19. **Erigeron lemmoni** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 2. 1883.

Fish Creek Canyon, eastern Maricopa County (*Peebles* 7953), Huachuca Mountains, Cochise County (*Lemmon* in 1882), near Tucson, Pima County (*Lemmon* in 1883), 1,600 (to 6,000?) feet, cliffs, May to September, type from Tanner Canyon, Huachuca Mountains (*Lemmon*). Known only from southern Arizona.

20. *Erigeron flagellaris* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 68. 1849.

Erigeron macdougalii Heller, Torrey Bot. Club Bul. 26: 591. 1899.

Erigeron tonsus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 186. 1913.

Northern Apache, Navajo, and Coconino Counties to the mountains of Cochise and Pima Counties, 5,000 to 9,500 feet, open coniferous forests and mountain parks, May to September, type of *E. macdougalii* from San Francisco Peaks (*MacDougal* 390). South Dakota and Wyoming to Texas, New Mexico, and southern Arizona.

Occasional specimens (such as *Wilcox* 44, *Pebbles* et al. 2642, *Chamberlain* 45) are suggestive of hybridism between this species and *E. nudiflorus*, combining the habit of one of these species with the pubescence of the other.

21. *Erigeron nudiflorus* Buckl., Acad. Nat. Sci. Phila. Proc. 1861: 456. 1862.

Erigeron commixtus Greene, Pittonia 5: 58. 1902.

Apache County to Mohave County, south to Santa Cruz and Pima Counties, 4,000 to 7,000 feet, rocky slopes, mesas, and canyons, common, March to July. Colorado and Utah to Texas, New Mexico, Arizona, and northern Mexico.

22. *Erigeron bellidiastrum* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 307. 1840.

Erigeron eastwoodiae Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 183. 1913.

Known for Arizona only by a collection in the Carrizo Mountains, Apache County (*Standley* 7433, the type of *E. eastwoodiae*). South Dakota to Nevada, Texas, and northeastern Arizona.

23. *Erigeron divergens* Torr. and Gray, Fl. North Amer. 2: 175. 1841.

? *Erigeron accedens* Greene, Pittonia 4: 155. 1900.

Erigeron wootoni Rydb., Torrey Bot. Club Bul. 33: 153. 1906.

Erigeron gracillimus Greene, Leaflets 2: 212. 1912.

Erigeron furcatus Greene, Leaflets 2: 213. 1912.

Throughout the State, 1,000 to 9,000 feet, dry rocky slopes and mesas and open pine woods, very common, February to October, type of *E. accedens* (not examined) from Clifton, Greenlee County (*Davidson* in 1899), type of *E. gracillimus* from Coconino National Forest (*Jardine* and *Hill* in 1911), type of *E. furcatus* from Kendrick Peak, Coconino County (*Knowlton* 45). South Dakota to British Columbia, south to Texas, New Mexico, Arizona, California, and northern Mexico.

24. *Erigeron lobatus* A. Nels., Amer. Jour. Bot. 21: 580. 1934.

Mohave, southern Gila, Maricopa, Pinal, Pima, and Yuma Counties, 1,500 to 3,000 feet, plains, mesas, and rocky slopes, March to May,

type from Canyon Lake, Maricopa County (A. Nelson 11209). Known only from southern and western Arizona.

25. *Erigeron neomexicanus* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 2. 1883.

Near Flagstaff (Coconino County) to the mountains of Cochise, Santa Cruz, and Pima Counties, 5,000 to 9,000 feet, with oaks or pines, August to October. New Mexico and Arizona.

Several specimens from the Chiricahua, Patagonia, and Santa Rita Mountains (*Blumer* 1352, *Eggleston* 10830, 10882, 10887, *Kearney* and *Peebles* 10072, 10564, *Griffiths* 6027) have the pubescence mostly appressed to ascending (not wide-spreading as in the typical form) and thus approach *E. delphinifolius* Willd. of Mexico, but in all of them the hairs toward the base of the stem are spreading, and they appear to represent a phase of *E. neomexicanus* rather than *E. delphinifolius*, which has not been recognized in the United States.

26. *Erigeron oreophilus* Greenm., Amer. Acad. Arts and Sci. Proc. 41: 257. 1905.

San Francisco Peaks and Flagstaff (Coconino County), Hualpai Mountain (Mohave County), and mountains of southern Yavapai, Graham, Gila, Pinal, Cochise, and Pima Counties, 4,500 to 9,000 feet, oak chaparral and open pine forests, July to October. Arizona and northern Mexico.

27. *Erigeron eriophyllus* A. Gray, Pl. Wright. 2: 77. 1853.

On the Sonoita, southwestern Cochise County (*Wright*, the type collection), near Ruby, Santa Cruz County, 4,300 feet (*Kearney* and *Peebles* 13783, 14914), with live oaks and grasses, September. Apparently known only from these 3 collections in southeastern Arizona.

28. *Erigeron schiedeanus* Less., Linnaea 5: 145. 1830.

Conyza subdecurrens DC., Prodr. 5: 379. 1836.

Erigeron subdecurrens A. Gray in Torr., U. S. and Mex. Bound. Bot. 78. 1859.

Kaibab Plateau and San Francisco Peaks (Coconino County), Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), Rincon and Santa Catalina Mountains (Pima County), 7,500 to 9,000 feet, open pine forests, August and September. Southwestern Colorado, New Mexico, Arizona, and Mexico.

29. *Erigeron linifolius* Willd., Sp. Pl. 3: 1955. 1804.

Agua Fria River bottom near Avondale, Maricopa County, 1,000 feet (*Peebles* et al. 2462). Southeastern United States, southern Arizona, and California; a common weed in the warmer parts of the Eastern and Western Hemispheres.

Erigeron lonchophyllus Hook., mainly a northern species but known also from New Mexico, Utah, Nevada, and southern California, is represented in the United States National Herbarium by specimens labeled as from northern Arizona (*P. F. Mohr* in 1874). It seems inadvisable to include the species formally in the flora of Arizona until specimens with more definite data become available.

30. *Erigeron canadensis* L., Sp. Pl. 863. 1753.

Leptilon canadense Britton in Britt. and Brown, Illus. Fl. 3: 391. 1898.

Throughout most of the State except the extreme western portion, 1,200 to 7,000 feet, waste land and cultivated fields, July to October.

Widely distributed in North America and South America, naturalized in the Old World.

Horseweed, a coarse unsightly plant. The form occurring in Arizona is much less pubescent than the common eastern form. The name var. *glabratus* A. Gray applies to it, but it scarcely appears to merit varietal distinction.

31. *Erigeron pusillus* Nutt., Gen. Pl. 2: 148. 1818.

Superior to Miami, Gila County, 4,800 feet (*Gillespie* 8634), October. Massachusetts to Florida, west to Arizona and southward into tropical America.

29. CONYZA

Herbs, similar to some species of *Erigeron* in habit, distinguished only by having the corollas of the outer (pistillate) flowers of the head tubular-filiform, not ligulate.

Key to the species

1. Leaves merely toothed to coarsely pinnatifid; achenes hispidulous (sometimes also glandular), not puncticulate..... 1. *C. COULTERI*.
 1. Leaves once or twice pinnately parted into mostly linear lobes; achenes glabrous, puncticulate in lines..... 2. *C. SOPHIAEFOLIA*.

1. *Conyza coulteri* A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 355. 1868.

Eschenbachia coulteri Rydb., Torrey Bot. Club Bul. 33: 154. 1906.

Kaibab Plateau (Coconino County) to Cochise and Pima Counties, 1,400 to 8,000 feet, fields, plains, and river bottoms, April to October. Colorado and Texas to California and Mexico.

Closely similar in appearance to *Erigeron schiedeanus* Less. and often confused with it. In *C. coulteri* the corollas of the pistillate flowers are tubular-filiform, without a ligule, and the achenes are only 0.5 to 0.8 mm. long. In *E. schiedeanus* the pistillate flowers possess small but definite ligules, and the achenes are 1 to 1.4 mm. long.

2. *Conyza sophiaefolia* H. B. K., Nov. Gen. et Sp. 4: 72. 1820.

Conyza coulteri var. *tenuisecta* A. Gray, Syn. Fl. 1²: 221. 1884.

Eschenbachia tenuisecta Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 186. 1913.

Chiricahua and Huachuca Mountains (Cochise County), Patagonia Mountains (Santa Cruz County), 4,000 to 6,000 feet, dry hills and plains, August to October, type of *C. coulteri* var. *tenuisecta* from near Fort Huachuca (*Lemmon* 2753). Southwestern New Mexico, southeastern Arizona, and Mexico.

30. BACCHARIS

Diocious shrubs, rarely only suffrutescent at base; leaves alternate, entire to toothed; heads usually numerous and paniced, discoid, whitish; involucre graduated, of chartaceous whitish phyllaries; pistillate heads composed entirely of tubular-filiform pistillate flowers; staminate heads composed entirely of hermaphrodite flowers, with tubular 5-toothed corollas, infertile; achenes small, 5- to 10-ribbed;

pappus in the pistillate flowers of copious capillary bristles, in the staminate flowers of scabrous, often twisted, clavellate bristles.

Most of the species are browsed at times, but their palatability is generally low and some of them (*B. pteronioides*, *B. sarthroides*) are reputed poisonous to livestock. The widely distributed and very common seepwillow (*B. glutinosa*) is recommended for erosion control, along water courses, because of its deep, widespreading root system and its tendency to form thickets. It is stated to be readily propagated by cuttings.

Key to the species

1. Plants low (usually 60 cm. high or less), woody only at base; leaves all small (mostly less than 1 cm. long), narrow, entire (2).
2. Plant glabrous; involucre 6 to 10 mm. high; pistillate pappus deep brown or purplish brown..... 1. *B. WRIGHTII*.
2. Plant densely hispidulous or hirtellous; involucre 6 mm. high or less; pistillate pappus merely brownish-tinged..... 2. *B. BRACHYPHYLLA*.
1. Plants either much taller, or definitely woody-stemmed, or the leaves conspicuously toothed (3).
3. Heads solitary at the tips of very short leafy branchlets, these racemously arranged along the branches; larger leaves mostly obovate and sharply toothed, those of the flowering branchlets minute and entire.
 3. *B. PTERONIOIDES*.
3. Heads otherwise arranged (4).
4. Broomlike shrubs, with numerous, erect, strongly sulcate-angled branches; leaves usually essentially absent at flowering time, if present, then mostly obovate or spatulate and usually entire (5).
5. Pistillate pappus very short, 3 to 4 mm. long, scarcely or not surpassing the styles; receptacle often rounded or elevated, usually bearing some pales between the flowers, at least in the pistillate head; staminate heads 2.5 to 4 mm. high..... 4. *B. SERGILOIDES*.
5. Pistillate pappus elongate in fruit (10 mm. long or more), much surpassing the styles; receptacle flattish, deeply alveolate but not bearing pales; staminate heads 3.5 to 7 mm. high... 5. *B. SARTHROIDES*.
4. Plants not broomlike (or sometimes somewhat so in *B. emoryi*); leaves normally present at flowering time, usually toothed (6).
6. Pistillate pappus in fruit elongate, surpassing the styles by 3 mm. or more (7).
7. Larger leaves cuneate-oblongate or oblong-oblongate, 3 to 18 mm. wide, distinctly 3-nerved; involucre 4 to 8 mm. high.
 6. *B. EMORYI*.
7. Larger leaves mostly linear or narrowly oblongate, 3 to 8 mm. wide, usually 1-nerved; involucre 3 to 4 mm. high.
 7. *B. NEGLECTA*.
6. Pistillate pappus in fruit not elongate, scarcely or not surpassing the styles (8).
8. Leaves narrowly linear or linear-lanceolate, 1.5 to 8 mm. wide, usually closely, evenly, and sharply spinulose-serrulate.
 8. *B. THESIOIDES*.
8. Leaves from lanceolate or elliptic to cuneate-obovate, entire or rather coarsely or unevenly toothed, the teeth not spinulose (9).
9. Leaves cuneate-oblong to oblong-oblongate, rather coarsely and unequally toothed, 1.5 to 3.5 cm. long, 4 to 15 mm. wide.
 9. *B. BIGELOVII*.
9. Leaves mostly lanceolate or elliptic-lanceolate, 5 to 15 cm. long, entire or evenly toothed (10).
10. Heads in a cymose panicle terminating the stem; leaves usually toothed..... 10. *B. GLUTINOSA*.
10. Heads in small cymose panicles terminating numerous short lateral branches as well as the main stem; leaves mostly entire..... 11. *B. VIMINEA*.

1. *Baccharis wrightii* A. Gray, Pl. Wright. 1: 101. 1852.

Apache, Navajo, Coconino, and northern Yavapai Counties, 5,000 to 6,200 feet, May to July. Kansas and western Texas to Arizona and Durango.

2. *Baccharis brachyphylla* A. Gray, Pl. Wright. 2: 83. 1853.

Mohave, Yavapai, Maricopa, Cochise, and Pima Counties, 2,500 to 3,500 feet, May to September. Arizona, southern California, and Sonora.

3. *Baccharis pteronioides* DC., Prodr. 5: 410. 1836.

Aplopappus ramulosus DC., *ibid.* p. 350.

Baccharis ramulosa A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 301. 1854.

Yavapai, Graham, Gila, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,600 feet, April to September. Western Texas, southern New Mexico, and Arizona, south to Puebla.

Yerba-de-pasmo. Although the name *ramulosa* has page priority, the name *pteronioides* was chosen by Gray⁶⁶ when the two specific names were first combined and must be used under the International Rules.

4. *Baccharis sergiloides* A. Gray in Torr., U. S. and Mex. Bound. Bot. 83. 1859.

Grand Canyon (Coconino County) to southern Mohave, Yavapai, and Maricopa Counties, 3,200 to 5,000 feet, flowering nearly throughout the year, the type collected by Emory's expedition along the Gila or Colorado River, probably in Arizona. Utah, Arizona, southeastern California, and Sonora.

5. *Baccharis sarothroides* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 211. 1882.

Baccharis arizonica Eastw., Calif. Acad. Sci. Proc. ser. 4, 20: 155. 1931.

Yavapai, Gila, Maricopa, Pinal, Santa Cruz, and Pima Counties, 1,000 to 4,000 feet, hillsides and bottom lands, sometimes in saline soil, September to February, types of *B. arizonica* from Packard, Gila County (*Eastwood* 15832, 15833). Southwestern New Mexico to southern California, northern Mexico, and Baja California.

Broom baccharis, rosinbrush.

6. *Baccharis emoryi* A. Gray in Torr., U. S. and Mex. Bound. Bot. 83. 1859.

Grand Canyon (Coconino County), Pierce Ferry (Mohave County), and in Pinal, Pima, and Yuma Counties, 500 to 4,000 feet, mostly along streams, September to November, the type collected by Emory's expedition along the Gila River in 1846. Texas to southern California and southern Utah, reported also to occur in northern Mexico.

Emory baccharis. Plants up to 2 m. high.

⁶⁶ GRAY, ASA. NOVITIAE ARIZONICAE, ETC. Amer. Acad. Arts and Sci. Proc. 17: 199-220. 1882. (See p. 212.)

7. *Baccharis neglecta* Britton in Britt. and Brown, Illus. Fl. 3: 394. 1898.

Known in Arizona only by a collection in the Huachuca Mountains, Cochise County (*Lemmon* in 1882). Nebraska to Texas, and Arizona to northern Mexico.

The only Arizona specimen examined, from Cave Canyon, Huachuca Mountains (*Lemmon* in 1882), is somewhat dubious, having the leaves considerably broader than normal but having the small pistillate heads of *B. neglecta*. Gray⁶⁷ referred this collection to *B. angustifolia* Michx. of which *B. neglecta* is a segregate.

8. *Baccharis thesioides* H. B. K., Nov. Gen. et Sp. 4: 61. 1820.

Mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, August and September. Southwestern New Mexico and southern Arizona, south to central Mexico.

Plants up to 2 m. high.

9. *Baccharis bigelovii* A. Gray in Torr., U. S. and Mex. Bound. Bot. 84. 1859.

Chiricahua and Mule Mountains (Cochise County), 5,000 to 6,000 feet, September. Southwestern Texas, southeastern Arizona, and northern Mexico.

10. *Baccharis glutinosa* Pers., Syn. Pl. 2: 425. 1807.

Grand Canyon (Coconino County), to Cochise, Santa Cruz, Pima, and Yuma Counties, up to 5,700 feet, but usually lower, very common along watercourses, often forming thickets, March to December. Colorado and Texas to California and Mexico; South America.

Seepwillow, also known as waterwillow, waterwally, and water-motie. Plants up to at least 2.2 m. high.

11. *Baccharis viminea* DC., Prodr. 5: 400. 1836.

Willow Springs Mountains (*Griffiths* 3647), near the mouth of the Gila River, Yuma County (*Monnet* 1057), spring and late summer. Southwestern Utah and western Arizona to California.

31. PLUCHEA. MARSH-FLEABANE

Herbs or shrubs; leaves alternate; heads small, disciform, in terminal cymes or panicles, the corollas purplish; involucre graduated, the bracts chartaceous to subscarios; receptacle naked; outer flowers pistillate, with a tubular-filiform corolla, the inner hermaphrodite; achenes small, 4- or 5-ribbed; pappus of capillary bristles; anthers caudate at base.

The rank-smelling arrowweed (*P. sericea*) forms dense thickets in stream beds and in moist saline soil at relatively low elevations. It is browsed by deer and sometimes by cattle and horses. The straight stems are used by the Pima Indians in constructing the roofs and walls of primitive huts, for making baskets, and, formerly, for arrow shafts. An infusion of the herbage was used as a remedy for sore eyes. The flowers are reported to be an important source of honey in Arizona.

⁶⁷ GRAY, ASA. SYNOPTICAL FLORA OF NORTH AMERICA 1²: 1884. (See p. 222.)

Key to the species

1. Green, glandular-pubescent annual; leaves mostly oblong or ovate, toothed; pappus bristles not dilated at tip----- 1. *P. CAMPHORATA*.
 1. Silky-pubescent shrub; leaves linear to lanceolate, entire; pappus bristles dilated at tip, especially in the hermaphrodite flowers--- 2. *P. SERICEA*.

1. **Pluchea camphorata** (L.) DC., Prodr. 5: 452. 1836.

Erigeron camphoratum L., Sp. Pl. ed. 2. 1212. 1763.

Bill Williams Mountain, Coconino County (*Palmer* in 1869), near Phoenix, Maricopa County (*Harrison* and *Kearney* 220), locally abundant along the Gila River, Pinal County, in alluvial soil, September and October. Maine to Texas, Nevada, and California, south to Mexico.

Saltmarsh-fleabane. The plant has a strong, camphorlike odor. The specific name *P. camphorata* is here used in the sense of Gray's Manual, ed. 7.⁶⁸

2. **Pluchea sericea** (Nutt.) Coville, Contrib. U. S. Natl. Herbarium 4: 128. 1893.

Polypappus sericeus Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 178. 1848.

Tessaria borealis Torr. and Gray ex A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 75. 1849.

Berthelotia sericea Rydb., Torrey Bot. Club Bul. 33: 154. 1906.

Almost throughout the State, up to 3,000 feet (seldom higher), very abundant along streams, sometimes in saline soil, flowering chiefly in spring. Texas to Utah, southern California, and northern Mexico.

32. STYLOCLINE

Low woolly annuals; leaves alternate, linear or spatulate-linear, entire; heads small, clustered, heterogamous, disciform; outer flowers pistillate, with filiform corollas, each subtended by a pale, the 4 or 5 inner flowers hermaphrodite and infertile; pales of the pistillate flowers boat-shaped, tipped with a hyaline appendage, completely inclosing the achenes and deciduous with them; pales subtending the hermaphrodite flowers flattish; pappus none in the fertile flowers, a few bristles in the hermaphrodite flowers.

Key to the species

1. Bracts enclosing the pistillate flowers with a narrow, only moderately woolly body, this broadly hyaline-winged throughout its length.
 1. *S. GNAPHALIOIDES*.
 1. Bracts enclosing the pistillate flowers with a broader, densely long-woolly body produced only at apex into an ovate hyaline appendage.
 2. *S. MICROPOIDES*.

1. **Stylocline gnaphalioides** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 338. 1840.

Stylocline arizonica Coville, Biol. Soc. Wash. Proc. 7: 79. 1892.

Fort Mohave (Mohave County) and at several localities in Maricopa County, 500 to 1,500 feet, February to May, type of *S. arizonica* from Verde Mesa (*Smart* in 1867). California to Baja California and Arizona.

⁶⁸ GRAY, ASA. NEW MANUAL OF BOTANY (ed. 7). 1908. (See p. 819.)

2. Stylocline micropoides A. Gray, Pl. Wright. 2: 84. 1853.

Northwestern Mohave County, and Maricopa, Pinal, Santa Cruz, and Pima Counties, 500 to 4,000 feet, March to May. New Mexico and Utah to southern California.

33. EVAX

Low, diffusely branched, white-woolly annual; leaves alternate, small, oblanceolate or spatulate, entire; heads small, disciform, clustered in bracted globose terminal glomerules; outer flowers pistillate, the inner (2 to 5) flowers hermaphrodite, infertile, all subtended by flattish pales; pappus none.

1. Evax multicaulis DC., Prodr. 5: 459. 1836.

Filago nivea Small, Torrey Bot. Club Bul. 24: 333. 1897.

Maricopa, Pinal, and Pima Counties, 1,500 to 2,500 feet, March to May. Texas and Oklahoma to southern Arizona and northern Mexico.

34. FILAGO

Low, whitish-woolly annuals; leaves alternate, narrow, entire; heads small, glomerate, disciform; outer flowers pistillate, the outermost of these subtended by boat-shaped open pales, epappose, the others usually without pales and with a pappus of capillary bristles; innermost flowers (2 to 5) hermaphrodite, usually without pales, pappose.

Key to the species

1. Plant diffuse, with very slender naked internodes, the leaves practically wanting except for those subtending and conspicuously surpassing the heads; flowers within the inner circle of pales mostly 4 or 5, all hermaphrodite.
 1. *F. ARIZONICA*.
1. Plants erect or diffuse, the stems normally leafy at least below, the leaves subtending the heads only rarely surpassing the latter; flowers within the inner circle of pales about 12 to 20, only about 2 to 4 of them hermaphrodite (2).
 2. Plant diffuse or merely ascending; achenes all smooth; outer bracts with a hyaline appendage about as long as the body----- 2. *F. DEPRESSA*.
 2. Plant normally erect; inner achenes papillose; outer bracts with a hyaline appendage about half as long as the body or less---- 3. *F. CALIFORNICA*.
- 1. Filago arizonica** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 652. 1873.

Maricopa, Pinal, Pima, and Yuma Counties, 1,000 to 2,500 feet, March and April, type from Verde Mesa (*Smart* in 1867). Southern Arizona to southern California and northern Baja California.

2. Filago depressa A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 3. 1883.

Maricopa, Pinal, and Pima Counties, 2,000 to 3,500 feet, March and April. Southern Arizona to southern California.

3. Filago californica Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 405. 1841.

Oglifa californica Rydb., Fl. Rocky Mount. 914. 1917.

Fort Mohave (Mohave County), and southern Apache, Gila, Maricopa, Pinal, and Pima Counties, 500 to 7,000 feet, March to May. Southern Arizona to Utah and California.

35. ANTENNARIA. PUSSYTOES

Dioecious, dwarf, tomentose, stoloniferous, perennial herbs, rarely suffruticulose; leaves mostly in a basal rosette, small, entire, obovate or spatulate, those of the stem reduced; heads rather small, discoid, strictly staminate or pistillate; involucre strongly graduated, of scarious phyllaries; pistillate corollas filiform; hermaphrodite (functionally staminate) corollas tubular, 5-toothed, whitish; achenes small; pappus of the pistillate flowers of copious capillary bristles, united at base and deciduous in a ring; pappus of the staminate flowers of more or less clavellate and slightly flattened bristles.

In many species of this genus parthenogenetic reproduction is the rule, and staminate plants are very rare; they are common, however, in *A. rosulata* and *A. marginata*.

Key to the species

1. Heads sessile or subsessile among the leaves of the basal rosettes, solitary or 2 or 3 together..... 1. *A. ROSULATA*.
1. Heads capitate or closely cymose at the tips of erect stems, these normally 5 cm. high or more (2).
2. Leaves soon glabrate and green above; inflorescence finely stipitate-glandular..... 2. *A. MARGINATA*.
2. Leaves persistently tomentose above; inflorescence not glandular (3).
3. Pistillate heads 8 to 10 mm. high or more; basal leaves usually 5 to 9 mm. wide..... 3. *A. APRICA*.
3. Pistillate heads less than 8 mm. high; basal leaves usually 4 mm. wide or less (4).
4. Phyllaries blackish green or fuscous toward the base, or nearly throughout..... 4. *A. UMBRINELLA*.
4. Phyllaries greenish or light brown at base, otherwise white..... 5. *A. ARIDA*.

1. *Antennaria rosulata* Rydb., Torrey Bot. Club Bul. 24: 300. 1897.

Rim of the Grand Canyon, San Francisco Peaks, Flagstaff (Coconino County), mostly 5,500 to 8,000 feet, May and June. Colorado, Utah, and Arizona.

2. *Antennaria marginata* Greene, Pittonia 3: 290. 1898.

Antennaria recurva Greene, Pittonia 3: 290. 1898.

Antennaria marginata var. *glandulifera* A. Nels., Wyo. Univ. Pub. Bot. 1: 134. 1926.

White Mountains (Apache County) and Coconino County to the mountains of Cochise and Pima Counties, 5,000 to 9,000 feet, rocky slopes and ridges, April to July, type of *A. recurva* from Flagstaff (*MaeDougal* in 1891), type of *A. marginata* var. *glandulifera* from Schultz Pass, near Flagstaff (*Hanson* 635). Colorado, Utah, and Arizona.

The type of *Antennaria recurva*, which is very immature, is one of the occasional specimens of this species in which the leaves remain tomentose above.

3. *Antennaria aprica* Greene, Pittonia 3: 282. 1898.

Coconino, Yavapai, Graham, Gila, and Pima Counties, from the Kaibab Plateau to the southern mountains, 5,000 to 9,000 feet, May to August. Manitoba to British Columbia, south to New Mexico and central Arizona.

4. *Antennaria umbrinella* Rydb., Torrey Bot. Club Bul. 24: 302. 1897.

San Francisco Peaks, Coconino County (*Little* 4637 (?), 4708, 4718). Montana to British Columbia, south to Colorado and Arizona.

5. *Antennaria arida* E. Nels., Bot. Gaz. 27: 210. 1899.

San Francisco Peaks, Coconino County (*Purpus* in 1902, *Hitchcock* in 1915). Montana to New Mexico and northern Arizona.

36. ANAPHALIS. PEARL-EVERLASTING

Erect perennial herb, usually 30 cm. high or more, tomentose, at least on the stem and the lower leaf surface; leaves alternate, linear or linear-oblong, entire, slightly or not at all decurrent; heads in close cymose panicles, discoid or disciform, subdioecious, the pistillate ones usually with a few central hermaphrodite flowers; involucre strongly graduated, of milk-white papery-scarious phyllaries, radiating when dry; achenes short; pappus of capillary bristles, these not united at base.

1. *Anaphalis margaritacea* (L.) A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 653. 1873.

Gnaphalium margaritaceum L., Sp. Pl. 850. 1753.

The Arizona form of this variable species is nearest var. *subalpina* Gray, although not typical. "Buckskin Mountains," Kaibab Plateau, Coconino County (*Jones* 6056 k), "northern Arizona" (*Mrs. E. P. Thompson* 383), flowering late summer and autumn. South Dakota to British Columbia, south to Utah and northern Arizona.

37. GNAPHALIUM. CUDWEED, EVERLASTING

Low herbs, more or less woolly; leaves alternate, narrow, entire; heads small, usually numerous, sometimes glomerate, disciform, all the flowers fertile; involucre graduated, of numerous scarious phyllaries; outer flowers numerous, pistillate, the inner ones hermaphrodite; receptacle naked; pappus of capillary bristles.

Key to the species

1. Pappus bristles united at base and deciduous in a ring; heads spicately; phyllary tips normally deep purple or brownish----- 9. *G. PURPUREUM*.
1. Pappus bristles not united at base, falling separately or in groups (2).
 2. Heads very small, clustered and imbedded in wool, the clusters leafy-bracted; involucre scarcely graduated, the scarious tips of the phyllaries relatively inconspicuous; low annuals, seldom more than 20 cm. high (3).
 3. Plant thinly but rather closely woolly; leaves linear-spatulate or linear, 1 to 3 mm. wide; inflorescence (when well developed) spiciform.
 7. *G. GRAYI*.
 3. Plant loosely floccose-woolly; leaves spatulate to oblong or obovate, 3 to 8 mm. wide; heads clustered at the tips of the stem and branches, not spicately arranged----- 8. *G. PALUSTRE*.
2. Heads medium-sized, not leafy-bracted; involucre strongly graduated, the phyllaries conspicuously scarious nearly throughout; plants usually 30 cm. high or more (4).
 4. Leaves gray-tomentose above as well as beneath, sometimes (in *G. arizonicum*) only thinly so (5).
 5. Leaves not at all or only obsoletely decurrent; phyllary tips white or slightly tinged with straw color, mostly obtuse-- 1. *G. WRIGHTII*.

5. Leaves definitely decurrent, or at least with broad adnate auricles (6).
6. Phyllaries straw color or distinctly yellowish, very obtuse; heads campanulate-subglobose, about 150- to 225-flowered.

2. *G. CHILENSE.*

6. Phyllary tips brownish (sometimes purplish-tinged), acute or acuminate; heads slender, about 31- to 47-flowered. 3. *G. ARIZONICUM.*

4. Leaves bright green and strongly glandular-pubescent above, whitish-tomentose beneath, all decurrent (7).

7. Phyllary tips pearly white, papery, not shining; stem densely whitish-tomentose. 4. *G. LEUCOCEPHALUM.*

7. Phyllary tips straw color or whitish, thin-scarious, shining; stem glandular-pilose, with or without a thin gray tomentum (8).

8. Heads campanulate-subglobose, 5 to 6 mm. high, about 130- to 150-flowered; phyllary tips straw color to pale brownish.

5. *G. MACOUNII.*

8. Heads subcylindric, 4 mm. high, 30- to 35-flowered; phyllary tips whitish. 6. *G. PRINGLEI.*

1. *Gnaphalium wrightii* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 214. 1882.

Gnaphalium viridulum I. M. Johnston, Gray Herbarium Contrib. 70: 86. 1924.

Grand Canyon (Coconino County) to Cochise, Santa Cruz, and Pima Counties, 3,500 to 7,000 feet, dry rocky slopes, August to October. Western Texas to southern California and northern Mexico.

2. *Gnaphalium chilense* Spreng., Syst. Veg. 3: 480. 1826.

Chuska Mountains (Apache County) and Pierce Spring (Mohave County) to Cochise and Santa Cruz Counties, 1,200 to 5,500 feet, along streams, May to October. Montana to Washington, south to Texas, southern Arizona, and California.

3. *Gnaphalium arizonicum* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 3. 1883.

Mogollon Escarpment (Coconino County), Rincon and Santa Catalina Mountains (Pima County), 6,000 to 7,500 feet, pine forests. August to October, type from near Fort Huachuca (*Lemmon*). Arizona and northern Mexico.

4. *Gnaphalium leucocephalum* A. Gray, Pl. Wright. 2: 99. 1853.

Eastern Maricopa County, Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,000 feet, sandy beds of streams, etc., July to September. Southern Arizona, southern California, and Sonora.

Plant with an odor of lemon-verbena, the stems sometimes 50 or more from 1 root.

5. *Gnaphalium macounii* Greene, Ottawa Nat. 15: 278. 1902.

Gnaphalium decurrens Ives, Amer. Jour. Sci. 1: 381. 1819.
Not *G. decurrens* L., 1759.

White Mountains (Apache County), Kaibab Plateau (Coconino County), and Hualpai Mountain (Mohave County) to the mountains of Cochise and Pima Counties, 5,600 to 10,000 feet, open coniferous forests, July to October. Canada south to West Virginia, Texas, southern Arizona, and northern California.

6. **Gnaphalium pringlei** A. Gray, Amer. Acad. Arts and Sci. Proc. 21: 387. 1886.

Mazatzal Mountains (Gila County) and mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, canyons, August to October. Southern Arizona and Chihuahua.

Not previously recorded from the United States.

7. **Gnaphalium grayi** Nels. and Macbr., Bot. Gaz. 61: 46. 1916.

Gnaphalium strictum A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 110. 1857. Not *G. strictum* Lam., 1788.

White Mountains (Apache and Greenlee Counties), Kaibab Plateau, San Francisco Peaks (Coconino County), 6,000 to 9,500 feet, mountain meadows, August and September. Wyoming to New Mexico and Arizona.

8. **Gnaphalium palustre** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 403. 1841.

Coconino, Yavapai, Gila, Maricopa, Pinal, and Pima Counties, 1,200 to 5,000 feet, moist soil, April to October. Alberta and British Columbia to New Mexico, southern Arizona, and California.

9. **Gnaphalium purpureum** L., Sp. Pl. 854. 1753.

Rincon, Santa Catalina, and Baboquivari Mountains (Pima County), 2,800 to 7,500 feet, March to May. Maine to Kansas and southern Arizona, also British Columbia to California.

38. LAGASCEA⁶⁹

Pubescent shrub about 1 m. high; leaves opposite, ovate, petioled, acuminate; heads 1-flowered, small, crowded at the tips of the branches in dense glomerules, these subtended by a few herbaceous bracts; involucre of the individual heads tubular, gamophyllous, 5- or 6-toothed; corolla tubular, yellow; achene columnar; pappus a short crown.

1. **Lagascea decipiens** Hemsl., Diagn. Pl. Mex. 33. 1879.

Nocca decipiens Kuntze, Rev. Gen. Pl. 1: 354. 1891 (as *Noccaea*).

Calhounia nelsonae A. Nels., Wyo. Univ. Pub. Bot. 1: 55. 1924.

Oro Blanco Mountains (Santa Cruz County), Baboquivari Mountains (Pima County), about 4,000 feet, canyons, December to May, type of *Calhounia nelsonae* from the Baboquivari Mountains (*Hanson* 1023). Southern Arizona and Mexico.

39. GUARDIOLA⁷⁰

Branching perennial, up to 1 m. high, glabrous, somewhat glaucous; leaves opposite, roundish-ovate, obtuse, toothed, subcordate, very short-petioled; heads rather small, in terminal cymose clusters, radiate, the corollas white, the anthers green; involucre cylindrical, of

⁶⁹ Reference: ROBINSON, B. L. SYNOPSIS OF THE GENUS NOCCA. Amer. Acad. Arts and Sci. Proc. 36 (Gray Herbarium Contrib. 20): 467-471. 1901.

⁷⁰ Reference: ROBINSON, B. L. REVISION OF THE GENUS GUARDIOLA. Torrey Bot. Club Bul. 26: 232-235. 1899.

few, thin, equal phyllaries; rays 1 to 5, fertile; disk flowers hermaphrodite, sterile; receptacle paleaceous; achenes oblong, epappose.

1. *Guardiola platyphylla* A. Gray, Pl. Wright. 2: 91. 1853.

Huachuca Mountains (Cochise County) to the Santa Catalina and Baboquivari Mountains (Pima County), also Slate Creek (western Gila County), 2,800 to 4,500 feet, canyons, February to September. Southern Arizona and northern Mexico.

A specimen in the U. S. National Herbarium, labeled as collected near Holbrook, Navajo County, by Myrtle Zuck, probably came from the vicinity of Tucson.

40. MELAMPODIUM ⁷¹

Low herbs; leaves opposite, entire to pinnatifid; heads small or medium-sized, radiate; outer phyllaries 4 or 5, herbaceous; inner phyllaries of the same number as the rays, completely enclosing the ray achenes like a coat and falling with them; rays white or yellow, pistillate, fertile; disk flowers hermaphrodite, sterile; receptacle paleaceous; achenes obovate-oblong; pappus none.

Key to the species

1. Rays white, often purplish-veined, conspicuous, 6 to 15 mm. long; plant perennial; heads 10 to 30 mm. wide, on peduncles usually 2 to 10 cm. long----- 1. *M. LEUCANTHUM*.
1. Rays yellow, inconspicuous, usually not more than 2 mm. long; plants annual; heads only 2 to 6 mm. wide, usually sessile or subsessile (2).
2. Fruit with a raised hood at apex, this usually prolonged into a recurved, dorsally pilosulous beak up to 2 mm. long----- 2. *M. LONGICORNE*.
2. Fruit (achene with the tightly enwrapping inner phyllary) not hooded or beaked at apex----- 3. *M. HISPIDUM*.

1. *Melampodium leucanthum* Torr. and Gray, Fl. North Amer. 2: 271 1842.

Fort Apache (southern Navajo County), to Kingman (Mohave County), south to Cochise and Pima Counties, 2,000 to 5,000 feet, common on dry rocky slopes and mesas, often on limestone, March to October. Kansas to Texas, southern Arizona, and Chihuahua.

A showy and attractive plant.

2. *Melampodium longicorne* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 321. 1854.

Mountains of Cochise and Santa Cruz Counties, 4,000 to 5,500 feet, canyons, often on limestone, August and September. Southeastern Arizona and northern Mexico.

3. *Melampodium hispidum* H. B. K., Nov. Gen. et Sp. 4: 273. 1820.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,000 feet, August and September. Southern Arizona and Mexico.

41. BERLANDIERA

Perennial herb, finely canescent-tomentulose; leaves alternate, lyrate-pinnatifid or merely crenate; heads rather large, radiate, yellow, solitary, long-peduncled; involucre broad, about 3-seriate, the phyl-

⁷¹ Reference: ROBINSON, B. L. SYNOPSIS OF THE GENUS MELAMPODIUM. Amer. Acad. Arts and Sci. Proc. 36 (Gray Herbarium Contrib. 20): 455-466. 1901.

laries broad; rays fertile; disk flowers sterile; receptacle paleaceous; ray achenes strongly flattened, epappose, adnate at base to the subtending phyllary and the spatulate pales of the 2 opposed sterile flowers, the whole falling together.

1. *Berlandiera lyrata* Benth., Pl. Hartw. 17. 1839.

Cochise, Santa Cruz, and eastern Pima Counties, 4,000 to 5,000 feet, plains and mesas, May to September. Kansas and Arkansas to Texas, southeastern Arizona, and northern Mexico.

The var. *macrophylla* A. Gray (*B. macrophylla* M. E. Jones), of which the type was collected in southern Arizona by Lemmon, is occasional in Cochise County. It differs from typical *B. lyrata* in having merely crenate, instead of lyrate-pinnatifid leaves. The flower heads of *B. lyrata* are reported to have been used by the Indians as seasoning in foods.

42. ENGELMANNIA

Perennial herb, rough-pubescent; leaves alternate, deeply pinnatifid; heads medium-sized, yellow, radiate, slender-peduncled; involucre graduated; rays fertile; disk flowers hermaphrodite but sterile; receptacle paleaceous; ray achenes strongly flattened, each adnate at base to the subtending phyllary and the pales of the opposed outer disk flowers, the whole falling away together; pappus in the ray flowers of an unequally lobed or toothed crown, in the disk flowers reduced.

***1. *Engelmannia pinnatifida* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 343. 1840.**

Kansas to Louisiana, west to Colorado and New Mexico, south to northern Mexico (reported from Arizona), dry hills and prairies, May to September.

43. PARTHENIUM

Low, branching, gray-tomentulose shrub; leaves alternate, pinnatifid, with blunt roundish lobes; heads small, white, cymose-panicled; rays fertile, very small; disk flowers sterile; achenes small, flattened, surrounded by a narrow callous margin, this adnate at base to the pales of the 2 opposed disk flowers and the subtending phyllary, at length tearing away from the achene below but remaining attached at apex.

1. *Parthenium incanum* H. B. K., Nov. Gen. et Sp. 4: 260. 1820.

Grand Canyon (Coconino County), Montezuma Well (Yavapai County), and Cochise and Pima Counties, 3,000 to 6,000 feet, dry plains and mesas, usually in "caliche" soil, June to October. Western Texas to Arizona and Mexico.

Mariola. A small shrub, common in the Lower Sonoran zone in the Grand Canyon (*V. Bailey*), and in southeastern Arizona. The plant is rarely browsed. It contains rubber like that of guayule (*Parthenium argentatum* A. Gray), but in smaller amount. Guayule, which may be distinguished by its narrowly lanceolate leaves, these entire or lacinate-toothed or lobed with acuminate lobes, and finely silvery-pubescent on both sides, has been cultivated in Arizona as a source of rubber.

44. PARTHENICE

Branching, cinereous-puberulent annual; leaves alternate, ovate, long-petioled, toothed; heads disciform, numerous, panicled, greenish

white; outer flowers pistillate, their corollas tubular, the ligule obsolete; disk flowers hermaphrodite, sterile; achenes dorso-ventrally flattened, apiculate, falling away at maturity with the pales of the opposed disk flowers.

1. *Parthenice mollis* A. Gray, Pl. Wright. 2: 85. 1853.

Patagonia Mountains (Santa Cruz County), Santa Rita and Baboquivari Mountains (Pima County), 3,500 to 4,500 feet, foothills and canyons, August and September. Southern Arizona and north-western Mexico, also reported from Colorado and New Mexico.

Stems up to 2 m. high.

45. IVA. MARSH-ELDER

Herbs; leaves alternate or opposite, toothed to dissected; heads small, greenish, paniced, disciform; involucre double, the outer phyllaries 5, broad, herbaceous the inner ones also 5, membranous or scarious; outer flowers 5, pistillate, fertile, their corollas vestigial, the inner flowers hermaphrodite, sterile; achenes obovate, thickened, eppose.

Key to the species

1. Leaves 2- to 3-pinnatifid, pubescent but not canescent beneath; stem pubescent throughout; heads loosely paniced, on slender peduncles up to 1 cm. long.----- 1. *I. AMBROSIAEFOLIA*.
1. Leaves sharply and unequally serrate, canescent beneath at least when young; stem essentially glabrous below; heads sessile or subsessile, spicate-paniced----- 2. *I. XANTHIFOLIA*.

1. *Iva ambrosiaefolia* A. Gray, Syn. Fl. North Amer. 1²: 246. 1884.

Euphrosyne ambrosiaefolia A. Gray, Pl. Wright. 1: 102. 1852.

Cyclachaena ambrosiaefolia Benth. and Hook. ex Rydb., North Amer. Fl. 33: 10. 1922.

Pinal, Cochise, and Pima Counties, 1,200 to 5,500 feet, mostly along streams, May to October. Western Texas to southern Arizona and northern Mexico.

2. *Iva xanthifolia* Nutt., Gen. Pl. 2: 185. 1818.

Cyclachaena xanthifolia Fresen., "Index Sem. Hort. Francof. 4. 1836."

Near Ganado, Apache County (*Griffiths* 5820), Keam Canyon, Navajo County (*Whiting* 854), 6,000 to 6,500 feet, along streams and in waste ground, July to October. Saskatchewan to Alberta and Washington, south to Nebraska, New Mexico, and northern Arizona, introduced eastward.

Contact with the plant induces dermatitis in some persons, and the pollen is a cause of hay fever.

Iva axillaris Pursh was collected in October, 1941, near Black Falls, Coconino County (*Whiting* 1089). The plant is a low perennial, with small entire leaves and heads solitary in the upper axils, forming leafy racemes.

46. OXYTENIA

Shrubby, slender-stemmed; leaves alternate, pinnately parted into 3 or 5 long filiform lobes, or the upper ones entire; heads numerous, disciform, small, whitish, in dense panicles; outer flowers about 5,

pistillate, their corollas vestigial; inner flowers hermaphrodite, sterile; achenes obovoid, long-villous.

1. *Oxytenia acerosa* Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 172. 1848.

Holbrook and Kayenta (Navajo County), Grand Canyon (Coconino County), 3,300 to 5,800 feet, often on saline soil, July to September. Southwestern Colorado and New Mexico to Nevada and southeastern California.

A large, often leafless shrub with rushlike branches. Considered by stockmen to be poisonous to cattle and sheep but seldom eaten.

47. DICORIA

Much-branched annual herbs, cinereous-strigose or -strigillose; leaves mostly alternate, ovate or suborbicular to lanceolate, toothed or entire; heads small, very numerous, paniced, heterogamous and disciform, or some of them unisexual and staminate; outer phyllaries about 5, small, herbaceous, the inner ones (subtending the 1 or 2 pistillate flowers) subscarious, accrescent, much surpassing the outer phyllaries at maturity; achenes dorso-ventrally flattened, oblong, black, with a narrow or broad, toothed or pectinate, crustaceous, whitish wing; pappus none or vestigial.

Key to the species

1. Mature achenes (solitary) surpassing the subtending phyllary; leaves linear-lanceolate to lance-oblong; wing of the achene pectinately divided into toothed lobes..... 1. *D. BRANDEGEL*.
1. Mature achenes (1 or 2) shorter than the subtending phyllaries; upper leaves elliptic to suborbicular, rarely oblong; wing of the achene merely toothed to pectinately divided..... 2. *D. CANESCENS*.

1. *Dicoria brandegei* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 76. 1876.

Navajo and eastern Coconino Counties, doubtless also in Apache County, about 5,000 feet, sandy soil, June to September. Southwestern Colorado, southern Utah, and northeastern Arizona.

It is stated that the Indians of northeastern Arizona used the flowers and seeds as food.

2. *Dicoria canescens* A. Gray in Torr., U. S. and Mex. Bound. Bot. 87. 1859.

Maricopa, Pinal, and Yuma Counties, doubtless elsewhere, up to 2,700 feet, sandy beds of streams and washes, June to November. Southwestern Utah, Arizona, southeastern California, and Sonora.

Specimens from near Tuba, Coconino County (*Kearney* and *Peebles* 12854), with oblong upper leaves and a comparatively narrow wing to the achene, agree with *Dicoria oblongifolia* Rydb. It is not clear, however, that *D. oblongifolia* is specifically distinct from *D. canescens*.

48. HYMENOCLEA. BURROBRUSH

Low, much-branched shrubs, monoecious or subdioecious; leaves alternate, linear-filiform and entire, or pinnately parted into a few linear-filiform lobes; heads small, those of both sexes usually intermixed in the same leaf axils; pistillate involucre fusiform, beaked,

indurate, 1-flowered, with 5 to 12 transverse scarious wings near the middle, completely enclosing the achene; staminate heads with a flattish 4- to 6-lobed involucre.

Characteristic and abundant shrubs of sandy stream beds and washes, tending to form thickets. Their forage value is small. The conspicuously winged fruiting involucre make these plants rather attractive.

Key to the species

1. Wings of the fruiting involucre spirally arranged, 5 to 8 mm. wide.
 1. *H. SALSOLA*.
1. Wings of the fruiting involucre in a single whorl (rarely with 1 or 2 additional wings above or below the middle), 1 to 4 mm. wide (2).
 2. Wings 5 to 7, flabellate or reniform-orbicular, 2.5 to 4 mm. wide.
 2. *H. PENTALEPIS*.
 2. Wings 7 to 12, mostly cuneate or obovate, 1 to 2 mm. wide.
 3. *H. MONOGYRA*.

1. ***Hymenoclea salsola*** Torr. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 79. 1849.

Mohave County to Pima and Yuma Counties, 4,000 feet or usually lower, sandy washes and rocky slopes, sometimes in saline soil, March and April. Southern Utah, Arizona, and southern California.

2. ***Hymenoclea pentalepis*** Rydb., North Amer. Fl. 33: 14. 1922.

Hymenoclea hemidioica A. Nels., Amer. Jour. Bot. 25: 117. 1938.

Topock (Mohave County), and Graham, Maricopa, Pima, and Yuma Counties, 2,700 feet or lower, February to April, type of *H. hemidioica* from the Mohawk Mountains, Yuma County (A. and R. Nelson 1340, 1341). Western and southern Arizona, southeastern California, and adjacent Mexico.

3. ***Hymenoclea monogyra*** Torr. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 79. 1849.

Gila, Pinal, Santa Cruz, and Pima Counties, 2,000 to 4,000 feet, usually in sandy soil, September. Western Texas to southern California and northern Mexico.

49. AMBROSIA. RAGWEED

Weedy monoecious herbs; leaves opposite or alternate, lobed or dissected; pistillate heads mostly axillary, 1-flowered, their involucre more or less turbinate, short-beaked, indurate, armed with a few tubercles in a single series around the middle, completely enclosing the achene; staminate heads naked-racemose above the pistillate ones, terminating the stem and branches.

Ragweed pollen is one of the commonest causes of hay fever.

Key to the species

1. Leaves large, palmately 3- to 5-lobed with serrate lobes, rarely ovate, not lobed, and merely serrate; fruiting involucre 4 to 7 mm. long. 1. *A. APTERA*.
1. Leaves smaller, pinnatifid or bipinnatifid; fruiting involucre 3 to 3.8 mm. long (2).
 2. Perennial, with a running rootstock; leaves thickish, mostly only once pinnatifid. 2. *A. PSILOSTACHYA*.
 2. Annual; leaves thin, the lower ones usually twice pinnatifid. 3. *A. ARTEMISIFOLIA*.

1. *Ambrosia aptera* DC., Prodr. 5: 527. 1836.

Ryan Ranch (southern Apache County), Rice (Gila County), Graham, Cochise, Santa Cruz, and Pima Counties, 2,300 to 5,000 feet, roadsides and bottom lands, July to October. Illinois to Colorado, south to Texas, Arizona, and northern Mexico.

2. *Ambrosia psilostachya* DC., Prodr. 5: 526. 1836.

Ambrosia coronopifolia Torr. and Gray, Fl. North Amer. 2: 291. 1842.

White Mountains (Apache County), Flagstaff (Coconino County), Prescott (Yavapai County), south to Cochise and Pima Counties, 3,200 to 7,000 feet, along streams and at roadsides, July to October. Illinois to Saskatchewan and Washington, south to northern Mexico.

3. *Ambrosia artemisiifolia* L., Sp. Pl. 988. 1753.

Ambrosia elatior L., Sp. Pl. 987. 1753.

Sierra Ancha, Gila County, about 6,000 feet, in a meadow (*Harrison* and *Kearney* 8317). A common weed nearly throughout the United States and southern Canada.

50. FRANSERIA. BUR-SAGE

Plants with the characters of *Ambrosia* but with the pistillate involucre armed with spines or prickles in more than 1 series, and 1- to 4-flowered.

Key to the species

1. Plants herbaceous (2).
 2. Fruit (mature pistillate involucre) 2 to 4 mm. long, obovoid, armed with about 10 to 20 hooked spines, these 0.8 mm. long or less.
 1. *F. CONFERTIFLORA*.
 2. Fruit usually 4 to 8 mm. long, the spines longer, rarely hooked (3).
 3. Leaves ovate or deltoid in outline, once to thrice pinnatifid, green or merely slightly paler beneath; fruit 4 to 8 mm. long, 1-beaked, armed with 6 to 30 strongly flattened straight spreading spines, these 2 to 5 mm. long; annual.----- 2. *F. ACANTHICARPA*.
 3. Leaves mostly oblong in outline, interruptedly bipinnatifid with a strongly toothed or lobed rachis, green above, densely canescent-strigillose beneath; fruit 3.5 to 6 mm. long, 2- or 3-beaked, bearing about 4 to 9 thick-subulate rarely hooked spines, these 1 to 2 mm. long and flattened only at base; perennial from running rootstocks.---- 3. *F. DISCOLOR*.
1. Plants shrubby, at least at base (4).
 4. Leaves canescent-pubescent beneath (5).
 5. Leaves once to thrice pinnately divided into small mostly ovate or obovate divisions, canescent-strigillose on both faces; fruit 4 to 6 mm. long, bearing about 25 to 40 rigid flattened straight spines.--- 4. *F. DUMOSA*.
 5. Leaves ovate to oblong, not pinnately divided into small divisions, greenish above, densely canescent-tomentulose beneath; fruit otherwise (6).
 6. Leaves subsessile, sinuate-toothed to pinnatifid; fruit fusiform, 8 to 10 mm. long, 1-beaked, glandular and densely long-villous, especially on the 20 or fewer straight subulate spines.--- 5. *F. ERIOCENTRA*.
 6. Leaves distinctly petioled, serrate or serrulate; fruit turbinate-ovoid or turbinate-subglobose, about 6 mm. long, 2- or 3-beaked, glandular and somewhat pilose-tomentose on the body, at least when young, bearing about 20 or more mostly strongly flattened, often hook-tipped spines.----- 6. *F. DELTOIDEA*.
 4. Leaves green beneath or sometimes (in *F. cordifolia*) cinereous or canescent when young (7).
 7. Leaves sessile and cordate-clasping, coarsely spinous-toothed, ovate, reticulate; fruit fusiform or globose-fusiform, 10 to 23 mm. long, 1- or 2-beaked, bearing very numerous hook-tipped spines, these 4 to 6 mm. long.----- 9. *F. ILICIFOLIA*.

7. Leaves slender-petioled, not spinous-toothed (8).
 8. Leaves broadly ovate, about as long as wide, 3-nerved, obtuse or acutish, bluntly toothed, sometimes lobed; fruit mostly turbinate-obovoid, 5 to 7 mm. long, bearing about 8 to 20 subulate hook-tipped spines, these 1.5 to 2.5 mm. long, often flattish at base.
7. *F. CORDIFOLIA.*
 8. Leaves elongate-triangular or oblong-lanceolate, pinnate-veined, acuminate, coarsely toothed; fruit fusiform (*Xanthium*-like), about 12 mm. long, bearing very numerous slender-subulate hook-tipped spines, these 2 to 3 mm. long, not flattened at base. 8. *F. AMBROSIOIDES.*

1. **Franseria confertiflora** (DC.) Rydb., North Amer. Fl. 33: 28. 1922.

Ambrosia confertiflora DC., Prodr. 5: 526. 1836.

Franseria tenuifolia Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 80. 1849.

Franseria incana Rydb., North Amer. Fl. 33: 30. 1922.

Near Flagstaff (Coconino County) and Kingman (Mohave County) to Cochise, Santa Cruz, and Pima Counties, 1,000 to 3,500 feet, mesas and slopes, sometimes a weed in cultivated land, April to October, type of *F. incana* from near Fort Huachuca (*Wilcox* in 1892). Oklahoma and Colorado to California, south to northern Mexico.

2. **Franseria acanthicarpa** (Hook.) Coville, Contrib. U. S. Natl. Herbarium 4: 129. 1893.

Ambrosia acanthicarpa Hook., Fl. Bor. Amer. 1: 309. 1834.

Gaertneria acanthicarpa Britton, Torrey Bot. Club Mem. 5: 332. 1894.

Apache, Navajo, and eastern Coconino Counties, 4,500 to 5,500 feet, dry or moist sandy soil, June to December. Minnesota to Alberta, south to western Texas, northern Arizona, and California.

Affords forage for sheep in northern Arizona.

3. **Franseria discolor** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 345. 1840.

Near the San Francisco Peaks and Flagstaff, Coconino County, 6,200 to 7,000 feet (*Leiberg* 5918, *Whiting* 756), plains and cultivated ground, June to September. Nebraska to Wyoming, south to New Mexico and Arizona.

4. **Franseria dumosa** A. Gray in Frém., Exped. Rocky Mount. Rpt. 316. 1845.

Franseria albicaulis Torr., Pl. Frémont. 16. 1853.

Mohave County to western Pinal and Pima Counties and throughout Yuma County, up to 3,000 feet, very common on dry plains and mesas, April to November. Southern Utah to southeastern California and northwestern Mexico.

White bur-sage. Plants up to 1 m. high, much branched, compact, spinescent. This plant is said to be preferred for forage by horses to all other desert shrubs. It is sometimes called burroweed, a name used for various southwestern plants.

5. **Franseria eriocentra** A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 355. 1868.

Grand Canyon (Coconino County) and Beaver Dam (Mohave County) to western Gila, Maricopa, and Pinal Counties, 1,500 to

5,000 feet, usually in sandy soil, often in washes, locally abundant, April and May. Southern Utah to southeastern California and south-central Arizona.

Woolly bur-sage. Plant up to 1 m. high, with rigid spreading branches.

6. *Franseria deltoidea* Torr., Pl. Frémont. 15. 1853.

Maricopa, Pinal, and Pima Counties, 1,000 to 2,800 feet, very abundant on plains and mesas, often in nearly pure stands, December to April, type collected by Frémont on the Gila River. South-central Arizona and Sonora.

7. *Franseria cordifolia* A. Gray, Syn. Fl. 1²: 445. 1884.

Horse Mesa Dam (eastern Maricopa County), Santa Catalina, Tucson, and Ajo Mountains (Pima County), 1,700 to 3,100 feet, locally abundant, canyons, rocky slopes, and washes, March and April, type from mountains near Tucson (*Pringle*). Southern Arizona and northern Mexico.

8. *Franseria ambrosioides* Cav., Icon. Pl. 2: 79. 1793.

Southern Yavapai County to Pinal, Pima, and Yuma Counties, up to 3,100 feet, common in sandy washes and canyons, March to May. Southern Arizona and northern Mexico.

9. *Franseria ilicifolia* A. Gray, Amer. Acad. Arts and Sci. Proc. 11: 77. 1876.

Desert mountain ranges of southern Yuma County, 1,000 feet or lower, usually in sand, March and April. Southwestern Arizona, southeastern California, and northern Baja California.

Hollyleaf bur-sage. A roundish, densely much-branched evergreen subshrub, the leaves spinescent.

51. XANTHIUM.⁷² COCKLEBUR

Monoecious weedy annuals; leaves alternate, sometimes with triple spines in the axils; hermaphrodite (staminate) heads clustered, borne above the pistillate ones, their involucre with free phyllaries; pistillate involucre burlike, 2-celled, 2-beaked, covered with stiff hooked prickles.

These are troublesome weeds in pastures and cultivated fields. The spiny burs clot the manes and tails of horses, and occasionally cause death of young animals by irritating or clogging the intestinal tract. The seeds and seedlings contain a glucoside, xanthostrumarin, which is poisonous to livestock, especially to swine and poultry. Some of the species yield an extract which is stated to have styptic properties.

Key to the species

1. Leaves lanceolate or lance-ovate, acute or acuminate at both ends, densely whitish-strigillose beneath; axils of the leaves bearing conspicuous 3-forked spines; fruit about 1 cm. long..... 1. X. SPINOSUM.
1. Leaves deltoid or broadly ovate, usually cordate, green beneath; axils without spines; fruit about 2 cm. long or more..... 2. X. SACCHARATUM.

⁷² References: MILLSPAUGH, C. F., and SHERFF, E. E. REVISION OF THE NORTH AMERICAN SPECIES OF XANTHIUM. Field Mus. Nat. Hist. Bot. Ser. 4: 9-49. 1919.
WIDDER, F. J. DIE ARTEN DER GATTUNG XANTHIUM. BEITRÄGE ZU EINER MONOGRAPHIE. Repert. Spec. Novarum Regni Veg. Beih. 20: 1-221. 1923.

1. **Xanthium spinosum** L., Sp. Pl. 987. 1753.

Ash Fork to Congress Junction (Yavapai County), also in Santa Cruz County, roadsides, August and September. A weed throughout most of the United States and the warmer and temperate parts of the world.

2. **Xanthium saccharatum** Wallr., Beitr. Bot. 1: 238. 1844.

Throughout the State, 100 to 6,000 feet, moist alluvial soil, summer. A common weed throughout the United States and in the Hawaiian Islands, perhaps elsewhere.

52. ZINNIA ⁷³

Herbs or undershrubs; leaves opposite, entire; heads medium-sized or large, radiate, showy; involucre graduated, of dry phyllaries; receptacle becoming conic or cylindrical; rays yellow, white, or purple, pistillate, sessile and indurate-persistent on the achenes; disk achenes strongly compressed; pappus none, or of 1 to 4 awns or teeth.

The very popular garden zinnia, *Z. elegans* Jacq., is a native of Mexico. The Arizona *Z. grandiflora* is an attractive plant, worthy of trial for ornamental borders.

Key to the species

1. Annual, usually 30 cm. high or more, single-stemmed; leaves ovate or lanceolate, usually 10 mm. wide or more; rays dark red, greenish on the back.
 1. *Z. MULTIFLORA*.
1. Low perennials, normally 20 cm. high or less, much branched from the base, woody below; leaves linear or acerose, not more than 2.5 mm. wide; rays yellow or white (2).
 2. Leaves more or less 3-ribbed; rays 8 to 16 mm. long, bright yellow; style branches hispid, with long acuminate appendages. 2. *Z. GRANDIFLORA*.
 2. Leaves 1-ribbed; rays usually 12 mm. long or less, light yellow or white; style branches merely hispidulous, with short bluntish appendages.
 3. *Z. PUMILA*.

1. **Zinnia multiflora** L., Sp. Pl. ed. 2, 1269. 1763.

Crassina multiflora Kuntze, Rev. Gen. Pl. 1: 331. 1891.

Near Bisbee and in the Huachuca Mountains (Cochise County), base of the Patagonia Mountains and near Ruby (Santa Cruz County), 4,000 to 5,300 feet, August and September. Florida and West Indies, southern Arizona and Mexico; South America.

2. **Zinnia grandiflora** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 348. 1840.

Crassina grandiflora Kuntze, Rev. Gen. Pl. 1: 331. 1891.

Navajo County to eastern Mohave County, south to Cochise and Pinal Counties, 4,000 to 6,500 feet, dry slopes and mesas, June to October. Kansas to Nevada, south to Texas, Arizona, and northern Mexico.

3. **Zinnia pumila** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 81. 1849.

Crassina pumila Kuntze, Rev. Gen. Pl. 1: 331. 1891.

Central Yavapai County to Cochise and Pima Counties, 2,500 to 5,000 feet, dry mesas and slopes, commonly in caliche soil, April to October. Texas to southern Arizona and northern Mexico.

⁷³ Reference: ROBINSON, B. L., and GREENMAN, J. M. A REVISION OF THE GENUS ZINNIA. Amer. Acad. Arts and Sci. Proc. 32 (Gray Herbarium Contrib. 10): 14-20. 1896.

53. SANVITALIA

Slender annual; leaves opposite, lanceolate or lance-linear, mostly entire; heads small, terminal, radiate, the rays white; pales of the receptacle with rigid cuspidate tips; rays sessile, persistent on the achenes; ray achenes narrowly 4-sulcate, their pappus of 3 short awns or tubercles; disk achenes 4-angled, epappose or nearly so.

1. **Sanvitalia aberti** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 87. 1849.

Apache County to eastern Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 4,500 to 7,300 feet, dry slopes and mesas, July to September. Western Texas to Arizona and northern Mexico.

54. HELIOPSIS. OXEYE

Perennial herb; leaves opposite, triangular-ovate, usually toothed, petioled; heads solitary, terminal, long-peduncled, radiate, yellow, showy; rays pistillate, persistent on the achenes; achenes short and thick, epappose.

1. **Heliopsis parvifolia** A. Gray, Pl. Wright. 2: 86. 1853.

Mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, rich soil in canyons, July to September. Southwestern Texas to southern Arizona and northern Mexico.

55. ECLIPTA

Low annual herb; leaves opposite, lanceolate, toothed; heads radiate, white, peduncled in the upper axils; rays numerous, short, narrow; pales of the receptacle bristlelike; achenes short, thick, 3- or 4-angled, truncate, epappose or essentially so.

1. **Eclipta alba** (L.) Hassk., Pl. Jav. Rar. 528. 1848.

Verbesina alba L., Sp. Pl. 902. 1753.

Sacaton (Pinal County), near Marana (Pima County), along the Colorado River (Yuma County), up to 2,000 feet, along streams and ditches, June to September. Massachusetts to Nebraska, south to Florida, Texas, southern Arizona, California, and South America; widely distributed in the warmer regions of the world.

56. RUDBECKIA. CONEFLOWER

Tall perennial; leaves alternate, the lower ones pinnately divided into few lobes, the upper leaves 3-cleft to entire; heads large, radiate, yellow; involucre herbaceous; disk becoming cylindrical; achenes 4-angled; pappus a short crown.

1. **Rudbeckia laciniata** L., Sp. Pl. 906. 1753.

Rudbeckia umbrosa Greene, Leaflets 2: 153. 1911. Not *R. umbrosa* Beadle and Boynton, 1901.

Apache County to Coconino County, south to Cochise and Pima Counties, 5,000 to 7,500 feet, rich soil along mountain streams, July to September, type of *R. umbrosa* from Oak Creek, Coconino County

(Pearson in 1909). Maine to Saskatchewan and Idaho, south to Florida, Colorado, and southern Arizona.

Cutleaf coneflower. A showy but rather coarse plant, of which a double form known as goldenglow is often cultivated. The plants are reported to be poisonous to cattle, sheep, and swine.

57. RATIBIDA.⁷⁴ CONEFLOWER

Perennial herbs; leaves alternate, pinnately parted; heads terminal, long-peduncled, showy, the rays yellow or partly brown-purple; disk globose to cylindrical; achenes short and broad, compressed, with 1-angled sides; pappus of 1 or 2 teeth, sometimes of squamellae.

Key to the species

1. Disk soon cylindrical, 10 to 40 mm. long, 6 to 10 mm. thick; rays usually 8 to 30 mm. long; peduncles 6 to 25 cm. long----- 1. *R. COLUMNARIS*.
 1. Disk subglobose, becoming oblong-ellipsoid, 6 to 13 mm. long, 6 to 9 mm. thick; rays 3 to 8 mm. long; peduncles 1 to 5 cm. long--- 2. *R. TAGETES*.

- 1. *Ratibida columnaris*** (Sims) D. Don in Sweet, Brit. Fl. Gard. ed. 2, 4: pl. 361. 1838.

Rudbeckia columnaris Sims, Curtis's Bot. Mag. 39: pl. 1601. 1813.

Lepachys columnaris Torr. and Gray, Fl. North Amer. 2: 315. 1842.

Ratibida columnifera Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 706. 1915.

Apache, Navajo, Coconino, Greenlee, and Santa Cruz Counties, 5,000 to 7,000 feet, plains and openings in pine woods, June to November. Minnesota to British Columbia, south to Tennessee, Colorado, and Arizona.

The var. *pulcherrima* (DC.) D. Don is an unimportant form with the rays partly or wholly brownish purple (yellow throughout in the typical form). *R. columnaris* is suspected of being poisonous to cattle, but the plant is rarely eaten.

- 2. *Ratibida tagetes*** (James) Barnhart, Torrey Bot. Club Bul. 24: 410. 1897.

Rudbeckia tagetes James in Long, Exped. 2: 68. 1823.

Lepachys tagetes A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 103. 1857.

Adamana, Apache County, 5,200 feet (*Griffiths* 5092), plains, June to September. Kansas and Colorado to Texas, New Mexico, and eastern Arizona.

58. ZALUZANIA ⁷⁵

Plant suffrutescent, branched, slightly pubescent; leaves alternate, ovate, 3-lobed; heads radiate, yellow, loosely clustered; receptacle conic; rays pistillate; achenes of the disk short, quadrangular, epappose, those of the ray with a few short setae.

⁷⁴ Reference: SHARP, W. M. A CRITICAL STUDY OF CERTAIN EPAPPOSE GENERA OF THE HELIANTHEAE-VERBESINAE OF THE NATURAL FAMILY COMPOSITAE. Mo. Bot. Gard. Ann. 22: 66-77. 1935.

⁷⁵ Reference: SHARP, W. M. A CRITICAL STUDY OF CERTAIN EPAPPOSE GENERA OF THE HELIANTHEAE-VERBESINAE OF THE NATURAL FAMILY COMPOSITAE. Mo. Bot. Gard. Ann. 22: 110-114. 1935.

1. **Zaluzania grayana** Robins. and Greenm., Amer. Acad. Arts and Sci. Proc. 34: 531. 1899.

Gymnolomia triloba A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 217. 1882. Not *Zaluzania triloba* Pers., 1807.

Chiricahua and Huachuca Mountains, Cochise County (*Lemmon, Pringle, Wilcox*), slopes and canyons, July to September, type of *G. triloba* from the Chiricahua Mountains (*Lemmon*). Southwestern New Mexico, southern Arizona, and Chihuahua.

59. WYETHIA. MULES-EARS

Perennial herbs; leaves alternate, linear to oblong, entire or essentially so; heads large, terminal, solitary, yellow, radiate; rays pistillate; achenes rather large, 3- or 4-angled; pappus a chaffy dentate crown, or divided into a few teeth.

Key to the species

1. Leaves uniform, linear or lance-linear, sessile, 0.7 to 2.3 cm. wide, like the stem harshly tuberculate-hispidulous or tuberculate-hispid; involucre strongly graduate, the phyllaries with an ovate indurate base, abruptly narrowed into a longer, very narrowly subulate, spreading, herbaceous tip.
 1. *W. SCABRA*.
1. Leaves not uniform, mainly oblong or elliptic, at least the basal ones petioled, 3 to 9 cm. wide, pilose or hirsute but not tuberculate, and much larger than those of the stem; involucre few-seriate, the phyllaries subequal, oblong, oval, or ovate, not abruptly narrowed into a subulate spreading tip.
 2. *W. ARIZONICA*.

1. **Wyethia scabra** Hook., London Jour. Bot. 6: 245. 1847.

Apache, Navajo (and probably Coconino) Counties, 5,000 to 6,000 feet, fairly common on dry slopes and mesas, June to October. Wyoming to east-central Utah, northwestern New Mexico, and northeastern Arizona.

A handsome but rather coarse plant with numerous stems from a woody base. Said to be used as an emetic by the Hopi and Navajo Indians, but they consider it dangerous.

2. **Wyethia arizonica** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 655. 1873.

Apache, Navajo, and Coconino Counties, 7,000 to 7,500 feet, slopes and canyons mostly in pine forest, June to August, type from Bear Springs (*Palmer* in 1869). Colorado, Utah, and northern New Mexico and Arizona.

60. TITHONIA ⁷⁶

Annual; leaves opposite below, alternate above, large, ovate, toothed, petioled; heads rather large, solitary, radiate, orange yellow, long-peduncled, the peduncle fistulose; rays neutral; achenes oblong, thickened; pappus of 1 awn and several squamellae.

1. **Tithonia thurberi** A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 655. 1873.

Patagonia Mountains (Santa Cruz County) to the Baboquivari Mountains (Pima County), 3,000 to 4,000 feet, rich soil near streams, locally abundant, August and September. Southern Arizona and Sonora.

⁷⁶ Reference: BLAKE, S. F. REVISION OF THE GENUS TITHONIA. Contrib. U. S. Natl. Herbarium 20: 423-436. 1921.

61. VIGUIERA ⁷⁷

Herbs or shrubs; leaves opposite (at least below), linear to ovate, usually toothed; heads medium-sized, radiate, yellow; rays neutral; achenes laterally compressed, thickened; pappus of 2 awns and several short squamellae, or sometimes none.

Key to the species

1. Pappus persistent, of 2 awns and several intermediate squamellae; achenes pubescent; leaves ovate, rarely lanceolate (2).
2. Plant shrubby; leaves mostly opposite, deltoid-ovate, 1.5 to 3.5 cm. long, tuberculate-hispidulous; involucre 5 to 9 mm. high. 1. *V. DELTOIDEA*.
2. Plants strictly herbaceous (3).
3. Leaves usually thin, on slender petioles, these rarely less and usually much more than 10 mm. long; disk of the heads 7 to 10 mm. high; phyllaries with ovate or oblong-ovate, indurate and ribbed base, and a rather abrupt, linear or sometimes spatulate, herbaceous tip.
 2. *V. DENTATA*.
 3. Leaves usually firm, very short-petioled (petioles 1 to 8 mm. long); disk of the heads 11 to 15 mm. high; phyllaries linear-lanceolate to oblong-lanceolate, acuminate, subherbaceous throughout or indurate below.
 3. *V. CORDIFOLIA*.
1. Pappus wanting; achenes glabrous; leaves linear to lanceolate or oval (4).
4. Plants perennial (5).
5. Leaves lance-ovate to linear-lanceolate, 2 to 30 mm. wide.
 4. *V. MULTIFLORA*.
 5. Leaves oval to elliptic-oblong, 2.4 to 5 cm. long, 14 to 23 mm. wide.
 5. *V. OVALIS*.
4. Plants annual (6).
6. Phyllaries merely hispid-ciliate, or sometimes also sparsely hispid on the back..... 6. *V. CILIATA*.
6. Phyllaries densely and more or less canescently strigose or strigillose on the back (7).
7. Leaves lanceolate to linear-lanceolate, 4 to 14 mm. wide; heads relatively large, the disk 6 to 14 mm. thick..... 7. *V. LONGIFOLIA*.
7. Leaves linear or linear-lanceolate, 1.5 to 3 mm. wide; heads relatively small, the disk 6 to 8 mm. thick..... 8. *V. ANNUA*.

1. *Viguiera deltoidea* A. Gray, Amer. Acad. Arts and Sci. Proc. 5: 161. 1861.

The species is represented in Arizona by var. *parishii* (Greene) Vasey and Rose (*V. parishii* Greene). Southern Yavapai County to Pima and Yuma Counties, up to 3,500 feet, dry mesas and rocky slopes, January to October. Southern Nevada to southern Arizona, southern California, and northwestern Mexico.

A small much-branched shrub, of limited value as browse.

2. *Viguiera dentata* (Cav.) Spreng., Syst. Veg. 3: 615. 1826.

Helianthus dentatus Cav., Icon. Pl. 3: 10. 1795.

Viguiera brevipes DC., Prodr. 5: 579. 1836.

Viguiera dentata var. *brevipes* Blake, Gray Herbarium Contrib. 54: 83. 1918.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, dry slopes and canyons, fields and ditch banks, occasionally in woods, June to October. Western Texas to Arizona and Mexico.

The var. *lancifolia* Blake, differing in its narrowly lanceolate leaves less than 2 cm. wide (in the typical form ovate, up to 8 cm. wide), occurs in the Santa Rita and Baboquivari Mountains (Pima County), also in Sonora.

⁷⁷ Reference: BLAKE, S. F. A REVISION OF THE GENUS VIGUIERA. Gray Herbarium Contrib. 54: 1-205. 1918.

3. *Viguiera cordifolia* A. Gray, Pl. Wright. 1: 107. 1852.

Fort Apache (southern Navajo County), Pinaleno Mountains (Graham County), and mountains of Cochise, Santa Cruz, and Pima Counties, 3,500 to 9,000 feet, dry slopes, canyons, and plains, mostly in pine forest, June to October. Western Texas to eastern and southern Arizona, and northern Mexico.

4. *Viguiera multiflora* (Nutt.) Blake, Gray Herbarium Contrib. 54: 108. 1918.

Helioomeris multiflora Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 171. 1848.

Gymnolomia multiflora Benth. and Hook. ex Rothr. in Wheeler, U. S. Survey West 100th Merid. Rpt. 6: 160. 1878.

Navajo and Coconino Counties, south to the mountains of Cochise, Santa Cruz, and Pima Counties, 4,500 to 8,500 feet, dry slopes, often in pine forest, common, May to October. Southwestern Montana to New Mexico, southern Arizona, Nevada, and eastern California.

The var. *nevadensis* (A. Nels.) Blake (*Gymnolomia nevadensis* A. Nels.), which differs in its narrowly linear-lanceolate, usually strongly revolute-margined leaves only 2 to 5 mm. wide (in the typical form the leaves lanceolate or lance-ovate, plane, 6 to 30 mm. wide), occurs throughout most of the range of the species in Arizona.

5. *Viguiera ovalis* Blake, Gray Herbarium Contrib. 54: 110. 1918.

Gymnolomia brevifolia Greene ex Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 190. 1913. Not *Viguiera brevifolia* Greenm., 1903.

Cave Creek, Chiricahua Mountains, Cochise County, about 6,000 feet (Harrison and Kearney 6150), September. Southwestern New Mexico and southeastern Arizona.

6. *Viguiera ciliata* (Robins. and Greenm.) Blake, Gray Herbarium Contrib. 54: 113. 1918.

Gymnolomia hispida var. *ciliata* Robins. and Greenm., Boston Soc. Nat. Hist. Proc. 29: 93. 1899.

Gymnolomia ciliata Rydb., Torrey Bot. Club Bul. 37: 328. 1910.

Camp Lowell, Pima County, 2,400 feet (Thornber 97), September and October. Southern Utah to eastern New Mexico, southern Arizona, and Sonora.

Thornber's specimen is intermediate between typical *V. ciliata* and var. *hispida* (A. Gray) Blake.

7. *Viguiera longifolia* (Robins. and Greenm.) Blake, Gray Herbarium Contrib. 54: 111. 1918.

Gymnolomia longifolia Robins. and Greenm., Boston Soc. Nat. Hist. Proc. 29: 92. 1899.

Coconino County to the mountains of Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,500 feet, dry slopes and plains, July to October. Western Texas to Arizona and Mexico.

8. *Viguiera annua* (M. E. Jones) Blake, Gray Herbarium Contrib. 54: 112. 1918.

Gymnolomia multiflora var. *annua* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 698. 1895.

Gymnolomia annua Robins. and Greenm., Boston Soc. Nat. Hist. Proc. 29: 93. 1899.

Apache County to eastern Mohave County, south to Cochise, Santa Cruz, and Pima Counties, 4,000 to 5,600 feet, hills, plains, and river bottoms, May to October. Western Texas to Arizona and northern Mexico.

Colors the landscape with brilliant yellow for many miles in northern Yavapai County. It is reported to make good forage for sheep.

62. HELIANTHUS.⁷³ SUNFLOWER

Annual or perennial herbs; leaves opposite or alternate, usually toothed; heads medium-sized to large, usually solitary or few, radiate, the rays yellow, the disk yellow, brown, or purple brown; involucre more or less herbaceous; achenes oblong, thickened; pappus of 2, rarely many, caducous paleaceous awns.

H. annuus, the State flower of Kansas, is a common and very conspicuous roadside weed in Arizona. In the plains States it is used for ensilage. The seeds of this and other species are eaten by the southwestern Indians. Cultivated varieties with very large heads (Russian sunflower) are grown for the seeds, which are fed to poultry and other birds. In Russia they are roasted and are a popular delicacy, taking the place of peanuts with us. They yield oil of sunflower, which is used as a hairdressing and sometimes as salad oil. The residue after pressing is of value as a concentrated cattle food. The Hopi Indians extract from the seeds of this, and perhaps other species of *Helianthus*, purple and black dyes for baskets and textiles, and for painting the body in certain of their ceremonies. The white tubers of the Jerusalem-artichoke (*H. tuberosus* L.) are used for human food and as feed for swine. They are rich in sugars, particularly levulose.

Key to the species

1. Plant strongly glaucous, low, usually less than 0.5 m. high, perennial; phyllaries ovate to oblong, obtuse to acute, closely imbricated, shorter than the disk, white-ciliate, glabrous on the back 1. *H. CILIARIS*.
1. Plants slightly or not at all glaucous, usually taller; phyllaries usually acuminate, more or less pubescent on the back (2).
 2. Disk (i. e. the tips of the disk corollas) yellow; plant perennial; leaves elongate-lanceolate, green, not conspicuously hispid; involucre not conspicuously hispid 2. *H. NUTTALLII*.
 2. Disk (i. e. the tips of the disk corollas) brown or purple brown; plants annual; leaves usually ovate or lance-ovate (3).
 3. Phyllaries narrowly linear or linear-lanceolate, only 1 to 2 mm. wide, light green, usually much surpassing the disk, conspicuously hispid, in about 2 series; pappus of numerous unequal palcae; leaves linear-lanceolate to lance-ovate, hispid with strongly tuberculate-based hairs 3. *H. ANOMALUS*.
 3. Phyllaries broader, or else blackish green; pappus normally of 2 awns; leaves otherwise (4).

⁷³ Reference: WATSON, E. E. CONTRIBUTIONS TO A MONOGRAPH OF THE GENUS HELIANTHUS. Mich. Acad. Sci. Papers 9: 305-475. 1929.

4. Central pales of the disk densely and conspicuously white-bearded; phyllaries normally lanceolate or linear-lanceolate, gradually acuminate, hispidulous but not or scarcely ciliate; leaves usually lanceolate or lance-ovate, seldom cordate..... 4. *H. PETIOLARIS*.
4. Central pales of the disk not white-bearded; phyllaries ovate, with an abrupt cirrhuslike acumination, hispidulous and conspicuously ciliate; leaves usually broadly ovate, at least the lower ones usually cordate..... 5. *H. ANNUUS*.

1. *Helianthus ciliaris* DC., Prodr. 5: 587. 1836.

White Mountains (Apache County) near the San Francisco Peaks, 6,500 feet, "Pierce" (perhaps Pierce Ferry, Mohave County), Gila Indian Reservation (Pinal County), often in saline soil, August to October. Texas to northern Arizona and Mexico.

Blueweed. Sometimes a troublesome weed in cultivated land, because of the creeping rootstocks.

2. *Helianthus nuttallii* Torr. and Gray, Fl. North Amer. 2: 324. 1842.

Helianthus fascicularis Greene, Pl. Baker. 3: 28. 1901.

Greer, Apache County (*Eggleston* 17091), Tuba, Coconino County (*Kearney and Peebles* 12876), Oak Creek, Coconino or Yavapai County (*Rusby* in 1883), 5,000 to 8,800 feet, marshy places, August and September. Saskatchewan to Alberta, south to New Mexico and northern Arizona.

3. *Helianthus anomalus* Blake, Wash. Acad. Sci. Jour. 21: 333. 1931.

Monument Valley, Navajo County (*Eastwood and Howell* 6659), Hopi Indian Reservation, Navajo County (*Whiting* 854), Beaver Dam, Mohave County (*Peebles* 13083), 2,000 to 6,000 feet, June to September. Utah and northern Arizona.

4. *Helianthus petiolaris* Nutt., Acad. Nat. Sci. Phila. Jour. 2: 115. 1821.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, Pima, and Yuma Counties, 1,200 to 7,500 feet, alluvial and cultivated land, common, March to October. Saskatchewan to Missouri and Texas, west to British Columbia and California, occasional farther east as an introduction.

The typical form is green or greenish and not conspicuously pubescent. The var. *canescens* A. Gray (*H. petiolaris* var. *canus* Britton, *H. canus* Woot. and Standl.), in its extreme form, is densely canescent-strigose or canescent-strigillose on the leaves, stem, and involucre. This variety occurs in Gila, Pima, and Yuma Counties, 2,500 feet or lower, on sandy or gravelly mesas, ranging from Texas to Arizona. Although at times very distinct in appearance, it intergrades with the typical form. It is also perplexingly close to *Helianthus niveus* (Benth.) T. S. Brandeg., of Baja California.

5. *Helianthus annuus* L., Sp. Pl. 904. 1753.

Helianthus lenticularis Dougl. in Lindl., Edwards's Bot. Reg. 15: pl. 1265. 1829.

Helianthus aridus Rydb., Torrey Bot. Club Bul. 32: 127. 1905.

Nearly throughout the State, 100 to 7,200 feet, roadsides and fields, very common, March to October. Saskatchewan to Texas and

westward, cultivated and escaping or becoming established elsewhere throughout the United States.

A sheet of *Helianthus subrhomboides* Rydb., labeled "Arizona, Dr. E. Palmer, 1869," is in the U. S. National Herbarium. The species is not otherwise known from Arizona but is reported from New Mexico. As the data accompanying Palmer's plants of 1869 are not always reliable, it seems best to await additional material before formally including the species in the flora of Arizona.

63. FLOURENSIA.⁷⁹ TARBUSH, VARNISHBUSH

Resinous, much-branched shrub; leaves alternate, small, ovate to oval, entire; heads rather small, discoid, yellow, nodding, axillary and terminal; involucre herbaceous; achenes cuneate, laterally compressed but somewhat thickened, villous; pappus of 2 unequal awns.

1. *Flourensia cernua* DC., Prodr. 5: 593. 1836.

Cochise County, 4,000 to 5,000 feet, plains and mesas, locally abundant, July to December. Western Texas to southeastern Arizona and northern Mexico.

A small shrub with hoplike odor and bitter taste, unpalatable to livestock. The leaves and heads are sold in the drug markets of northern Mexico under the name "hojasé" or "hojasén" and are taken in the form of a decoction for indigestion.

64. ENCELIA⁸⁰

Low, branching shrubs; leaves alternate, ovate or oblong, entire or toothed; heads medium-sized, solitary or paniced, radiate or discoid, yellow, or with the disk purple; rays neutral; achenes compressed, very flat, obovate, notched at apex, ciliate, more or less pubescent on the sides; pappus none, or of 1 or 2 weak awns.

Key to the species

1. Heads cymose or paniced; inflorescence glabrous or essentially so; leaves densely whitish-tomentulose..... 1. *E. FARINOSA*.
1. Heads solitary at the tips of the stem and branches; peduncles pubescent; leaves not tomentulose..... 2. *E. FRUTESCENS*.

1. *Encelia farinosa* A. Gray ex Torr. in Emory, Mil. Recon. 143. 1848.

Mohave County to western Gila, Maricopa, Pinal, Pima, and Yuma Counties, up to 3,000 feet, very abundant on dry rocky slopes, November to May. Southern Nevada, southern and western Arizona, southern California, and northwestern Mexico.

The var. *phenicodonta* (Blake) I. M. Johnston, which has dark purple instead of yellow disk flowers, occurs with the typical form in the Mohawk and Tule Mountains, Yuma County.

Brittlebush, incienso. The plants reach a height of about 1 m. The stems exude a gum which was chewed by the Indians, and also used as incense in the churches of Baja California.

⁷⁹ Reference: BLAKE, S. F. REVISION OF THE GENUS FLOURENSIA. Contrib. U. S. Natl. Herbarium 20: 393-409. 1921.

⁸⁰ Reference: BLAKE, S. F. A REVISION OF ENCELIA AND SOME ALLIED GENERA. Amer. Acad. Arts and Sci. Proc. 49 (Gray Herbarium Contrib. 41): 358-376. 1913.

2. *Encelia frutescens* A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 657. 1873.

Simsia frutescens A. Gray in Torr., U. S. and Mex. Bound. Bot. 89. 1859.

Grand Canyon (Coconino County) and Mohave County, to Graham, Pima, and Yuma Counties, up to about 4,000 feet, common on rocky slopes and mesas, March to September, type from Agua Caliente, Maricopa County (*Emory* in 1846). Southern Utah to southern California and Arizona.

Key to the varieties

1. Leaves not densely cinereous- or canescent-pubescent (2).
2. Leaves sparsely tuberculate-hispidulous with conical tuberculate-based white hairs, not obviously glandular; peduncles not glandular; involucre hispid, not or only slightly glandular; heads usually discoid.
 - E. FRUTESCENS.
 2. Leaves tuberculate-hispidulous and also conspicuously glandular; peduncles more or less glandular; involucre densely glandular, sparsely hispidulous; heads radiate..... var. RESINOSA.
1. Leaves cinereous- or canescent-pubescent; heads radiate (3).
3. Leaves cinereous with fine appressed hairs, these intermixed with stouter, tuberculate-based, antrorse hairs..... var. VIRGINENSIS.
3. Leaves canescent or cinereous with fine soft appressed hairs, without longer tuberculate-based hairs..... var. ACTONI.

The var. *resinosa* M. E. Jones has been collected near Winslow (type, *Jones* in 1890) and in Monument Valley (Navajo County), and along the Little Colorado River near Cameron (Coconino County), 4,300 to 5,300 feet. The var. *virginensis* (A. Nels.) Blake (*E. virginensis* A. Nels.), occurs in Coconino, Mohave, Graham, Gila, Pinal, and western Cochise Counties. The var. *actoni* (Elmer) Blake (*E. actoni* Elmer) has been reported from western Arizona.

Encelia californica Nutt. A collection of this species, purporting to be from Fort Mohave (*Cooper* in 1860-61), has been the only basis for the recording of this species from Arizona. As the plant has not been found by subsequent collectors, and as it is definitely known only from coastal southern California and the west coast of Baja California, it seems almost certain that the locality given for this collection is incorrect. The species may be recognized by its solitary heads, purple disk, and densely soft-pubescent involucre. The plant is reported to cause severe dermatitis in susceptible persons.

65. SIMSIA ⁸¹

Annual herb, pubescent, branched; leaves mostly opposite, ovate, often toothed, petioled; heads numerous, paniced, medium-sized, yellow, radiate; achenes obovate, compressed, very flat, glabrous, epappose.

1. *Simsia exaristata* A. Gray, Pl. Wright. 2: 87. 1853.

Encelia exaristata A. Gray in Hemsl., Biol. Cent. Amer. Bot. 2: 183. 1881.

Near Tombstone, Cochise County, 4,500 feet (*Peebles* et al. 3377), valleys, September and October. Western Texas to southeastern Arizona and Mexico.

⁸¹ Reference: BLAKE, S. F., A REVISION OF ENCELIA AND SOME ALLIED GENERA. Amer. Acad. Arts and Sci. Proc. 49 (Gray Herbarium Contrib. 41): 376-396. 1913.

66. GERAEA.⁸² DESERT-SUNFLOWER

Annual herb, hirsute, branching; leaves alternate, oblong, ovate, or obovate, toothed; heads large, showy, yellow, radiate; phyllaries conspicuously white-ciliate; achenes cuneate, strongly compressed, silky-villous, the body black, the narrow whitish margin continuous with the 2 strong awns, these connected by a low entire whitish crown.

1. *Geraea canescens* Torr. and Gray, Amer. Jour. Sci. ser. 2, 3: 275. 1847.

Encelia eriocephala A. Gray, Amer. Acad. Arts and Sci. Proc. 8: 657. 1873.

Mohave, Maricopa, Pinal, western Pima, and Yuma Counties, 1,500 feet or lower, common in sandy soil, January to June. Southern Utah to southeastern California, western and southern Arizona, and Sonora.

The var. *paniculata* (A. Gray) Blake (*Encelia eriocephala* var. *paniculata* A. Gray), is an unimportant form with stems paniculately much-branched above, bearing very numerous heads only 2 to 2.8 cm. wide, known only from the type collection, at Phoenix (Pringle in 1882).

67. ENCELIOPSIS⁸³

Scapose perennial herb, silvery-velutinous; leaves obovate, entire, in a basal tuft; heads solitary, large, yellow, radiate, on naked scapes; achenes oblong, strongly compressed, silky-villous, black, with a white cartilaginous border and crown; pappus of 2 short awns, or none.

1. *Enceliopsis argophylla* (D. C. Eaton) A. Nels., Bot. Gaz. 47: 433. 1909.

Tithonia argophylla D. C. Eaton in King, Geol. Expl. 40th Par. 5: 423. 1871.

Navajo Bridge, Coconino County (*Peebles* and *Parker* 14654), Mohave County, at Virgin Narrows (*Cottam* 5131) and near Boulder Dam (*Kearney* and *Peebles* 11239), 1,000 to 3,700 feet, dry slopes and sandy washes, April to June. Southern Utah, southern Nevada, and northwestern Arizona.

The record of *Enceliopsis nudicaulis* (A. Gray) A. Nels. from Arizona⁸⁴ was based on a specimen without heads, so labeled, in the National Herbarium (*Jones* 5095ak, from above Pagumpa Springs, 1894), which on more careful examination is found to be *Gaillardia parryi* Greene.

68. HELIANTHELLA

Perennial herbs; leaves opposite or alternate, lanceolate to ovate, entire; heads radiate, medium-sized or large, with yellow rays and a yellow or purple disk; achenes strongly compressed, obovate, not ciliate; pappus of fimbriate squamellae and often 2 slender awns.

⁸² Reference: BLAKE, S. F. A REVISION OF ENCELIA AND SOME ALLIED GENERA. Amer. Acad. Arts and Sci. Proc. 49 (Gray Herbarium Contrib. 41): 355-357. 1913.

⁸³ Reference: BLAKE, S. F. A REVISION OF ENCELIA AND SOME ALLIED GENERA. Amer. Acad. Arts and Sci. Proc. 49 (Gray Herbarium Contrib. 41): 351-355. 1913.

⁸⁴ BLAKE, S. F., Asteraceae, in Tidestrom, Ivar. FLORA OF UTAH AND NEVADA. Contrib. U. S. Natl. Herbarium 25: 1925. (See p. 586.)

Key to the species

1. Disk purple; pales of the receptacle comparatively firm; plant usually much-branched above, with several to many small heads. 1. *H. MICROCEPHALA*.
1. Disk yellow; pales of the receptacle soft and mainly scarious; plants usually simple or little branched, the heads solitary or few (2).
2. Heads small, the disk not more than 1.5 cm. wide, the rays 2 cm. long or less; leaves thick and firm, the basal and lower ones not more than 2.3 cm. wide.----- 2. *H. PARRYI*.
2. Heads large, the disk usually 2 to 3 cm. wide, the rays usually 3 cm. long or more; leaves thin, the basal and lower ones 2.5 to 7.5 cm. wide.----- 3. *H. QUINQUENERVIS*.

1. ***Helianthella microcephala*** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 10. 1883.

Encelia microcephala A. Gray, ibid. 8: 657. 1873.

Carrizo Mountains, Apache County (*Standley* 7350). Southwestern Colorado, southern Utah, northwestern New Mexico, and northeastern Arizona, July and August.

2. ***Helianthella parryi*** A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 65. 1863.

White Mountains, Apache County (*Griffiths* 5266, *Eggleston* 17051), 8,500 feet, mountainsides, often under aspens, July to September. Wyoming to New Mexico and eastern Arizona.

3. ***Helianthella quinquenervis*** (Hook.) A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 10. 1883.

Helianthus quinquenervis Hook., London Jour. Bot. 6: 247. 1847.

Helianthella quinquenervis var. *arizonica* A. Gray, Syn. Fl. 1²: 284. 1884.

White Mountains (Apache and Greenlee Counties), Kaibab Plateau and Flagstaff (Coconino County), Pinaleno Mountains (Graham County), Johnston Ranch (Cochise County), Santa Catalina Mountains (Pima County), 5,000 to 10,000 feet, mountain meadows and woods, July to September. South Dakota to Idaho (?), south to New Mexico, Arizona, and Chihuahua.

69. ZEXMENIA ⁸⁵

Perennial herb, the roots tuberous-thickened; leaves opposite, ovate, toothed, subsessile; heads medium-sized, yellow, radiate, solitary, long-peduncled; rays pistillate; achenes obovate, compressed, 2-winged; pappus of 2 slender awns and several small intermediate squamellae, or the latter wanting.

1. ***Zexmenia podocephala*** A. Gray, Syn. Fl. 1²: 286. 1884.

Verbesina podocephala A. Gray, Pl. Wright. 2: 92. 1853.

Mountains of Cochise and Santa Cruz Counties, and Santa Rita Mountains (Pima County), 4,000 to 5,000 feet, August and September. Southeastern Arizona and northern Mexico.

⁸⁵ Reference: JONES, W. W. A REVISION OF THE GENUS ZEXMENIA. Amer. Acad. Arts and Sci. Proc. 41 (Gray Herbarium Contrib. 30): 143-167. 1905.

70. VERBESINA.⁸⁶ CROWNBEARD

Annual or perennial herbs; leaves opposite or alternate, linear to ovate, usually toothed; heads medium-sized or rather large, radiate, yellow; rays pistillate or rarely neutral; achenes strongly compressed, 2-winged; pappus none or of 1 or 2 awns.

Key to the species

1. Leaves linear or linear-lanceolate, long-acuminate, sessile, 9 to 23 cm. long, 5 to 18 mm. wide, subentire or slightly serrate, strongly veiny beneath; achenes narrowly winged; pappus awns wanting or rudimentary.
 1. *V. LONGIFOLIA*.
1. Leaves lanceolate to ovate or deltoid, obtuse to acuminate, much broader in proportion to their length, usually sharply toothed, seldom veiny; achenes broadly winged (2).
 2. Leaves sessile, auriculate-clasping, green on both sides; perennial, with usually simple stems, and solitary heads on long naked peduncles.
 2. *V. ROTHROCKII*.
 2. Leaves petioled, densely white-strigose beneath, green or greenish above; annual, often much-branched, and with numerous heads.
 3. *V. ENCELIOIDES*.

1. *Verbesina longifolia* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 12. 1883.

Actinomeris longifolia A. Gray, Pl. Wright. 2: 89. 1853.

Mountains of Cochise, Santa Cruz, and Pima Counties, 5,000 to 8,000 feet, July to October. Southwestern New Mexico, southeastern Arizona, and northern Mexico.

2. *Verbesina rothrockii* Robins. and Greenm., Amer. Acad. Arts and Sci. Proc. 34: 541. 1899.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,600 feet, rocky slopes, May to September. Southern New Mexico, southern Arizona, and Coahuila.

3. *Verbesina encelioides* (Cav.) Benth. and Hook. ex A. Gray, Bot. Calif. 1: 350. 1876.

Ximenesia encelioides Cav., Icon. Pl. 2: 60. 1793.

Apache County to Mohave County, south to Cochise and Pima Counties, up to 7,200 feet but usually much lower, a common weed of roadsides and waste ground, April to November. Kansas to Montana, south to Texas, California, and northern Mexico.

The commoner form in Arizona is var. *exauriculata* Robins. and Greenm. (*V. exauriculata* Cockerell, *Ximenesia exauriculata* Rydb.), distinguished from the typical form by having the petioles not auriculate-dilated at base. This plant is said to have been used by Indians and white pioneers for boils and skin diseases. The Hopis are reported to bathe in water in which this plant has been soaked, to relieve the pain of spider bite.

71. COREOPSIS.⁸⁷ TICKSEED

Annual herbs; leaves mostly opposite, pinnatisect or dissected; heads medium-sized or rather large, showy, the rays yellow or with a

⁸⁶ Reference: ROBINSON, B. L., and GREENMAN, J. M. SYNOPSIS OF THE GENUS VERBESINA, WITH AN ANALYTICAL KEY TO THE SPECIES. Amer. Acad. Arts and Sci. Proc. 34 (Gray Herbarium Contrib. 16): 534-566. 1899.

⁸⁷ Reference: SHERFF, E. E. REVISION OF THE GENUS COREOPSIS. Field Mus. Nat. Hist. Bot. Ser. 11: 279-475. 1936.

purple brown base; involucre double, the outer phyllaries narrow, herbaceous, the inner ones broad, membranous; achenes strongly dorso-ventrally compressed, sometimes wing-margined; pappus a small cup, or obsolete.

Several species of this genus are well known as cultivated ornamentals.

Key to the species

1. Scapose or subscapose, usually less than 30 cm. high; heads solitary; rays yellow throughout; achenes with thick corky wings---3. *C. DOUGLASHII*.
1. Leafy-stemmed, usually 30 cm. high or more; heads loosely cymose-panicled; rays yellow with a purple-brown base (2).
 2. Achenes with thin wings----- 1. *C. CARDAMINEFOLIA*.
 2. Achenes wingless----- 2. *C. TINCTORIA*.

1. ***Coreopsis cardaminefolia*** (DC.) Torr. and Gray, Fl. North Amer. 2: 346. 1842.

Calliopsis cardaminefolia DC., Prodr. 5: 568. 1836.

Near Flagstaff, Walnut Canyon, and Oak Creek (Coconino County), 5,600 to 7,000 feet, openings in pine forest, rich moist soil, June to September. Kansas to Louisiana, north-central Arizona, and northern Mexico.

- *2. ***Coreopsis tinctoria*** Nutt., Acad. Nat. Sci. Phila. Jour. 2: 114. 1821.

In low ground, Minnesota and Manitoba to Louisiana, west to British Columbia and New Mexico, and reported from Arizona.

Commonly cultivated in gardens under the name calliopsis, and frequently escaping both east and west of the range here given.

3. ***Coreopsis douglasii*** (DC.) H. M. Hall, Calif. Univ. Pub. Bot. 3: 140. 1907.

Leptosyne douglasii DC., Prodr. 5: 531. 1836.

Coconino, Mohave, Graham, Maricopa, and Pinal Counties, 2,000 to 3,500 feet, open places, February to May (sometimes August). Arizona, southern California, and northern Baja California.

Coreopsis atkinsoniana Dougl. is recorded (see footnote 87, p. 961, Sherff, p. 429) from a meadow near the San Francisco Peaks (*Lemmon* 4159, collected in 1884). As the normal range of the species is from southern Canada to Oregon and South Dakota, the specimen was probably a waif.

72. COREOCARPUS⁸⁸

Branching suffrutescent perennial; leaves opposite, pinnately divided into 3 or 5 linear lobes; heads small, cymose, radiate, yellow; involucre of 5 to 8 subequal, 2-seriate, submembranous, dark-lined phyllaries; rays pistillate; achenes oblong, strongly dorso-ventrally compressed, with 2 pectinately divided wings; pappus none, or of 1 or 2 retrorsely spinulose awns.

1. ***Coreocarpus arizonicus*** (A. Gray) Blake, Amer. Acad. Arts and Sci. Proc. 49: 344. 1913.

Leptosyne arizonica A. Gray, *ibid.* 17: 218. 1882.

Santa Cruz and Pima Counties, 3,000 to 5,000 feet, rich soil along

⁸⁸ Reference: BLAKE, S. F. A REDISPOSITION OF THE SPECIES HERETOFORE REFERRED TO LEPTOSYNE Amer. Acad. Arts and Sci. Proc. 49 (Gray Herbarium Contrib. 41): 342-345. 1913.

streams, January to October, type from Camp Lowell, Pima County (Lemmon in 1880). Southern Arizona and northern Mexico.

73. HETEROSPERMA

Low slender annual; leaves opposite, once or twice pinnately divided into linear lobes; heads small, terminal, radiate, yellow; involucre double, much as in *Coreopsis*; rays fertile; outer achenes oval, incurved, wing-margined, epappose; inner achenes narrower, often infertile, not margined, narrowed into a beak, their pappus of 2 deciduous awns.

1. *Heterosperma pinnatum* Cav., Icon. Pl. 3: 34. 1795.

Near Flagstaff (Coconino County), near Prescott (Yavapai County), south to Cochise, Santa Cruz, and Pima Counties, commoner in southern Arizona, 5,000 to 6,000 feet, rich soil, sometimes on limestone, August and September. Southwestern Texas to Arizona, south to Guatemala.

74. THELESPERMA

Slender perennials; leaves opposite, mostly pinnately parted into a few narrow lobes; heads medium-sized or small, long-peduncled, radiate or discoid, entirely yellow or the disk brownish; involucre double, the outer phyllaries narrow, herbaceous, the inner ones broad, scarious-margined, connate to about the middle or higher; pales of the receptacle broadly scarious-margined; achenes oblong to linear, thickish, more or less papillate; pappus of 2 retrorsely hispid awns, or obsolete.

Key to the species

1. Lobes of the disk corollas lanceolate or linear, longer than the throat; pappus of 2 triangular hispid teeth 1 mm. long or longer; plants usually 30 to 60 cm. high, leafy below, naked above, usually branched; heads normally discoid, rather large, the disk 1 to 1.5 cm. thick; outer phyllaries very short, broadly ovate, rounded..... 1. *T. MEGAPOTAMICUM*.
1. Lobes of the disk corollas ovate, shorter than the throat; pappus a mere crown or obsolete; plants normally 40 cm. high or less, very leafy below, with long naked erect peduncles (2).
 2. Heads relatively large (the disk about 1 to 1.5 cm. thick), normally with conspicuous rays; leaf divisions lanceolate to linear, 1.5 to 6 mm. wide; involucre about 9 mm. high; inner phyllaries with broad and conspicuous scarious margins..... 2. *T. SUBNUDUM*.
 2. Heads small (the disk 5 to 10 mm. thick), always discoid; leaf divisions filiform, about 0.5 mm. wide; involucre 4 to 5 mm. high; inner phyllaries less conspicuously scarious-margined..... 3. *T. LONGIPES*.

1. *Thelesperma megapotamicum* (Spreng.) Kuntze, Rev. Gen. Pl. 3²: 182. 1898 (as *Thelespermum*).

Bidens megapotamica Spreng., Syst. Veg. 3: 454. 1826.

Bidens gracilis Torr., Ann. Lyc. N. Y. 2: 215. 1828.

Thelesperma gracile A. Gray, Jour. Bot. and Kew Gard. Misc. 1: 252. 1849.

Apache, Navajo, Yavapai, Pinal, Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,000 feet, grassy plains and mesas, May to September. Nebraska and Wyoming to Utah, south to Texas, Arizona, and Mexico; southern South America.

The Hopi make a tea from the flowers and young leaves, which are dried and then boiled. A reddish-brown dye for baskets and textiles is also obtained by them from this plant.

2. *Thelesperma subnudum* A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 72. 1874.

Apache County to eastern Coconino County, 5,000 to 6,200 feet, dry hills and stream banks, May to August. Colorado and Utah to northern New Mexico and northeastern Arizona.

Sometimes known as Navajo-tea.

3. *Thelesperma longipes* A. Gray, Pl. Wright. 1: 109. 1852.

Chiricahua, Mustang, and Santa Catalina Mountains (Cochise, Santa Cruz, and Pima Counties), 5,000 to 6,000 feet, slopes and canyons, often on limestone, June to September. Western Texas to southeastern Arizona and northern Mexico.

Used as a substitute for tea in New Mexico, under the name cota.

Thelesperma simplicifolium A. Gray (*T. subsimplicifolium* A. Gray) is reported to occur in Arizona but has not been seen by the writer from west of Texas.

75. BIDENS.⁸⁹ SPANISH-NEEDLES

Annual or perennial herbs; leaves, at least the lower ones, opposite, entire to dissected; heads medium-sized to large, often showy, usually radiate and yellow, sometimes discoid or with white rays; involucre double as in *Coreopsis*; achenes linear-fusiform or linear to cuneate, more or less tetragonal or dorso-ventrally compressed; pappus of 2 to 4 retrorsely hispid awns, rarely wanting.

These plants are known also as bur-marigold, sticktight, pitchforks, beggarticks, and watermarigold, most of these names referring to the tendency of the awned fruits to adhere to clothing and the hair of animals.

Key to the species

1. Leaves sessile, serrate or serrulate, not lobed, lanceolate or lance-oblong; achenes narrowly cuneate, retrorse-hispidulous on the margin; rays 1.5 to 3 cm. long, bright yellow..... 1. *B. LAEVIS*.
1. Leaves petioled, pinnately or bipinnately divided (except in *B. aurea*); achenes linear or linear-fusiform, antrorsely pilose or hispidulous on the margin, or glabrous; rays usually smaller (2).
 2. Achenes not conspicuously elongate, usually little exceeding the involucre; inner phyllaries with conspicuous yellow margins half as wide as the brown center, or wider; rays yellow, conspicuous, 1 cm. long or longer (3).
 3. Leaves twice or thrice pinnatisect, the lobes narrowly linear, not more than 2 mm. wide..... 9. *B. FERULAEFOLIA*.
 3. Leaves lanceolate or oblong, serrate and not lobed, or pinnately parted into 3 or 5 lanceolate or linear divisions at least 6 mm. wide.
 10. *B. AUREA*.
 2. Achenes (at least the inner ones) conspicuously elongate (least so in *B. pilosa*), usually (including the awns) twice as long as the inner phyllaries; inner phyllaries with inconspicuous pale margins; rays wanting or inconspicuous, or if conspicuous, then white (4).
 4. Leaves all pinnately 3- or 5-parted, with lance-oblong to rhombic-ovate, serrate to incised divisions..... 2. *B. PILOSA*.
 4. Leaves all once or twice pinnately dissected (5).
 5. Outer and inner phyllaries more or less densely pilose or hirsute; heads campanulate; leaves 2 or 3 times dissected, into linear lobes.
 5. *B. TENUISSECTA*.
 5. Outer and inner phyllaries merely short-ciliate, rarely sparsely pilose (6).
 6. Heads (when normally developed) campanulate, more than 13-flowered (7).

⁸⁹ Reference: SHERFF, E. E. THE GENUS BIDENS. Field Museum Nat. Hist. Bot. Ser. 16: 1-709. 1937

7. Outer achenes only moderately shorter than the inner ones and not conspicuously broader; awns usually 3 or 4. 3. *B. BIPINNATA*.
7. Outer achenes conspicuously shorter and broader than the inner ones, usually not more than half their length; awns 2, sometimes 3.----- 4. *B. BIGELOVII*.
6. Heads cylindric or subcylindric, 5- to 13-flowered (8).
8. Leaf divisions filiform or narrowly linear (1 mm. wide or less); achenes glabrous; heads 5- to 9-flowered. 8. *B. HETEROSPERMA*.
8. Leaf divisions lanceolate or ovate to linear, usually more than 1 mm. wide (9).
9. Heads subsessile or short-peduncled; achenes glabrous; outer phyllaries linear-spatulate, 5 to 8 mm. long, or longer; leaf divisions mostly linear or linear-oblong, 1.5 to 3.5 mm. wide.----- 6. *B. LEMMONI*.
9. Heads long-peduncled; achenes antrorse-hispidulous above; outer phyllaries minute, slenderly subulate or filiform-subulate, less than 3 mm. long; leaf divisions broader, mostly lanceolate. 7. *B. LEPTOCEPHALA*.

1. *Bidens laevis* (L.) B. S. P., Torrey Bot. Club Mem. 5: 337. 1894.

Helianthus laevis L., Sp. Pl. 906. 1753.

Bidens chrysanthemoides Michx., Fl. Bor. Amer. 2: 136. 1803.

Bidens persicaefolia Greene, Pittonia 4: 266. 1901.

Known in Arizona only from the Bradshaw Mountains, southern Yavapai County (*Toumey* 680, type of *B. persicaefolia*), and the Santa Cruz River (*Pringle* in 1881). Massachusetts to Florida, Arizona, and California, south to South America.

2. *Bidens pilosa* L., Sp. Pl. 832. 1753.

Chiricahua, Huachuca, Patagonia, and Baboquivari Mountains (Cochise, Santa Cruz, and Pima Counties), 3,500 to 5,000 feet. Florida to California; tropical and subtropical regions of the world.

The typical form, with discoid heads, has been reported from Arizona but has not been seen by the writer. The principal Arizona form is var. *radiata* Schultz Bip. (*B. leucantha* (L.) Willd.), with 5 or 6 conspicuous white rays 7 to 15 mm. long. Other Arizona specimens are intermediate between var. *radiata* and the typical form, e. g., a collection in the Mule Mountains, Cochise County (*Harrison* and *Kearney* 6237).

3. *Bidens bipinnata* L., Sp. Pl. 832. 1753.

Mule and Huachuca Mountains (Cochise County), Tumacacori Mission (Santa Cruz County), 3,000 to 6,000 feet, rich alluvial soil, August and September. Rhode Island to Kansas, southeastern Arizona, and California, southward to South America; also in the Old World.

Specimens from Arizona closely approach the preceding and the next following species.

4. *Bidens bigelovii* A. Gray in Torr., U. S. and Mex. Bound. Bot. 91. 1859.

Sierra Ancha (Gila County), Chiricahua and Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), about 6,000 feet, stream banks and moist shady places, July to October. Colorado to western Texas, New Mexico, Arizona, and Sonora.

5. *Bidens tenuisecta* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 86. 1849.

Bidens cognata Greene, Leaflets 1: 149. 1905.

Near Flagstaff (Coconino County), Chiricahua Mountains (Cochise County), Santa Catalina Mountains (Pima County), 6,000 to 8,000 feet, oak chaparral and open pine forests, July to October. Idaho to western Texas, New Mexico, Arizona, and Chihuahua.

6. *Bidens lemmoni* A. Gray, Syn. Fl. 1²: 297. 1884.

Chiricahua and Huachuca Mountains (Cochise County), Patagonia Mountains (Santa Cruz County), Santa Rita Mountains (Pima County), about 6,000 feet, September and October, type from Apache Pass (*Lemmon* in 1881). Southern Arizona and Mexico.

7. *Bidens leptcephala* Sherff, Bot. Gaz. 64: 22. 1917.

Apache, Cochise, Santa Cruz, and Pima Counties, 5,000 to 6,000 feet, mostly along streams, preferring shaded sandy soil, August to October, type from the Chiricahua Mountains (*Blumer* 1712). Western Texas to Arizona, Chihuahua, and Baja California.

8. *Bidens heterosperma* A. Gray, Pl. Wright. 2: 90. 1853.

San Francisco Peaks, Coconino County (*Knoulton* 157), Chiricahua Mountains, Cochise County (*Harrison* and *Kearney* 6193), Patagonia Mountains, Santa Cruz County (*Kearney* and *Peebles* 10078), 6,000 to 8,000 (?) feet, September. Southern Colorado to New Mexico, Arizona, and northern Mexico.

9. *Bidens ferulaefolia* (Jacq.) DC., Prodr. 5: 603. 1836.

Coreopsis ferulaefolia Jacq., Pl. Hort. Schoenbr. 3: 65. 1798.

Bidens procera D. Don, Bot. Reg. 8: pl. 684. 1822.

Chiricahua and Huachuca Mountains, Cochise County (*Lemmon* in 1881, *Wilcox* 398), Sonoita Valley, Santa Cruz County (*Rothrock* 671), August and September. Southeastern Arizona to Guatemala.

10. *Bidens aurea* (Ait.) Sherff, Bot. Gaz. 59: 313. 1915, as to synonym only.⁹⁰

Coreopsis aurea Ait., Hort. Kew 3: 252. 1789.

Bidens heterophylla Ortega, Hort. Matr. Dec. 99. 1798.

Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, moist sandy soil along streams, spring and autumn. Southern Arizona to Guatemala; adventive or naturalized in France and Italy.

The poorly distinguished var. *wrightii* (A. Gray) Sherff has narrowly lance-linear leaves only 6 to 8 mm. wide, these entire or divided into entire or subentire lance-linear lobes.

76. COSMOS⁹¹

Slender annual; leaves opposite, dissected into narrow lobes; heads medium-sized, terminal, the rays white or rosy, the disk yellow; involucre double, as in *Coreopsis* and *Bidens*; achenes fusiform, slender-beaked; pappus of 2 to 4 retrorse-hispid awns.

Two species of cosmos, *C. bipinnatus* with white to crimson rays and *C. sulphureus* with yellow rays, are common in cultivation.

⁹⁰ See SHERFF, EARL EDWARD. STUDIES IN THE GENUS *BIDENS* VII. Bot. Gaz. 81: 25-54. 1926. (See p. 42.)

⁹¹ Reference: SHERFF, E. E. REVISION OF THE GENUS *COSMOS*. Field Museum Nat. Hist. Bot. Ser. 8) 401-447. 1932.

1. *Cosmos parviflorus* (Jacq.) H. B. K., Nov. Gen. et Sp. 4: 241. 1820.

Coreopsis parviflora Jacq., Pl. Hort. Schoenbr. 3: 65. 1798.

Near Flagstaff and on the Mogollon Escarpment (Coconino County), and from the Chiricahua to the Santa Rita Mountains (Cochise, Santa Cruz, and Pima Counties), apparently rare in northern Arizona, 4,000 to 7,500 feet, hillsides and canyons, sometimes in cultivated land, July to October. Southeastern Colorado to southwestern Texas, Arizona, and Mexico.

77. BEBBIA

An intricately branched shrub with slender branches; leaves few, linear, the lower ones opposite; heads yellow, discoid, solitary or few and terminal; involucre strongly graduated; achenes somewhat compressed; pappus of about 20 plumose bristlelike awns.

1. *Bebbia juncea* (Benth.) Greene, Calif. Acad. Sci. Bul. 1: 180. 1885.

Carphephorus junceus Benth., Bot. Voy. Sulph. 21. 1844.

Grand Canyon (Coconino County) and Mohave County to Pima and Yuma Counties, up to 4,000 feet, dry slopes and washes, flowering most of the year. Arizona, southern Nevada and California, and northwestern Mexico.

The plant is a shrub with rushlike branches. The typical form, with glabrous stems, is less common in Arizona than var. *aspera* Greene (*B. aspera* A. Nels.) which has the stems more or less hispidulous with usually tuberculate-based, often deciduous hairs.

78. GALINSOGA ⁹²

Annual herbs; leaves opposite, narrowly lanceolate or the lower leaves lance-ovate, toothed, petioled; heads small, radiate, the rays white, very small, the disk yellow; achenes small, obovoid, somewhat thickened; pappus of the disk flower of about 20 fimbriate subequal squamellae or paleae, in the ray flowers reduced or wanting, in a rare variety wanting in both rays and disk.

1. *Galinsoga semicalva* (A. Gray) St. John and White, Rhodora 22: 100. 1920.

Galinsoga parviflora var. *semicalva* A. Gray, Pl. Wright. 2: 98. 1853.

Mountains of Cochise and Pima Counties, 5,300 to 8,100 feet, rich soil in shade, September and October. Southern New Mexico and Arizona, and northern Mexico.

In the typical form the disk achenes are finely hispidulous and bear a pappus of about 20 blunt fringed squamellae or paleae nearly as long as the corolla, and the ray achenes are glabrous or usually somewhat hispidulous above on the inner face, and bear a reduced pappus or none. In var. *percalva* Blake, known only from the Santa Rita Mountains, Pima County (*Griffiths* and *Thorner* 162, type), both ray and disk achenes are glabrous and epappose.

⁹² Reference: ST. JOHN, HAROLD, and WHITE, DONALD. THE GENUS GALINSOGA IN NORTH AMERICA. Rhodora 22: 97-101. 1920.

79. HEMIZONIA. TARWEED

Annual herbs; leaves all or mostly alternate, pinnatifid to entire, sometimes spinescent; heads small or medium-sized, radiate, yellow, sometimes leafy-bracted; phyllaries in a single series, each partly enclosing a ray achene in its enfolded base; ray achenes much thickened, epappose, tipped with a very short oblique beak; disk achenes all or mostly sterile, epappose or with a pappus of several often connate squamellae or paleae.

Key to the species

1. Leaves and their lobes with spinescent tips; heads involucrate by spinose-tipped bracts; receptacle paleaceous throughout; disk achenes epappose.
 1. *H. PUNGENS.*
1. Leaves and their lobes not spinescent-tipped; heads not involucrate; pales of the receptacle in a single row, connate into a cup; disk achenes with pappus----- 2. *H. KELLOGGII.*

1. **Hemizonia pungens** (Hook. and Arn.) Torr. and Gray, Fl. North Amer. 2: 399. 1843.

Hartmannia (?) *pungens* Hook. and Arn., Bot. Beechey Voy. 357. 1840.

Centromadia pungens Greene, Man. Bot. San Francisco Bay 196. 1894.

Santa Cruz River bottoms, Tucson, Pima County (*Thornber*, May 1903). California; a casual introduction in Arizona. This collection was originally reported⁹³ as *Hemizonia fitchii* A. Gray.

2. **Hemizonia kelloggii** Greene, Torrey Bot. Club Bul. 10: 41. April 1883.

Hemizonia wrightii A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 17. October 1883.

"Common around habitations on mesas," Tucson, Pima County (*Thornber* in 1903 [no. 386] and in 1905). California; introduced in Arizona.

Two of the three sheets examined are true *H. kelloggii*, with the pappus squamellae partly united into a tube; the other (no. 386) has the squamellae mostly free, and represents the form described as *H. wrightii* A. Gray.

80. LAYIA

Plant low, annual, pubescent and stipitate-glandular; leaves lanceolate or linear, mostly alternate, the lower ones pinnatifid or incised, the upper leaves entire; heads terminal, showy, the rays white, the disk yellow; receptacle with a series of thin pales between the rays and the outer disk flowers, otherwise naked; ray achenes glabrous, epappose; disk achenes pubescent, their pappus of about 10 stout villous bristles, the hairs on their outer side straight, on the inner entangled into a woolly mass.

⁹³ THORNBER, J. J., in SPALDING, V. M. DISTRIBUTION AND MOVEMENTS OF DESERT PLANTS. Carnegie Inst. Wash. Pub. 113: 112. 1909.

1. *Layia glandulosa* (Hook.) Hook. and Arn., Bot. Beechey Voy. 358. 1840.

Blepharipappus glandulosus Hook., Fl. Bor. Amer. 1: 316. 1834.

Navajo County to Mohave County, south to Santa Cruz and Pima Counties, up to 5,000 feet, dry slopes and mesas, not abundant, March to June. Idaho and British Columbia to southwestern New Mexico and Baja California.

Plant handsome in flower, with pure white rays.

81. PSILOSTROPHE

Herbs or shrubs, more or less woolly; leaves alternate, entire or the lower ones pinnatifid; heads small, radiate, yellow; receptacle naked; rays persistent, becoming papery; achenes slender; pappus of 4 to 6 hyaline paleae.

Key to the species

1. Stem and branches densely pannose-tomentose with white wool; leaves linear or narrowly linear-lanceolate, entire; plant definitely shrubby; heads mostly solitary at the tips of the branches, slender-peduncled. 1. *P. COOPERI*.
1. Stems and branches not pannose-tomentose; leaves (at least the basal ones) usually spatulate to obovate; plants herbaceous (2).
2. Stem and leaves rather densely lanate or tomentose; heads in close cymose clusters at the tips of the stem and branches.----- 2. *P. TAGETINAE*.
2. Stem and leaves green, thinly pilose or pilosulous; heads usually scattered or in loose cymes----- 3. *P. SPARSIFLORA*.

1. *Psilostrophe cooperi* (A. Gray) Greene, Pittonia 2: 176. 1891.

Riddellia cooperi A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 358. 1868.

Mohave and Yavapai Counties to Graham, Pima, and Yuma Counties, 2,000 to 5,000 feet, mesas and plains, common, flowering throughout the year, type from Fort Mohave (*Cooper* in 1861). Southern Utah (and southwestern New Mexico?) to southern California and northern Baja California.

Plant showy and handsome in flower.

2. *Psilostrophe tagetinae* (Nutt.) Greene, Pittonia 2: 176. 1891, as *P. tagetina*.

Riddellia tagetinae Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 371. 1841.

Psilostrophe tagetina var. *lanata* A. Nels., Biol. Soc. Wash. Proc. 16: 22. 1903.

Psilostrophe lanata Prain, Index Kew. Suppl. 3: 145. 1908.

Apache, Navajo, Coconino, Greenlee, and Cochise Counties, 4,000 to 7,000 feet, open plains and mesas, and yellow pine forests, April to October. Western Texas (and southern Colorado?) to Arizona and Chihuahua.

It is reported that sheep are sometimes fatally poisoned by this plant.

3. *Psilostrophe sparsiflora* (A. Gray) A. Nels., Biol. Soc. Wash. Proc. 16: 23. 1903.

Riddellia tagetina var. *sparsiflora* A. Gray, Syn. Fl. 1²: 318. 1884.

Psilostrophe divaricata Rydb., North Amer. Fl. 34: 8. 1914.

Psilostrophe grandiflora Rydb., *ibid.*

Apache County to eastern Mohave County and in Cochise County, 4,300 to 7,300 feet, dry mesas, slopes, and open pine forests, abundant in places, May to September, type of *P. divaricata* from the Grand Canyon (*D. T. Allen* in 1897), type of *P. grandiflora* from near Paradise, Cochise County (*Blumer* 1709). Utah, New Mexico, Arizona, and Chihuahua.

82. BAILEYA. DESERT-MARIGOLD

Low floccose-woolly herbs; leaves alternate, pinnatifid to entire; heads solitary or cymose, long-peduncled, radiate, yellow; rays persistent, becoming papery, reflexed in age; achenes striate, epappose.

Key to the species

1. Rays 5 to 7; heads loosely cymose toward the tips of the branches, relatively small, the disk in flower 6 mm. thick or less..... 1. B. PAUCIRADIATA.
1. Rays about 20 to 50; heads mostly solitary at the tips of the stem and branches, larger, the disk in flower at least 10 mm. thick (2).
2. Stem leafy only at base or below the middle, the peduncles 10 to 20 cm. long..... 2. B. MULTIRADIATA.
2. Stem leafy to above the middle or nearly to the apex, the peduncles 10 cm. long or less..... 3. B. PLENIRADIATA.

1. *Baileya pauciradiata* Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 105. 1849.

Aztec to Yuma (Yuma County), 500 feet or lower, sandy deserts, March to May (sometimes October). Southwestern Arizona, southeastern California, and adjacent Sonora and Baja California.

2. *Baileya multiradiata* Harv. and Gray ex Torr. in Emory, Mil. Recon. 144. 1848.

Baileya multiradiata var. *nudicaulis* A. Gray, Syn. Fl. 1²: 318. 1884.

Mohave County to Graham, Cochise, Santa Cruz, Pima, and Yuma Counties, up to 5,000 feet, very common on sandy plains and mesas, especially at roadsides, March to October. Western Texas to southern Utah and Nevada, southeastern California, and Chihuahua.

The large flower heads are very showy and this or a similar species is sometimes cultivated in California for the flower trade. It is stated that horses crop the heads, but fatal poisoning of sheep and goats eating this plant on overgrazed ranges has been reported.

3. *Baileya pleniradiata* Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 105. 1849.

Baileya multiradiata pleniradiata Coville, Contrib. U. S. Natl. Herbarium 4: 133. 1893.

Baileya pleniradiata var. *perennis* A. Nels., Bot. Gaz. 47: 431. 1909.

Baileya perennis Rydb., North Amer. Fl. 34: 10. 1914.

Mohave County to Cochise, Pima, and Yuma Counties, 200 to 5,000 feet, plains and mesas, common in southwestern Arizona,

March to November. Western Texas to southern Utah and Nevada, southeastern California, and northern Mexico.

Not always readily distinguishable from *B. multiradiata*.

83. PERITYLE

Herbaceous or suffruticulose, not woolly; leaves toothed or dissected, the lower ones opposite; heads small, radiate, the rays white; achenes strongly compressed, strongly ciliate on the margin, usually with a narrow callous margin; pappus of 1 or 2 awns and a crown of squamellae.

Key to the species

1. Plants annual, conspicuously stipitate-glandular above (2).
2. Achenes without an evident callous margin----- 1. *P. EMORYI*.
2. Achenes with a conspicuous callous margin----- 2. *P. MICROGLOSSA*.
1. Plants perennial, many-stemmed, cinereous-puberulent above, not obviously glandular (3).
3. Leaves triangular in outline, ternately lobed or dissected.
 5. *P. CORONOPIFOLIA*.
3. Leaves ovate, merely toothed (4).
4. Leaves not impressed-punctate beneath----- 3. *P. SPILANTHOIDES*.
4. Leaves strongly impressed-punctate beneath----- 4. *P. CILIATA*.

1. *Perityle emoryi* Torr. in Emory, Mil. Recon. 142. 1848.

Mohave, southern Yavapai, Maricopa, Pinal, and Yuma Counties, up to 3,000 feet, common on rocky slopes and cliffs, February to October. Southwestern Arizona, southern California, and northwestern Mexico.

The typical form has a pappus of squamellae and a slender awn. In var. *nuda* (Torr.) A. Gray the awn is wanting.

2. *Perityle microglossa* Benth., Bot. Voy. Sulph. 119. 1845.

Perityle microglossa var. *effusa* A. Gray, Syn. Fl. 1²: 322. 1884.

Perityle effusa Rose, Contrib. U. S. Natl. Herbarium 1: 104. 1891.

Apparently known to occur in Arizona only in the Santa Catalina Mountains (Pima County), where the type of var. *effusa* was collected (Pringle in 1882). Southwestern Texas, southern Arizona (and southern California?).

Perityle plumigera Harv. and Gray, a species of Sonora and Sinaloa, has been doubtfully recorded from Arizona on the basis of the not definitely localized original collection by Coulter. It is distinguished from *P. microglossa* by its single pappus awn, longer than the achene and plumose above (in *P. microglossa* the pappus of 2 short awns).

*3. *Perityle spilanthisoides* (Schultz Bip.) Rydb., North Amer. Fl. 35: 17. 1914.

Galinsogeopsis spilanthisoides Schultz Bip. in Seem., Bot. Voy. Herald 307. 1856.

Perityle microcephala A. Gray, Amer. Acad. Arts and Sci. Proc. 21: 391. 1886.

Reported as occurring in Arizona, known otherwise only from northern Mexico.

4. **Perityle ciliata** (L. H. Dewey) Rydb., North Amer. Fl. 34: 17. 1914.

Laphamia ciliata L. H. Dewey, Bot. Gaz. 20: 425. 1895.

Coconino, Yavapai, Gila, and Pima Counties, 3,000 to 7,000 feet, rocky slopes, May to November, type from near Pine, Gila County (*MacDougal* 676). Known only from central and southern Arizona.

Perityle ciliata may be only a stunted form of *P. spilanthoides*, with fewer and rather larger, shorter-peduncled heads and thicker leaves with conspicuously immersed glands.

5. **Perityle coronopifolia** A. Gray, Pl. Wright. 2: 82. 1853.

Laphamia coronopifolia Hemsl., Biol. Cent. Amer. Bot. 2: 210. 1881.

Mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 7,500 feet, among rocks and on cliffs, often on limestone, June to October. Southern New Mexico, southern Arizona (and Chihuahua?).

84. LAPHAMIA

Plants low, suffruticulose; leaves toothed, lobed, or parted, rarely entire, at least the lower ones opposite; heads small or medium-sized, radiate or discoid, yellow or the rays white; achenes strongly compressed, not ciliate, rarely callous-margined; pappus of 1 or 2 bristle-like awns, or wanting.

Key to the species

1. Leaves entire or merely toothed (2).
 2. Principal leaves spatulate or oblanceolate, varying to elliptic-ovate, usually entire..... 1. *L. TOUMEYI*.
 2. Principal leaves ovate, usually toothed (3).
 3. Stem hirtellous; leaf blades not more than 8 mm. wide, repandly 3- to 5-toothed..... 2. *L. CONGESTA*.
 3. Stem short-pilose or pilosulous; leaf blades mostly 10 to 18 mm. wide, sharply several-toothed..... 3. *L. PALMERI*.
1. Leaves lobed or parted (4).
 4. Heads radiate; stem essentially glabrous (5).
 5. Rays white; larger leaves 3-parted, with short ovate or oblong segments..... 4. *L. GILENSIS*.
 5. Rays yellow; leaves dissected into elongate linear or filiform divisions..... 5. *L. SAXICOLA*.
 4. Heads discoid; stem pilosulous to villous (6).
 6. Leaves pedately 3-parted or 3-lobed with relatively broad chiefly entire divisions, these up to 2.5 mm. wide..... 6. *L. GRACILIS*.
 6. Leaves lobed or pedately parted, with numerous small ultimate divisions..... 7. *L. DISSECTA*.

1. **Laphamia toumeyii** Robins. and Greenm., Amer. Jour. Sci. ser. 3, 50: 176. 1895.

Monothrix toumeyii Rydb., North Amer. Fl. 34: 20. 1914.

Grand Canyon (Coconino County), both rims, 5,000 to 7,000 feet, dry ground among rocks, June to October, type from the Grand Canyon (*Toumey* in 1892). Known only from northern Arizona.

2. **Laphamia congesta** M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 703. 1895.

Monothrix congesta Rydb., North Amer. Fl. 34: 20. 1914.

Northern Coconino County and northern Mohave County, 6,200 to 7,000 feet, clefts of rocks, June to September, type from below the

"Buckskin Mountains," Kaibab Plateau (*Jones* 6063). Known only from northern Arizona.

3. *Laphamia palmeri* A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 372. 1878.

Monothrix palmeri Rydb., North Amer. Fl. 34: 21. 1914.

Beaver Dam, Mohave County (*Palmer*, in 1877?, the type collection), about 2,000 feet, rocky canyons, July and probably later. Southern Utah and northwestern Arizona.

The var. *tenella* M. E. Jones, from crevices of sandstone rocks at Springdale, Utah, distinguished by its loosely villous stems, may occur in Arizona.

4. *Laphamia gilensis* M. E. Jones, Zoe 2: 15. 1891.

Leptopharynx gilensis Rydb., North Amer. Fl. 34: 24. 1914.

Laphamia arizonica Eastw., Calif. Acad. Sci. Proc. ser. 4, 20: 159. 1931.

Laphamia dura A. Nels., Amer. Jour. Bot. 23: 266. 1936.

Southern Gila, northeastern Pinal, and eastern Maricopa Counties, about 2,500 feet, clefts in rocks in canyons, April to October, type from Putnam Ranch (*Jones* in 1890), type of *L. arizonica* from Fish Creek (*Eastwood* 8753), type of *L. dura* from Canyon Lake (*A. Nelson* 10323). Known only from south-central Arizona.

5. *Laphamia saxicola* Eastw., Calif. Acad. Sci. Proc. ser. 4, 20: 159. 1931.

Near Roosevelt Dam, Gila and Maricopa Counties, about 2,500 feet (*Eastwood* 17401, the type collection, *Peebles* 9420), the stems hanging from crevices of cliffs, May and doubtless later. Known only from south-central Arizona.

6. *Laphamia gracilis* M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 703. 1895.

Perityle gracilis Rydb., North Amer. Fl. 34: 19. 1914, as to synonymy.

Nagle Ranch, Kaibab Plateau, 7,000 feet (*Jones* 6050c, type), September. Southern Nevada and northern Arizona.

The type collection is a real *Laphamia* as here taken (*Monothrix* of Rydberg), and the plant described under the name *Perityle gracilis* by Rydberg is a coarse form of *Perityle coronopifolia* A. Gray.

7. *Laphamia dissecta* Torr. in A. Gray, Pl. Wright. 2: 81. 1853.

Laphamia lemmoni A. Gray, Amer. Acad. Arts and Sci. Proc. 16: 101. 1880.

Laphamia lemmoni var. *pedata* A. Gray, Syn. Fl. 1²: 319. 1884.

Perityle dissecta A. Gray, *ibid.* p. 320.

Leptopharynx dissecta Rydb., North Amer. Fl. 34: 24. 1914.

Leptopharynx lemmoni Rydb., *ibid.*

Mountains of Graham, Cochise, and Pima Counties, 3,000 to 4,600 feet, crevices of cliffs, May to October, types of *L. lemmoni* and *L. lemmoni* var. *pedata* from near Camp Lowell, Pima County (*Lemmon* in 1880). Southwestern Texas to southeastern Arizona.

85. PERICOME

Perennial herb, branched, puberulent; leaves opposite, hastate-triangular, caudate-acuminate; heads numerous, cymose-panicled, discoid, yellow; phyllaries lightly connate into a cup; achenes narrow-oblong, strongly compressed, villous-ciliate; pappus a crown of lacerate-ciliate squamellae, sometimes with 1 or 2 awns.

1. *Pericome caudata* A. Gray, Pl. Wright. 2: 82. 1853.

Mountains of Apache, Navajo, Coconino, Graham, Cochise, and Pima Counties, 6,000 to 9,000 feet, rich soil in coniferous forests, locally abundant, July to October. Southern Colorado and New Mexico to southern Nevada, California, and Chihuahua.

86. BAERIA

Low slender annual, slightly pubescent; leaves opposite, linear, entire; heads small, terminal, radiate, yellow; receptacle conical; achenes linear-clavate, 4-angled; pappus none, or of 2 to 5 lanceolate awns.

1. *Baeria chrysostoma* Fisch. et Mey., Index Sem. Hort. Petrop. 2: 29 (reprint 2: 4). 1836.

The only form occurring in Arizona is var. *gracilis* (DC.) Hall, characterized by pubescent achenes with a pappus of 2 to 5 lanceolate awns. Western Gila, Maricopa, Pinal, Cochise, and Pima Counties, 1,500 to 3,500 feet, mesas and plains, March to May. Central and southern Arizona to Oregon, California, and Baja California.

Goldfields. In spring extensive areas are sometimes carpeted with the bright yellow flowers of this plant, which is reported to be cropped by horses.

87. FLAVERIA⁹⁴

Low glabrous annual, dichotomously branched; leaves opposite, lanceolate, toothed, 3-nerved; heads very small, 1- or 2-flowered, densely glomerate, the glomerules sessile in the forks and terminal; phyllaries 1 or 2; ray solitary or none; achenes oblong, 8- to 10-ribbed, glabrous, epappose.

1. *Flaveria trinervia* (Spreng.) C. Mohr, Contrib. U. S. Natl. Herbarium 6: 810. 1901.

Oedera trinervia Spreng., Bot. Gart. Halle 63. 1800.

Flaveria repanda Lag., Gen. et Sp. Pl. 33. 1816.

Southern Yavapai and Pinal Counties (probably elsewhere), 1,200 to 4,000 feet, moist soil at roadsides and on ditch banks, May to November. Florida and Alabama to southern Arizona, southward to South America, probably not indigenous in the United States.

88. SYNTRICHOPAPPUS

Dwarf floccose-woolly winter annual; leaves mostly alternate, spatulate to linear, often 3-lobed at tip; heads small, yellow, radiate, solitary at the tips of the branches; paleae of the pappus dissected into numerous bristles, these united only at base.

⁹⁴ Reference: JOHNSTON, J. R. A REVISION OF THE GENUS FLAVERIA. Amer. Acad. Arts and Sci. Proc. 39 (Gray Herbarium Contrib. 26): 279-292. 1903.

1. *Syntrichopappus fremontii* A. Gray in Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 106. 1857.

Peach Springs to Oatman (Mohave County), 3,500 to 5,000 feet, mesas and rocky slopes, March to June. Southern Utah and Nevada, western Arizona, and southern California.

89. SCHKUHRIA

Slender branching annuals; leaves opposite or alternate, pinnately parted into filiform lobes, or entire; heads small, few-flowered, discoid or with 1 ray; achenes obpyramidal, 4-angled; pappus of 8 scarios paleae or squamellae.

Key to the species

1. Paleae of the pappus all very obtuse, subequal..... 1. *S. WRIGHTII*.
 1. Paleae of the pappus, at least in part, awned (2).
 2. Paleae essentially equal in length, all usually short-awned. 2. *S. HOPKIRKIA*.
 2. Paleae very unequal, 4 of them short-awned, the others shorter and very blunt..... 3. *S. WISLIZENI*.

1. *Schkuhria wrightii* A. Gray, Pl. Wright. 2: 95. 1853.

Tetracarpum wrightii Rydb., North Amer. Fl. 34: 44. 1914.

Cochise and Santa Cruz Counties, 4,300 to 6,000 feet, mesas and slopes, August to October. Southwestern New Mexico, southeastern Arizona, and northern Mexico.

2. *Schkuhria hopkirkia* A. Gray, Pl. Wright. 2: 94. 1853.

Hopkirkia anthemoidea DC., Prodr. 5: 660. 1836.

Schkuhria anthemoides (sic) Coult. in J. D. Smith, Enum. Pl. Guat. 4: 93. 1895. Not Wedd., 1855-56.

Tetracarpum anthemoideum Rydb., North Amer. Fl. 34: 45. 1914.

Chiricahua and Huachuca Mountains (Cochise County), about 5,500 feet, mesas and slopes, July to October. Southeastern Arizona to southern Mexico.

3. *Schkuhria wislizeni* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 96. 1849.

Tetracarpum wislizeni Rydb., North Amer. Fl. 34: 45. 1914.

Chiricahua and Mule Mountains (Cochise County), about 6,000 feet, ridges and slopes, August and September. Southeastern Arizona and Chihuahua.

90. HYMENOPAPPUS⁹⁵

Tomentose herbs; leaves alternate, pinnatifid to dissected, or the lowest leaves in one species entire, often all or most of them basal; heads usually several, cymose, medium-sized, usually discoid, yellow or white, in 1 species with conspicuous white rays; involucre of 6 to 12 equal, oblong or oval, scarios-margined phyllaries; achenes obpyramidal, 4- or 5-angled, pubescent, often villous; pappus of 10 to 20 mostly obtuse scarios paleae or squamellae.

The root of *H. lugens* is reported to be used by the Hopi as an emetic and in treating toothache.

⁹⁵ Reference: JOHNSTON, I. M. DIAGNOSES AND NOTES RELATING TO THE SPERMATOPHYTES CHIEFLY OF NORTH AMERICA. Gray Herbarium Contrib. 68: 80-104. 1923. (See pp. 92-98.)

Key to the species

1. Heads radiate, the rays white, conspicuous----- 1. *H. RADIATUS*.
1. Heads discoid (2).
2. Leaves entire and oblanceolate or obovate, or once pinnatifid with comparatively broad segments, these 2 to 6 mm. wide---- 2. *H. MEXICANUS*.
2. Leaves once to thrice pinnatifid, with narrowly linear or linear-filiform segments (3).
3. Plant biennial, single-stemmed, tall, 30 to 80 cm. high, leafy-stemmed, the stem leaves numerous, at least the lower ones not conspicuously smaller than the basal leaves; corolla teeth more than half as long as the throat----- 3. *H. ROBUSTUS*.
3. Plants perennial, usually several-stemmed, lower, rarely more than 30 cm. high; corolla teeth one-third to one-fourth as long as the throat (4).
4. Plant scapose or subscapose, rarely with 2 or 3 stem leaves.
4. Plant leafy-stemmed----- 4. *H. LUGENS*.
5. *H. PAUCIFLORUS*.

1. *Hymenopappus radiatus* Rose, Contrib. U. S. Natl. Herbarium 1: 122. 1891.

Southern Apache, Navajo, and Coconino Counties, 5,000 to 7,000 feet, pine forests and open flats, May to July, type from Willow Spring, Apache County (*Palmer* 615 in 1890). New Mexico and Arizona.

2. *Hymenopappus mexicanus* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 29. 1883.

Hymenopappus integer Greene, Pittonia 3: 249. 1897.

Hymenopappus obtusifolius Heller, Torrey Bot. Club Bul. 26: 551. 1899.

Hymenopappus petaloideus Rydb., North Amer. Fl. 34: 54. 1914.

White Mountains (Apache and Navajo Counties), San Francisco Peaks (Coconino County), south to the mountains of Cochise and Pima Counties, 5,000 to 10,000 feet, open coniferous forests, common, June to September, type of *H. obtusifolius* from Fort Valley, near Flagstaff (*MacDougal* 240), type of *H. petaloideus* from the Chiricahua Mountains (*Blumer* 1202). Western Texas to Arizona and Mexico.

3. *Hymenopappus robustus* Greene, Torrey Bot. Club Bul. 9: 63. 1882.

Apache, Navajo, Coconino, Graham, and Gila Counties, 3,500 to 6,500 feet, mesas and slopes, April to September. Texas to central Arizona and northern Mexico.

4. *Hymenopappus lugens* Greene, Pittonia 4: 43. April 1899.

Hymenopappus gloriosus Heller, Torrey Bot. Club Bul. 26: 551. October 1899.

Hymenopappus scaposus Rydb., Torrey Bot. Club Bul. 27: 634. 1900.

Hymenopappus macroglottis Rydb., *ibid.* p. 636.

Apache County to eastern Mohave County, south to Santa Cruz County, 5,000 to 7,000 feet, dry rocky slopes and mesas, usually with pines or junipers, common, May to September, type of *H. gloriosus* from Mormon Mountain, Coconino County (*MacDougal* 71), type of *H. scaposus* from near Flagstaff (*MacDougal* 129), type of *H. macroglottis* from Oak Creek (*Rusby* in 1883). Colorado to Nevada, Arizona, and southern California.

5. *Hymenopappus pauciflorus* I. M. Johnston, Gray Herbarium Contrib. 68: 97. 1923.

Northern Apache and Navajo Counties and eastern Coconino County, 5,000 to 6,200 feet, dry mesas and slopes, June to September. Southern Utah and northeastern Arizona.

91. HYMENOTHRIX

Slender annual or perennial herbs, slightly pubescent; leaves alternate, dissected into narrow divisions; heads numerous, cymose-panicled, radiate or discoid, yellow, white, or purple; achenes narrowly obpyramidal, 4- or 5-angled; pappus of 12 to 20 lanceolate hyaline paleae, the costa prolonged into an awn.

Key to the species

1. Heads radiate, definitely yellow----- 1. *H. wislizeni*.
 1. Heads discoid, purple, white, whitish, or pale yellow (2).
 2. Petioles incurved-puberulent; lobes of the disk corollas about as long as the throat or a little longer----- 2. *H. loomisii*.
 2. Petioles (at least the lower ones) spreading-hirsute; lobes of the disk corollas several times longer than the very short throat----- 3. *H. wrightii*.

1. *Hymenothrix wislizeni* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 102. 1849.

Hymenopappus wislizeni var. *setiformis* M. E. Jones, Contrib. West. Bot. 12: 47. 1908.

Cochise, Santa Cruz, Pima, and Pinal Counties, 2,400 to 5,500 feet, plains, mesas, and washes, preferring sandy soil, June to December, type of var. *setiformis* from Oracle, Pinal County (*Jones* in 1903). Southern New Mexico, southern Arizona, and northern Mexico.

2. *Hymenothrix loomisii* Blake, Biol. Soc. Wash. Proc. 40: 49. 1927.

Hutchinsonia hyalina M. E. Jones, Contrib. West. Bot. 18: 85. 1933.

Kingman (Mohave County) to eastern and southern Yavapai County, 4,000 to 5,000 feet, mesas and plains, often abundant at roadsides, June to October, type of *H. loomisii* from Ash Fork (*Loomis* 3241), type of *Hutchinsonia hyalina* from Peach Springs (*Mrs. Susan W. Hutchinson* in 1932). Known only from central Arizona.

3. *Hymenothrix wrightii* A. Gray, Pl. Wright. 2: 97. 1853.

Hymenopappus wrightii H. M. Hall, Calif. Univ. Pub. Bot. 3: 179. 1907.

Trichymenia wrightii Rydb., North Amer. Fl. 34: 56. 1914.

Eastern Mohave and northern Yavapai Counties to Graham, Cochise, Santa Cruz, and Pima Counties, 4,000 to 8,000 feet, mostly in the scrub-oak and yellow-pine belts, June to November. Southern New Mexico, central and southern Arizona, southern California, and northwestern Mexico.

92. PALAFOXIA

Annual (or perennial?) herb; leaves mostly alternate, linear or lanceolate, entire; heads 2 to 2.8 cm. high, discoid, flesh-colored or whitish; achenes slender, linear-tetragonal, about 1 cm. long; pappus of 4 or 5 linear paleae with an excurrent nerve, or reduced in some of the flowers.

1. *Palafoxia linearis* (Cav.) Lag., Gen. et Sp. Pl. 26. 1816.

Ageratum lineare Cav., Icon. Pl. 3: 3. 1795.

Northern Mohave and western Maricopa Counties to southern Yuma County, up to 2,000 feet, sandy plains and mesas, February to November. Southern Utah, southern Nevada, western Arizona, southeastern California, and northern Mexico.

A large coarse form, var. *gigantea* M. E. Jones (var. *arenicola* A. Nels.), 1 to 2 m. high, with larger leaves and heads (the involucre 1.5 to 2 cm. high, the achenes 1.5 to 1.8 cm. long), occurs on sand dunes in the vicinity of Yuma.

This plant, known in California as Spanish-needles, apparently is rapidly spreading eastward along highways in Arizona.

93. ERIOPHYLLUM.⁹⁶ WOOLLY-DAISY

Tomentose herbs or shrubs; leaves alternate or opposite, entire to bipinnatifid; heads small, radiate or discoid, yellow or the rays sometimes white or rosy; achenes slender, 4- or 5-angled; pappus of 4 to 12 squamellae or paleae, rarely wanting.

Key to the species

1. Suffrutescent, up to 0.5 m. high; leaves pinnatifid or bipinnatifid with very narrow segments; heads cymosely clustered, pedicellate, radiate, yellow.
 1. *E. CONFERTIFLORUM.*
1. Dwarf annuals; leaves entire, or few-toothed or -lobed (2).
 2. Heads clustered at the tips of the stem and branches, sessile; pappus of laciniate squamellae (sometimes wanting in the disk flowers); anther tips obtuse (3).
 3. Rays present----- 2. *E. MULTICAULE.*
 3. Rays wanting----- 3. *E. PRINGLEI.*
 2. Heads solitary at the tips of the stem and branches, pedunculate; pappus of entire or merely erose squamellae; anther tips elongate, linear-subulate (4).
 4. Rays yellow; squamellae of the pappus equal, short, very blunt, opaque, sometimes wanting----- 4. *E. WALLACEI.*
 4. Rays white or rosy; squamellae or paleae of the pappus unequal, the longer ones nearly as long as the corolla, lanceolate, acuminate or awned, not opaque----- 5. *E. LANOSUM.*

*1. *Eriophyllum confertiflorum* (DC.) A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 25. 1883.

Bahia confertiflora DC., Prodr. 5: 657. 1836.

Dry hills, central California to Baja California and northern Mexico (reported from Arizona), April to September.

Eriophyllum confertiflorum is a variable species, divided into several by Rydberg, who uses the name *E. tenuifolium* (DC.) Rydb. for the form he records from Arizona.⁹⁷

*2. *Eriophyllum multicaule* (DC.) A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 24. 1883.

Actinolepis multicaulis DC., Prodr. 5: 656. 1836.

Sandy soil, southern California and southern Arizona (east to Tucson, according to Gray⁹⁸), March to June.

⁹⁶ Reference: CONSTANCE, LINCOLN. A SYSTEMATIC STUDY OF THE GENUS ERIOPHYLLUM LAG. Calif. Univ. Pub. Bot. 18: 69-135. 1937.

⁹⁷ RYDBERG, P. A. NORTH AMERICAN FLORA. 34: 1915. (See p. 96.)

⁹⁸ GRAY, ASA. SYNOPTICAL FLORA OF NORTH AMERICA. 12: 1884. (See p. 328.)

3. *Eriophyllum pringlei* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 25. 1883.

Actinolepis pringlei Greene, Fl. Francisc. 441. 1897.

Yucca (Mohave County) and in Maricopa and Pima Counties, 1,500 to 3,000 feet, gravelly mesas and slopes, March to May. Southern Nevada, western and southern Arizona, and southern California.

4. *Eriophyllum wallacei* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 25. 1883.

Bahia wallacei A. Gray in Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 105. 1857.

Antheropeas wallacei Rydb., North Amer. Fl. 34: 98. 1915.

Valentine to Chloride and Oatman (Mohave County), 3,000 to 4,000 feet, mesas and plains, March to June. Southern Utah and western Arizona to southern California.

5. *Eriophyllum lanosum* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 25. 1883.

Burrielia lanosa A. Gray in Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 107. 1857.

Antheropeas lanosum Rydb., North Amer. Fl. 34: 98. 1915.

Northern Mohave County to Pinal, Pima, and Yuma Counties, 1,200 to 3,000 feet, dry gravelly mesas and slopes, common, February to May. Southern Utah, southern Nevada, western Arizona, south-eastern California, and Baja California.

94. CHAENACTIS⁹⁹

Low herbs; leaves alternate, entire to bipinnatifid, the blade or its divisions narrow; heads flesh-colored or white, discoid but sometimes with enlarged outer corollas; achenes linear; pappus of hyaline paleae, these without a midrib.

Key to the species

1. Phyllaries attenuate into pale, almost aristiform tips; plant scurfy-puberulent, not tomentose or glandular; receptacle with some setaceous pales.
 1. *C. CARPHOCLINIA.*
1. Phyllaries obtuse to acuminate, but not attenuate into aristiform tips; plant tomentose or glandular, at least when young; receptacle naked (2).
 2. Leaves entire and linear, or once pinnatifid, with few unequal lobes; plants soon glabrate (3).
 3. Involucre 8 to 10 mm. high, the phyllaries not loose-tipped; pappus of 4 usually equal paleae, these in a single series; marginal corollas decidedly larger than the others..... 2. *C. FREMONTI.*
 3. Involucre normally 12 to 17 mm. high, the phyllaries usually loose-tipped; pappus of 4 long paleae and 4 very short outer squamellae; marginal corollas not definitely larger than the others..... 3. *C. XANTIANA.*
 2. Leaves (at least the lower ones) bipinnatifid, with usually numerous lobes, more or less persistently tomentose (4).
 4. Involucre 10 to 15 mm. high; anthers not exerted; pappus of 4 paleae and 2 to 4 very short outer squamellae; outer phyllaries with loose tips.
 4. *C. MACRANTHA.*
 4. Involucre 6 to 9 (rarely 12) mm. high; anthers exerted; pappus of 4 to 8 paleae, these sometimes unequal but not 2-seriate; outer phyllaries scarcely loose-tipped (5).
 5. Pappus of 4 paleae; plant annual; outer corollas distinctly larger than the others..... 5. *C. STEVIODES.*
 5. Pappus of about 8 paleae; plant perennial or biennial; outer corollas not enlarged..... 6. *C. DOUGLASII.*

⁹⁹ Reference: STOCKWELL, PALMER. A REVISION OF THE GENUS CHAENACTIS. Contrib. Dudley Herb. Stanford Univ. 3: 89-167. 1940.

1. *Chaenactis carphoclinia* A. Gray in Torr., U. S. and Mex. Bound. Bot. 94. 1859.

Mohave, Pinal, Pima, and Yuma Counties, up to 2,500 feet, plains and mesas, March to May. Southern Utah to southern Arizona, southeastern California and northern Baja California.

The type of var. *attenuata* (A. Gray) M. E. Jones (*C. attenuata* A. Gray), distinguished by having the pappus paleae of all the achenes very short and usually obtuse (those of the central achenes in the typical form being at least half as long as the corolla and usually acuminate), came from Ehrenberg, Yuma County (*Janvier*). The variety has been collected also at Papago Well (western Pima County) and in the Gila Mountains (Yuma County).

2. *Chaenactis fremonti* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 30. 1883.

Mohave, Maricopa, Pinal, and (doubtless) Yuma Counties, 1,000 to 3,300 feet, plains and mesas, March to June. Southwestern Utah, southern Nevada, western Arizona, and southeastern California.

3. *Chaenactis xantiana* A. Gray, Amer. Acad. Arts and Sci. Proc. 6: 545. 1865.

Hackberry, Mohave County, 3,550 feet (*Jones* 4561), Havasu Canyon, Coconino County. Eastern Oregon to southern California, western Nevada, and western Arizona, May and June.

4. *Chaenactis macrantha* D. C. Eaton in King, Geol. Expl. 40th Par. 5: 171. 1871.

Kingman and westward (Mohave County), also near Tucson (Pima County), about 3,000 feet, dry plains and slopes, April to June. Southern Utah and Nevada, western and southern Arizona, and southeastern California.

5. *Chaenactis stevioides* Hook. and Arn., Bot. Beechey Voy. 353. 1840.

Apache County to Mohave County, south to Graham, Pinal, and Yuma Counties, 1,500 to 6,300 feet, very common on dry mesas and plains, March to May. Wyoming to Idaho, south to New Mexico, southern California, and Sonora.

The var. *brachypappa* (A. Gray) H. M. Hall (*C. brachypappa* A. Gray) differs in having the paleae of the pappus in all of the flowers blunt and not more than 2 mm. long, whereas, in typical *C. stevioides*, the central flowers have the paleae at least two-thirds as long as the corolla, and usually acute. The variety is not typically developed in Arizona, but an approach to this form is shown by collections in the Sacaton Mountains, Pinal County (*Peebles* 11038), and at Chloride, Mohave County (*Kearney* and *Peebles* 11204). The var. *thornberi* Stockwell, which differs in being coarser and having yellow, or sometimes lemon or cream flowers, those of the other forms being white, is cited from Yavapai, Pinal, Pima, and Santa Cruz Counties, type from Wilnot, near Tucson (*Thornber* 385).

6. *Chaenactis douglasii* (Hook.) Hook. and Arn., Bot. Beechey Voy. 354. 1840.

Hymenopappus douglasii Hook., Fl. Bor. Amer. 1: 316. 1834.

Jacobs Lake to Fredonia, northern Coconino County, about 7,000 feet, open pine forest (*Peebles* 13041, 13052). Alberta and British

Columbia to northern New Mexico, northern Arizona, and California.

Chaenactis gillespiei Stockwell (ibid. p. 123), described from a single collection from near Granite Reef Dam, Maricopa County (*Gillespie* 5611), is insufficiently known. It is an annual with bipinnatifid leaves with comparatively few, linear segments, white flowers, and a double pappus of 4 long lanceolate inner paleae and 1 to 4 short outer squamellae.

95. CHAMAECHAENACTIS

Dwarf scapose caespitose perennial; leaves small, roundish, crenate or entire, slender-petioled, greenish above, canescent-strigose beneath, 3-nerved; heads medium-sized, discoid, flesh-colored, solitary on short scapes; achenes slender, obpyramidal, about 5-ribbed, villous; pappus of about 8 unequal, blunt, oblong, scarious paleae, these with a thickened midrib.

1. *Chamaechaenactis scaposa* (Eastw.) Rydb., Torrey Bot. Club Bul. 33: 156. 1906.

Chaenactis scaposa Eastw., Zoe 2: 331. 1891.

Fifteen miles north of Ganado, Apache County, 6,200 feet, May and June (*Peebles* and *Smith* 13468). Southwestern Wyoming, southwestern Colorado, eastern Utah, and northeastern Arizona.

96. BAHIA

Herbs, rarely suffrutescent; leaves opposite or alternate, entire to dissected; heads radiate or rarely discoid, yellow; achenes narrow, 4-angled; pappus of several squamellae or paleae, these with a callous-thickened base or midrib, or rarely wanting.

Key to the species

1. Leaves oblong or elliptic, entire, green at maturity, about 1 cm. wide.
 1. B. OBLONGIFOLIA.
1. Leaves dissected or lobed or, if entire, then much narrower or else whitened beneath (2).
 2. Pappus wanting; plant normally 30 cm. high or more, glandular, especially above; leaves once to thrice ternately divided into linear to oblong lobes; heads usually numerous and paniced..... 2. B. DISSECTA.
 2. Pappus present (3).
 3. Heads discoid; low annual; leaves entire or 3-cleft, narrowly linear or linear-filiform..... 3. B. NEOMEXICANA.
 3. Heads radiate (4).
 4. Stem glandular above (5).
 5. Leaves pedately divided into 3 stipitate, mostly obovate or cuneate divisions, these again lobed or parted, the ultimate divisions broad; squamellae of the pappus in all the flowers very blunt, with the nerve disappearing below the apex..... 4. B. PEDATA.
 5. Leaves biternately divided into linear segments about 1 mm. wide or less; squamellae of the pappus in the inner flowers pointed by the excurrent nerve..... 5. B. BITERNATA.
 4. Stem strigillose above, not evidently glandular (6).
 6. Heads solitary or few at the tips of the stem and branches, long-peduncled; achenes conspicuously long-hairy at base; leaves with usually broad segments, sometimes entire; plants usually relatively tall, canescent-puberulent with appressed hairs.
 8. B. ABSINTHIFOLIA.
 6. Heads usually several (sometimes solitary) at the tips of the stem and branches, on peduncles not more than 2 cm. long; achenes not conspicuously long-hairy at base; leaves nearly all opposite, 3- or 5-parted into linear usually entire divisions, these 2.5 mm. wide or narrower; plants low, much branched, not more than 20 cm. high, green or merely cinereous (7).

7. Achenes hirsutulous, especially toward the base; paleae of the pappus lanceolate, acute or acuminate, the stout nerve reaching the apex and usually excurrent----- 6. B. WOODHOUSEI.
 7. Achenes sessile-glandular only; paleae of the pappus narrowly obovate, blunt, the nerve disappearing below the apex.
 7. B. OPPOSITIFOLIA.

1. Bahia oblongifolia A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 27. 1883.

Schkuhria integrifolia var. *oblongifolia* A. Gray in Parry, Amer. Nat. 8: 213. 1874.

Platyschkuhria oblongifolia Rydb., Torrey Bot. Club Bul. 33: 155. 1906.

Carrizo Mountains, Apache County, dry hills (*Standley* 7363). Southwestern Colorado or southeastern Utah, northwestern New Mexico, and northeastern Arizona, July.

2. Bahia dissecta (A. Gray) Britton, N. Y. Acad. Sci. Trans. 8: 68. 1889.

Amauria (?) *dissecta* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 104. 1849.

Bahia chrysanthemoides A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 28. 1883.

Amauriopsis dissecta Rydb., North Amer. Fl. 34: 37. 1914.

Apache County to Mohave County, south to Cochise and Pima Counties, 5,000 to 9,000 feet, common in grassland and open pine forests, August to October. Wyoming to northern Mexico and Arizona.

3. Bahia neomexicana A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 27. 1883.

Schkuhria neomexicana A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 96. 1849.

Cephalobembix neomexicana Rydb., North Amer. Fl. 34: 46. 1914.

Fort Whipple, Yavapai County (*Palmer* in 1869), between Kayenta and Betatakin, Navajo County (*Eastwood* and *Howell* 6574), 5,300 to 7,100 feet, September. Colorado to New Mexico, Arizona, and Chihuahua.

***4. Bahia pedata** A. Gray, Pl. Wright. 1: 123. 1852.

Hills and rocky slopes, southwestern Texas, southern New Mexico, and Arizona (according to Rydberg¹), April to September.

5. Bahia biternata A. Gray, Pl. Wright. 2: 95. 1853.

Pinal Mountains, Gila County, among scrub oaks (*Peebles* et al. 3228), also in the Gila River bed near Sacaton, Pinal County (*Harrison* 1912), where doubtless carried by floodwater from higher elevations. Western Texas to central Arizona and Sonora, May to October.

¹ RYDBERG, P. A. NORTH AMERICAN FLORA 34: 1915. (See p. 36.)

6. **Bahia woodhousei** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 28. 1883.

Achyropappus woodhousei A. Gray, *ibid.* 6: 546. 1865.

Picradeniopsis woodhousei Rydb., Torrey Bot. Club Bul. 37: 333. 1910.

Woodruff, Navajo County (*Ward* in 1901), Red Butte to Rattlesnake Tanks, Coconino County (*Leiberg* 5915), about 5,000 feet, June to September. Northwestern Texas, Colorado, and northern Arizona.

- *7. **Bahia oppositifolia** (Nutt.) DC., Prodr. 5: 656. 1836.

Trichophyllum oppositifolium Nutt., Gen. Pl. 2: 167. 1818.

Picradeniopsis oppositifolia Rydb. ex Britton, Manual 1008. 1901.

Plains and hillsides, North Dakota to Montana, south to western Texas and New Mexico (reported from Arizona), June to September.

The plant contains a cyanogenic principle but is rarely if ever eaten by livestock in sufficient quantity to cause prussic-acid poisoning.

8. **Bahia absinthifolia** Benth., Pl. Hartw. 18. 1839.

Cochise County near the Mexican boundary (*Mearns* 756, etc.), mesas and slopes, April to October. Southern Texas and southeastern Arizona to central Mexico.

Much more common in Arizona than the typical form is var. *dealbata* A. Gray, which differs in having the leaves merely 3-cleft into lanceolate lobes, or entire (in the typical form the leaves pedately parted into 3 or 5 narrowly linear or lance-linear divisions, these usually again few-lobed). The variety occurs in Graham, Maricopa, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,400 to 5,500 feet, and ranges to western Texas and Chihuahua. It is particularly abundant on shallow caliche soils around Tucson.

97. TRICHOPTILIUM

Low, diffusely branched, floccose-woolly, winter annual; leaves mostly alternate, oblong to lanceolate, sharply dentate; heads terminal, solitary, slender-peduncled, discoid, yellow; achenes turbinate, 5-nerved, hairy; pappus of 5 paleae, these dissected into numerous bristles.

1. **Trichoptilium incisum** A. Gray in Torr., U. S. and Mex. Bound. Bot. 97. 1859.

Psathyrotes incisus A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 322. 1854.

Mohave, Maricopa, and Yuma Counties, up to 2,000 feet, sandy or gravelly mesas and slopes, February to May (sometimes autumn). Southern Nevada, western Arizona, southeastern California, and Baja California.

98. ACTINEA

Annual or perennial herbs; leaves alternate, entire to pinnatifid; heads radiate, yellow; involucre in 2 or more series, the phyllaries often rigid, the outer ones sometimes united at base; pappus of 5 to 12 paleae.

The fragrant-bitterweed (*A. odorata*), and pingüe or "pingwing" (*A. richardsoni*), are toxic to livestock, especially to sheep, but are eaten only when other forage is scarce. These plants tend to increase on over-grazed ranges. The latex of some of the species contains rubber and *A. richardsoni* var. *floribunda* is known as Colorado rubber-plant. The Hopi are reported to make a stimulating drink from *A. acaulis* var. *arizonica* and to apply the plant locally in alleviating pain, especially in pregnancy. The bark of the roots of *A. richardsoni* is used as a substitute for chewing gum by Indians in New Mexico. Arizona's larger-headed species are handsome and *A. acaulis* is cultivated in Europe as an ornamental.

Key to the species

1. Heads solitary (rarely 2 or 3), long-peduncled, on naked scapes or sparsely leafy stems; leaves entire or 3-parted (2).
2. Involucre densely and loosely pilose-tomentose with matted hairs; basal leaves narrowly linear, entire or 3-parted; stem about 10 to 20 cm. high, sparsely leafy; pappus of about 5 lance-attenuate paleae.
 1. *A. BRANDEGELI*.
2. Involucre not densely and loosely pilose-tomentose, although sometimes silky-villous (3).
3. Phyllaries lanceolate, the outer ones subherbaceous, acuminate, the inner ones attenuate, indurate, stiff; leaves not punctate, the basal leaves narrowly linear, entire or sometimes 3-lobed; stem 20 to 40 cm. high, sparsely leafy; pappus of 10 lance-attenuate paleae.
 2. *A. BIGELOVII*.
3. Phyllaries mostly elliptic or oblong, obtuse or merely acute; leaves conspicuously impressed-punctate (4).
4. Plant strictly scapose, the leaves all basal; scapes always simple and 1-headed; basal leaves narrowly oblanceolate, sparsely or rather densely silky-pubescent..... 3. *A. ACAULIS*.
4. Plants with the stems sparsely leafy, at least below; stems often few-branched, 1- to 3-headed (5).
5. Leaves glabrous or rather sparsely silky-pilose, especially beneath.
 4. *A. LEPTOCLADA*.
 5. *A. ARGENTEA*.
1. Heads several or many, cymose or cymose-panicled; stems very leafy; leaves almost always deeply pinnatifid (6).
6. Stems several or numerous from a perennial multicapital caudex, conspicuously long-villous or woolly at base among the petiole-bases of the lowest leaves..... 6. *A. RICHARDSONI*.
6. Stems solitary or few from an annual, biennial, or perennial root or caudex, not long-villous or woolly at base (7).
7. Plant annual, usually branching almost from the base... 7. *A. ODORATA*.
7. Plant biennial or perennial, usually branching only in the inflorescence (8).
8. Plant subsericeous-canescens; leaves entire or 3-cleft, the blades or their lobes relatively broad, 1.5 to 4 mm. wide... 8. *A. SUBINTEGRA*.
8. Plant green or, if slightly canescens, then the leaves or their lobes much narrower (9).
9. Leaves either entire or divided into 3 to 5 lobes, the blades or their lobes relatively broad, mostly 2 to 5 mm. wide (10).
10. Heads usually few (3 to 10 per stem, rarely more) and comparatively large (the disk 10 to 18 mm. thick), on more or less elongate peduncles distinctly surpassing the leaves; leaves divided into 3 or 5 lobes, or the lowest sometimes entire.
 9. *A. LEMMONI*.
10. Heads numerous and small (disk 5 to 10 mm. thick), in close rounded or flattish cymes or cymose panicles, on peduncles scarcely or not surpassing the leaves; leaves entire or the middle ones divided into 3 or 5 lobes..... 10. *A. RUSBYI*.

9. Leaves all or nearly all divided into 3 to 5 narrowly linear or linear-filiform lobes (0.8 to 1.5 mm. wide); heads usually large (disk 8 to 15 mm. thick) and few (normally 3 to 6, rarely up to 20 per stem), usually on elongate peduncles conspicuously surpassing the leaves (11).
11. Outer phyllaries 5 to 8, very strongly keeled (or even 3-ribbed) especially in fruit, the keels conspicuously decurrent on the peduncles; leaf divisions linear, mostly 0.8 to 1.5 mm. wide; plant apparently perennial, usually without a conspicuous basal rosette of spreading or deflexed leaves or persistent petioles ----- 11. *A. QUINQUESQUAMATA*.
11. Outer phyllaries (8) 10 to 14, not strongly keeled, usually with a thickened and sulcate center; leaf divisions usually linear-filiform and less than 1 mm. wide; plant biennial, usually with a conspicuous basal rosette of spreading or deflexed leaves or of persistent petioles ----- 12. *A. COOPERI*.

1. **Actinea brandegei** (Porter) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Actinella grandiflora var. *glabrata* Porter in Port. and Coult., Syn. Fl. Colo. 76. 1874.

Actinella brandegei Porter ex A. Gray, Amer. Acad. Arts and Sci. Proc. 13: 373. 1878.

Rydbergia brandegei Rydb., Torrey Bot. Club Bul. 33: 156. 1906.

Summit of Baldy Peak, Apache County, 11,500 feet (*Bailey* 1449, *Peebles* and *Smith* 12546), August and September. Southern Colorado, New Mexico, and eastern Arizona, mostly above timber line

2. **Actinea bigelovii** (A. Gray) Kuntze, Rev. Gen. Pl. 1: 303. 1891, as *A. bigelowii*.

Actinea bigelovii A. Gray, Pl. Wright. 2: 96. 1853.

Macdougalia bigelovii Heller, Torrey Bot. Club Bul. 25: 629. 1898.

Actinea gaillardia A. Nels., Wyo. Univ. Pub. Bot. 1: 140. 1926.

White Mountains (Apache and Navajo Counties), San Francisco Peaks and southward (Coconino County), Sierra Ancha and Mazatzal Mountains (Gila County), 6,000 to 7,500 feet, mostly in pine forests, May to July, types of *A. gaillardia* from Flagstaff (*Hanson* A32 and 584). Western New Mexico to central Arizona.

3. **Actinea acaulis** (Pursh) Spreng., Syst. Veg. 3: 574. 1826.

Gaillardia acaulis Pursh, Fl. Amer. Sept. 743. 1814, as *Gaillardia*.

The Arizona form is var. *arizonica* (Greene) Blake (*Tetraneris arizonica* Greene). Apache County to eastern Mohave County, especially common at the Grand Canyon, 4,000 to 7,000 feet, dry rocky slopes and mesas, mostly with pine or juniper. April to October, type from Treadwell (*Palmer* 259 in 1877). Colorado to Nevada, south to New Mexico and north-central Arizona.

4. **Actinea leptoclada** (A. Gray) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Actinella leptoclada A. Gray in Torr., U. S. Rpt. Expl. Miss. Pacif. 4: 107. 1857.

Tetraneris leptoclada Greene, Pittonia 3: 269. 1898.

Apache County to eastern Mohave County, 5,000 to 7,000 feet, dry hills, April to August. Colorado, southeastern Utah, New Mexico, and northern Arizona.

In the formal var. *ivesiana* (Greene) Macbride the basal leaves are narrowly oblanceolate or almost linear, 1 to 3 mm. wide (3 to 6 mm. wide in the typical form).

5. *Actinea argentea* (A. Gray) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Actinella argentea A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 100. 1849.

Ten miles south of Snowflake, southern Navajo County, in the pinyon-juniper association (*Peebles* 9627), April to October. New Mexico and eastern Arizona.

6. *Actinea richardsoni* (Hook.) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Picradenia richardsoni Hook., Fl. Bor. Amer. 1: 317. 1834.

The Arizona form is var. *floribunda* (A. Gray) Cory (*Hymenoxys floribunda* Cockerell, *H. floribunda* var. *arizonica* Cockerell and var. *intermedia* Cockerell). Apache, Navajo, and Coconino Counties, 5,200 to 8,800 feet, mostly in yellow pine forests, June to September, types of *H. floribunda* var. *arizonica* and var. *intermedia* from near Flagstaff (*MacDougal* 219 and 359). Wyoming to New Mexico, Utah, and northern Arizona.

7. *Actinea odorata* (DC.) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Hymenoxys odorata DC., Prodr. 5: 661. 1836.

Hymenoxys chrysanthemoides var. *excurrens* Cockerell, Torrey Bot. Club Bul. 31: 501. 1904.

South-central Navajo County and Greenlee County to Pinal, Cochise, Pima, and Yuma Counties, 6,000 feet or lower, moist alluvial soil, especially abundant along the lower Gila River, March to May, type of *H. chrysanthemoides* var. *excurrens* from Yuma (*Vasey* in 1881). Kansas to Texas, west to southeastern California, south into Mexico.

A closely related plant, of which no material has been available for examination, is *Hymenoxys davidsonii* (Greene) Cockerell (*Picradenia davidsonii* Greene), the type from Clifton, Greenlee County.

8. *Actinea subintegra* (Cockerell) Blake, Wash. Acad. Sci. Jour. 19: 278. 1929.

Hymenoxys subintegra Cockerell, Torrey Bot. Club Bul. 31: 480. 1904.

Kaibab Plateau and Cameron to Navajo Bridge (Coconino County), 5,500 to 8,000 feet, dry soil in the open and in coniferous forests, June to August, type from Nagle's ranch,² Kaibab Plateau (*Jones* 6054 o). Known only from northern Arizona.

Cockerell's record³ of *Hymenoxys lemmoni* subsp. *greenei* Cockerell from Arizona, based on Mrs. Thompson's collection [no. 382] from "northern Arizona," rests on a specimen of this species.

²The following information regarding the type locality of this species, derived from the late M. E. Jones, deserves to be placed on record. Nagle's ranch was about 60 miles south of Kanab, Utah, on the west slope of the Buckskin Mountains (i. e. the Kaibab Plateau), and was the first watering place on the old wagon road to the Grand Canyon from Kanab. The old Valley Tan ranch was about 15 miles farther up on the plateau and was the first ranch reached on the way to the Canyon after ascending the plateau. The present wagon road now ascends the plateau many miles farther north. The name Buckskin Mountains, as applied to the Kaibab Plateau, is now obsolete. Recent maps of the State show another range of the same name just south of Williams River (Bill Williams Fork).

³Reference: COCKERELL, T. D. A. THE NORTH AMERICAN SPECIES OF HYMENOXYLS. Torrey Bot. Club Bul. 31: 461-509. 1904. (See p. 480.)

9. *Actinea lemmoni* (Greene) Blake in Tidestrom, Contrib. U. S. Natl. Herbarium 25: 596. 1925.

Picradenia lemmoni Greene, Pittonia 3: 272. 1898.

Hymenoxys lemmoni Cockerell, Torrey Bot. Club Bul. 31: 477. 1904.

Hymenoxys lemmoni subsp. *greenii* Cockerell, *ibid.* p. 479.

Hymenoxys greenii Rydb., Torrey Bot. Club Bul. 37: 448. 1910.

Lukachukai Mountains, Apache County, 7,250 feet (*Pebbles* 14401), June. Utah, Nevada, northeastern Arizona, and California.

10. *Actinea rusbyi* (A. Gray) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Actinella rusbyi A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 33. 1883.

Hymenoxys rusbyi Cockerell, Torrey Bot. Club Bul. 31: 496. 1904.

Southern Coconino and eastern Yavapai Counties to central Gila County, 5,400 to 7,000 feet, dry soil, mostly with juniper, pinyon, and *Gutierrezia*, locally very abundant, July to September. Southwestern New Mexico and central Arizona.

11. *Actinea quinquesquamata* (Rydb.) Blake, Wash. Acad. Sci. Jour. 30: 472. 1940.

Hymenoxys cooperi subsp. *grayi* Cockerell, Torrey Bot. Club Bul. 31: 495. 1904.

Hymenoxys quinquesquamata Rydb., North Amer. Fl. 34: 114. 1915.

Huachuca Mountains (Cochise County), Rincon and Santa Rita Mountains (Pima County), about 5,000 feet, July to September, type from Carr Peak, Huachuca Mountains (*Goodding* 874), type of *H. cooperi* subsp. *grayi* from the Huachuca Mountains (*Lemmon* 2774). Known only from southeastern Arizona.

12. *Actinea cooperi* (A. Gray) Kuntze, Rev. Gen. Pl. 1: 303. 1891.

Actinella cooperi A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 359. 1868.

Actinella biennis A. Gray, *ibid.* 13: 373. 1878.

Hymenoxys canescens var. *nevadensis* Cockerell, Torrey Bot. Club Bul. 31: 484. 1904.

Hymenoxys cooperi Cockerell, *ibid.*, p. 494.

Hymenoxys cooperi var. *argyrea* Cockerell, *ibid.*, p. 496.

Hymenoxys biennis H. M. Hall, Calif. Univ. Pub. Bot. 3: 204. 1907.

Hymenoxys virgata A. Nels., Amer. Jour. Bot. 18: 439. 1931.

Coconino and northern Mohave Counties, 2,000 to 7,000 feet, dry rocky places, June and July, type of *Actinella biennis* from Mokiak Pass (*Palmer* 260 in 1877), type of *Hymenoxys cooperi* var. *argyrea* from the Grand Canyon (*MacDougal* 189), type of *H. virgata* from the Bright Angel Trail, Grand Canyon (*Osterhout* 6991). Southern Utah and Nevada, northern Arizona, and southeastern California

99. HELENIUM. SNEEZEWEED

Biennial or perennial herbs; leaves alternate, usually narrow, entire or toothed; heads small to large, radiate or discoid, the rays yellow, the disk yellow or purple brown; involucre about 2-seriate, spreading, at length reflexed; achenes turbinate, 8- to 10-ribbed; pappus of 5 to 8 scarious paleae or squamellae.

Key to the species

1. Leaves not decurrent; plant subtomentose when young; rays spreading, linear or oval. Leaves thickish, strictly entire, the lowest obovate or oblanceolate, normally 15 cm. long or longer; heads few (usually 3 to 6), large, at least 5 cm. wide across the spreading rays..... 1. *H. HOOPESII*.
1. Leaves more or less decurrent; plant not subtomentose; rays soon drooping, cuneate, wanting in one species (2).
2. Rays wanting; squamellae of the pappus very short and blunt.
 2. *H. THURBERI*.
2. Rays present; squamellae of the pappus at least half as long as the corolla, acute or acuminate (3).
3. Leaves laciniate; plant cinereous-puberulent..... 3. *H. LACINIATUM*.
3. Leaves entire or slightly toothed; plants glabrous or puberulous, not cinereous (4).
4. Leaves essentially uniform, sessile, lanceolate; stem winged essentially throughout; plant perennial..... 4. *H. AUTUMNALE*.
4. Leaves not uniform, the basal ones oblanceolate, distinctly larger than the cauline leaves and narrowed into a petioliform base; cauline leaves with an ampliate amplexicaul base, very shortly decurrent; stem not winged throughout; plant apparently biennial.
 5. *H. ARIZONICUM*.

1. ***Helenium hoopesii*** A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 65. 1863.

Dugaldia hoopesii Rydb., N. Y. Bot. Gard. Mem. 1: 425. 1900.

Apache, Coconino, Greenlee, Graham, Cochise, and Pima Counties, 7,500 to 11,000 feet, abundant in rich soil in coniferous forests and mountain meadows, June to September. Wyoming to Oregon, south to New Mexico, Arizona, and California.

Orange sneezeweed, sometimes called owlclaws. The plant contains a toxic glucoside, dugaldin, which causes "spewing sickness" in sheep. It is also poisonous to cattle, but is rarely eaten by them.

2. ***Helenium thurberi*** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 32. 1882.

Pinal, Cochise, and Pima Counties, 1,200 to 5,000 feet, marshy places along streams, March to August, types from southern Arizona (Coulter 359, Thurber 346, Pringle 137). Southern Arizona and Mexico.

- *3. ***Helenium laciniatum*** A. Gray, Amer. Acad. Arts and Sci. Proc. 9: 203. 1874.

Southeastern California, adjacent Arizona, and adjacent Mexico (according to Gray⁴). Gray's record of this plant from Arizona appears to be based on the supposition that the original specimens of Thomas Coulter (nos. 356, 358) may have come from that State. There seems to be no definite record of the species from either Arizona or California, and it is omitted from recent floras of California.

⁴ GRAY, A. SYNOPTICAL FLORA OF NORTH AMERICA. 1²: 1884. (See p. 349.)

*4. *Helenium autumnale* L., Sp. Pl. 886. 1753.

Helenium montanum Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 384. 1841.

Reported as occurring in the Huachuca Mountains (Cochise County). Eastern Canada to British Columbia, south to Florida, Texas, New Mexico, and southeastern Arizona.

5. *Helenium arizonicum* Blake, Wash. Acad. Sci. Jour. 27: 389. 1937.

Known only from southern Coconino County near Mormon Lake (*Toumey* 681, the type collection), and near Buck Springs (*Collom* 630), 7,000 to 7,500 feet, September.

100. GAILLARDIA. BLANKETFLOWER

Annual or perennial herbs; leaves alternate, entire to pinnatifid; heads solitary, radiate, showy, the rays yellow or partly purple, the disk yellow or purple; receptacle with subulate or setiform fimbriae; achenes turbinate, 5-ribbed, villous at least at base; pappus of 5 to 10 scarious paleae, these often awned.

Species of this genus are prized as ornamentals, the cultivated gaillardias being derived mainly from *G. pulchella*.

Key to the species

1. Corolla teeth long-acuminate, tipped with a long awn or cusp; plant annual, leafy-stemmed; lower leaves usually lobed, the upper ones mostly oblong-lanceolate, entire; achenes densely silky-pilose on the lower half, but the whole body concealed by the hairs; rays yellow toward the tip, purple at base; disk purple; paleae of the pappus lanceolate, awn-pointed.
 1. *G. PULCHELLA*.
1. Corolla teeth merely acute or obtuse, not tipped with an awn or cusp (2).
 2. Paleae of the pappus broadly oblong or oval, awnless or with an abrupt awn shorter than the body of the palea; plants annual, scapose or subscapose, with deeply pinnatifid or sometimes merely toothed leaves; rays and disk yellow.----- 2. *G. ARIZONICA*.
 2. Paleae of the pappus lanceolate, rather gradually narrowed into an awn (3).
 3. Leaves ovate or obovate, entire or subentire, 3-nerved; rays and disk yellow; plant perennial, multicapital, scapose or subscapose.
 3. *G. PARRYI*.
 3. Leaves linear to lanceolate or rarely obovate, when broad always toothed or lobed to pinnatifid; rays yellow, the disk purple; stem usually leafy.
 4. *G. PINNATIFIDA*.

1. *Gaillardia pulchella* Foug., [Paris] Acad. Sci. Mém. 1786: 5. 1788.

Graham, Pinal, and Cochise Counties, 4,000 to 5,000 feet, plains, May to September. Nebraska and Missouri to Louisiana, west to Colorado and southeastern Arizona. Sometimes known as firewheel and Indian-blanket.

2. *Gaillardia arizonica* A. Gray, Syn. Fl. 1²: 353. 1884.

Gaillardia pedunculata A. Nels., Bot. Gaz. 47: 432. 1909.

Mohave, Maricopa, and Pima Counties, 1,100 to 4,000 feet, plains and mesas, February to July, type probably from Beaver Dam, Mohave County. Southern Utah and southern Nevada to southern Arizona.

The var. *pringlei* (Rydb.) Blake (*G. pringlei* Rydb., *G. crinita* Rydb.), distinguished by the awned paleae of the pappus (these blunt

in the typical form), has been collected below Black Falls, Little Colorado River (eastern Coconino County), and occurs also in Maricopa, Pinal, and Pima Counties. The type of *G. pringlei* (Pringle in 1884) and the type of *G. crinita* (Griffiths 2386) both came from near Tucson.

3. *Gaillardia parryi* Greene, Torrey Bot. Club Bul. 24: 512. 1897.

Gaillardia acaulis A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 73. 1874. Not Pursh, 1814.

Kaibab Plateau, Coconino (?) County (Jones in 1890), above Pagumpa Springs and north of Wolf Hole, northern Mohave County, about 5,000 feet (Jones 5059ak, Peebles 14735), plains and hillsides, May and June. Southern Utah and northern Arizona.

4. *Gaillardia pinnatifida* Torr., Ann. Lye. N. Y. 2: 214. 1828, as *Gaillardia*.

Gaillardia multiceps Greene, Torrey Bot. Club Bul. 24: 512. 1897.

Gaillardia mearnsii Rydb., Torrey Bot. Club Bul. 37: 443. 1910.

Gaillardia linearis Rydb., North Amer. Fl. 34: 137. 1915.

Gaillardia crassa Rydb., *ibid.* p. 138.

Gaillardia globosa A. Nels., Wyo. Univ. Pub. Bot. 1: 135. 1926.

Navajo, Coconino, and eastern Mohave Counties, south to Cochise, Santa Cruz, and Pima Counties, 3,500 to 7,000 feet, mesas, plains, and open pine forest, often on limestone, May to October, type of *G. multiceps* from south of Woodruff, type of *G. mearnsii* from Fort Verde (Mearns 322), type of *G. crassa* from foothills of the Santa Rita Mountains (Pringle in 1884), type of *G. globosa* from near Flagstaff (MacDougal 291). Colorado and Utah to Texas, Arizona, and Mexico.

This species is reported to be used by the Hopi Indians as a diuretic. *G. linearis* and *G. multiceps* are forms with narrow entire leaves. *G. mearnsii* apparently was based on plants flowering in their first year.

101. PLUMMERA

Perennial (?) herbs, with aspect of *Actinea richardsoni* but taller; leaves alternate, divided into filiform lobes; heads very small, cymose-panicked, radiate, yellow, the rays 2 to 5, fertile, the disk flowers 6 or 7, hermaphrodite but sterile; involucre double; ray achenes obovoid, plump, about 15-ribbed, villous; pappus none, or of 4 to 6 oblong squamellae.

Key to the species

1. Achenes epappose, villous with flexuous hairs..... 1. *P. FLORIBUNDA*.
 1. Achenes with a pappus of 4 to 6 oblong to lanceolate squamellae, villous with straight hairs..... 2. *P. AMBIGENS*.

1. *Plummera floribunda* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 215. 1882.

Chiricahua, Dos Cabezas, and Mule Mountains (Cochise County), 5,000 to 6,500 feet, September, type from Apache Pass (Lemmon in 1881). Known only from southeastern Arizona.

2. *Plummera ambigens* Blake, Wash. Acad. Sci. Jour. 19: 276. 1929.

Known only from the lower slopes of the Pinaleno Mountains (Graham County), where it is abundant at about 5,000 feet, in stony sterile soil, July to October, type from this locality (*Pebbles* et al. 4395).

102. TAGETES. MARIGOLD

Herbaceous or suffrutescens; leaves mostly opposite, entire or pinnately divided, dotted with translucent oil glands; heads small or large, radiate or discoid, yellow; phyllaries 1-seriate, united into a toothed cup or tube, dotted with oil glands; achenes slender; pappus of 3 to 6 paleae.

Several species, particularly *Tagetes erecta* and *T. patula*, are commonly cultivated as ornamentals under the names African marigold and French marigold.

Key to the species

1. Tall suffrutescens perennial; rays large, about 10 mm. long, bright yellow; leaves with 3 to 7 mostly lanceolate divisions, these 4 to 12 mm. wide.
 1. *T. LEMMONI*.
1. Dwarf annual; rays tiny (or wanting), 2 mm. long or less, pale yellow; leaves filiform and entire, or of 3 or 5 filiform divisions.----- 2. *T. MICRANTHA*.

1. *Tagetes lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 40. 1883.

Mountains of Cochise and Pima Counties, 6,000 to 7,500 feet, rich moist soil in canyons, August to October, type from the Huachuca Mountains (*Lemmon* in 1882). Known only from southeastern Arizona.

A handsome but very ill-scented plant.

2. *Tagetes micrantha* Cav., Icon. Pl. 4: 31. 1797.

Pinetop, southern Navajo County, and mountains of Cochise and Santa Cruz Counties, about 6,000 feet, August and September. Western Texas to southeastern Arizona and central Mexico.

103. DYSSODIA

Annual or perennial herbs, or suffruticose; leaves opposite or alternate, entire to pinnatisect, marked with translucent glands; heads small to rather large, radiate, yellow or orange, or the rays rarely white; involucre usually calyculate (subtended by bractlets), the principal phyllaries equal, usually 2-seriate and united at base, or almost to the apex; pappus of 10 to 15 squamellae or paleae, often tipped with 1 or 3 bristles or dissected into numerous bristles.

Dyssodia papposa and *D. acerosa* are sometimes abundant on overgrazed land and are regarded as range pests. The former is suspected of being poisonous to livestock, but definite information is lacking.

Key to the species

1. Heads large, the disk 1.5 to 2 cm. high or more; pappus of 10 to 15 paleae, each dissected into numerous bristles (2).
2. Stem glabrous; leaves pinnately 3- or 5-parted into narrow lobes.
 1. *D. POROPHYLLOIDES*.
2. Stem densely puberulous or hispidulous; larger leaves oval or ovate, merely spinulose-toothed or with small basal lobes.----- 2. *D. COOPERI*.

1. Heads smaller, the disk less than 1 cm. high, or (in *D. acerosa*) up to 1.5 cm (3).
3. Paleae of the pappus each dissected into 5 to 12 capillary bristles, the alternate ones in *D. acerosa* dissected into only 3 bristles (4).
4. Leaves entire, linear-filiform, needlelike; plant perennial, the numerous stems or branches woody at base----- 3. *D. ACEROSA*.
4. Leaves pinnately lobed, not needlelike; plants annual (5).
5. Rays white, conspicuous; involucre essentially naked at base, the phyllaries united three-fourths of their length or more, and with numerous small roundish glands----- 4. *D. CONCINNA*.
5. Rays yellow, small, inconspicuous; involucre subtended by several mostly herbaceous bractlets of about its own length, the phyllaries distinctly in 2 series and united only toward the base, their glands few, linear or elliptic, rather large----- 5. *D. PAPPOSA*.
3. Paleae of the pappus tipped with only 1 to 3 bristles, or the outer paleae without bristles (6).
6. Outer paleae (as well as the inner ones) bristle- or awn-tipped.----- 6. *D. THURBERI*.
6. Outer paleae merely acute or obtuse, not awn-tipped (7).
7. Phyllaries of both the inner and the outer series (not the bractlets of the calyculus) united nearly to the apex; involucre puberulent all over.----- 7. *D. HARTWEGI*.
7. Phyllaries of the outer series free-margined to below the middle of the involucre, the free margins densely short-ciliate; involucre otherwise glabrous----- 8. *D. PENTACHAETA*.

1. **Dyssodia porophylloides** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 322. 1854.

Clomenocoma porophylloides Rydb., North Amer. Fl. 34: 166. 1915.

Western Mohave and southern Yavapai Counties to Pinal, Pima, and Yuma Counties, 4,000 feet or lower, washes, mesas, and dry rocky slopes, March to October. Arizona, southern California, Sonora, and Baja California.

The plant has a strong, disagreeable odor.

2. **Dyssodia cooperi** A. Gray, Amer. Acad. Arts and Sci. Proc. 9: 201. 1874.

Clomenocoma cooperi Rydb., North Amer. Fl. 34: 166. 1915.
Clomenocoma laciniata Rydb., *ibid*.

Hackberry to the Colorado River (Mohave County), 3,500 feet or lower, dry canyons, slopes, and mesas, April to August, type of *Clomenocoma laciniata* from Hackberry (*Jones* in 1884). Western Arizona, southern Nevada, and southeastern California.

3. **Dyssodia acerosa** DC., Prodr. 5: 641. 1836.

Aciphyllaea acerosa A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 91. 1849.

Southern Coconino, Yavapai, Gila, Cochise, and Pima Counties, 3,500 to 6,000 feet, dry rocky slopes and mesas, April to October. Texas to southern Nevada and Arizona, south to central Mexico.

4. **Dyssodia concinna** (A. Gray) Robinson, Amer. Acad. Arts and Sci. Proc. 49: 507. 1913.

Hymenatherum concinnum A. Gray, Syn. Fl. 1²: 446. 1884.
Boeberastrum concinnum Rydb., North Amer. Fl. 34: 162. 1915.

Mesas near Tucson (*Pringle* in 1884, the type collection), 2,500 feet or lower, May. Southern Arizona and Sonora.

5. *Dyssodia papposa* (Vent.) Hitchc., Acad. Sci. St. Louis Trans. 5: 503. 1891.

Tagetes papposa Vent., Pl. Jard. Cels. pl. 36. 1801.

Boebera papposa Rydb. ex Britton, Manual 1012. 1901.

Coconino, Gila, Cochise, and Santa Cruz Counties, 4,500 to 7,000 feet, roadsides and waste places, September and October. Illinois to Montana, south to Louisiana and Arizona.

6. *Dyssodia thurberi* (A. Gray) Robinson, Amer. Acad. Arts and Sci. Proc. 49: 508. 1913.

Hymenatherum thurberi A. Gray, *ibid.* 19: 41. 1883.

Thymophylla thurberi Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 191. 1913.

Grand Canyon (Coconino County) and northern Mohave County to Pima and Yuma Counties, 3,500 feet or lower, dry rocky slopes and mesas, April to October. Texas to southern Nevada, southeastern California, and northern Mexico.

7. *Dyssodia hartwegi* (A. Gray) Robinson, Amer. Acad. Arts and Sci. Proc. 49: 507. 1913.

Hymenatherum hartwegi A. Gray, Pl. Wright. 1: 117. 1852.

Thymophylla pringlei Rydb., North Amer. Fl. 34: 177. 1915.

Chiricahua Mountains, Cochise County, about 5,500 feet, on limestone, September to October. Southeastern Arizona to central Mexico.

8. *Dyssodia pentachaeta* (DC.) Robinson, Amer. Acad. Arts and Sci. Proc. 49: 507. 1913.

Hymenatherum pentachaetum DC., Prodr. 5: 642. 1836.

Thymophylla pentachaeta Small, Fl. Southeast. U. S. 1295. 1903.

Thymophylla gracilis Rydb., North Amer. Fl. 34: 176. 1915.

Lees Ferry and Grand Canyon (Coconino County), near Tucson (Pima County), 2,500 to 3,500 feet, dry slopes and mesas, March to October. Texas to Arizona and northern Mexico.

104. POROPHYLLUM

Glabrous herbs or suffrutescent perennials; leaves opposite or alternate, with conspicuous translucent oil glands in the tissue; heads medium-sized, discoid, whitish or purplish; phyllaries 5 to 8, linear or oblong, 1-seriate, equal, free, with conspicuous linear oil glands, without accessory bractlets; achenes slender, elongate; pappus of copious free capillary bristles.

P. gracile, called yerba-del-venado by the Mexicans, is said to be relished by deer and cattle, notwithstanding the strong, unpleasant odor of the plant.

Key to the species

1. Annual; leaf blades oval, thin, mostly 2 to 4 cm. long, on slender petioles about as long as the blades; peduncles thickened toward the apex; heads 2 to 2.5 cm. high. ----- 1. *P. MACROCEPHALUM*.
1. Perennial, more or less woody toward the base; leaves filiform to narrowly linear, sessile; peduncles not noticeably thickened toward the apex; heads 1.5 to 2 cm. high. ----- 2. *P. GRACILE*.

1. *Porophyllum macrocephalum* DC., Prodr. 5: 648. 1836.

Cochise, Santa Cruz, and Pima Counties, from the Huachuca to the Baboquivari Mountains, 3,500 to 5,000 feet, rocky slopes and canyons, August to October. Southern Arizona, south to South America.

2. *Porophyllum gracile* Benth., Bot. Voy. Sulph. 29. 1844.

Porophyllum junciforme Greene, Leaflets 2: 154. 1911.

Porophyllum leucospermum Greene, *ibid.* p. 155.

Porophyllum putidum A. Nels., Amer. Jour. Bot. 18: 440. 1931.

Grand Canyon (Coconino County) and Mohave County to western Cochise, Pima, and Yuma Counties, 4,000 feet or lower, dry rocky slopes and canyons, March to October, type of *P. junciforme* from the Mescal Mountains (*M. E. Jones*), type of *P. putidum* from east of Douglas, Cochise County (*Goodding* 2277). Southern Nevada, Arizona, southeastern California, Sonora, and Baja California.

105. PECTIS.⁵ FETID-MARIGOLD

Annual or perennial herbs, usually low, slender-stemmed; leaves opposite, entire, dotted with pellucid glands, almost always ciliate with a few stiff bristles toward the base; heads small, radiate, yellow, the rays often purplish beneath; involucre 1-seriate; achenes slender; pappus of numerous bristles or of few awns or paleae, or reduced to a low crown.

With remarkable promptitude after summer rains have fallen, especially in the southern part of the State, the ground is carpeted with the small yellow heads of the strong-smelling chinchweed (*P. papposa*). In New Mexico the flowers of this species are used by the Indians for seasoning meat. It is reported that in Arizona the Hopi Indians use *P. angustifolia* for food and seasoning, either raw or dried, and extract a dye from the plant.

Key to the species

- 1. Pappus of 2 to 6 lanceolate, acuminate, more or less scarious paleae; low and diffuse annuals; leaves oblanceolate to nearly linear, with scattered oil glands; heads sessile or essentially so, much surpassed by the subtending leaves (2).
- 2. Involucre finely puberulous or hispidulous..... 3. *P. URCEOLATA*.
- 2. Involucre glabrous (3).
- 3. Phyllaries 5..... 1. *P. PROSTRATA*.
- 3. Phyllaries 3..... 2. *P. CYLINDRICA*.
- 1. Pappus of bristles or of stout, not paleaceous awns, or sometimes of short squamellae, rarely reduced to a low crown (4).
- 4. Pappus of 2 to 6 rigid, subulate, corneous awns, sometimes also with a few short squamellae (5).
- 5. Plant definitely perennial, from a woody rootstock; stems relatively tall, 30 to 100 cm. high, erect, stiff; leaves normally without basal bristles; pappus usually partly of erect subulate awns and partly of short squamellae..... 4. *P. IMBERBIS*.
- 5. Plants annual (sometimes perennial in *P. coulteri* ?); stems low and diffuse, or else not rigid; leaves usually with basal bristles; pappus usually wholly of stout subulate awns (6).
- 6. Pappus of 2 to 6 retrorsely barbed spreading awns; plant diffuse; leaves conspicuously bristle-toothed at base..... 5. *P. COULTERI*.

⁵ Reference: FERNALD, M. L. A SYSTEMATIC STUDY OF THE UNITED STATES AND MEXICAN SPECIES OF PECTIS. Amer. Acad. Arts and Sci. Proc. 33 (Gray Herbarium Contrib. 12): 57-86. 1897.

6. Pappus of 2 to 4 smooth or antrorse-hispidulous awns (7).
 7. Pappus of 2 or 3 smooth divergent awns; ligules about 1 mm. long.
 6. *P. LINIFOLIA*.
 7. Pappus of 2 to 4 antrorse-hispidulous awns; ligules 4 to 6 mm. long.----- 8. *P. FILIPES*.
 4. Pappus various, but not of 2 to 6 rigid subulate awns (8).
 8. Plants perennial, with a woody rootstock, low, 10 to 20 cm. high, leafy only toward the base, with long naked peduncles; leaves with 1 to 3 pairs of bristles at base; phyllaries 12 to 15; pappus of the disk flowers of 20 to 40 unequal bristles, that of the ray flowers of 2 bristles and sometimes a few squamellae----- 7. *P. LONGIPES*.
 8. Plants annual (9).
 9. Phyllaries 5; pappus of 1 to 4 subulate awns and sometimes a few squamellae, or reduced to a crown of squamellae--- 8. *P. FILIPES*.
 9. Phyllaries 8 to 10 (10).
 10. Heads rather crowded, sessile or peduncled, not obviously surpassing the leaves (11).
 11. Leaves not dilated at base; pappus normally of 12 to 18 bristles, sometimes reduced to a crown----- 9. *P. PAPPOSA*.
 11. Leaves dilated at base; pappus a crown of squamellae, with or without 1 or 2 awns----- 10. *P. ANGUSTIFOLIA*.
 10. Heads mostly solitary at the tips of the branches and in the axils and forks of the stem, the peduncles usually considerably surpassing the leaves (12).
 12. Pappus in the ray flowers of 2 to 5 slender awns or bristles, in the disk flowers of numerous bristles at least half as long as the disk corollas----- 11. *P. PALMERI*.
 12. Pappus in the ray flowers of 1 or 2 slender awns or bristles, in the disk flowers of numerous short bristles or reduced to a crown----- 12. *P. RUSBYI*.

1. *Pectis prostrata* Cav., Icon. Pl. 4: 12. 1797.

Mountains of Cochise and Pima Counties, 4,000 to 6,000 feet, sandy plains and dry slopes, August to October. Western Texas to southeastern Arizona, south to northern South America; also in Florida, Cuba, and Jamaica.

2. *Pectis cylindrica* (Fernald) Rydb., North Amer. Fl. 34: 198. 1916.

Pectis prostrata var. *cylindrica* Fernald, Amer. Acad. Arts and Sci. Proc. 33: 68. 1897.

Beaver Creek (eastern Yavapai County), Sacaton and Eloy (Pinal County), San Bernardino Ranch (Cochise County), Duquesne (Santa Cruz County), 1,300 to 5,000 feet, sandy-gravelly plains and mesas, May to September. New Mexico, Arizona, and Sonora.

3. *Pectis urceolata* (Fernald) Rydb., North Amer. Fl. 34: 197. 1916.

Pectis prostrata var. *urceolata* Fernald, Amer. Acad. Arts and Sci. Proc. 33: 68. 1897.

Gila, Cochise, and Santa Cruz Counties, 4,000 to 5,000 feet, August and September. New Mexico, southeastern Arizona, and Chihuahua.

It is doubtful whether *P. urceolata* and *P. cylindrica* are specifically distinct from *P. prostrata*. Two of the few collections examined (Smart, Santa Cruz, August 10, 1867, Peebles et al., 5566, from near Nogales) have only 3 phyllaries as in *P. cylindrica*, but these are puberulous as in *P. urceolata*, which normally has 5.

4. *Pectis imberbis* A. Gray, Pl. Wright. 2: 70. 1853.

Southwestern Cochise County and Santa Cruz County, 4,000 to 5,500 feet, August to October, type from "on the Sonoita," probably in southwestern Cochise County (Wright 1399). Southwestern Arizona, Sonora, and Chihuahua.

- *5. *Pectis coulteri* Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 62. 1849.
Sonora, and reported from Arizona.

6. *Pectis linifolia* L., Syst. Nat. ed. 10, 1221. 1759.

Pectis linifolia var. *marginalis* Fernald, Amer. Acad. Arts and Sci. Proc. 33: 85. 1897.

Cochise and Pima Counties, 3,000 to 6,000 feet, shaded canyons and slopes, August and September. Southeastern Arizona to northern South America; West Indies.

7. *Pectis longipes* A. Gray, Pl. Wright. 2: 69. 1853.

Cochise, Santa Cruz, and Pima Counties, 3,500 to 5,500 feet, gravelly flats and rocky slopes, April to September, type from between the San Pedro River and Santa Cruz, Sonora (*Wright* 1127). Western Texas to southeastern Arizona and northern Mexico.

8. *Pectis filipes* Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 62. 1849.

Pinal, Cochise, Santa Cruz, and Pima Counties, 3,000 to 6,000 feet, sandy plains, mesas, and rocky slopes, August to October. Western Texas to southern Arizona and northern Mexico.

9. *Pectis papposa* Harv. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 62. 1849.

Coconino, Mohave, western Graham, Maricopa, Pinal, Pima, and Yuma Counties, 3,000 feet or lower, sandy-gravelly plains and mesas, very common, June to October. New Mexico to California and northern Mexico.

10. *Pectis angustifolia* Torr., Ann. Lyc. N. Y. 2: 214. 1828.

Navajo, eastern Coconino, and western Gila Counties, 3,300 to 7,000 feet, also reported from the vicinity of Yuma, dry sandy or gravelly mesas, September. Nebraska to Texas, Arizona, and Mexico.

11. *Pectis palmeri* S. Wats., Amer. Acad. Arts and Sci. Proc. 24: 58. 1889.

Pectis mearnsii Rydb., North Amer. Fl. 34: 209. 1916.

Eastern Yavapai, southern Gila, and western Pima Counties, 2,500 to 3,000 feet, August, type of *P. mearnsii* from Fort Verde (*Mearns* 184). Southern Arizona, Sonora, and Baja California.

12. *Pectis rusbyi* Greene in A. Gray, Syn. Fl. 1²: 361. 1884.

Yavapai County, about 4,000 feet, August and September, type from Beaver Creek (*Rusby* in 1883). Known only from central Arizona.

106. ANTHEMIS. CAMOMILE

Branching annual, thinly pilose, rank-scented; leaves alternate, bi- or tripinnatisect into narrowly linear, cuspidate-tipped divisions; heads medium-sized, solitary at the tips of the stem and branches, naked-peduncled, the rays 10 to 15, white, the disk yellow; involucre hemispheric, of lance-ovate or oblong, scarious-margined phyllaries; receptacle conic, naked toward the base, bearing stiff narrow acuminate pales above; achenes subcylindric, 10-ribbed, glandular-roughened; pappus none.

1. *Anthemis cotula* L., Sp. Pl. 894. 1753.

Maruta cotula DC., Prodr. 6: 13. 1837.

Yavapai, Maricopa, Pinal, Cochise, and Pima Counties, 1,000 to 8,000 feet, roadsides and waste places, April to July. Throughout most of the United States and Canada; naturalized from Eurasia.

Mayweed, dogfennel. The powdered flowers are effective against bedbugs, fleas, and flies. A decoction of the leaves may also be employed as an insecticide.

107. ACHILLEA. YARROW, MILFOIL

Perennial herbs, usually less than 0.5 m. high, thinly or densely pilose, sometimes silky-canescens, leafy, with creeping rootstocks; leaves linear to oblong, finely dissected into very numerous, short, linear to ovate, callous-cuspidate divisions not more than 1 mm. wide; heads small, numerous, in a dense corymbose terminal panicle, both the rays and the disk white; rays small, roundish, about 2 mm. long; receptacle with scarious chaff; pappus none.

A. millefolium L., a European species extensively naturalized in the eastern United States, contains achilleine, a drug sometimes used in acute suppression of the menses. It was formerly prescribed as a tonic and in urinary disorders. Mrs. Collom (ms.) reports that a decoction of the leaves and flowers of *A. lanulosa* is used in family medicine in Arizona.

1. *Achillea lanulosa* Nutt., Acad. Nat. Sci. Phila. Jour. 7: 36. 1834.

Apache, Navajo, and Coconino Counties to Cochise and Pima Counties, 5,300 to 11,300 feet, mostly in the mountains, common in yellow pine forests, June to September. Manitoba to British Columbia, south to Kansas, New Mexico, Arizona, California, and northern Mexico.

In var. *alpicola* Rydb. (*A. subalpina* Greene, *A. alpicola* Rydb.), seen from the San Francisco Peaks, Coconino County, and Baldy Peak, Apache County, 8,400 to 11,280 feet, the margins of the phyllaries are dark brown, whereas they are straw-colored to pale brown in the typical form.

Achillea lanulosa, western yarrow, a certainly indigenous plant, is not clearly distinguishable from the introduced *A. millefolium* common in the eastern United States. Specimens from the Chiricahua Mountains (*Blumer* 1340) are suggestive of *A. millefolium*. A collection from the north end of the Carrizo Mountains, Apache County (*Standley* 7379), has comparatively large heads and large leaves with remote divisions, and has been referred to *A. laxiflora* Pollard and Cockerell, but does not seem to be specifically distinct from other Arizona material.

107a. LEUCAMPYX

Leucampyx newberryi A. Gray is known definitely only from Colorado and New Mexico. *Hymenopappus radiatus* Rose, very similar in practically all characters except the naked receptacle (that of *Leucampyx* bearing a broad membranous pale at the base of each flower), has sometimes been mistaken for it. The only specimen of *Leucampyx* allegedly from Arizona examined is one in the U. S. National Herbarium, labeled "Arizona, Dr. E. Palmer, 1872" in George Vasey's handwriting, and bearing the identification by Dr. Gray and his note "new to Arizona." The species was not recorded from Arizona in the Synoptical

Flora,⁶ however, and the data for some of Dr. Palmer's early collections are so vague, or at any rate so vaguely recorded by Vasey on the labels, that it is inadvisable to include the plant in the flora of Arizona until a definite record is forthcoming.

108. MATRICARIA. FALSE-CAMOMILE

Annual herbs, usually 30 cm. high or less, sweet-scented, essentially glabrous; leaves alternate, 2- or 3-pinnatisect into linear or linear-filiform divisions; heads medium-sized, radiate or discoid, solitary at the tips of the stem and branches; involucre of subequal, oblong or oval, broadly scarious-margined phyllaries; receptacle conic, naked; achenes small, oblong, oblique, ribbed on the inner side; pappus a low crown or nearly wanting.

Key to the species

1. Rays none; pappus an evident oblique crown; plant pineapple-scented.
 1. *M. MATRICARIOIDES.*
1. Rays present, white; pappus obsolete; plant not pineapple-scented.
 2. *M. CHAMOMILLA.*

1. **Matricaria matricarioides** (Less.) Porter, Torrey Bot. Club Mem. 5: 341. 1894.

Santolina suaveolens Pursh, Fl. Amer. Sept. 520. 1814.

Artemisia matricarioides Less., Linnaea 6: 210. 1831.

Matricaria discoidea DC., Prodr. 6: 50. 1837.

Matricaria suaveolens Buch., Fl. Nord. Tief. 496. 1894. Not L., 1755.

Pinal and Pima Counties, up to 2,400 feet, roadsides, waste places, and river bottoms, February to April. Native from Alaska to Montana, Arizona, and Baja California, naturalized eastward; adventive in Europe.

Called pineapple-weed, in allusion to the pleasant odor of the plant.

2. **Matricaria chamomilla** L., Sp. Pl. 891. 1753.

Known in Arizona only by a collection at Phoenix (*Dewey* in 1891). Occasionally adventive in the United States; native of Europe.

The closely related *Matricaria courrantiana* DC. (*M. chamomilla* var. *coronata* Boiss.), differing mainly in its conspicuous pappus, is recorded by Rydberg⁷ from Arizona, but Dewey's plant, the only Arizona specimen of the group seen, although identified by Rydberg as *M. courrantiana*, has no pappus and is definitely *M. chamomilla*.

109. CHRYSANTHEMUM

Annual or perennial, glabrous or sparsely pubescent, leafy-stemmed herbs; leaves toothed to tripinnatisect; heads medium-sized, solitary at the tips of the stem and branches, the rays white or yellow, the disk yellow; involucre of scarious-margined phyllaries; receptacle naked, broad, flattish; achenes 5- to 10-ribbed, sometimes narrowly 2- or 3-winged; pappus none.

Several species are in cultivation as ornamentals, and the insecticide, pyrethrum, is obtained from 2 of them.

⁶ GRAY, ASA. SYNOPTICAL FLORA OF NORTH AMERICA. 1st: 1884. (See p. 362.)

⁷ RYDBERG, P. A. NORTH AMERICAN FLORA 34: 1916. (See p. 232.)

Key to the species

1. Lower leaves obovate or spatulate, toothed or incised, on slender petioles longer than the blades; stem leaves linear to oblanceolate, sessile, incised-serrate to pinnatifid; phyllaries with a narrow dark brown submarginal area; rays clear white, normally more than 1 cm. long.----- 1. *C. LEUCANTHEMUM*.
1. Leaves all essentially similar, mostly broadly obovate, 2- or 3-pinnatifid, with a winged pinnatifid or toothed petiolar base; phyllaries with broad pale scarious margin; rays pale yellow, less than 1 cm. long.
2. *C. CORONARIUM*.

1. *Chrysanthemum leucanthemum* L., Sp. Pl. 888. 1753.

Mogollon Escarpment, Gila County (*Collom* 174), Pinal Mountains, Gila County (*Peebles* 14091), fields and roadsides, rare in Arizona, midsummer. Extensively naturalized in the United States; introduced from Europe.

The common oxeye-daisy, represented in Arizona by var. *pinnatifidum* Lecoq and Lam.

2. *Chrysanthemum coronarium* L., Sp. Pl. 890. 1753.

Near Chandler, Maricopa County (*Harrison* 1787), Tucson, Pima County (*Toumey* 710), roadsides and waste ground, spring. Occasional in the United States; introduced from Europe.

Crowndaisy, sometimes cultivated under the name summer chrysanthemum.

110. ARTEMISIA.⁸ WORMWOOD, SAGEBRUSH

Herbs or shrubs; leaves alternate, entire to once, twice, or thrice pinnatifid; heads small, discoid or disciform, usually very numerous, spicate, racemose, or paniced; pistillate outer flowers, without rays, sometimes present; achenes short, thick, glabrous or merely glandular, or in 1 species pubescent; pappus none.

The best known species is *A. tridentata*, the big sagebrush, State flower of Nevada, which covers vast areas in the Great Basin region and adjacent territory. The strong aromatic odor of the plant is unmistakable and persistent. A heavy growth of this plant indicates a good depth of fertile soil, free from "alkali." Many of the species, notably estafiata (*A. frigida*), *A. tridentata*, *A. filifolia*, *A. bigelovii*, and bud-sage (*A. spinescens*), are valuable browse plants, especially in winter and early spring, but some of them are reported to be toxic to domestic animals if eaten in excess. Several species are useful for controlling soil erosion. Some of these plants (*A. filifolia*, *A. frigida*, *A. tridentata*) were used medicinally by the Indians and the early white settlers. The drug santonin, a remedy for roundworm, is obtained from *A. mexicana*. A vermifuge is also manufactured from the European *A. absinthium* L. The Hopi Indians roasted leaves of *A. frigida* with sweet corn, to flavor it. The silvery foliage and feathery panicles of some of the sagebrushes, together with their pleasant odor, make them worthy of consideration for cultivation as ornamentals. They are attractive in mixed bouquets.

⁸ Reference: HALL, H. M., and CLEMENTS, F. E. THE PHYLOGENETIC METHOD IN TAXONOMY. THE NORTH AMERICAN SPECIES OF ARTEMISIA, CHRYSOTHAMNUS, AND ATRIPLEX. Carnegie Inst. Wash. Pub. 326: 31-156. 1923.

Key to the species

1. Plants shrubs or undershrubs, with foliage silvery-canescens on both sides (2).
2. Leaves twice or thrice pinnatifid into linear divisions; receptacle villous; plant an undershrub, 20 to 50 cm. high, several- or many-stemmed.
 8. *A. FRIGIDA*.
2. Leaves entire, 3-toothed, or 3-parted; receptacle glabrous; plants often taller (3).
3. Leaves linear-filiform, less than 1 mm. wide, entire or 3-parted.
 11. *A. FILIFOLIA*.
3. Leaves broader, at least the lower ones 3-dentate at apex (4).
4. Pistillate outer flowers (1 or 2) usually present; involucre densely and persistently gray-tomentose throughout, only about 2 mm. high.
 7. *A. BIGELOVII*.
4. Pistillate outer flowers none; involucre usually glabrate, at least on the inner phyllaries, larger (5).
5. Heads very numerous, in dense crowded panicles 1.5 to 7 cm. thick; phyllaries, at least the outer ones, canescens-pubescent; plants usually at least 50 cm. high.
 12. *A. TRIDENTATA*.
5. Heads fewer, in less crowded often spikelike or racemelike panicles rarely more than 1.5 cm. thick; phyllaries greenish yellow or yellowish brown, nearly glabrous; plants 10 to 30 cm. high.
 13. *A. NOVA*.
1. Plants herbs or, if rarely shrubby, then the foliage not silvery-canescens, although often white-tomentose (6).
6. Branchlets spinescent; achenes of the pistillate flowers cobwebby-pubescent; leaves small, about 1 cm. long, roundish in outline, twice to thrice pinnatifid into spatulate divisions.
 14. *A. SPINESCENS*.
6. Branchlets not spinescent; achenes glabrous or merely glandular (7).
7. Leaves, at least the lower ones, twice or thrice pinnatifid (8).
8. Plant essentially glabrous, equably leafy throughout; leaves twice or thrice pinnatisect into very numerous acute divisions (9).
9. Panicle dense, spikelike; plant inodorous.
 5. *A. BIENNIS*.
9. Panicle very loose and broad; plant sweet-scented.
 6. *A. ANNUA*.
8. Plant decidedly hairy, at least on the lower leaves or the under leaf surface, the leaves usually much reduced above (10).
10. Whole plant densely silky-canescens; receptacle villous.
 8. *A. FRIGIDA*.
10. Plant not silky-canescens except sometimes on the lower leaves; receptacle glabrous (11).
11. Leaves green above, canescens-tomentulose beneath, bipinnatifid, the divisions not linear-filiform; heads 5 to 7 mm. thick.
 1. *A. FRANSERIOIDES*.
11. Leaves about equally pubescent on both sides, not bicolor, the principal divisions linear-filiform or very narrowly linear; heads about 2 to 3 mm. thick.
 10. *A. PACIFICA*.
7. Leaves entire to once pinnatifid (12).
12. Leaves elongate-linear, entire or some of the lower ones sometimes 3-cleft, usually 5 to 8 cm. long, 1 to 6 mm. wide, glabrous or somewhat pubescent but never tomentose.
 9. *A. DRACUNCULOIDES*.
12. Leaves usually broader or else usually lobed, toothed, or pinnatifid, always tomentose, at least beneath (13).
13. Leaves pinnatisect essentially to the midrib into linear or linear-filiform lobes 1 mm. wide, or narrower.
 4. *A. CARRUTHII*.
13. Leaves from entire to toothed or pinnatisect, the lobes when present 2 mm. wide, or wider (14).
14. Leaves oblong or oblong-lanceolate, persistently gray-tomentose above, entire or few-toothed, or the lower ones sometimes with a few short broad lobes.
 2. *A. GNAPHALODES*.
14. Leaves linear to lanceolate or rarely oblong or obovate, soon glabrate and green above, from entire to deeply pinnatifid.
 3. *A. LUDOVICIANA*.

1. *Artemisia franserioides* Greene, Torrey Bot. Club Bul. 10: 42. 1883.

Pinaleno Mountains (Graham County), Chiricahua Mountains (Cochise County), Santa Catalina Mountains (Pima County), 8,000

to 10,000 feet, open coniferous forest, August and September. Colorado to New Mexico, southeastern Arizona, and Chihuahua.

2. *Artemisia gnaphalodes* Nutt., Gen. Pl. 2: 143. 1818.

Artemisia albula Woot., Contrib. U. S. Natl. Herbarium 16: 193. 1913.

Kaibab Plateau and Grand Canyon (Coconino County) to the mountains of Graham, Cochise, Santa Cruz, and Pima Counties, 2,700 to 7,300 feet, dry slopes and canyons, often on limestone, August to November. Southern Canada to Missouri, Texas, Arizona, California, and Mexico.

Cudweed-sagewort. *Artemisia albula* is a form with much-branched inflorescence and small heads.

3. *Artemisia ludoviciana* Nutt., Gen. Pl. 2: 143. 1818.

Artemisia silvicola Osterhout, Torrey Bot. Club Bul. 28: 645. 1901.

Grand Canyon (Coconino County) and southern Apache County to the mountains of Cochise and Pima Counties, 2,400 to 8,000 feet, dry slopes and canyons, often in open pine forests, August to October. Montana and Washington to Texas, Arizona, California, and northern Mexico.

Artemisia mexicana Willd., distinguished by the narrow elongate lobes (2 to 4 mm. wide) of at least the lower leaves, is probably not specifically distinct from *A. ludoviciana*. This form has been collected in Apache, Navajo, Coconino, Greenlee, and Santa Cruz Counties. *Artemisia ludoviciana* itself is only artificially distinguished from *A. gnaphalodes* by its glabrate upper leaf surface, and intermediate specimens are too common. *Artemisia sulcata* Rydb. is apparently a form of *A. mexicana*.

4. *Artemisia carruthii* Wood in Carruth, Kansas Acad. Sci. Trans. 5: 51. 1877.

White Mountains (Apache County), Hopi Indian Reservation (Navajo County), Grand Canyon and vicinity of Flagstaff (Coconino County), mostly 6,000 to 8,000 feet, open pine forest, August to October. Missouri to Texas, west to Utah and Arizona.

The var. *wrightii* (A. Gray) Blake (*A. wrightii* A. Gray), differing from the typical form only in having the upper surface of the leaves glabrate and green, has a wider range in Arizona, from the Carrizo Mountains (Apache County) to Hualpai Mountain (Mohave County), also in the White, Pinaleno, Pinal, and Chiricahua Mountains (Greenlee, Graham, Pinal, and Cochise Counties).

5. *Artemisia biennis* Willd., Phytogr. 11. 1794.

Near Flagstaff, Coconino County, 7,200 feet (*Pearson* 102), Gila River bed, Sacaton, Pinal County (*Harrison* 1969), June to September. Canada to New Jersey, Kentucky, Missouri, Arizona, and California, native in the western part of this range, elsewhere naturalized.

6. *Artemisia annua* L., Sp. Pl. 847. 1753.

Santa Catalina Mountains, Pima County, about 6,000 feet, roadside, August (*Harrison* and *Kearney* 8134). A weed here and there in the United States; naturalized from Europe.

Sweet wormwood.

7. *Artemisia bigelovii* A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 110. 1857.

Artemisia petrophila Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 193. 1913.

Apache, Navajo, and Coconino Counties, 5,000 to 7,000 feet, dry mesas and slopes, sometimes with pinyon, August to October. Colorado and Utah to Texas, New Mexico, and northern Arizona.

A small, many-stemmed shrub.

8. *Artemisia frigida* Willd., Sp. Pl. 3: 1838. 1804.

Navajo and Coconino Counties, 6,000 to 7,000 feet, dry stony soil, July to October. Canada and Alaska, south to Texas, New Mexico, and northern Arizona; Siberia.

Estafiata. An undershrub or almost herbaceous, often forming mats, valuable as forage.

9. *Artemisia dracunculoides* Pursh, Fl. Amer. Sept. 742. 1814.

Apache County to Mohave County, south to the mountains of Cochise, Santa Cruz, and Pima Counties, 3,300 to 9,000 feet, open coniferous forests and chaparral, common, August to October. Manitoba to British Columbia, south to Texas, Arizona, and Baja California.

False-tarragon. Much of the Arizona material, in its small rather long-peduncled heads (the peduncles up to 5 mm. long) approaches var. *dracunculina* (S. Wats.) Blake (*A. dracunculina* S. Wats.), described from Chihuahua. The type of that form, however, has rather densely pilose stems and leaves, and the only Arizona specimen examined that completely agrees with it is one from Mount Lemmon, Pima County, 6,000 feet (Harrison and Kearney 8051).

10. *Artemisia pacifica* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 401. 1841.

Artemisia camporum Rydb., North Amer. Fl. 34: 254. 1916.

Hopi Indian Reservation (Navajo County) and Kaibab Plateau (Coconino County), to the White Mountains (Apache County), Prescott (Yavapai County), and Sierra Ancha (Gila County), 5,500 to 8,000 feet, open coniferous forest, July to October. South Dakota to northwestern Canada, south to New Mexico and central Arizona.

11. *Artemisia filifolia* Torr., Ann. Lye. N. Y. 2: 211. 1828.

Apache, Navajo, and Coconino Counties, 5,000 to 6,000 feet, loose sandy soil, August to November. Nebraska and Wyoming to Nevada, south to Texas, northern Arizona, and northern Mexico.

Sand sagebrush. A small much-branched shrub.

12. *Artemisia tridentata* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 398. 1841.

Apache, Navajo, and Coconino Counties, 6,000 to 7,000 feet, plains, mesas, and rocky slopes, in the open or with pinyon and juniper, common, July to October. South Dakota to British Columbia, south to New Mexico, northern Arizona, and Baja California.

Big sagebrush occurs in nearly pure stands over large areas in central Apache and Navajo Counties. Varies greatly in size according to habitat, forming an extensive root system and reaching a height of

2 m. (7 feet) or more where conditions permit. A good growth of this sagebrush indicates a deep, fertile, nonsaline soil.

13. *Artemisia nova* A. Nels., Torrey Bot. Club Bul. 27: 274. 1900.

Navajo Indian Reservation (Apache and Navajo Counties), Kaibab Plateau and Grand Canyon (Coconino County), 6,000 to 7,000 feet, dry slopes and mesas, usually in shallow stony soil, August and September. Montana to New Mexico, northern Arizona, and California.

A small shrub.

14. *Artemisia spinescens* D. C. Eaton in King, Geol. Expl. 40th Par. 5: 180. 1871.

Picrothamnus desertorum Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 417. 1841. Not *A. desertorum* Spreng., 1826.

Northern Apache County, Carrizo Mountains and near Rock Point (*Standley* 7479, *Peebles* and *Smith* 13545), 5,500 to 6,000 feet, dry slopes and mesas, often in saline soil. Montana to Oregon, south to New Mexico, northeastern Arizona, and California.

Bud-sage, a small rigid, spiny shrub, very resistant to drought and overgrazing.

110a. LEPIDOSPARTUM. SCALEBROOM

Lepidospartum squamatum A. Gray was reported by Gray⁹ from "Desert of the Colorado, Arizona, 1870. Dr. Palmer." This reference was to a peculiar form, *Linosyris squamata* var. *palmeri* A. Gray, now *Lepidospartum squamatum* var. *palmeri* (A. Gray) L. C. Wheeler. According to L. C. Wheeler,¹⁰ Palmer's plant probably came from near Whitewater, Riverside County, Calif. Practically all later authors have continued to include Arizona in the range of the species, but not one has cited material from the State. It seems advisable to exclude *Lepidospartum* from the flora of Arizona until actual specimens are forthcoming.

111. ARNICA

Low pubescent perennial herbs; leaves opposite; heads solitary or few, rather large, long-peduncled, yellow, radiate; involucre 2-seriate, equal, of thin, subherbaceous, lance-oblong, acute or acuminate phyllaries; pappus of barbellate bristles.

Tincture of arnica is obtained from a European species, *A. montana* L.

Key to the species

1. Lower leaves broadly ovate, cordate; heads almost always solitary.
 1. *A. CORDIFOLIA*.
1. Lower leaves oblong to lance-ovate, tapering at base; heads normally 3 or more ----- 2. *A. FOLIOSA*.

1. *Arnica cordifolia* Hook., Fl. Bor. Amer. 1: 331. 1834.

North rim of the Grand Canyon (Grand Canyon Herbarium 2007). Alaska to South Dakota, New Mexico, northern Arizona, and California.

2. *Arnica foliosa* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 407. 1841.

Kaibab Plateau, 9,100 feet (*Collom* in 1940). Alaska to Colorado, Utah, northern Arizona, and California.

⁹ GRAY, ASA. MISCELLANEOUS BOTANICAL NOTES AND CHARACTERS. Amer. Acad. Arts and Sci. Proc. 8: 282-296. 1870. (See p. 290.)

¹⁰ WHEELER, LOUIS C. TYPE OF THE GENUS LEPIDOSPARTUM. Rhodora 40: 320-323. 1938.

112. PEUCEPHYLLUM. PIGMY-CEDAR

Much-branched shrub, whitish-barked, resinous-viscid, essentially glabrous, denudate below, very leafy above; leaves alternate, linear-filiform, subterete, obtuse or apiculate, densely glandular-punctate, 8 to 20 mm. long; heads solitary at the tips of the branches, sessile, yellow, discoid; involucre 2-seriate, subequal, of linear-lanceolate acuminate phyllaries; achenes silky-pilose; pappus of numerous graduated bristles, the inner ones sometimes narrowly linear, flattened, and paleaceous.

1. **Peucephyllum schottii** A. Gray in Torr., U. S. and Mex. Bound. Bot. 74. 1859.

Northern Mohave County to central Yuma County, up to 5,000 feet but commonly lower, dry rocky slopes, March to June. Southern Nevada, western Arizona, southern California, and Baja California.

113. PSATHYROTES

Low, spreading, divaricately branched, annual (or perennial?), scurfy-tomentose, very leafy herbs; leaves alternate, ovate to deltoid-ovate, toothed or entire, petioled; heads solitary in the forks, small, discoid, nodding or erect, yellow or purplish; involucre 2- or 3-seriate, somewhat graduated, the phyllaries lanceolate to oblong or obovate, at least the outer ones herbaceous, at least above; achenes densely silky-villous; pappus of numerous graduated bristles, becoming yellow-brown in age.

Key to the species

1. Leaves entire, scurfy-tomentulose and bearing conspicuous, long, many-jointed hairs, especially on the margin and petiole; achenes subcylindric, hispidulous..... 1. *P. PILIFERA*.
1. Leaves toothed or crenate, without conspicuous, long, many-jointed hairs; achenes obconic, densely silky-pilose (2).
2. Outer phyllaries obovate, much broader than the inner ones; plant lanate-tomentose as well as scurfy..... 2. *P. RAMOSISSIMA*.
2. Outer phyllaries lanceolate, lance-ovate, or spatulate, not broader than the inner ones; plant scurfy-tomentose..... 3. *P. ANNUA*.

1. **Psathyrotis pilifera** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 50. 1883.

Lees Ferry, Coconino County, 4,200 feet (*E. W. Nelson* 55), August and September. Southern Utah and northern Arizona.

2. **Psathyrotis ramosissima** (Torr.) A. Gray, Amer. Acad. Arts and Sci. Proc. 7: 363. 1868.

Tetradymia ramosissima Torr. in Emory, Mil. Recon. 145. 1848.

Mohave and Yuma Counties, 1,000 feet or lower, plains and mesas in gravelly or sandy soil, flowering throughout the year. Southwestern Utah to western Arizona, southeastern California, and northern Baja California.

3. **Psathyrotis annua** (Nutt.) A. Gray, Pl. Wright. 2: 100. 1853.

Bulbostylis annua Nutt., Acad. Nat. Sci. Phila. Jour. ser. 2, 1: 179. 1848.

Southern Utah to southeastern California, western Arizona (?), northern Baja California, and Sonora.

No specimens from Arizona have been examined, except some possibly from that State labeled Arizona (*Palmer* in 1877), but the known range of the species is such that its occurrence in Arizona is practically certain.

114. CACALIA. INDIAN-PLANTAIN

Herbaceous perennial, about 1 m. high, woolly-tufted at base, otherwise nearly glabrous; leaves mostly in a basal tuft, broad, long-petioled, 3- or 4-pinnatisect into linear or lance-linear ultimate divisions, the stem leaves few, the upper ones much reduced; heads numerous, small, discoid, white, 5- to 7-flowered, in a dense terminal corymbiform panicle; phyllaries 5 or 6, less than half as long as the flowers; achenes glabrous; pappus of numerous capillary bristles.

1. *Cacalia decomposita* A. Gray, Pl. Wright. 2: 99. 1853.

Willow Spring (southern Apache County), Chiricahua and Huachuca Mountains (Cochise County), Patagonia Mountains (Santa Cruz County), 5,000 to 8,000 feet, rich shaded soil, July to September. Southeastern Arizona, southwestern New Mexico, and Sonora.

115. TETRADYMIA. HORSEBRUSH

Shrub, 1 m. high or less, stiffly much-branched, canescent-tomentose throughout; leaves oblanceolate to linear, entire, sessile, callous-tipped, usually less than 1.5 cm. long, often with axillary fascicles; heads medium-sized, discoid, 4-flowered, yellow, clustered at the tips of the branches; involucre of 4 equal thick-chartaceous phyllaries, tomentose outside; achenes obovoid, densely silky-pilose; pappus of copious, whitish, capillary bristles.

1. *Tetradymia canescens* DC., Prodr. 6: 440. 1837.

Navajo County to eastern Mohave County, 6,000 to 7,000 feet, dry open ground, in sandy or rocky, sometimes saline soil, often abundant, July to September. Montana to New Mexico, northern Arizona, and California.

The only form occurring in Arizona is var. *inermis* (Nutt.) A. Gray. The plant is said to be browsed locally by sheep, but its forage value is low and it is suspected of being poisonous. The Hopi are reported to use the leaves and roots as a tonic and for uterine disorders. White-haired animals eating this plant are reported to suffer photosensitization of the skin, resulting in severe dermatitis.

Tetradymia axillaris A. Nels. (*T. longispina* (M. E. Jones) Rydb.) has been listed from Arizona by various authors, but no material from the State has been seen by the writer. It can be distinguished readily by its long straight spines (transformed primary leaves), 5 or 6 phyllaries, and 5- to 9-flowered heads.

116. SENECIO.¹¹ GROUNDSEL

Herbs or shrubs; leaves alternate, entire to once or twice pinnatifid; heads medium-sized or rather large, yellow, radiate or discoid; involucre essentially 1-seriate, of equal, usually narrow, subherbaceous phyllaries, often with a calyculus of shorter bractlets at base; achenes glabrous or pubescent; pappus of soft white capillary bristles.

¹¹ Reference: GREENMAN, J. M. MONOGRAPH OF THE NORTH AND CENTRAL AMERICAN SPECIES OF THE GENUS SENECIO, PART II. Mo. Bot. Gard. Ann. 2: 573-626. 1915; 3: 85-194. 1916; 4: 15-36. 1917; 5: 37-108. 1918. (Not et completed.)

S. longilobus, *S. spartioides*, and perhaps other species, are poisonous to cattle and horses, less so to sheep, but are seldom eaten when better forage is available. The liver is the organ chiefly affected. *S. cruentus* DC., of the Canary Islands, is supposed to be the parent of the showy forms cultivated under the name cineraria.

Key to the species

1. Leaves pinnatilobate with narrowly linear or linear-filiform entire lobes, or entire and narrowly linear or linear-filiform; plants very leafy throughout, usually suffrutescent (2).
2. Leaves entire, narrowly linear, or rarely with a pair of filiform lobes; plant essentially glabrous; heads numerous, narrowly campanulate or subcylindric, in a close cymose panicle.----- 1. *S. SPARTIOIDES*.
2. Leaves pinnatilobate, or the upper ones often entire, or if all the leaves entire (rarely so in *S. longilobus*), then the plant tomentose (3).
3. Heads subcylindric or narrowly campanulate; phyllaries 8 to 10; plant glabrous----- 2. *S. MULTICAPITATUS*.
3. Heads broadly campanulate; phyllaries 13 to 21; plant glabrous or tomentose (4).
4. Bracteoles inconspicuous, less than half as long as the involucre; plant permanently tomentose, or sometimes glabrate below.
 3. *S. LONGILOBUS*.
4. Bracteoles conspicuous, half as long as the involucre or longer; plant glabrous or nearly so----- 4. *S. MONOENSIS*.
1. Leaves neither pinnatilobate with narrowly linear or linear-filiform entire lobes, nor entire and narrowly linear (5).
5. Leaves all or nearly all deeply pinnatifid, with usually toothed or lobed divisions (6).
6. Stem uniformly leafy to the inflorescence; leaves laciniately once or twice pinnatifid, the lobes mostly acute or acuminate; heads small and narrow, the involucre 5 to 7 mm. high, 3 to 5 mm. thick.
 5. *S. MACDOUGALII*.
6. Stem with the upper leaves generally much reduced; leaf lobes often blunt; heads larger, the involucre 6 to 10 mm. high, 4 to 10 mm. thick (7).
7. Plant coarse and tall (70 to 100 cm. high), glabrous and somewhat glaucous; leaves with comparatively few divisions, the terminal one large, roundish, 2.5 to 5 cm. wide----- 6. *S. QUERCETORUM*.
7. Plant smaller and more slender, not evidently glaucous, often tomentose; leaves mostly with numerous divisions, the terminal one rarely more than 2 cm. wide (8).
8. Plant dwarf (10 cm. high or less); heads few; involucre 7 to 10 mm. high----- 7. *S. FRANCISCANUS*.
8. Plant taller; heads usually rather numerous; involucre not more than 8 mm. high (9).
9. Achenes hirtellous (10).
10. Phyllaries about 13----- 8. *S. MULTILOBATUS*.
10. Phyllaries about 21----- 9. *S. MILLELOBATUS*.
9. Achenes glabrous (11).
11. Leaves with the primary divisions again pinnatifid into numerous small divisions----- 10. *S. LYNCEUS*.
11. Leaves not with the primary divisions pinnatifid into numerous small divisions (12).
12. Plant essentially glabrous except for woolly tufts in the leaf axils----- 11. *S. STYGIIUS*.
12. Plant more or less tomentose on the leaves and stem.
 12. *S. UINTAHENSIS*.
5. Leaves mostly entire or merely toothed (the stem leaves pinnatifid in *S. hartianus*, sometimes also in *S. neomexicanus*) (13).
13. Heads nodding, discoid----- 13. *S. BIGELOVII*.
13. Heads not nodding, usually radiate (14).
14. Leaves suborbicular, about 10 cm. wide, palmately 5- or 7-nerved from the base and conspicuously reticulate, shallowly repand-lobed and repand-dentate; heads very numerous, small, in a broad panicle.
 14. *S. SEEMANNII*.

14. Leaves much narrower, not palmate-nerved, not evidently reticulate (15).
15. Phyllaries 8, broad, blunt, with a conspicuous, usually bright yellow margin; plant a shrub, with narrowly lance-linear leaves tapering to the base..... 15. *S. SALIGNUS*.
15. Phyllaries more numerous, narrow, usually acute or acuminate; plants herbaceous or suffrutescent (16).
16. Leaves conspicuously clasping; plants not tomentose (17).
17. Plant densely glandular-pubescent..... 16. *S. PARRYI*.
17. Plant glabrous (18).
18. Plant annual; heads disciform or discoid; leaves oblong or oblong-ovate, 2 to 6 cm. long..... 17. *S. MOHAVENSIS*.
18. Plant perennial; heads conspicuously radiate; leaves usually larger (19).
19. Leaves oblong, the middle ones 20 to 25 cm. long, 4 to 6.5 cm. wide, closely repand-denticulate; plant herbaceous, simple below the inflorescence... 18. *S. HUACHUCANUS*.
19. Leaves lanceolate or linear, 4 to 10 (17) cm. long, rarely more than 1.5 cm. wide, irregularly dentate, chiefly toward the base; plant suffrutescent, branched.
19. *S. LEMMONI*.
16. Leaves not clasping, or, if so (sometimes in *S. cynthioides*), then the lower leaves tomentose beneath (20).
20. Plant glabrous and somewhat glaucous..... 20. *S. WOOTONII*.
20. Plant tomentose, at least at the base of the stem (21).
21. Heads solitary (very rarely 2 or 3), large, the involucre 10 to 12 mm. high; basal leaves obovate, crenate-toothed; stem leaves few, small, narrow, entire, bractlike.
21. *S. ACTINELLA*.
21. Heads several or many (rarely solitary in *S. werneriaefolius* and *S. neomexicanus*), smaller (22).
22. Basal leaves ovate, 2 to 5.5 cm. wide, often subcordate, closely dentate or dentate-serrate... 22. *S. ARIZONICUS*.
22. Basal leaves linear-oblongate to obovate, usually much narrower, if as broad, then not closely dentate-serrate (23).
23. Involucre persistently tomentose, at least toward the base; plant low, rarely more than 20 cm. high; stem naked or with 1 or 2 narrowly subulate bracts.
23. *S. WERNERIAEFOLIUS*.
23. Involucre glabrous or soon glabrate; plants usually taller; stems more or less leafy (24).
24. Basal leaves elliptic, oval, or obovate, finely and closely crenate-serrate or serrate; tomentum mostly fugacious..... 24. *S. HARTIANUS*.
24. Basal leaves otherwise; tomentum more persistent (25).
25. Basal and stem leaves essentially similar, narrowly oblanceolate (about 5 to 12 cm. long, 4 to 10 mm. wide), entire to remotely toothed, green and glabrescent or glabrate above, gray-tomentulose beneath; stem almost uniformly leafy throughout..... 25. *S. CYNTHIOIDES*.
25. Basal and stem leaves usually dissimilar, at least the basal ones normally broader, often sharply toothed; stem usually with much reduced leaves above..... 26. *S. NEOMEXICANUS*.

1. *Senecio spartioides* Torr. and Gray, Fl. North Amer. 2: 438. 1843.

Northern Navajo County, Coconino County, and Hualpai Mountain (Mohave County), 6,500 to 9,200 feet, openings in pine forests, July to October. Nebraska and Wyoming, south to Texas and Arizona.

Broom groundsel. The plant is known to be poisonous to livestock, but is rarely eaten.

2. **Senecio multicapitatus** Greenm. ex Rydb., Torrey Bot. Club Bul. 33: 160. 1906.

Apache, Navajo, and Coconino Counties, 5,000 to 7,000 feet, plains and mesas, May to November. Colorado, Utah, New Mexico, and Arizona.

3. **Senecio longilobus** Benth., Pl. Hartw. 18. 1839.

Senecio filifolius Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 414. 1841. Not Berg., 1767.

Senecio orthophyllus Greene, Leaflets 1: 221. 1906.

Apache, Navajo, and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 2,500 to 7,000 feet, common on dry stony plains, mesas, and slopes, and along washes, May to November, type of *S. orthophyllus* from Willow Spring, Apache County (*Palmer* 479 in 1890). Colorado and Utah, south to Texas and Mexico.

Threadleaf groundsel. The United States Department of Agriculture has found *S. longilobus* to be one of the most poisonous of the groundsel, especially to cattle and horses, the leaves of the new growth being most toxic. The primary effect is to produce lesions in the liver. This species is used extensively in the domestic medicine of the Indians.

4. **Senecio monoensis** Greene, Leaflets 1: 221. 1906.

Senecio lathyroides Greene, Leaflets 2: 21. 1909.

Senecio filicifolius Greenm., Mo. Bot. Gard. Ann. 1: 274. 1914.

Senecio pectinatus A. Nels., Wyo. Univ. Pub. Bot. 1: 141. 1926.

Almost throughout the State, 1,200 to 6,000 feet, dry sandy or stony soil on mesas and slopes, and in canyons, often in chaparral, flowering in nearly all months, type of *S. lathyroides* from Pierce Spring (*M. E. Jones* 5077), type of *S. filicifolius* from the Santa Cruz River valley (*Pringle* 316 in 1881), type of *S. pectinatus* from near the Baboquivari Mountains, Pima County (*Hanson* 1020). Utah and Arizona to California and Mexico.

A specimen from Superior (*Whitehead* 269) has a woolly involucre and young branchlets and approaches *S. douglasii* DC., but other specimens from the same region are definitely *S. monoensis*. The latter is closely related to *S. douglasii*, differing chiefly in its essentially glabrous character and its more herbaceous stem, and may be no more than a variety.

5. **Senecio macdougallii** Heller, Torrey Bot. Club Bul. 26: 592. 1899.

Apache and Coconino Counties to Cochise and Pima Counties, 7,000 to 10,500 feet, coniferous forests, July to October, type from Walnut Canyon, near Flagstaff (*MacDougal* 342). New Mexico and Arizona.

A specimen from the north end of the Carrizo Mountains (*Standley* 7376), identified by Greenman as *S. ambrosioides* Rydb., is the only collection of that species cited by him from Arizona. (See footnote 11, p. 1005, Greenman, vol. 2, p. 596). The heads are young, but the number of flowers (6 ray, 30 disk) agrees as well with *S. macdougallii* as with *S. ambrosioides*.

6. **Senecio quercetorum** Greene, Leaflets 2: 20. 1909.

Southern Coconino County and mountains of Graham and Gila Counties, 3,500 to 6,000 feet, chiefly in the oak belt, March to May, type from Oak Creek (*Rusby* 672). Known only from Arizona.

7. **Senecio franciscanus** Greene, Pittonia 2: 19. 1889.

San Francisco Peaks (Coconino County), where the type was collected by Greene in 1889, up to 12,000 feet, July and August. Known only from Arizona.

8. **Senecio multilobatus** Torr. and Gray in A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 109. 1849.

Northern Apache, Navajo, and Coconino Counties, 6,000 to 7,000 feet, June to August. New Mexico and Arizona.

Senecio multilobatus var. *standleyi* Greenm. does not seem different from *S. multilobatus*, at least as to the only Arizona specimen seen, from the north end of the Carrizo Mountains (*Standley* 7513).

9. **Senecio millelobatus** Rydb., Torrey Bot. Club Bul. 27: 171. 1900.

Kaibab Plateau (Coconino County), Fredonia (Mohave County), near Prescott (Yavapai County), 4,500 to 7,000 feet, also bed of the Agua Fria River (Maricopa County), about 1,000 feet, where doubtless a stray from farther north, May and June. Texas to Arizona and Chihuahua.

10. **Senecio lynceus** Greene, Erythea 3: 22. 1895.

Northern Navajo County and from the Kaibab Plateau to near Prescott (Coconino and Yavapai Counties), 5,500 to 7,500 feet, pine forests, May to October, type not definitely stated but, by implication, from Lynx Creek, Yavapai County (*Rusby* 665, in 1883). Southern Utah and northern Arizona.

11. **Senecio stygius** Greene, Leaflets 2: 21. 1909.

Senecio prolixus Greenm., Mo. Bot. Gard. Ann. 1: 264. 1914.

Grand Canyon (Coconino County), Pagumpa Springs, Kingman, and Chloride (Mohave County), 3,300 to 6,000 (?) feet, near springs, April and May, type of *S. stygius* from the Grand Canyon (*Lemmon* in 1884), type of *S. prolixus* (*Lemmon* 3130) probably a duplicate of this collection. Northwestern Arizona, southern Nevada, and south-eastern California.

12. **Senecio uintahensis** A. Nels. in Coult., New Man. Rocky Mount. 581. 1909.

Senecio nelsonii var. *uintahensis* A. Nels., Torrey Bot. Club Bul. 26: 484. 1899.

Kaibab Plateau, Grand Canyon, and near Flagstaff (Coconino County), about 7,000 feet, June to September. Wyoming to Arizona, west to Oregon and California.

Species 8 to 12 are doubtfully distinct. The plants are very variable in the amount of tomentum, the leaves vary greatly in degree of lobing or dissection, and the characters drawn from the number of phyllaries and pubescence of the achenes seem of little consequence. *Senecio thornberi* Greenm., type from the San Francisco Peaks (*Rusby*

666), seems intermediate between *S. wintahensis* and *S. neomexicanus*, and is not clearly distinct from either.

13. *Senecio bigelovii* A. Gray, U. S. Rpt. Expl. Miss. Pacif. 4: 111. 1857.

Senecio rusbyi Greene, Torrey Bot. Club Bul. 9: 64. 1882.

San Francisco Peaks to Long Valley (Coconino County), White Mountains (Apache and Greenlee Counties), Pinaleno Mountains (Graham County), and mountains of Cochise and Pima Counties, 7,000 to 11,000 feet, rich moist soil in coniferous forests, July to September. New Mexico and Arizona.

14. *Senecio seemannii* Schultz Bip. in Seem., Bot. Voy. Herald 311. 1856.

Mountains of Cochise, Santa Cruz, and Pima Counties, about 6,000 feet, rich shaded soil, September and October. Southern Arizona and northern Mexico.

Senecio hartwegi Benth., to which the Arizona plant has generally been referred, is, according to Greenman,¹² a distinct species of west-central Mexico, with the branches, petioles, and lower leaf surface tomentose.

15. *Senecio salignus* DC., Prodr. 6: 430. 1837.

Cochise, Santa Cruz, and Pima Counties, near the Mexican boundary, 2,300 to 4,500 feet, rich soil along streams, February to April. Southern Arizona to Guatemala.

A shrub, up to at least 2 m. (7 feet) high.

16. *Senecio parryi* A. Gray in Torr., U. S. and Mex. Bound. Bot. 103. 1859.

Chiricahua Mountains, Cochise County (*Harrison* and *Kearney* 6135), Santa Rita Mountains, Pima County (*Thornber* 331), about 6,000 feet, July to September. Western Texas to southern California.

17. *Senecio mohavensis* A. Gray, Syn. Fl. 1²: 446. 1884.

Sacaton Mountains, Pinal County (*Peebles* and *Harrison* 1076), Laguna Dam, Yuma County (*Peebles* and *Harrison* 5059), 2,000 feet or lower, sandy washes and bottoms of canyons, March. South-western Arizona, southeastern California, and Sonora.

18. *Senecio huachucanus* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 54. 1883.

Near Fort Huachuca, Cochise County (*Lemmon* 2784, in 1882, the type collection), September and October. Southeastern Arizona and Chihuahua.

19. *Senecio lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 220. 1882.

Senecio decorticans A. Nels., Amer. Jour. Bot. 23: 266. 1936.

Gila, Maricopa, Pinal, and Pima Counties, 1,500 to 3,700 feet, rocky slopes usually among shrubs, common, February to May, type of *S. lemmoni* from the Santa Catalina Mountains (*Lemmon* 389), types of *S. decorticans* from along Salt River, near the Apache Trail (*Nelson* 10309 and 11287). Southern Arizona and northern Baja California.

¹² GREENMAN, J. M. *SENECIO* IN STANDLEY, PAUL C. TREES AND SHRUBS OF MEXICO. Contrib. U. S. Natl. Herbarium 23: 1926. (See p. 1628.)

20. **Senecio wootonii** Greene, Torrey Bot. Club Bul. 25: 122. 1898.
Senecio toluccanus var. *microdontus* A. Gray, Syn. Fl. 1²: 388. 1884.
Senecio microdontus Heller, Torrey Bot. Club Bul. 24: 479. 1897. Not *S. microdontus* Baker, 1881.
Senecio anacletus Greene, Pittonia 4: 307. 1901.
Senecio percalvus A. Nels., Wyo. Univ. Pub. Bot. 1: 142. 1926.
 Mountains of Coconino, southern Apache, Graham, Gila, Cochise, and Pima Counties, 6,000 to 9,000 feet, coniferous forest, May to September, type of *S. percalvus* from Elden Mountain near Flagstaff, Coconino County (*Hanson* 1572). Colorado, New Mexico, Arizona, and Chihuahua.
21. **Senecio actinella** Greene, Torrey Bot. Club Bul. 10: 87. 1883.
 Apache, Coconino, Greenlee, and Gila Counties, 5,500 to 9,500 feet, coniferous forest, May to August, type from near Flagstaff (*Rusby* 671). New Mexico, Arizona, and northern Mexico.
Senecio actinella var. *mogollonicus* (Greene) Greenm., said to have larger leaves than the typical form, does not seem taxonomically distinct. It is also known from New Mexico.
22. **Senecio arizonicus** Greene, Torrey Bot. Club Bul. 10: 87. 1883.
 Near Prescott (Yavapai County), about 5,500 feet, June and July, type from Lynx Creek (*Rusby* in 1883). Southern New Mexico and central Arizona.
23. **Senecio werneriaefolius** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 54. 1883.
Senecio aureus L. var. *werneriaefolius* A. Gray, Acad. Nat. Sci. Phila. Proc. 1863: 68. 1863.
 Kaibab Plateau and San Francisco Peaks (Coconino County), 9,000 to 10,000 feet (and perhaps higher), June to August. South Dakota, Wyoming, Colorado, Utah, and northern Arizona.
24. **Senecio hartianus** Heller, Torrey Bot. Club Bul. 26: 622. 1899.
 Mountains of Apache, Navajo, Coconino, and Gila Counties, 6,500 to 8,000 feet, May to August, type from Hart Spring, San Francisco Peaks (*MacDougal* 230). New Mexico and Arizona.
25. **Senecio cynthioides** Greene, Leaflets 1: 212. 1906.
 A collection from the head of the Little Colorado River, Apache County (*Goodding* 1146), is cited by Greenman (see footnote 11, p. 1005, Greenman, vol. 5, p. 94). New Mexico and eastern Arizona, July.
26. **Senecio neomexicanus** A. Gray, Syn. Fl. 1²: 392. 1884.
Senecio toumeyii Greene, Pittonia 3: 349. 1898.
Senecio mutabilis Greene, *ibid.* 4: 113. 1900.
Senecio blumeri Greene, Leaflets 2: 20. 1909.
Senecio encelia Greene, *ibid.* p. 22.
Senecio papagonius A. Nels., Wyo. Univ. Pub. Bot. 3: 110. 1937.
 White Mountains (Apache, Navajo, and Greenlee Counties) and vicinity of Flagstaff (Coconino County), to the mountains of Cochise, Santa Cruz, and Pima Counties, 3,000 to 9,000 feet, commonly in oak chaparral, sometimes in pine forest, April to August, the type of *S. toumeyii* from the Chiricahua Mountains (*Toumey* in 1896), that of

S. blumeri from the Chiricahua Mountains (*Blumer* in 1907), that of *S. encelia* from the Pinal Mountains (*Jones* in 1890), that of *S. papagonyus* from near "Massacre Camp," between Ruby and the Tucson-Nogales highway (*A. and R. E. Nelson* 1494). Colorado, New Mexico, and Arizona.

One of the most widely distributed and abundant species of *Senecio* in Arizona. Specimens from the Apache-Verde road, east of Baker Butte (*Coville* 1043), referred to *S. mutabilis* Greene by Greenman (see footnote 11, p. 1005, Greenman, vol. 5, p. 49), are not distinguishable from others referred by him to *S. neomexicanus*. *S. neomexicanus* var. *griffithsii* Greenm. is a form with glabrous achenes (those of the typical form being hirtellous); the type was collected in the Santa Rita Mountains (*Griffiths* 4212).

117. CIRSIUM.¹³ THISTLE

Biennial or perennial herbs, often woolly, with spiny or prickly leaves and involucre; leaves alternate, toothed or lobed; heads medium or large, discoid, purple, pink, or red, rarely white or greenish yellow; involucre broad, many-seriate, the phyllaries, at least some of them, tipped with spines; receptacle densely bristly; achenes oblong or obovate; pappus of numerous plumose bristles or very narrow paleae, these united at base and deciduous in a ring.

The Navajo and Hopi Indians are reported to use thistles medicinally for various disorders.

Key to the species

1. Corollas greenish yellow; middle and inner phyllaries arachnoid-villous with long hairs, and with dilated, submembranous, lacerate-fringed tips.
 1. *C. PARRYI*.
1. Corollas purple, pink, red, or whitish or, if rarely yellowish (in *C. drummondii*), then the involucre not as in *C. parryi* (2).
 2. Phyllaries more or less densely and persistently tomentose, the middle ones spreading, the outer ones reflexed.----- 3. *C. NEOMEXICANUM*.
 2. Phyllaries glabrous or the margin hispidulous or somewhat arachnoid-tomentose, the outer ones not reflexed (3).
 3. Prickles of the involucre very small (less than 2 mm. long), mostly appressed (mere cusps rather than prickles); phyllaries very numerous, with a conspicuous glandular dorsal line; plant glabrate or glabrescent.----- 4. *C. WRIGHTII*.
 3. Prickles of the phyllaries more than 2 mm. long (4).
 4. Inner phyllaries with elongate, attenuate plane, usually bright red or reddish (rarely purple) tips (5).
 5. Leaves glabrous or quickly glabrate on both faces (6).
 6. Spines of the middle phyllaries about 10 mm. long, longer than the body of the phyllaries.----- 5. *C. ROTHROCKII*.
 6. Spines of the middle phyllaries not more than 5 mm. long, shorter than the body of the phyllaries.----- 6. *C. BIPINNATUM*.
 5. Leaves persistently tomentose, at least beneath (7).
 7. Spines of the middle phyllaries 1 to 2 cm. long, stout, yellowish.----- 7. *C. NIDULUM*.
 7. Spines of the middle phyllaries shorter, slender (8).
 8. Corollas bright red or carmine.----- 8. *C. ARIZONICUM*.
 8. Corollas pink-purple.----- 9. *C. PULCHELLUM*.
 4. Inner phyllaries with usually more or less dilated and twisted, often erose tips (9).
 9. Phyllaries stiffly hispidulous-ciliolate (almost serrulate) on the margin.----- 10. *C. GRAHAMI*.

¹³ Reference: PETRAK, F. DIE NORDAMERIKANISCHEN ARTEN DER GATTUNG CIRSIUM. Bot. Centbl. Beihefte 35, Abt. 2: 223-567. 1917.

9. Phyllaries not hispidulous-ciliate on the margin (10).
 10. Heads (1 to 3) very large, 4 to 6 cm. thick; phyllaries broad, conspicuously graduated in many ranks; anthers with elongate, slender-subulate tips; prickles of the leaves and involucre usually strong and stiff, about 1 cm. long or more, sometimes shorter----- 11. *C. OCHROCENTRUM*.
 10. Heads usually several or smaller, or the involucre or the anthers not as in *C. ochrocentrum* (11).
 11. Heads normally more than 1, crowded and subsessile at the apex of the stem; corollas not more than tinged with purple.
 2. *C. DRUMMONDII*.
 11. Heads normally solitary at the tips of the stem and branches; corollas rosy purple, rarely ochroleucous (12).
 12. Phyllaries with a comparatively broad, ovate or lance-ovate body----- 12. *C. WHEELERI*.
 12. Phyllaries with a narrower, lanceolate or lance-oblong body----- 13. *C. UNDULATUM*.

1. ***Cirsium parryi*** (A. Gray) Petrak, Bot. Tidsskr. 31: 68. 1911.

Cnicus parryi A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 47. 1874.

Carduus inornatus Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 195. 1913.

Cirsium inornatum Woot. and Standl., ibid. 19: 751. 1915.

San Francisco Peaks, Coconino County (*MacDougal* 364), Pinaleno Mountains, Graham County (*Kearney* and *Peebles* 9947, 14126), 9,000 feet, openings in coniferous forests, August. Colorado, New Mexico, and Arizona.

2. ***Cirsium drummondii*** Torr. and Gray, Fl. North Amer. 2: 459. 1843.

Carduus coloradensis Rydb., Torrey Bot. Club Bul. 32: 132. 1905.

Cirsium coloradense Cockerell ex Daniels, Fl. Boulder, Colo. 254. 1911.

White Mountains (Apache and northern Greenlee Counties), San Francisco Peaks and vicinity (Coconino County), 7,000 to 9,500 feet, openings in coniferous forest, July to September. Saskatchewan to British Columbia, south to Arizona and California.

Flowers straw-colored, sometimes tinged with purple.

3. ***Cirsium neomexicanum*** A. Gray, Pl. Wright. 2: 101. 1853.

Cirsium arcuatum A. Nels., Amer. Jour. Bot. 25: 118. 1938.

Coconino, Yavapai, and northern Mohave Counties, south to Cochise, Santa Cruz, and Pima Counties, 1,200 to 6,500 feet, plains, mesas, and foothills, common, March to September, type of *C. arcuatum* from Canyon Lake, Maricopa County (*A.* and *R. Nelson* 1740). Colorado to Nevada, south to New Mexico, Arizona, and southern California.

Flowers lavender. *Cirsium utahense* Petrak, at least as represented in Arizona, does not seem distinct from *C. neomexicanum*.

*4. ***Cirsium wrightii*** A. Gray, Pl. Wright. 2: 101. 1853.

Reported by Gray¹⁴ from eastern Arizona. Western Texas to Arizona.

¹⁴ GRAY, ASA. SYNOPTICAL FLORA OF NORTH AMERICA. 1st: 1884. (See p. 404.)

5. *Cirsium rothrockii* (A. Gray) Petrak, Bot. Tidsskr. 31: 68. 1911.

Cnicus rothrockii A. Gray, Amer. Acad. Arts and Sci. Proc. 17: 220. 1882.

Southern Navajo, Gila, and Cochise Counties (probably elsewhere), 4,000 to 6,000 feet, June to September, type from Arizona without definite locality. Utah (?) and Arizona.

Flowers rose-colored to carmine.

6. *Cirsium bipinnatum* (Eastw.) Rydb., Fl. Rocky Mount. 1010, 1068. 1917.

Cnicus drummondii var. *bipinnatus* Eastw., Zoe 4: 8. 1893.

Carrizo Mountains, Apache County, in a deep canyon (*Standley* 7401) near Tuba, Coconino County, where reported as common on the desert (*Clute* 117), perhaps also in the Huachuca Mountains, Cochise County (*Wilcox* in 1894, *Gooding* 1352), 5,000 to 6,000 feet, June to August. Colorado, Utah, New Mexico, and Arizona.

7. *Cirsium nidulum* (M. E. Jones) Petrak, Bot. Centbl. Beiheft. 35²: 553. 1917.

Cnicus nidulus M. E. Jones, Calif. Acad. Sci. Proc. ser. 2, 5: 705. 1895.

? *Carduus rusbyi* Greene, Acad. Nat. Sci. Phila. Proc. 1892: 361. 1893.

Cameron to Navajo Bridge and base of Navajo Mountain, eastern Coconino County, 5,500 to 6,300 feet (*Peebles* 13009, 13929), north rim of the Grand Canyon, 8,000 feet (*Collom* in 1940), perhaps also in the Santa Rita Mountains, Pima County, 5,000 feet (*Thorner* 272), June and July. Southern Utah, Nevada, and Arizona.

Specimens intermediate between this species and *C. rothrockii* have been collected at the Grand Canyon (*MacDougal* 174, *A. E. Hitchcock* 68).

8. *Cirsium arizonicum* (A. Gray) Petrak, Bot. Tidsskr. 31: 68. 1911.

Cnicus arizonicus A. Gray, Amer. Acad. Arts and Sci. Proc. 10: 44. 1874.

Flagstaff region (Coconino County), Hualpai Mountain (Mohave County), south to the mountains of Cochise and Pima Counties, 3,000 to 7,000 feet, frequent on rocky slopes, often in chaparral, May to October, type probably from Cochise County. Utah (?) and Arizona.

In the Hopi Reservation, on the Kaibab Plateau, and at the Grand Canyon, specimens intermediate between this species and *C. nidulum* have been collected. Species 5 to 8 are closely related, and intermediates, presumably of hybrid origin, are not infrequent.

9. *Cirsium pulchellum* (Greene) Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 752. 1915.

Carduus pulchellus Greene ex Rydb., Colo. Agr. Expt. Sta. Bul. 100: 401. 1906.

Hopi Indian Reservation, Navajo County (*Zuck* in 1897), Tuba, Coconino County (*Harrison* and *King* 8709), perhaps also in Yavapai and Gila Counties, 5,000 to 6,000 feet, June to August. Colorado, Utah, New Mexico, and Arizona.

10. *Cirsium grahami* A. Gray, Pl. Wright. 2: 102. 1853.

McNary, Apache County, 7,400 feet (*Peebles* and *Smith* 12475), Huachuca Mountains, Cochise County (*Lemmon* 2791, *Mearns* 2560), August to October. Southwestern New Mexico, eastern Arizona, and Sonora.

Flowers deep purple.

11. *Cirsium ochrocentrum* A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 110. 1849.

Navajo and Coconino Counties, south to Cochise, Santa Cruz, and Pima Counties, 4,500 to 8,000 feet, open land and in the pinyon-juniper association, often abundant, May to October. Nebraska to Texas and Arizona.

Flowers cream-colored or rose-colored to deep carmine or purple. Arizona specimens that have been identified as *C. megacephalum* (A. Gray) Cockerell are included here.

12. *Cirsium wheeleri* (A. Gray) Petrak, Bot. Tidsskr. 31: 67. 1911.

Cnicus wheeleri A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 56. 1883.

Carduus perennans Greene, Torrey Bot. Club Bul. 25: 123. 1898.

Cirsium perennans Woot. and Standl., Contrib. U. S. Natl. Herbarium 19: 753. 1915.

Cirsium blumeri Petrak, Bot. Centbl. Beihefte 35²: 504. 1917.

Apache, Coconino, Yavapai, Graham, Gila, Cochise, and Pima Counties, 5,000 to 9,000 feet, mostly in open pine forest, common, June to October, type of *C. wheeleri* from near Fort Apache (*Rothrock* 293), type of *C. blumeri* from Spud Ranch, Rincon Mountains (*Blumer* in 1910). Southern New Mexico and Arizona.

Flowers purple or lavender.

13. *Cirsium undulatum* (Nutt.) Spreng., Syst. Veg. 3: 374. 1826.

Carduus undulatus Nutt., Gen. Pl. 2: 130. 1818.

Huachuca Mountains (*Peebles* et al., 3418), October. Michigan to British Columbia, south to Texas and Arizona, where apparently it is rare.

Carduus nutans L., musk-thistle, was collected in 1939 at a roadside about 8 miles south of Greasewood Trading Post, Apache County (*Goodman* and *Payson* 3174). The material was received too late to permit inserting the genus in the key. The plant is distinguished from *Cirsium*, which it closely resembles in appearance, by having essentially smooth (not plumose) pappus bristles, and from *Silybum*, to which it might run in the key, by having the leaves without white markings and the coriaceous-herbaceous appendages of the phyllaries spine-tipped but not spinulose-margined.

118. CYNARA. ARTICHOKE, GLOBE-ARTICHOKE

Coarse perennial, whitish-woolly, especially on the lower leaf surface; leaves very large, deeply pinnatisect, with mostly lanceolate, entire or few-toothed, scarcely spiny lobes; heads large (about 6 to 10 cm. thick or more), the phyllaries many-seriate, coriaceous, ovate to oblong, not spiny, glabrous, the inner ones often purplish; receptacle densely setose; corollas purple; pappus of numerous, several-seriate, very narrow, plumose paleae, deciduous in a ring.

1. *Cynara scolymus* L., Sp. Pl. 827. 1753.

Near Phoenix (Maricopa County), occasional along roadsides and in waste places, May to August. Occasionally or frequently escaping from cultivation in the western United States, most commonly in California, where the artichoke is grown extensively; native of Europe.

119. SILYBUM. MILKTHISTLE

Coarse thistlelike herb; leaves large, lobed or pinnatifid, white-veined and white-blotched; heads large (the disk 2.5 to 5 cm. wide), purple; involucre subglobose, the phyllaries several-seriate, rigid, with spreading, ovate or lanceolate, spinulose-margined and stiffly spine-tipped, coriaceous-herbaceous appendages.

1. *Silybum marianum* (L.) Gaertn., Fruct. et Sem. 2: 378. 1802.

Carduus marianus L., Sp. Pl. 823. 1753.

Gila, Maricopa, and Pinal Counties, occasional at roadsides and in waste ground, May to September. Occasional in much of the United States and adjacent Canada, naturalized in California; native of Europe.

The plant has been used medicinally in Europe. A noxious field weed, difficult to exterminate.

120. CENTAUREA. STAR-THISTLE, KNAPWEED

Herbs, with entire leaves or the lower ones pinnatifid; heads medium or large, pink, purple, or yellow, rarely white; involucre strongly graduated, the phyllaries appendaged with spines or prickles, or with scarious or hyaline tips; outer flowers sometimes enlarged and falsely radiate; achenes with an oblique attachment; pappus various, setose, paleaceous, or wanting.

The introduced species are objectionable weeds in California, especially in grainfields, because of the prickly involucre. The plants are not yet sufficiently abundant in Arizona to be troublesome.

Key to the species

1. Phyllaries tipped with a stiff spreading spine or prickle, this with 2 or 3 pairs of smaller prickles at its base; leaves more or less decurrent; corollas yellow (2).
 2. Terminal spine of the phyllary yellowish, comparatively stout, 1.2 to 2 cm. long; plant thinly tomentose..... 1. *C. SOLSTITIALIS*.
 2. Terminal spine or prickle of the phyllary normally purplish toward the base, rather slender, less than 1 cm. long; plant hispidulous.
 2. *C. MELITENSIS*.
1. Phyllaries not spiny-tipped; leaves not decurrent; corollas rosy or purplish, rarely white (3).
 3. Phyllaries with thin, whitish, essentially entire, hyaline tips, those of the outer series obtuse and practically glabrous, those of the inner series pointed and densely pilose; heads small, the involucre less than 1 cm. thick; outer corollas not enlarged; leaves mainly linear, not clasping..... 3. *C. PICRIS*.
 3. Phyllaries with a pectinate-fringed scarious terminal appendage; heads large, the involucre mostly 2 to 4 cm. thick; outer corollas much enlarged; leaves lanceolate or ovate, the larger ones more or less clasping (4).
 4. Appendage of the phyllaries whitish (rarely brownish or purplish), with 4 to 6 pairs of not conspicuously ciliate lobes, its undivided portion lanceolate..... 4. *C. AMERICANA*.
 4. Appendage deep brown, with 8 to 12 pairs of light-edged conspicuously ciliate lobes, its undivided portion broadly triangular or ovate.
 5. *C. ROTHROCKII*.

1. *Centaurea solstitialis* L., Sp. Pl. 917. 1753.

Waste places, Yuma (*Stitt* 1248), apparently rare in Arizona, summer. An occasional weed in much of the United States, naturalized in California; native of Europe.

2. *Centaurea melitensis* L., Sp. Pl. 917. 1753.

Apache, Yavapai, Maricopa, Pinal, Cochise, and Pima Counties, waste ground and open, rocky slopes, May and June. Occasional weed in much of the United States, abundant in the West; native of Europe.

3. *Centaurea picris* Pall., "Tabl. Taur. 58"; Willd., Sp. Pl. 3: 2302. 1804.

? *Centaurea repens* L., Sp. Pl. ed. 2, 1293. 1763.

Joseph City (Navajo County), in waste places, apparently rare in Arizona, summer. Occasional or naturalized from Michigan and Missouri to Washington, Oregon, and California; native of eastern Europe and Asia.

Often a pernicious weed.

4. *Centaurea americana* Nutt., Acad. Nat. Sci. Phila. Jour. 2: 117. 1821.

White Mountains (*Griffiths* 5398), Fort Apache, Navajo County (*Hough*), apparently rare in Arizona, July and August. Missouri and Louisiana to Kansas, eastern Arizona, and northern Mexico.

A very ornamental plant, sometimes cultivated under the name American basketflower.

5. *Centaurea rothrockii* Greenm., Bot. Gaz. 37: 221. 1904.

Chiricahua and Huachuca Mountains (Cochise County), 6,000 to 8,000 feet, along streams, September and October, type probably from the Chiricahua Mountains (*Rothrock* 527). Southwestern New Mexico and southeastern Arizona to Oaxaca.

Very similar to *C. americana* and equally handsome.

121. CHAPTALIA

Scapose perennial; leaves pinnatifid or sinuate, glabrate and green above, thinly white-tomentose beneath; scapes several, up to 0.5 m. high, 1-headed; head 2 to 2.5 cm. high; involucre strongly graduate; outer flowers pistillate, with a strap-shaped 3-toothed purplish corolla, the disk flowers hermaphrodite, whitish, more or less bilabiate; achenes fusiform, beaked; pappus of copious capillary whitish or brownish bristles.

1. *Chaptalia alsophila* Greene, Leaflets 1: 158. 1905.

Chaptalia confinis Greene, *ibid.*

Chaptalia sonchifolia Greene; Leaflets 1: 191. 1906.

Chiricahua and Huachuca Mountains (Cochise County), Rincon Mountains (Pima County), about 8,000 feet, coniferous forests, rare, May to October, the type of *C. confinis* from the Huachuca Mountains (*Lemmon* 2789), the type of *C. sonchifolia* from the Rincon Mountains (*Nealley* 223). Southwestern New Mexico and southeastern Arizona.

Specimens from the White Mountains, Apache County (*Kearney* and *Peebles* 12431), and from Long Valley, Coconino County (*Peebles*

9496) may belong to a different species, but the material available is insufficient for identification. *C. alsophila* is the southwestern representative of the widespread tropical and subtropical American *C. nutans* (L.) Polak., differing from that species primarily in the much shorter, stouter, densely hispidulous beak of its achene.

122. PEREZIA¹⁵

Perennial herbs, with alternate, sessile and often clasping, spinulose-toothed leaves and lavender-pink heads, the stem woolly-tufted at base; involucre strongly graduate; flowers all hermaphrodite, bilabiate, the outer lip 3-toothed, the inner lip 2-parted; achenes subcylindric or fusiform, densely glandular or glandular-hispidulous; pappus of numerous scabrous bristles.

Key to the species

1. Heads solitary, broad, about 15- to 24-flowered; leaves suborbicular or obovate-suborbicular, 2 to 5 cm. long and about as wide, coarsely and unequally spinulose-dentate; plant usually dwarf, sometimes up to 25 cm. high.
 1. *P. NANA*.
1. Heads numerous, paniced, narrow, 4- to 11-flowered; leaves mostly ovate, larger, normally much longer than wide, usually more evenly spinulose-denticulate; plants taller, 40 to 150 cm. high (2).
 2. Phyllaries obtuse or merely acutish, not glandular; heads 8- to 11-flowered.
 2. *P. WRIGHTII*.
 2. Phyllaries strongly acuminate, stipitate-glandular; heads 4- to 6-flowered.
 3. *P. THURBERI*.

1. ***Perezia nana*** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 111. 1849.

Maricopa, Pinal, Cochise, and Pima Counties, up to 5,000 feet, mesas and slopes, usually under bushes, March to June. Texas to Arizona and northern Mexico.

Desert-holly, an attractive little plant, making a good ground cover where sufficiently abundant. The flowers are delightfully fragrant, with an odor of violets. The roots of this species and of *P. wrightii* yield pipitzaholic acid, which may be used in chemical analysis as an indicator of alkalinity.

2. ***Perezia wrightii*** A. Gray, Pl. Wright. 1: 127. 1852.

Perezia arizonica A. Gray, Bot. Calif. 1: 422. 1876.

Throughout most of the State, not above 6,000 feet, foothills and canyons, common, January to June (sometimes autumn), type of *P. arizonica* collected in Arizona, without definite locality (*Palmer*). Western Texas to southern Utah, Arizona, and northern Mexico.

The pink flowers are honey-scented. The root was used as a styptic by the Indians.

3. ***Perezia thurberi*** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 324. 1854.

Mountains of Cochise, Santa Cruz, and Pima Counties, 4,000 to 6,000 feet, slopes and canyons, June to October. Southwestern New Mexico and southern Arizona to central Mexico.

¹⁵ Reference: BACIGALUPI, RIMO. A MONOGRAPH OF THE GENUS PEREZIA, SECTION ACOURTIA, WITH A PROVISIONAL KEY TO THE SECTION EUPEREZIA. Gray Herbarium Contrib. 97: 1-81. 1951.

123. TRIXIS¹⁶

Shrub; leaves alternate, lanceolate, densely sessile-glandular beneath; heads 9- to 12-flowered, yellow, solitary or clustered; involucre double, the outer series of several linear to elliptic herbaceous bracts, the inner series of about 8 linear acuminate phyllaries, these corky-thickened at base; corollas all 2-lipped, the outer lip 3-toothed, the inner lip 2-cleft; achenes densely hispidulous, subrostrate; pappus of numerous straw-colored bristles.

1. *Trixis californica* Kellogg, Calif. Acad. Sci. Proc. 2: 182. 1863.

Trixis angustifolia DC. var. *latiusecula* A. Gray, Syn. Fl. 1²: 410. 1884.

Grand Canyon (Coconino County), and from southern Yavapai County to Cochise, Pima, and Yuma Counties, up to 4,500 feet but usually lower, rocky slopes, February to June (sometimes autumn). Western Texas to southern California and northern Mexico.

Browsed to some extent by cattle.

124. CICHORIUM. CHICORY

Branched perennial herb; lowest leaves runcinate-pinnatifid, those of the stem clasping, toothed, those of the stiff branches minute; heads blue, rarely pink or white, sessile along the branches or at the tips of short fistulose branchlets; involucre double, the outer series of about 5 short ovate phyllaries, these corky-thickened at base in age, the inner series of 8 to 10 linear phyllaries; achenes obovoid, somewhat ribbed; pappus a short toothed crown.

1. *Cichorium intybus* L., Sp. Pl. 813. 1753.

Navajo, Yavapai, and Pima Counties, occasional at roadsides and in waste ground, summer. Common weed in the United States and Canada; naturalized from Europe.

The leaves, especially of cultivated varieties, are cooked like spinach or eaten raw in salads; the root is eaten, under the names "barbe" and "witloof," and also furnishes one of the leading adulterants or substitutes for coffee. The large, bright blue flower heads are very attractive.

125. ATRICHOSERIS

Glabrous, scapose, winter annual, the scape branched above, several- or many-headed; leaves obovate, spinulose-toothed, 3 to 10 cm. long, often spotted; heads up to 3.5 cm. wide, white; involucre of about 12 to 15 equal, 2-seriate, lance-linear, narrowly scarious-margined phyllaries, with a few much shorter ovate outer bractlets; achenes oblong, with more or less corky-thickened ribs, epappose.

1. *Atrichoseris platyphylla* A. Gray, Syn. Fl. 1²: 410. 1884.

Malacothrix platyphylla A. Gray, Amer. Acad. Arts. and Sci. Proc. 9: 214. 1874.

Mohave and Yuma Counties, up to 2,000 feet, sandy or stony slopes and mesas, March and April. Southwestern Utah and western Arizona to southeastern California.

¹⁶ Reference: ROBINSON, B. L., and GREENMAN, J. M. REVISION OF THE MEXICAN AND CENTRAL AMERICAN SPECIES OF TRIXIS. Amer. Acad. Arts and Sci. Proc. 40 (Gray Herbarium Contrib. 28): 6-14. 1904.

126. MICROSERIS

Subscapose annual; leaves narrowly linear and entire, or pinnatisect into narrow lobes; heads solitary; corollas yellow, often drying purplish; pappus of 5 linear-lanceolate, scarious, 1-nerved, bifid paleae, as long as the achene or longer, the midrib excurrent as a slender bristle shorter than the body of the palea.

1. **Microseris linearifolia** (DC.) Schultz Bip., *Pollichia* 22-24: 308. 1866.

Calais linearifolius DC., *Prodr.* 7: 85. 1838.

Uropappus linearifolius Nutt., *Amer. Phil. Soc. Trans. ser. 2,* 7: 425. 1841.

Uropappus pruinosis Greene, *Leaflets* 1: 213. 1906.

Mohave County to Graham, Gila, Santa Cruz, and Pima Counties, up to 5,000 feet but usually lower, common on plains, mesas, and foothills, March to June. Idaho and Washington to New Mexico, Arizona, and Baja California.

127. KRIGIA¹⁷

Slender perennial herb; leaves chiefly basal, oblanceolate or spatulate, entire or sinuate-dentate; stem leaves few, small, sessile and somewhat clasping; heads few, yellow; involucre of about 9 to 18 thin equal phyllaries; pappus of 10 to 15 small oblong squamellae, and an equal or larger number of much longer capillary bristles.

1. **Krigia biflora** (Walt.) Blake, *Rhodora* 17: 135. 1915.

Hyoseris biflora Walt., *Fl. Carol.* 194. 1788.

Hyoseris amplexicaulis Michx., *Fl. Bor. Amer.* 2: 87. 1803.

Krigia amplexicaulis Nutt., *Gen. Pl.* 2: 127. 1818.

Cynthia viridis Standl., *Contrib. U. S. Natl. Herbarium* 13: 357. 1911.

Willow Spring, southern Apache County (*Rothrock* 218, *Palmer* 539), Lakeside, southern Navajo County (*Harrison* 5505), 6,200 to 7,200 feet, June. New York to Minnesota, south to Georgia, Texas, and eastern Arizona.

128. ANISOCOMA

Low, scapose, winter annual; leaves pinnatifid; scapes 1-headed; heads pale yellow; involucre strongly graduated, 1.2 to 2.7 cm. high, the phyllaries orbicular (the outer ones) to linear-oblong, broadly rounded to obtuse, thin, appressed, with a usually purplish midline and a pale scarious margin; pappus readily deciduous, of about 5 long and 5 much shorter bright white plumose bristles, inserted within the apical border of the achene.

1. **Anisocoma acaulis** Torr. and Gray, *Boston Soc. Nat. Hist. Proc.* 1: 212. 1845.

Peach Springs to Kingman and Chloride (Mohave County), 3,000 to 4,000 feet, plains and mesas, March to May. Nevada, northwestern Arizona, and eastern California.

¹⁷ Reference: STANDLEY, P. C. A REVISION OF THE CICHORACEOUS GENERA KRIGIA, CYNTHIA, AND CYMBIA. *Contrib. U. S. Natl. Herbarium* 13: 351-357. 1911.

129. LEONTODON. HAWKBIT

Low scapose perennial; leaves subentire to sinuate-pinnatifid, hispid; scapes 1-headed; head rather small, yellow; achenes fusiform, tapering into a slender beak equaling or shorter than the body, muriculate; pappus of the outer achenes of short more or less united squamellae, that of the other achenes of about 10 paleaceous-based, long-plumose setae and about as many much shorter naked setae.

1. **Leontodon nudicaulis** (L.) Banks ex Lowe, Cambridge Phil. Soc. Trans. 4: 28. 1833.

Crepis nudicaulis L., Sp. Pl. 805. 1753.

Leontodon hirtus L., Sp. Pl. ed. 2, 1123. 1763.

Sacaton, Pinal County, in a lawn (*Beckett* 13084), probably not established, summer. An occasional weed in the United States and Canada, introduced from Europe.

130. STEPHANOMERIA

Annual or perennial herbs; leaves linear to oblong, entire to pinnatifid, those on the upper part of the stem usually greatly reduced; heads small, usually paniced, rosy or flesh-color; involucre of several equal phyllaries and some calyculate bractlets, or more regularly graduated; achenes columnar, 5-angled; bristles of the pappus 1-seriate, plumose at least above, often paleaceous toward the base, sometimes connate into groups.

Key to the species

1. Involucre 9 to 13 mm. high, 10- to 20-flowered (2).
 2. Stems branched from the base, more or less spreading, leafy throughout with runcinate-pinnatifid leaves, the branchlets near the heads with greatly reduced, ovate, spinulose-toothed leaves; pappus brownish tinged, the bristles naked toward the base----- 1. *S. PARRYI*.
 2. Stems erect, usually branched only above, the leaves at base of the stem runcinate-pinnatifid, the upper leaves much reduced, linear, entire, the heads thus naked-paniced; pappus bright white, the bristles plumose to the base----- 2. *S. THURBERI*.
1. Involucre 5 to 9 (rarely 10) mm. high, 3- to 9-flowered (3).
 3. Plants annual (4).
 4. Pappus of 4 to 6 lanceolate paleae, these plumose on the shorter aristiform tip, not longer than the achene----- 3. *S. SCHOTII*.
 4. Pappus of 5 to 18 bristles, these plumose above the middle, longer than the achene, often paleaceous-dilated at base----- 4. *S. EXIGUA*.
 3. Plants perennial (5).
 5. Pappus brownish tinged, the bristles naked and merely scabrous toward the base----- 5. *S. PAUCIFLORA*.
 5. Pappus bright white, the bristles plumose to the base----- 6. *S. TENUIFOLIA*.

1. **Stephanomeria parryi** A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 61. 1883.

Ptiloria parryi Coville, Contrib. U. S. Natl. Herbarium 4: 144. 1893.

Known in Arizona only by a collection at Kingman, Mohave County, 3,300 feet (*Lemmon* in 1884). Southwestern Utah, northwestern Arizona, and southeastern California, May and June.

2. **Stephanomeria thurberi** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 5: 325. 1854.

Ptiloria thurberi Greene, Pittonia 2: 133. 1890.

Navajo, Coconino, and Yavapai Counties, also Cochise and Santa Cruz Counties, 4,000 to 8,000 feet, open forests of pine, pinyons, and junipers, April to August. New Mexico, Arizona, and northern Mexico.

3. **Stephanomeria schottii** A. Gray, Bot. Calif. 1: 427. 1876.

Hemiptilium schottii A. Gray in Torr., U. S. and Mex. Bound. Bot. 105. 1859.

Known only from the original collection made by Schott on the Gila River.

4. **Stephanomeria exigua** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 428. 1841.

Hemiptilium bigelovii A. Gray in Torr., U. S. and Mex. Bound. Bot. 105. 1859.

Ptiloria exigua Greene, Pittonia 2: 132. 1890.

Ptiloria bigelovii Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 176. 1913.

Apache County to Mohave County, south to Graham, Gila, Pima, and Yuma Counties, 2,000 to 6,000 feet, plains, mesas, and hillsides, often among shrubs, April to September. Wyoming to New Mexico, Arizona, and California.

It is reported that the Navajo Indians use this plant as a diuretic. In the typical form the pappus consists of 9 to 18 bristles, these often more or less connate at base into about 5 groups. In var. *penta-chaeta* (D. C. Eaton) H. M. Hall, which has been collected at Yucca (Mohave County) and near Tucson, the pappus consists of 5 to 7 distinct bristles.

5. **Stephanomeria pauciflora** (Torr.) A. Nels. in Coult., New Man. Rocky Mount. 588. 1909.

Prenanthes(?) pauciflora Torr., Ann. Lyc. N. Y. 2: 210. 1828.

Ptiloria pauciflora Raf., Atlant. Jour. 145. 1832.

Almost throughout the State, 1,200 to 7,000 feet, dry plains, mesas, and slopes, flowering throughout the year. Kansas to Texas, Arizona, and California.

The Hopi Indians, according to one authority, apply the plant both externally and internally to stimulate milk flow in women.

6. **Stephanomeria tenuifolia** (Torr.) H. M. Hall, Calif. Univ. Pub. Bot. 3: 256. 1907.

Prenanthes(?) tenuifolia Torr., Ann. Lyc. N. Y. 2: 210. 1828.

Ptiloria tenuifolia Raf., Atlant. Jour. 145. 1832.

Apache, Navajo, Coconino, and Yavapai Counties, 5,000 to 7,000 feet, July and August. Montana to Washington, south to Colorado, northern Arizona, and California.

Stephanomeria wrightii A. Gray was doubtfully recorded by Gray¹⁸ from Arizona on the basis of material collected by Rusby. The identity of these specimens is uncertain, but they do not seem to belong to *S. wrightii*.

¹⁸ GRAY, ASA. SYNOPTICAL FLORA OF NORTH AMERICA. 12: 1884. (See p. 414.)

131. NEMOSERIS

Glabrous branching annuals; leaves mostly pinnatifid; heads rather large, solitary at the tips of the branches and branchlets, white; involucre of about 7 to 15 equal, lanceolate, acuminate, scarious-margined phyllaries and of some much shorter, unequal, outer bractlets; achenes subfusiform, tapering into a beak; pappus of long-plumose setae.

Key to the species

1. Corollas exceeding the involucre by about 5 mm.; achenes with a slender beak about as long as the body; pappus dull or brownish white, the bristles plumose essentially to the apex with straight hairs. 1. *N. CALIFORNICA*.
1. Corollas exceeding the involucre by 10 mm. or more; achenes with a more gradually tapering and stouter beak shorter than the body; pappus bright white, the bristles not plumose near the apex, the hairs of the plume softer, subarachnoid.----- 2. *N. NEOMEXICANA*.

1. **Nemoseris californica** (Nutt.) Greene, *Pittonia* 2: 193. 1891.

Rafinesquia californica Nutt., *Amer. Phil. Soc. Trans. ser. 2*, 7: 429. 1841.

Mazatzal Mountains (Gila-Maricopa Counties), Santa Catalina and Baboquivari Mountains (Pima County), probably elsewhere, 3,500 to 4,500 feet, April and May. Southwestern Utah to southern Arizona, California, and northern Baja California.

2. **Nemoseris neomexicana** (A. Gray) Greene, *Pittonia* 2: 193. 1891.

Rafinesquia neomexicana A. Gray, *Pl. Wright. 2*: 103. 1853.

Mohave, Maricopa, Pinal, Pima, and Yuma Counties, 500 to 3,000 feet, abundant on plains and mesas, March to May. Western Texas to southern Utah, southern California, and northern Baja California.

One of the conspicuous spring flowers of the more desert parts of the State.

132. TRAGOPOGON. GOATSBEARD

Biennial or perennial, nearly glabrous herbs; leaves elongate, grass-like, strongly nerved, entire, somewhat clasping; heads large, yellow or purple, solitary on often fistulose peduncles; involucre of 8 to 13 lanceolate, acuminate, equal phyllaries; achenes subfusiform, long-beaked, muricate; pappus of somewhat flattened plumose bristles.

The well-known garden vegetable, salsify, oysterplant, or vegetable-oyster is *T. porrifolius* L.

Key to the species

1. Phyllaries 8 or 9, equaling or shorter than the chrome-yellow corollas. 1. *T. PRATENSIS*.
1. Phyllaries usually 10 to 13, much longer than the lemon-yellow corollas. 2. *T. DUBIUS*.

1. **Tragopogon pratensis** L., *Sp. Pl.* 789. 1753.

Coconino County, where common in waste ground near Flagstaff and Williams, also at Lakeside (Navajo County), summer. Widely distributed in the United States and Canada; naturalized from Europe.

2. **Tragopogon dubius** Scop., *Fl. Carn. ed. 2*, 2: 95. 1772.

Walnut Canyon, Coconino County, 6,800 feet (*Whiting* 2841), summer. Colorado to Idaho, New Mexico, and Arizona; adventive from Europe.

133. PINAROPAPPUS

Low perennial herb, sometimes scapose; leaves entire to runcinate-pinnatifid; heads solitary; receptacle bearing thin narrow paleae; achenes subfusiform, tapering into a short beak; pappus of copious, brownish, capillary bristles.

1. Pinaropappus roseus Less., Syn. Gen. Compos. 143. 1832.

Achyrophorus roseus Less., Linnaea 5: 133. 1830.

Chiricahua and Huachuca Mountains (Cochise County), about 8,000 feet, open grassy pine forests, July to October. Louisiana (where doubtless introduced), Texas, and Arizona, south to Guatemala.

The large heads are white, turning pink in drying.

134. MALACOTHRIX

Annual herbs; leaves toothed to pinnatisect; heads small or medium-sized, yellow or white; involucre of subequal phyllaries and calyculate, or strongly graduated, the phyllaries narrowly or broadly scarious-margined; achenes columnar, truncate, ribbed; pappus of soft bristles deciduous more or less in a ring, 1 to 8 of them (rarely none) stiffer and persistent, the achene often also crowned with a ring of minute teeth.

Key to the species

1. Involucre 12 to 15 mm. high, strongly graduated, the phyllaries 3 to 4 mm. wide, with a linear green and purplish midline and a very broad scarious margin, all but the inner phyllaries suborbicular to oval; stem leaves oblong or elliptic to ovate, cordate-clasping, the upper leaves subentire to repand-dentate, rarely lacinate..... 1. *M. COULTERI*.
1. Involucre 5 to 12 mm. high, calyculate but scarcely graduated, the phyllaries 1.5 mm. wide or less, lanceolate to linear, acute or acuminate, with a narrow subscarious margin; leaves linear to oblong or ovate, mostly pinnatifid (2).
2. Leaf segments linear-filiform, less than 1 mm. wide..... 2. *M. GLABRATA*.
2. Leaf segments oblong or triangular to linear-lanceolate, comparatively short, usually toothed (3).
3. Ligules inconspicuous, little exceeding the involucre; heads numerous, paniced, small (the involucre 5 to 8 mm. high); achenes finely 15-ribbed, with 1 (rarely 2) persistent pappus bristles and a crown of minute white setulose teeth..... 3. *M. CLEVELANDI*.
3. Ligules conspicuous, bright yellow, much exceeding the involucre; heads larger, mostly solitary or few at the tips of the branches and branchlets; pappus otherwise (4).
4. Achene cylindric, evenly 15-ribbed, 2 mm. long, the outer coat prolonged into a dark, truncate, unribbed, entire collar, this bearing inside below the apex a denticulate whitish ring and 0 to 2 persistent pappus bristles..... 4. *M. FENDLERI*.
4. Achene more or less 5-angled (5 of the 15 ribs stronger than the others, sometimes almost winglike, continuous to the apex of the achene or prolonged beyond it into knoblike teeth), the outer coat not prolonged into a collar (5).
5. Persistent bristles of the pappus 2 to 8, with minute teeth between them; 5 of the ribs of the achene much stronger than the others, almost winglike; phyllaries long-acuminate; achene 3 to 3.5 mm. long..... 5. *M. TORREYI*.
5. Persistent bristles of the pappus none, the achene with a finely denticulate whitish crown; stronger ribs of the achene not winglike; phyllaries merely acute or short-acuminate; achene about 2.5 mm. long..... 6. *M. SONCHOIDES*.

1. **Malacothrix coulteri** A. Gray, Amer. Acad. Arts and Sci. Mem. ser. 2, 4: 113. 1849.

Mohave, Maricopa, Pinal, and Pima Counties, 500 to 3,500 feet, March and April. Southwestern Utah to southern Arizona and southern California; Argentina.

Sometimes called snakeshead.

2. **Malacothrix glabrata** A. Gray, Syn. Fl. 1²: 422. 1884.

Malacothrix californica var. *glabrata* A. Gray ex D. C. Eaton in King, Geol. Expl. 40th Par. 5: 201. 1871.

Coconino, Mohave, Maricopa, Pinal, Pima, and Yuma Counties, up to 7,000 feet, common and abundant on plains and mesas, March to June. Idaho to Arizona and California.

A conspicuous element in the spring flora of the deserts.

3. **Malacothrix clevelandi** A. Gray, Bot. Calif. 1: 433. 1876.

Mazatzal Mountains (Gila-Maricopa Counties) to the mountains of Pima County, 2,500 to 4,300 feet, mostly along streams, March to May. Southern Arizona and California.

4. **Malacothrix fendleri** A. Gray, Pl. Wright. 2: 104. 1853.

Navajo, Yavapai, Greenlee, Pinal, Cochise, Santa Cruz, and Pima Counties, 2,000 to 5,000 feet, sandy plains, mesas, and rocky slopes, March to June. Western Texas to Arizona.

5. **Malacothrix torreyi** A. Gray, Amer. Acad. Arts and Sci. Proc. 9: 213. 1874.

Both sides of the Grand Canyon (Coconino County), southwest of Pipe Springs (Mohave County), 5,000 to 7,000 feet, May to July. Utah to Oregon, northern Arizona, and California.

6. **Malacothrix sonchoides** (Nutt.) Torr. and Gray, Fl. North Amer. 2: 486. 1843.

Leptoseris sonchoides Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 439. 1841.

Navajo, Coconino, and Mohave Counties, especially along the Little Colorado River, apparently also at Patagonia, Santa Cruz County, 1,500 to 6,000 feet, April to June. Nebraska to Idaho, Arizona, and California.

Malacothrix saxatilis var. *tenuifolia* (Nutt.) Torr. and Gray was reported by Gray from Arizona¹⁹ in 1884, but no material from that State has been seen by the author, and it is apparently not recorded by later writers; the locality of Gray's specimen was probably erroneous.

135. CALYCOSERIS

Low, branching, winter annuals, glabrous except for conspicuous stipitate glands on the upper part of the stem and on the involucre; leaves pinnatisect into narrowly linear or filiform divisions; heads white, rosy, or yellow; involucre of equal phyllaries, calyculate; achenes fusiform, 5- or 6-ribbed, tapering into a short beak, this expanded at apex into a shallow denticulate cup; pappus of numerous hispidulous white bristles, deciduous in a ring.

¹⁹ GRAY, ASA. SYNOPTICAL FLORA OF NORTH AMERICA. 1²: 1884. (See p. 423.)

Key to the species

1. Flowers white or rose-colored; achenes tuberculate, not very deeply sulcate between the ribs, dark-colored----- 1. *C. WRIGHTII*.
 1. Flowers bright yellow; achenes minutely rugulose, not tuberculate, very deeply sulcate between the ribs, light gray----- 2. *C. PARRYI*.

1. *Calycoseris wrightii* A. Gray, Pl. Wright. 2: 104. 1853.

Mohave County to Graham, Pinal, Cochise, Pima, and Yuma Counties, 1,200 to 4,000 feet, common on plains, mesas, and rocky slopes, March to May. Western Texas to Utah, Arizona, southern California, and northern Mexico.

One of the handsomest of Arizona spring flowers, and conspicuous in the more desert areas.

2. *Calycoseris parryi* A. Gray in Torr., U. S. and Mex. Bound. Bot. 106. 1859.

Western Mohave County, about 3,000 feet (*Eastwood* 18174, *Kearney* and *Peebles* 13125), "central Arizona" (*Palmer* 292, in 1876), March and April. Southern Utah, Arizona, and southern California.

136. GLYPTOPLEURA

Dwarf depressed winter annuals; leaves pinnatifid, with a toothed, white, crustaceous margin; heads white or pale yellow, turning pink in drying; involucre of about 7 to 12 equal, lanceolate, scarious-margined phyllaries, with a calyculus of several spatulate bractlets, these crustaceous-margined above and lacerate-toothed or pinnatifid; achenes oblong or columnar, 5-ribbed, cancellate-rugose, at apex produced into a thick 5-lobed cuplike border, from which is exerted an abrupt short beak dilated at apex to bear the pappus; pappus copious, soft, white, capillary, deciduous.

1. *Glyptopleura setulosa* A. Gray, Amer. Acad. Arts and Sci. Proc. 9: 211. 1874.

Fredonia, Coconino County, about 4,800 feet (*Peebles* 13062), Fort Mohave, Mohave County (*Lemmon* in 1884), without definite locality (*Palmer* in 1869), April to June. Southern Utah and northwestern Arizona to southern California.

Glyptopleura marginata D. C. Eaton has been reported from Arizona, but no specimens have been seen by the writer. In *G. marginata* the crustaceous margin of the leaves is broad, with short teeth, the bracts of the calyculus are pinnatifid above and lacerate-fringed most of the way to the base, and the ligules are short and little exerted; in *G. setulosa* the crustaceous leaf-margin is produced into slender teeth longer than the margin itself, the bracts of the calyculus are lacerate-fringed at the conspicuously dilated apex and naked below it, and the ligules are long-exserted.

137. TARAXACUM.²⁰ DANDELION

Scapose perennial herbs; leaves all basal, runcinate-pinnatifid or sometimes merely toothed or sinuate-lobed; heads solitary, large, yellow, on hollow scapes; involucre double, the outer phyllaries much shorter than the inner ones, often recurved, the inner phyllaries 1-seriate, erect; achenes more or less fusiform, 4- or 5-ribbed, muricate above, prolonged into a slender beak, this bearing the simple capillary pappus.

The common dandelion is often used for greens, as a substitute for spinach, and large-leaved cultivated varieties have been developed in

²⁰ Reference: SHERFF, E. E. NORTH AMERICAN SPECIES OF TARAXACUM. Bot. Gaz. 70: 329-358. 1920.

Europe. The roots, reputed to have medicinal properties, are sometimes eaten as a salad.

Propagation in this genus is partly or wholly parthenogenetic, which results in the production and preservation in nature of a multitude of closely similar but distinguishable forms. The material available from Arizona is rather scanty, and the treatment here given is tentative. The possible existence of a fourth species is indicated by a dwarf specimen from the San Francisco Peaks (*Little* 4635), but the material available is not sufficient for identification in the present knowledge of the western species of the genus.

Key to the species

1. Achenes blackish, the murications comparatively short and blunt; outer phyllaries ovate, appressed or erect, not recurved----- 1. *T. LYRATUM*.
1. Achenes greenish or reddish; outer phyllaries recurved-spreading (2).
 2. Achenes bright red or reddish brown, the murications toward the apex very sharp and comparatively long----- 2. *T. LAEVIGATUM*.
 2. Achenes greenish, the murications less acute and shorter-- 3. *T. PALUSTRE*.

1. **Taraxacum lyratum** (Ledeb.) DC., Prodr. 7: 148. 1838.

Leontodon lyratus Ledeb., Fl. Alt. 4: 152. 1833.

San Francisco Peaks, Coconino County (*Knowlton* 142). Greenland and northern Canada south to Colorado, Utah, and northern Arizona; Asia.

2. **Taraxacum laevigatum** (Willd.) DC., Cat. Hort. Monsp. 149. 1813.

Leontodon laevigatus Willd., Sp. Pl. 3: 1546. 1804.

Taraxacum erythrospermum Andr. in Besser, Enum. Pl. 75. 1822.

Lukachukai Mountains (Apache County), Betatakin (Navajo County), Tuba, and San Francisco Peaks (Coconino County), 5,000 to 11,500 feet, June to August. Nova Scotia to British Columbia, south to Virginia, New Mexico, and northern Arizona; naturalized from Europe.

3. **Taraxacum palustre** (I. Lyons) Lam. et DC., Fl. Franç. 4: 45. 1805.

Leontodon palustre I. Lyons, Fasc. Pl. 48. 1763.

Lukachukai Mountains, Apache County (*Peebles* 14379 in part), probably also near Prescott and Kirkland, Yavapai County (*Peebles* et al., 2613, 4180). Northern Canada to Mexico; naturalized from Europe, or possibly native.

The Arizona form is the common dandelion of the United States, var. *vulgare* (Lam.) Fernald.

138. SONCHUS. SOWTHISTLE

Coarse weedy annuals, with subentire to pinnatifid, spinulose-toothed leaves and medium-sized, irregularly cymose-panicked, yellow heads; lower leaves usually petioled, the upper ones sessile and strongly clasping; involucre more or less regularly graduate, the phyllaries thin, corky-thickened at base in age; achenes strongly flattened, several-ribbed, not beaked; pappus copious, of soft white capillary bristles.

Key to the species

1. Achenes strongly 3 (5-)ribbed on each face, thin-margined, not transversely wrinkled; auricles of the leaf base rounded..... 1. *S. ASPER*.
 1. Achenes striate and also strongly wrinkled transversely, not thin-margined; auricles of the leaf base acute..... 2. *S. OLERACEUS*.

1. *Sonchus asper* (L.) Hill, Herbarium Brit. 1: 47. 1769.*Sonchus oleraceus* var. *asper* L., Sp. Pl. 794. 1753.

Here and there in Apache, Yavapai, Maricopa, Pinal, Cochise, and Pima Counties, 1,100 to 8,000 feet, roadsides and waste ground, April to August. An abundant weed nearly throughout North America; naturalized from Europe.

2. *Sonchus oleraceus* L., Sp. Pl. 794. 1753.

Maricopa, Pinal, and Pima Counties, roadsides and waste places, April to September. An abundant weed in most parts of North America; naturalized from Europe.

A gum obtained by evaporation of the juice of this plant is said to be a powerful cathartic, and it has been used as a so-called cure for the opium habit.

139. LACTUCA. LETTUCE, WILD LETTUCE

Annual or perennial herbs, nearly or quite glabrous, leafy-stemmed; leaves variable, from linear and entire to oblong and pinnatifid; heads small or medium-sized, paniced, yellow or blue; involucre rather slender, more or less strongly graduated; achenes strongly flattened, abruptly or gradually beaked; pappus copious, of soft white capillary bristles.

The garden lettuce is *L. sativa* L. Lactucarium, a sedative, is obtained from *L. virosa*. Sheep sometimes feed on *L. pulchella*, but the plant is reputed to be slightly poisonous.

Key to the species

1. Achene lanceolate or lance-oblong, strongly several-ribbed on each face' gradually narrowed into a short stoutish beak; flowers blue.
 1. *L. PULCHELLA*.
 1. Achene oval or oval-oblong, abruptly narrowed into a slender beak sometimes as long as the body; flowers yellow or purplish (2).
 2. Achene small, the body 3 mm. long or less, light gray, about 5-nerved on each side, finely hispidulous above, not rugulose, the beak very slender, longer than the achene; leaves stiffly spinulose on the margin and usually on the midrib beneath..... 2. *L. SERRIOLA*.
 2. Achene larger, the body 4 to 6 mm. long, dark brown or blackish, 1-nerved on each side, not hispidulous, finely transverse-rugulose; leaves not stiffly spinulose (3).
 3. Achene with a body about 6 mm. long, the beak about half as long; leaves mostly narrowly linear and entire, the lower ones often broader and pinnatifid..... 3. *L. GRAMINIFOLIA*.
 3. Achene with a body about 4 mm. long, the beak about as long; leaves all obovate or oblong, at least the lower ones pinnatifid, the upper ones often not lobed..... 4. *L. LUDOVICIANA*.

1. *Lactuca pulchella* (Pursh) DC., Prodr. 7: 134. 1838.*Sonchus pulchellus* Pursh, Fl. Amer. Sept. 502. 1814.

Apache, Navajo, and Coconino Counties, 6,000 to 7,500 feet, summer. Saskatchewan to British Columbia, south to Missouri, New Mexico, Arizona, and California.

2. *Lactuca serriola* L., Cent. Pl. 2: 29. 1756; Amoen. Acad. 4: 328. 1756.

Lactuca scariola L., Sp. Pl. ed. 2, 1119. 1763.

Coconino, Yavapai, Maricopa, Pinal, and Cochise Counties, 1,000 to 7,000 feet, May to September. Abundant in southern Canada and the United States; naturalized from Europe.

Prickly lettuce, a common weed of roadsides and waste ground. Two forms occur commonly—the typical form, with pinnatifid leaves, and f. *integrifolia* Bogenhard (*L. scariola* var. *integrata* Gren. and Godr.), with unlobed leaves.

3. *Lactuca graminifolia* Michx., Fl. Bor. Amer. 2: 85. 1803.

Apache, Coconino, Graham, Cochise, Santa Cruz, and Pima Counties, 5,000 to 7,000 feet, May to September. South Carolina to Florida, west to Arizona.

4. *Lactuca ludoviciana* (Nutt.) DC., Prodr. 7: 141. 1838.

Sonchus ludovicianus Nutt., Gen. Pl. 2: 125. 1818.

Fort Verde, Yavapai County (*MacDougal* 515), Tonto Basin, Gila County (*Toumey* 617), 3,000 to 5,000 feet, July and August. Minnesota to Missouri, west to Colorado, Texas, and central Arizona.

This species has not previously been recorded from Arizona.

140. LYGODESMIA

Annual or perennial herbs, essentially glabrous or merely puberulent, sometimes spinescent; leaves entire or toothed; heads very small to large, the corollas pink or rosy; involucre slender, of few equal phyllaries and a calyculus; achenes subcylindric or linear-prismatic, few-ribbed, not beaked; pappus of numerous capillary bristles, stiffish or soft.

Key to the species

1. Branches spinescent, rigid, divaricate; stems with tufts of brown wool at base: lower leaves linear, entire, about 3 cm. long or less, the upper ones reduced to scales..... 1. *L. SPINOSA*.
1. Branches not spinescent; stem without tufts of wool at base; leaves otherwise (2).
 2. Leaves grasslike, linear, entire, conspicuous, up to 10 cm. long; involucre 18 to 20 mm. high; achenes at least 10 mm. long; plant perennial.
 2. *L. GRANDIFLORA*.
 2. Basal leaves obovate or oblanceolate, repand-toothed or lobed, those of the stem reduced and inconspicuous; involucre about 5 mm. high; achenes about 3 mm. long; plant annual..... 3. *L. EXIGUA*.

1. *Lygodesmia spinosa* Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 444. 1841.

Flagstaff to the Little Colorado River (Coconino County), 6,500 to 7,500 feet, August and September. Montana to British Columbia, northern Arizona, and California.

2. *Lygodesmia grandiflora* (Nutt.) Torr. and Gray, Fl. North Amer. 2: 485. 1843.

Erythremia grandiflora Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 445. 1841.

Navajo and Coconino Counties, about 5,000 feet, common on sandy plains, often with grasses, May and June. Wyoming to Idaho, south to New Mexico and central Arizona.

The bright pink heads are large for the size of the plant. It is reported that the Hopi Indians boil the leaves with meat and with mush, and regard the plant as stimulative of milk flow in women.

3. *Lygodesmia exigua* A. Gray, Amer. Acad. Arts and Sci. Proc. 9: 217. 1874.

Prenanthes exigua A. Gray, Pl. Wright. 2: 105. 1853.

Stephanomeria minima M. E. Jones., Contrib. West. Bot. 17: 31. 1930.

Navajo, Coconino, Mohave, Pima, and Yuma Counties (probably elsewhere), 1,000 to 5,500 feet, hills and mesas, March to June, the type of *Stephanomeria minima* from Fredonia, Coconino County (M. E. Jones in 1929). Colorado to Texas, Arizona, and California.

141. AGOSERIS. MOUNTAIN-DANDELION

Perennial or rarely annual, scapose herbs; leaves narrow, entire to pinnatifid; heads solitary, medium-sized, on long naked scapes; involucre usually graduated; receptacle naked; corollas yellow, orange, or purple; achenes subfusiform, ribbed, smooth, beaked; pappus of soft, white, capillary bristles.

The genus is much in need of a thorough revision, and the present key is only tentative.

Key to the species

1. Plant annual; achene 3 to 4 mm. long, the beak about twice as long; involucre pilose or villous with many-celled, often gland-tipped hairs.
 1. A. HETEROPHYLLA.
1. Plant perennial; achene larger; involucre usually glabrous or glabrate, the hairs, when present, not gland-tipped (2).
 2. Beak of the achene comparatively stout, nerved throughout, much shorter than the body----- 2. A. GLAUCA.
 2. Beak of the achene slender, not nerved throughout (3).
 3. Beak of the achene shorter than the body; corollas orange, becoming purple in age----- 3. A. AURANTIACA.
 3. Beak of the achene as long as or longer than the body; corollas light yellow, often becoming purplish in age or on drying----- 4. A. ARIZONICA.

1. *Agoseris heterophylla* (Nutt.) Greene, Pittonia 2: 178. 1891.

Macrorhynchus heterophyllus Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 430. 1841.

Pima County, 3,500 to 5,000 (?) feet, plains, mesas, and canyons, March and April. British Columbia to Arizona, California, and northwestern Mexico.

2. *Agoseris glauca* (Pursh) D. Dietr., Syn. Pl. 4: 1332. 1847.

Troximon glaucum Pursh, Fl. Amer. Sept. 505. 1814.

Apache, Coconino, Yavapai, Greenlee, Graham, and Pima Counties, 6,600 to 10,000 feet, meadows and open coniferous forests, June to October. British Columbia, south to New Mexico, Arizona, and Nevada.

Represented in Arizona by 3 varieties: Var. *parviflora* (Nutt.) Rydb., chiefly in the southeastern counties, but also on the Kaibab Plateau, with linear or linear-lanceolate entire leaves 2 to 8 mm. wide; var. *laciniata* (D. C. Eaton) Smiley, in Apache, Coconino, and Yavapai Counties, with retrorse-pinnatifid leaves; and var. *dasycephala*

(Torr. and Gray) Jepson, with broad, entire or subentire leaves about 2 cm. wide, and a more or less densely pilose and ciliate involucre. The last variety is known in Arizona only by a collection without definite locality (*E. Palmer* in 1869).

3. *Agoseris aurantiaca* (Hook.) Greene, *Pittonia* 2: 177. 1891.

Troximon aurantiacum Hook., *Fl. Bor. Amer.* 1: 300. 1834.

Macrorhynchus purpureus A. Gray, *Amer. Acad. Arts and Sci. Mem. ser. 2, 4*: 114. 1849.

Agoseris purpurea Greene, *Pittonia* 2: 177. 1891.

Kaibab Plateau, San Francisco Peaks, and near Flagstaff (Coconino County), 6,000 to 9,000 feet, grassy slopes, meadows, and open pine forests, June to August. Alberta and British Columbia to New Mexico and northern Arizona.

4. *Agoseris arizonica* Greene, *Pittonia* 2: 176. 1891.

Troximon arizonicum Greene, *Pittonia* 2: 78. 1890.

Apache, Coconino, Yavapai, Graham (?), Gila, and Pima Counties, 5,500 to 11,000 feet, mostly in open pine forests, especially in the Flagstaff region, April to August. Wyoming to New Mexico and Arizona.

Doubtfully distinct from the preceding, or at any rate difficult to separate in herbarium specimens, which mostly lack ripe fruit and almost never have the color of the flowers noted.

142. PYRRHOPAPPUS. FALSE-DANDELION

Nearly glabrous perennial, several-stemmed, the stems sparsely leafy, somewhat branched; leaves entire to pinnatifid, mostly in a basal rosette; heads few, long-peduncled, rather large, yellow; phyllaries narrowly lanceolate, corniculate below the tip, with a calyculus of narrow bractlets less than half as long; achenes subfusiform, about 5-sulcate, tapering into a slender beak longer than the body; pappus copious, of soft brown hairs, surrounded at base by a short villous ring.

1. *Pyrrhopappus multicaulis* DC., *Prodr.* 7: 144. 1838.

Pyrrhopappus rothrockii A. Gray, *Amer. Acad. Arts and Sci. Proc.* 11: 80. 1876.

Sitilias multicaulis Greene, *Pittonia* 2: 179. 1891.

White Mountains (Navajo County), Huachuca Mountains (Cochise County), Arivaca (Pima County), 3,500 to 7,200 feet, in moist sometimes saline soil, apparently rare, June to September, the type of *P. rothrockii* from Fisch's Ranch, southern Arizona (*Rothrock* 699). Texas to Arizona and Mexico.

143. CREPIS.²¹ HAWKSBEARD

Low perennial herbs, leafy-stemmed or scapose, glabrous to tomentose; leaves mostly in a basal rosette, entire to pinnatifid; heads several or numerous, medium-sized, cymose or paniced, yellow; involucre of narrow equal phyllaries and some calyculate bractlets; achenes

²¹ Reference: BABCOCK, E. B., and STEBBINS, G. L., JR. THE AMERICAN SPECIES OF CREPIS. THEIR INTERRELATIONSHIPS AND DISTRIBUTION AS AFFECTED BY POLYFLOIDY AND APOMIXIS. Carnegie Inst. Wash. Pub. 504: 1-199. 1935.

columnar or fusiform, 10- to 20-ribbed; pappus copious, of soft white capillary bristles.

Key to the species

1. Plant glabrous and glaucous, scapose or with a single stem leaf. 1. *C. GLAUCA*.
1. Plant more or less pubescent, glandular or tomentose; stem more or less leafy (2).
2. Heads thick-cylindric (5 to 9 mm. thick at anthesis), normally 12- to 25-flowered; plant low, usually less than 30 cm. high; involucre tomentulose and often glandular-hispid; heads usually few. 2. *C. OCCIDENTALIS*.
2. Heads slender-cylindric (3 to 5 mm. thick at anthesis), normally 5- to 15-flowered; plant usually taller, more than 30 cm. high; involucre tomentulose or glabrous; heads usually numerous (3).
3. Involucre normally glabrous except for some ciliation on the outer bractlets; principal phyllaries 5 to 7; heads 5- to 10-flowered.
3. Involucre tomentulose; principal phyllaries 8; heads 10- to 15-flowered. 3. *C. ACUMINATA*.
4. *C. INTERMEDIA*.

1. ***Crepis glauca*** (Nutt.) Torr. and Gray, Fl. North Amer. 2: 488. 1843.

Crepidium glaucum Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 436. 1841.

Crepis chamaephylla Woot. and Standl., Contrib. U. S. Natl. Herbarium 16: 175. 1913.

Apache and Navajo Counties, about 5,000 feet, sometimes in saline soil, June to August, the type of *C. chamaephylla* from the Carrizo Mountains (Standley 7419). South Dakota, Saskatchewan, and Idaho, south to Colorado and northeastern Arizona.

A specimen from the White Mountains (*Griffiths* 5354) is regarded by Babcock and Stebbins (see footnote 21, p. 1031, Babcock and Stebbins, p. 102) as intermediate between their *C. runcinata* subsp. *glauca* and subsp. *barberi* (Greenm.) Babcock and Stebbins, of New Mexico and Chihuahua, having the very narrow leaves of subsp. *barberi* but the short involucre of subsp. *glauca*.

2. ***Crepis occidentalis*** Nutt., Acad. Nat. Sci. Phila. Jour. 7: 29. 1834.

Keam Canyon (Navajo County), Grand Canyon and Flagstaff to Ash Fork (Coconino County), 6,200 to 7,200 feet, open ground, June. Saskatchewan to British Columbia, south to northern New Mexico, northern Arizona, and California.

3. ***Crepis acuminata*** Nutt., Amer. Phil. Soc. Trans. ser. 2, 7: 437. 1841.

"Arizona," without definite locality (*Palmer* in 1869), July and August. Montana to Washington, south to Colorado, northern Arizona, and California.

Palmer's specimen is the only one purporting to have been collected in Arizona that the writer has examined. It has a glabrous involucre, as is normal for the species. Babcock and Stebbins (see footnote 21, p. 1031, Babcock and Stebbins, p. 177) cite a specimen from Jacobs Pools, Coconino County (*Jaeger* in 1926) as related to their apomictic form *nevadensis*, which has the inner phyllaries lightly tomentulose.

4. ***Crepis intermedia*** A. Gray, Syn. Fl. 1²: 432. 1884.

Grand Canyon, Coconino County (*Toumey* 664, *Ward* in 1901), June and July. Colorado to Alberta, south to northern Arizona and California.

144. *HIERACIUM*.²² HAWKWEED

Perennial herbs, sometimes scapose; leaves linear to oblong or obovate, entire or merely toothed; heads small, yellow, rarely white or rosy; involucre of several equal phyllaries and a few short calyculate bractlets; achenes columnar, or sometimes narrowed upward but not beaked, about 10-ribbed; pappus of brownish or white capillary bristles.

Key to the species

1. Basal leaves villous-lanate..... 1. *H. PRINGLEI*.
 1. Basal leaves pilose, hirsute, or hispid, not villous-lanate (2).
 2. Plant somewhat glaucous, glabrous except for the long-pilose basal leaves and base of the stem and the sometimes sparsely ciliate lower stem leaves; stem leafy to the inflorescence, the leaves elongate, narrowly linear; corollas rose-color..... 2. *H. CARNEUM*.
 2. Plant usually not glaucous, usually hairy on the stem; stem leaves when present not elongate or narrowly linear; corollas not rose-color (3).
 3. Stem decidedly leafy (the leaves mostly oblong, with a broad, more or less clasping base) and densely long-setose..... 3. *H. LEMMONI*.
 3. Stem (scape) leafless or with 1 or 2 small leaves or bracts (these not at all clasping) and rather sparsely setose..... 4. *H. FENDLERI*.

1. *Hieracium pringlei* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 69. 1883.

Huachuca Mountains (Cochise County), Santa Rita Mountains (Pima County), probably about 6,000 feet, June to September, type from the Santa Rita Mountains (*Pringle*). Southwestern New Mexico and southeastern Arizona.

2. *Hieracium carneum* Greene, Bot. Gaz. 6: 184. 1882.

Huachuca Mountains (Cochise County), Patagonia Mountains (Santa Cruz County), Rincon Mountains (Pima County), 6,000 to 7,000 feet, July to September. Southwestern Texas to southeastern Arizona and adjacent Mexico.

3. *Hieracium lemmoni* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 70. 1883.

Mountains of Cochise and Pima Counties, 7,000 to 8,000 feet, July to October, type from Cave Canyon, Huachuca Mountains (*Lemmon*). Southwestern New Mexico and southeastern Arizona.

4. *Hieracium fendleri* Schultz Bip., Bonplandia 9: 173. 1861.

Hieracium fendleri var. *discolor* A. Gray, Amer. Acad. Arts and Sci. Proc. 19: 69. 1883.

Navajo Mountain and Grand Canyon (Coconino County) southward to the mountains of Graham, Cochise, and Pima Counties, 6,000 to 9,500 feet, mostly in pine forests, May to August. South Dakota to New Mexico, Arizona, and Mexico.

The commonest and most widely distributed species of hawkweed in Arizona. *H. fendleri* var. *discolor* was based on specimens collected in the Santa Rita and Huachuca Mountains by J. G. Lemmon and C. G. Pringle.

²² Reference: ROBINSON, B. L., and GREENMAN, J. M. REVISION OF THE MEXICAN AND CENTRAL AMERICAN SPECIES OF *HIERACIUM*. Amer. Acad. Arts and Sci. Proc. 40 (Gray Herbarium Contrib. 28): 14-24. 1904.

ADDENDA

The statement (see p. 1) that "there has never been a comprehensive publication dealing with this extraordinarily interesting State flora," although correct when written, is no longer so, "A flora of New Mexico and Arizona," by Ivar Tidestrom and Sister Teresita Kittell, having been issued in 1941.

Arrhenatherum elatius (L.) Presl, Fl. Cech. 17. 1819.

Tall-oatgrass. This was collected recently near Flagstaff, Coconino County (*Whiting* 1211). It is a tall grass with elongate narrow panicles, cultivated and escaped here and there in North America, native of Europe. The genus is closely related to *Avena* (see p. 108) but is distinguished by having the lower of the 2 florets staminate, with a long geniculate awn, and the upper floret perfect, with a short straight awn.

Muhlenbergia appressa C. O. Goodding, Wash. Acad. Sci. Jour. 31: 504. 1941.

Gila, Pinal, Maricopa, and Graham Counties, 3,000 to 4,000 feet, canyons and slopes, March and April. Known only from southern Arizona. Closely related to *M. microsperma* (DC.) Kunth (see p. 115), differing in having narrow panicles with closely appressed branches and longer spikelets, 4.5 to 6 mm. long.

Muhlenbergia brevis C. O. Goodding, Wash. Acad. Sci. Jour. 31: 505. 1941.

Bowie, Cochise County, 3,760 feet, open ground, August to October. Colorado and Texas to Arizona, south to the Federal District, Mexico. This species is related to *M. depauperata* Scribn. (see p. 116), to which specimens have been referred, but differs in having lemmas 4 to 5 mm. long, awns 10 to 20 mm. long, and glumes much shorter than the spikelet.

Sporobolus patens Swallen, Wash. Acad. Sci. Jour. 31: 352. 1941.

Wilcox, Cochise County (*Silveus* 3504, type); known only from the type collection. A slender erect annual with short flat blades 1 to 2 cm. long and rather delicate loosely flowered panicles with long-pediceled spikelets 1.8 to 2 mm. long.

Sporobolus pulvinatus Swallen, Wash. Acad. Sci. Jour. 31: 351. 1941.

Apache and Cochise Counties, 3,500 to 5,300 feet, open sandy plains and roadsides. Texas to Arizona and northern Mexico. Specimens of this species have been referred to *S. pyramidatus* (Lam.) Hitchc. (see p. 122) but differ in being annual with short flat blades and in having smaller spikelets of which the second glume and lemma are abruptly acute or subobtuse.

Cyperus pringlei Britton. Of the specimens identified by the writers as of this species (see p. 160), Hugh O'Neill has referred several with a condensed inflorescence to *C. flavus* (Vahl) Nees and others with an open, long-rayed inflorescence to *C. mutisii* (H. B. K.) Griseb. The latter species is distinguished by rather narrowly cylindrical spikes 2 to 4 cm. long, and 1- to 3-flowered spikelets, these plump at maturity. *C. subambiguus* var. *pallidicolor* Kükenthal is regarded by Father O'Neill as not distinct from *C. flavus*. On the basis of these identifications, the known ranges of the 3 species in Arizona are: *C. pringlei*,

Gila, Cochise, and Pima Counties; *C. flavus*, Gila, Cochise, and Pima Counties; *C. mutisii*, Graham, Santa Cruz, and Pima Counties.

Scirpus californicus (C. A. Mey.) Steud., Nov. ed. 2, 2: 538. 1841.

As this species occurs in California and New Mexico, it is to be looked for in Arizona. It somewhat resembles *S. validus* and *S. acutus* (see p. 162), but the stem is triangular, at least toward the apex, and the perianth bristles are plumose.

Salix geyeriana Anderss., Amer. Acad. Arts and Sci. Proc. 4: 63. 1858.

This willow occurs in Apache, Navajo, Coconino, and Yavapai Counties. It has distinctly petioled leaves with narrowly lanceolate or oblanceolate, entire or nearly entire blades, these sparsely short-pilose above and glaucous beneath. The pistillate catkins are short and broad, and the capsules are pubescent. It is readily distinguished from *S. bebbiana* Sarg. (see p. 219) by its much narrower leaf blades.

Paronychia jamesii Torr. and Gray, Fl. N. Amer. 1: 171. 1838.

E. L. Core (The North American species of *Paronychia*. Amer. Midland Nat. 26: 393. 1941) refers the Eastwood and Howell collection (see p. 312) to *P. jamesii* and cites also a collection by Lemmon in the Chiricahua Mountains. *P. depressa* Nutt. should therefore be excluded from the flora of Arizona.

Draba spectabilis Greene, Pittonia 4: 19. 1899.

This has been collected in the Lukachukai Mountains, northern Apache County (*Pebbles* 14388). The collection in question belongs to var. *typica* C. L. Hitchc. This species has the pods flat or nearly so and mostly shorter than the pedicels, whereas in the other perennial, leafy-stemmed, yellow-flowered species of Arizona, *D. aurea*, *D. petrophila*, *D. helleriana* (see pp. 361, 362), the pods are usually more or less twisted and longer than the pedicels.

Prosopis (see p. 420). Benson²³ refers the Arizona specimens which the writers regarded as belonging to *Prosopis juliflora* var. *glandulosa* (Torr.) Cockerell to a new variety, var. *torreyana* Benson, and restricts the area of var. *glandulosa* to Kansas, Louisiana, Texas, and eastern New Mexico. He also considers the name *Prosopis pubescens* Benth. to be the proper designation of the Fremont screw-bean, rather than *P. odorata* Torr. and Frém.

Phaseolus wrightii A. Gray (see p. 505). The var. *grayanus* commonly has a very short, relatively stout, persistent style, but in some of the Arizona specimens the style is as long and slender as in the type collection of *P. wrightii* A. Gray.

Strophostyles. An unidentified and perhaps undescribed species of this genus has been collected between Nogales and Ruby, Santa Cruz County (*Kearney* and *Pebbles* 14901). It has narrowly lanceolate, entire, thickish, prominently reticulate-veined leaflets. The genus differs from *Phaseolus* (see p. 503) in having the keel petals strongly incurved but not curled or coiled.

Echinocactus. A species of *Echinocactus* was discovered in 1939 in the vicinity of Holbrook, Navajo County. Reference to this discovery is omitted from the text (see pp. 599-603) for the reason that

²³ BENSON, LYMAN. THE MESQUITES AND SCREWBEANS OF THE UNITED STATES. Amer. Jour. Bot. 28: 748-754. 1941.

the new species has not been described. Plants short-cylindric, about 2.5 cm. high, 2 cm. in diameter, strongly tuberculate, not ribbed; spines small in diameter, unique in having a thick dense coat of hair, in this respect resembling the flowering spikes of the cattail (*Typha*); flowers 16 mm. long, campanulate, the outer perianth segments broadly oblong, rounded-obtuse, maroon, the inner segments narrower, sub-acute, apiculate, whitish with a faint pink median strip.

Mammillaria arizonica Engelm. Boissevain and Davidson²⁴ are probably justified in suggesting that this species (see p. 605) is not distinguished by substantial characters from *M. vivipara* (Nutt.) Haw., a species known to range from southern Canada to Kansas, northern Texas, and southern Colorado.

Gilia gracilis (Dougl.) Hook. (see p. 720). This plant is referred by Herbert L. Mason (Madroño 6: 122-127. 1941) to the genus *Phlox*, as *P. gracilis* (Dougl.) Greene.

Phacelia laxiflora J. T. Howell, Leaflets West. Bot. 3: 95. 1941.

A newly described species, known only from in and near the Grand Canyon, Coconino and Mohave Counties. It is stated to be related to *P. perityloides* Coville of the Death Valley region, Calif. Of the species previously recorded for Arizona, *P. laxiflora* most nearly resembles in leaf shape *P. rotundifolia* Torr. (see p. 733), but the plant is perennial.

Hesperochiron pumilus (Dougl.) Porter in Hayden, U. S. Geol. Survey Ter. Ann. Rpt. 6: 778. 1873.

Mormon Lake, Coconino County, in wet soil under yellow pines, flowering in May (*Deaver* in 1941). Idaho and Washington to northern Arizona and northern California.

A low, acaulescent, nearly glabrous perennial herb with entire, linear to obovate, long-petioled leaves in a basal rosette from a thickened caudex, and rather showy flowers, these solitary on naked peduncles, the corolla campanulate-rotate, lilac. Readily distinguished from all other Arizona plants of the Hydrophyllaceae (see p. 728) by the exclusively basal leaves and solitary flowers.

LITERATURE CONSULTED

VEGETATION OF ARIZONA

BLUMER, J. C.

1909. ON THE PLANT GEOGRAPHY OF THE CHIRICAHUA MOUNTAINS. *Sci.* (n. s.) 30: 720-724.

EASTWOOD, ALICE.

1919. EARLY SPRING AT THE GRAND CANYON NEAR EL TOVAR. *Plant World* 22: 95-99.

HANSON, HERBERT C.

1924. A STUDY OF THE VEGETATION OF NORTHEASTERN ARIZONA. *Univ. Nebr. Studies* 24, Nos. 3-4, pp. 85-175.

MACDOUGAL, D. T.

1908. ACROSS PAPAGUERIA. *Amer. Geog. Soc. Bul.* 40: 1-21.

1908. BOTANICAL FEATURES OF NORTH AMERICAN DESERTS. *Carnegie Inst. Wash. Pub.* 99, 111 pp., illus.

1908. THE COURSE OF THE VEGETATION SEASON IN SOUTHERN ARIZONA. *Plant World* 11: 189-208; 217-231; 237-249; 261-270.

²⁴ BOISSEVAIN, CHARLES A., and DAVIDSON, CAROL. COLORADO CACTI. *Cact. and Succ. Jour.* 13, no. 4. 1941. Suppl. p. 65.

- MERRIAM, C. HART.
1890. RESULTS OF A BIOLOGICAL SURVEY OF THE SAN FRANCISCO MOUNTAIN REGION AND DESERT OF THE LITTLE COLORADO, ARIZONA. U. S. Dept. Agr. North Amer. Fauna, No. 3, 136 pp., illus.
- NICHOL, A. A.
1937. THE NATURAL VEGETATION OF ARIZONA. Univ. Ariz. Tech. Bul. 68, pp. 181-222.
- PEARSON, G. A.
1931. FOREST TYPES IN THE SOUTHWEST AS DETERMINED BY CLIMATE AND SOIL. U. S. Dept. Agr. Tech. Bul. 247.
——— GOLDMAN, E. A., SHREVE, FORREST, and VORHIES, CHARLES T.
1926. ARIZONA, IN NATURALISTS' GUIDE TO THE AMERICAS. Pp. 562-569, Baltimore.
- READ, A. D.
1915. THE FLORA OF THE WILLIAMS DIVISION OF THE TUSAYAN NATIONAL FOREST, ARIZONA. Plant World 18: 112-123.
- SHANTZ, H. L., and ZON, R.
1924. NATURAL VEGETATION. Atlas of Amer. Agr. pt. I, sect. E.
——— and PIEMEISEL, R. L.
1925. INDICATOR SIGNIFICANCE OF THE NATURAL VEGETATION OF THE SOUTHWESTERN DESERT REGION. Jour. Agr. Res. 28: 721-801, illus.
- SHREVE, FORREST.
1915. THE VEGETATION OF A DESERT MOUNTAIN RANGE AS CONDITIONED BY CLIMATIC FACTORS. Carnegie Inst. Wash. Pub. 217, 112 pp., illus.
———
1917. A MAP OF THE VEGETATION OF THE UNITED STATES. Geog. Rev. 3: 119-125, illus.
———
1936. THE PLANT LIFE OF THE SONORAN DESERT. Sci. Monthly 42: 195-213.
- THORNER, J. J.
1910. THE GRAZING RANGES OF ARIZONA. Ariz. Agr. Expt. Sta. Bul. 65, pp. 245-360, illus.
- TURNAGE, W. V., and HINCKLEY, A. L.
1938. FREEZING WEATHER IN RELATION TO PLANT DISTRIBUTION IN THE SONORAN DESERT. Ecol. Monog. 8: 529-550.

USES AND POPULAR INTEREST

- ALSBERG, C. L., and BLACK, O. F.
1912. LABORATORY STUDIES ON THE RELATION OF BARIUM TO THE LOCO-WEED DISEASE. U. S. Dept. Agr., Bur. Plant Indus. Bul. 246, pt. 2.
- BALL, WALTER S., and others.
1931. [WEEDS]. Calif. Dept. Agr., Monthly Bul. 22: 252-305.
- BARTLETT, O. C.
1930. ARIZONA LIST OF DANGEROUS PLANT PESTS AND PLANT DISEASES. Ariz. Comm. Agr. and Hort. (Names of host plants.)
- BEATH, O. A.
1939. THE SELENIFEROUS ASTRAGALUS OSTERHOUTH JONES. Amer. Jour. Bot. 26: 729-730.
——— GILBERT, C. S., and EPPSON, H. F.
1939. THE USE OF INDICATOR PLANTS IN LOCATING SELENIFEROUS AREAS IN WESTERN UNITED STATES. Amer. Jour. Bot. 26: 257-269, 296-315.
——— GILBERT, C. S., and EPPSON, H. F.
1940. THE USE OF INDICATOR PLANTS IN LOCATING SELENIFEROUS AREAS IN WESTERN UNITED STATES. Amer. Jour. Bot. 27: 564-573.
- BECKETT, R. E., and STITT, R. S.
1935. THE DESERT MILKWEED (ASCLEPIAS SUBULATA) AS A POSSIBLE SOURCE OF RUBBER. U. S. Dept. Agr. Tech. Bul. 472.
——— STITT, R. S., and DUNCAN, E. N.
1938. RUBBER CONTENT AND HABITS OF A SECOND DESERT MILKWEED (ASCLEPIAS EROSA) OF SOUTHERN CALIFORNIA AND ARIZONA. U. S. Dept. Agr. Tech. Bul. 604.
- BELL, W. H., and CASTETTER, E. F.
1937. THE UTILIZATION OF MESQUITE AND SCREWBEAN BY THE ABORIGINES IN THE AMERICAN SOUTHWEST. N. Mex. Univ. Bul. 314.
- BIDWELL, G. L., and WOOTON, E. O.
1925. SALTBUSHES AND THEIR ALLIES IN THE UNITED STATES. U. S. Dept. Agr. Bul. 1345.

BRAY, W. L.

1910. THE MISTLETOE PEST IN THE SOUTHWEST. U. S. Dept. Agr., Bur. Plant Indus. Bul. 166.

CASTETTER, E. F.

1935. UNCULTIVATED NATIVE PLANTS USED AS SOURCES OF FOOD. N. Mex. Univ. Bul. 266.

— and UNDERHILL, R. M.

1935. THE ETHNOBIOLOGY OF THE PAPAGO INDIANS. N. Mex. Univ. Bul. 275.

— and OPLER, M. E.

1936. ETHNOBIOLOGY OF THE CHIRICAHUA AND MESCALERA APACHE. N. Mex. Univ. Bul. 297.

— and BELL, W. H.

1937. THE ABORIGINAL UTILIZATION OF THE TALL CACTI IN THE AMERICAN SOUTHWEST. N. Mex. Univ. Bul. Biol. ser. 5, no. 1.

— BELL, W. H., and GROVE, A. R.

1938. THE EARLY UTILIZATION AND THE DISTRIBUTION OF AGAVE IN THE AMERICAN SOUTHWEST. N. Mex. Univ. Bul. 335.

CHESNUT, V. K.

1898. THIRTY POISONOUS PLANTS OF THE UNITED STATES. U. S. Dept. Agr. Farmers' Bul. 86.

CRAIGHEAD, F. C., and HOFER, G.

1921. PROTECTION OF MESQUITE CORDWOOD AND POSTS FROM BORERS. U. S. Dept. Agr. Farmers' Bul. 1197.

CRAWFORD, A. C.

1907. THE LARKSPURS AS POISONOUS PLANTS. U. S. Dept. Agr., Bur. Plant Indus. Bul. 111.

DAYTON, WILLIAM A.

1931. IMPORTANT WESTERN BROWSE PLANTS. U. S. Dept. Agr. Misc. Pub. 101.

— and others.

1937. RANGE PLANT HANDBOOK. U. S. Forest Serv.

DODGE, NATT N.

1936. TREES OF GRAND CANYON NATIONAL PARK. Grand Canyon Nat. Hist. Assoc. Bul. 3.

DURRELL, L. W., and NEWSOM, I. E.

1939. COLORADO'S POISONOUS AND INJURIOUS PLANTS. Colo. Expt. Sta. Bul. 455.

FORBES, R. H.

1895. THE MESQUITE TREE: ITS PRODUCT AND USES. Ariz. Expt. Sta. Bul. 13.

FORSLING, C. L.

1919. CHOPPED SOAPWEED AS EMERGENCY FEED FOR CATTLE ON SOUTHWESTERN RANGES. U. S. Dept. Agr. Bul. 745.

GOODING, LESLIE N.

1938. NOTES ON NATIVE AND EXOTIC PLANTS IN REGION 8 WITH SPECIAL REFERENCE TO THEIR VALUE IN THE SOIL CONSERVATION PROGRAM. U. S. Dept. Agr., Soil Conserv. Serv. Bul. 247. [Multigraphed.]

1939. NATIVE LEGUMES IN REGION 8. U. S. Dept. Agr., Soil Conserv. Serv. Reg. Bul. 55. [Multigraphed.]

GRAHAM, EDWARD H.

1939. LEGUMES: THEIR EROSION-CONTROL AND WILD-LIFE VALUES. U. S. Dept. Agr., Soil Conserv. Serv. TP-23. [Multigraphed.]

GRIFFITHS, D.

1904. RANGE INVESTIGATIONS IN ARIZONA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 67.

1905. PRICKLY PEAR AND OTHER CACTI AS FOOD FOR STOCK. U. S. Dept. Agr., Bur. Plant Indus. Bul. 74.

1908. THE PRICKLY PEAR AS A FARM CROP. U. S. Dept. Agr., Bur. Plant Indus. Bul. 124.

— BIDWELL, G. L., and GOODRICH, C. E.

1915. NATIVE PASTURE GRASSES OF THE UNITED STATES. U. S. Dept. Agr. Bul. 201.

1920. PRICKLY PEAR AS STOCK FEED. U. S. Dept. Agr. Farmers' Bul. 1072.

HANSEN, A. A.

1920. COCKLEBUR. U. S. Dept. Agr. Cir. 109.

- HENDRICKS, B. A.
1936. VINE-MESQUITE FOR EROSION CONTROL ON SOUTHWESTERN RANGES. U. S. Dept. Agr. Leaflet 114.
- HENKEL, A.
1904. WEEDS USED IN MEDICINE. U. S. Dept. Agr. Farmers' Bul. 188.
1907. AMERICAN ROOT DRUGS. U. S. Dept. Agr., Bur. Plant Indus. Bul. 107.
1909. AMERICAN MEDICINAL BARKS. U. S. Dept. Agr., Bur. Plant Indus. Bul. 139.
1911. AMERICAN MEDICINAL LEAVES AND HERBS. U. S. Dept. Agr., Bur. Plant Indus. Bul. 219.
1913. AMERICAN MEDICINAL FLOWERS, FRUITS, AND SEEDS. U. S. Dept. Agr. Bul. 26.
- HILL, R. R.
1917. EFFECTS OF GRAZING UPON WESTERN YELLOW PINE REPRODUCTION IN THE NATIONAL FORESTS OF ARIZONA AND NEW MEXICO. U. S. Dept. Agr. Bul. 580.
- HITCHCOCK, A. S.
1935. MANUAL OF THE GRASSES OF THE UNITED STATES. U. S. Dept. Agr. Misc. Pub. 200.
- HOUGH, W.
1898. ENVIRONMENTAL INTERRELATIONS IN ARIZONA. Amer. Anthrop. 11: 133-155.
- LUMHOLTZ, C.
1912. NEW TRAILS IN MEXICO.
- MARSH, C. D.
1908. RESULTS OF LOCO-WEED INVESTIGATIONS IN THE FIELD. U. S. Dept. Agr., Bur. Plant Indus. Bul. 121.
1914. CICUTA, OR WATER HEMLOCK. U. S. Dept. Agr. Prof. Paper 69.
1916. LUPINES AS POISONOUS PLANTS. U. S. Dept. Agr. Bul. 405.
— CLAWSON, A. B., and MARSH, HADLEIGH.
1918. LARKSPUR OR "POISON WEED." U. S. Dept. Agr. Farmers' Bul. 988.
— and CLAWSON, A. B.
1919. THE LOCO-WEED DISEASE. U. S. Dept. Agr. Farmers' Bul. 1054. (Revised 1929.)
1921. WESTERN SNEEZEWEED (HELENIUM HOOPESII) AS A POISONOUS PLANT. U. S. Dept. Agr. Bul. 947.
— and CLAWSON, A. B.
1921. THE MEXICAN WHORLED MILKWEED (ASCLEPIAS MEXICANA) AS A POISONOUS PLANT. U. S. Dept. Agr. Bul. 969.
1926. RAYLESS GOLDENROD (APLOPAPPUS HETEROPHYLLUS) AS A POISONOUS PLANT. U. S. Dept. Agr. Bul. 1391.
1929. STOCK-POISONING PLANTS OF THE RANGE. U. S. Dept. Agr. Bul. 1245.
- McINDOO, N. E., and SIEVERS, A. F.
1924. PLANTS TESTED FOR OR REPORTED TO POSSESS INSECTICIDAL PROPERTIES. U. S. Dept. Agr. Bul. 1201.
- McKEE, R.
1919. AUSTRALIAN SALTBUUSH. U. S. Dept. Agr. Bul. 617.
- McMINN, H. E.
1939. AN ILLUSTRATED MANUAL OF CALIFORNIA SHRUBS . . . WITH A CHAPTER ON THE USE OF THE CALIFORNIA SHRUBS IN THE GARDEN DESIGN, BY F. H. SCHUMACHER. 689 pp. San Francisco.
- MUENSCHER, W. C.
1939. POISONOUS PLANTS OF THE UNITED STATES.
- NICHOL, A. A.
1937. THE NATURAL VEGETATION OF ARIZONA. Univ. Ariz. Tech. Bul. 68.
1938. EXPERIMENTAL FEEDING OF DEER. Univ. Ariz. Tech. Bul. 75.

- PARKER, K. W.
1936. PREVENTION OF DEATH LOSSES IN SHEEP ON AREAS INFESTED WITH PINGUE (*ACTINEA RICHARDSONI*). N. Mex. Expt. Sta. Bul. 241.
- PARKS, H. B.
1937. VALUABLE PLANTS NATIVE TO TEXAS. Tex. Agr. Expt. Sta. Bul. 551.
- PEARSON, G. A.
1923. NATURAL REPRODUCTION OF WESTERN YELLOW PINE IN THE SOUTHWEST. U. S. Dept. Agr. Bul. 1105.
-
1931. FOREST TYPES IN THE SOUTHWEST AS DETERMINED BY CLIMATE AND SOIL. U. S. Dept. Agr. Tech. Bul. 247.
- PLUMMER, C. C.
1938. THE TOXICITY OF HAPLOPHYTON CIMICIDUM A. DC. TO FRUITFLIES. U. S. Dept. Agr. Cir. 455.
- ROSE, J. N.
1899. NOTES ON USEFUL PLANTS OF MEXICO. U. S. Natl. Mus., Contrib. U. S. Natl. Herbarium 5: 209-259.
- RUSSELL, F.
1908. THE PIMA INDIANS. U. S. Bur. Amer. Ethnol. Ann. Rpt. 1904-5.
- SAFFORD, W. E.
1917. NARCOTIC PLANTS AND STIMULANTS OF THE ANCIENT AMERICANS. Smithsn. Inst. Ann. Rpt. 1916: 405-409.
- SAUNDERS, CHARLES FRANCIS.
1938. WESTERN WILD FLOWERS AND THEIR STORIES.
- SHANTZ, H. L.
1911. NATURAL VEGETATION AS AN INDICATOR OF THE CAPABILITIES OF LAND FOR CROP PRODUCTION IN THE GREAT PLAINS AREA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 201.
- SMILEY, E. J.
1922. WEEDS OF CALIFORNIA AND METHODS OF CONTROL. Calif. Dept. Agr. Monthly Bul. 11, nos. 2-3.
- STANDLEY, P. C.
1920-26. TREES AND SHRUBS OF MEXICO. U. S. Natl. Mus., Contrib. U. S. Natl. Herbarium 23: 1-1721.
- STREETS, R. B., and STANLEY, E. B.
1938. CONTROL OF MESQUITE AND NOXIOUS SHRUBS ON SOUTHERN ARIZONA GRASSLAND RANGES. Ariz. Univ. Tech. Bul. 74.
- THACKERY, F. A., and LEDING, A. R.
1929. THE GIANT CACTUS OF ARIZONA. Jour. Hered. 20: 401-414.
——— and GILMAN, M. F.
1931. A RARE PARASITIC FOOD PLANT OF THE SOUTHWEST. Smithsn. Inst. Ann. Rpt. 1930: 409-416.
- THORNER, J. J.
1910. THE GRAZING RANGES OF ARIZONA. Ariz. Univ. Bul. 65.
-
1911. NATIVE CACTI AS EMERGENCY FORAGE PLANTS. Ariz. Agr. Expt. Sta. Bul. 67.
- UNIVERSITY OF ARIZONA.
1937. BOTANY AND RANGE ECOLOGY. Ariz. Agr. Expt. Sta. Ann. Rpt. 48: 39-50.
- VAN DERSAL, WILLIAM R.
1938. NATIVE WOODY PLANTS OF THE UNITED STATES. THEIR EROSION-CONTROL AND WILD-LIFE VALUES. U. S. Dept. Agr. Misc. Pub. 303.
- VESTAL, P. A.
1940. NOTES ON A COLLECTION OF PLANTS FROM THE HOPI INDIAN REGION OF ARIZONA MADE BY J. C. OWENS IN 1891. Harvard Univ., Bot. Mus. Leaflet 8: 153-168.
- WHITING, ALFRED F.
1939. ETHNOBOTANY OF THE HOPI. Mus. North. Ariz. Bul. 15.
- WOOD, H. C., et al.
1926. THE DISPENSATORY OF THE U. S. A. Ed. 21.
- WOOTON, E. O., and STANDLEY, P. C.
1915. FLORA OF NEW MEXICO. U. S. Natl. Mus., Contrib. U. S. Natl. Herbarium 19: 1-1794.
- YANOVSKY, ELIAS.
1936. FOOD PLANTS OF THE NORTH AMERICAN INDIANS. U. S. Dept. Agr. Misc. Pub. 237.

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<i>vaginiflorus</i>	121 (120)	Tillandsia	176
<i>wrightii</i>	123 (15, 16, 18, 120, 121)	<i>Tiquilia</i>	742
Stachys	776 (769)	Tithonia	952 (870, 881, 959)
Stanleya	341 (338, 339)	<i>Tithymalus</i>	539-541
Stanleyella	344 (339)	<i>Tium</i>	486
<i>Stegnocarpus</i>	741	<i>Toumeyia</i>	603
<i>Steironema</i>	668	Townsendia	914 (882)
Stellaria	303	<i>Toxicodendron</i>	548 (549)
Stemodia	821 (801)	<i>Toxicosordion</i>	188
<i>Stenogonum</i>	246	Trachypogon	153 (80)
<i>Stenobium</i>	834	Tradescantia	178 (177)
<i>Stenophyllus</i>	168	Tragia	530 (525)
<i>Stenotus</i>	906	Tragopogon	1023 (870, 871)
Stephanomeria	1021 (16, 871, 1030)	Tragus	130 (78)
Sterculiaceae	580 (48, 53)	Trautvetteria	326 (316)
Stevia	883 (874)	Trianthes	296
Stillingia	533 (525)	Tribulus	512 (511, 514)
Stipa	124 (17, 81)	Tricardia	739 (728)
<i>arida</i>	126 (125)	Trichachne	141 (79)
<i>bloomeri</i>	124	Trichloris	135 (81)
<i>columbiana</i>	127 (125)	<i>Trichochloa</i>	115
<i>comata</i>	126 (18, 125)	<i>Trichophyllum</i>	983
<i>coronata</i>	126 (125)	Trichoptilium	983 (874, 877)
<i>eminens</i>	126 (125)	Trichostema	771 (768, 770)
<i>fimbriata</i>	124	<i>Trichymenia</i>	977
<i>hymenoides</i>	124	<i>Tricuspis</i>	99
<i>lettermani</i>	127 (125)	Trifolium	442 (430)
<i>lobata</i>	126 (125)	<i>alboburpureum</i>	444 (443)
<i>minor</i>	127	<i>amabile</i>	444 (442)
<i>neomexicana</i>	125	<i>arizonicum</i>	444 (442)
<i>parishii</i>	126	<i>biflorum</i>	493
<i>pennata</i>	125	<i>dasyphyllum</i>	444 (443)
<i>pringlei</i>	126 (125)	<i>fendleri</i>	444 (21, 442)
<i>robusta</i>	126 (124, 125)	<i>fistulosum</i>	444 (442)
<i>scribneri</i>	126 (125)	<i>gracilentum</i>	444 (443)
<i>speciosa</i>	125	<i>howellii</i>	445
<i>tenacissima</i>	125	<i>hybridum</i>	445 (442, 443)
<i>vaseyi</i>	126	<i>lacerum</i>	444 (442)
Stokesia	870	<i>longicaule</i>	444
Streptanthella	344 (339)	<i>longipes</i>	445
Streptanthus	345 (339, 342-344)	<i>macilentum</i>	445 (443)
Streptopus	201 (186)	<i>melilotus indica</i>	441
<i>Strombocarpa</i>	420	<i>melilotus officinalis</i>	441
Strophostyles	1035	<i>microcephalum</i>	443 (442)

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neurophyllum	445 (443)	<i>prismatica</i>	767
pinetorum	444 (442)	<i>pubera</i>	763
pratense	445 (442, 443)	<i>remota</i>	764
repens	.....	445 (442, 443)	<i>scabra</i>	.....	764 (763)
rusbyi	.....	445 (443)	<i>verna</i>	.....	763
subcaulescens	.....	444 (443)	<i>wrightii</i>	.....	764 (762)
variegatum	.....	443 (442)	Verbenaceae	.....	761 (55, 57)
villiferum	.....	445 (443)	Verbesina	.....	961 (880, 881, 950, 960)
Triglochin	.....	75	Vernonia	.....	870
Triodia	.....	98 (83)	Veronica	.....	823 (801)
<i>Tripolium</i>	.....	921	<i>Vesicaria</i>	.....	358 (359)
Tripsacum	.....	154 (79)	<i>Viborguia</i>	.....	453
Tripterocalyx	.....	294 (285)	Vicia	.....	497 (429)
Trisetum	.....	107 (82)	Viguiera	.....	953 (880, 881)
<i>Triticum</i>	.....	101 (102)	<i>Vilfa</i>	.....	116 (117, 121, 123)
Trixis	.....	1019 (871)	<i>Vincetozicum</i>	.....	697
<i>Troximon</i>	.....	1030 (1031)	Viola	.....	586 (585)
Tumamoca	.....	862 (861)	Violaceae	.....	585 (50)
<i>Turritis</i>	.....	351 (367)	<i>Viorna</i>	.....	323 (325)
Typha	.....	71 (13)	Viscum	.....	231 (234)
Typhaceae	.....	71 (46)	Vitaceae	.....	559 (52, 54)
Ulmaceae	.....	228 (49)	Vitex	.....	761
Ulmus	.....	580	Vitis	.....	560
Umbelliferae	.....	639 (47, 51)	Waitzia	.....	870
<i>Uniola</i>	.....	96	Waltheria	.....	581 (580)
<i>Urachne</i>	.....	124	Washingtonia	.....	175 (7, 644)
<i>Uralepis</i>	.....	95	<i>Wedelia</i>	.....	289
<i>Uropappus</i>	.....	1020	<i>Weddiella</i>	.....	289 (290)
Ursinia	.....	870	<i>Whipplea</i>	.....	383
Urtica	.....	230	<i>Wilcoxia</i>	.....	595
Urticaceae	.....	229 (48)	Wislizenia	.....	373 (371)
<i>Urtica</i>	.....	602	Wolfiella	.....	175
<i>Urtularia</i>	.....	201	Woodsia	.....	27 (26)
<i>Vaccaria</i>	.....	315	Woodwardia	.....	31 (26)
Vaccinium	.....	664 (660)	Wyethia	.....	952 (881)
<i>Vachellia</i>	.....	416	Xanthisma	.....	870
<i>Vagnera</i>	.....	200 (201)	Xanthium	.....	948 (872)
Valeriana	.....	859 (858)	Xanthocephalum	.....	894 (879, 882, 896)
Valerianaceae	.....	858 (47, 55, 56)	<i>Xanthoxalis</i>	.....	508 (509)
<i>Valerianella</i>	.....	859	Xeranthemum	.....	870
<i>Valota</i>	.....	141	<i>Xerocassia</i>	.....	424
Vandevca	.....	895 (874)	<i>Ximenesia</i>	.....	961
Vauquelinia	.....	391 (389)	<i>Xylophacos</i>	.....	478 (479, 480)
Veratrum	.....	188 (186)	<i>Xylorhiza</i>	.....	920
Verbasum	.....	801 (800)	<i>Xylosteon</i>	.....	858
Verbena	.....	762 (761)	<i>Xylosteum</i>	.....	858
<i>ambrosifolia</i>	.....	764	Yuca	.....	196 (185, 186)
<i>bipinnatifida</i>	.....	764 (762)	Zaluzania	.....	951 (880)
<i>bracteata</i>	.....	764 (762)	Zannichellia	.....	75 (73)
<i>bracteosa</i>	.....	764	<i>Zapania</i>	.....	766
<i>canescens</i>	.....	765	Zauschneria	.....	621 (620)
<i>carolina</i>	.....	764 (763)	Zephyranthes	.....	202
<i>ciliata</i>	.....	763 (762)	Zexmenia	.....	960 (881)
<i>gooddingii</i>	.....	763 (762)	Zinnia	.....	949 (870, 878—880)
<i>gracilis</i>	.....	764 (762)	<i>Zizyphus</i>	.....	555
<i>hastata</i>	.....	765 (763)	Zornia	.....	493 (429)
<i>ligustrina</i>	.....	766	Zuckia	.....	273 (263)
<i>macdougalii</i>	.....	764 (763)	Zygadenus	.....	187 (186)
<i>menthaefolia</i>	.....	765	Zygophyllaceae	.....	511 (54)
<i>neomexicana</i>	765 (763)	<i>Zygophyllum</i>	541 (542)
<i>plicata</i>	764 (762, 763)	<i>Zygophyllum</i>	512
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Acanthus family	838	Antelope-brush	408
Addersmouth	212	Antelope-horns	694
Adderstongue	.....	25	Antelope-sage	.....	250
Adderstongue family	.....	24	Apache-plume	.....	404 (18)
Adelia	.....	672	Apachejogress	.....	113
Agrimony	.....	408	Apple	.....	388
Aizoon family	.....	295	Apricot	.....	388
Alder	.....	222 (21)	Apricot-mallow	.....	568
Alfalfa	.....	440 (412)	Arizona-poppy	.....	513
Alfileria	.....	507	Arizona-rosewood	.....	391
Algerita	.....	333	Arrowgrass	.....	75
Algodoncillo	.....	579	Arrowgrass family	.....	75
Alkali-grass	.....	89	Arrowhead	.....	76
Allscale	.....	272	Arrowleaf	.....	885
Almond	.....	388	Arrowweed	.....	934 (13)
Alumroot	380	Artichoke	1015 (870)
Amaranth	279	Arum family	175
Amaranth family	278	Ash	670 (15, 20)
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Beggarticks.....	493 (964)	Burrobrush.....	944 (408)
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Bellflower.....	866	Burroweed.....	947
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Bentgrass.....	110	Butter-and-eggs.....	802
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Betony.....	776	Butterfly bush.....	674
Bignonia family.....	833	Butterfly-pea.....	500
Bigroot.....	864	Butterfly-weed.....	692
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Birch.....	222 (22)	Button-snakeroot.....	642
Birch family.....	221	Buttonweed.....	848
Bird-of-paradise-flower.....	428	Cabbage.....	387 (15)
Bird-pepper.....	793	Cacao family.....	338 (351)
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Biscuitroot.....	655	beavertail.....	610 (13)
Bisnaga.....	599 (13)	beehive.....	602
Bitterbrush.....	408	cane.....	607
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Blueberry.....	664	Caltrop.....	512
Bluebonnets.....	434	Caltrop family.....	511
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Box family.....	547	Caraway.....	640
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Bracken.....	34	Carelessweed.....	279 (280)
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Cattle-spinach	272	Crowfootgrass	133
Cauliflower	338 (351)	Crown daisy	961
Cedar	68	Crown-of-thorns	999
Celery	645 (640)	Crucifixion-thorn	585
Centizo	273	Crucifixion-thorn	517 (7, 15, 585)
Century plant	202	Cucumber	860
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Chaete	421	Cudweed-sagewort	1001
Chaffbush	897	Cupgrass	142
Chaffweed	668	Curly-mesquite	131
Chainfern	31	Currant	384
Chamiso	273	Cutgrass	141
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Charlock	352	Cypress	67
Cheatgrass	83	Cypressvine	708
Cheeseweed	572	Dallisgrass	143
Cherry	410 (388, 411)	Dandelion	1026
Chia	778	Darnel	105
Chicalote	336	Datil	196
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Chicory	1019	Deathamas	187 (186)
Chilicote	501	Deerbrowse	406
Chillipiquin	793	Deerbrush	559
China-aster	870	Deerclover	445
Chinchweed	994	Deernut	547
Chinese-pusley	744	Deers-ears	680
Chives	189	Deervetch	445
Chokecherry	411 (412)	Desert-almond	411
Cholla	607 (614-616)	Desert-holly	272 (1018)
Chrysanthemum, summer	999	Desert-honeysuckle	840
Chuchupate	649	Desert-lavender	785
Chufa	156	Desertlily	189
Chuparosa	840 (842)	Desertmallow	568
Cigarflower	620	Desert-marigold	970
Cineraria	1000	Desertplume	341
Cinquefoil	397	Desertpoppy	336
Clammyweed	373	Desert-sunflower	959
Cliffbrake	38	Desert-thorn	787
Cliffbush	382	Desert-trumpet	247
Cliffrose	405	Desertwillow	834
Cloakfern	39	Devilsclaw	835 (415)
Clover	442 (412, 444, 445)	Dewberry	396
Clubflower	829	Dill	649 (640)
Coachwhip	583	Dock	254 (236, 257)
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Cocklebur	948	Dogbane	685
Cockroach-plant	682	Dogbane family	682
Cockspur	147	Dogfennel	997
Coffeeberry	557	Dogwood	658
Coffeeberry-bush	658	Dogwood family	657
Coffeebush	547	Douglas-fr	64 (21, 22)
Coffeetree	845	Doveweed	527
Colorado River hemp	468	Dragonhead	774
Colorado-rubberplant	870	Dropseed	120
Columbine	317	Duckbill	832
Coneflower	950 (951)	Duckweed	176
Convolvulus family	698	Duckweed family	175
Coralbean, western	501	Eggplant	786
Coralbells	381	Elder	853 (15, 854)
Coralroot	212	Elephanthead	833
Coraltree	501	Elephanttree	518(7)
Cordgrass	134	Elkslip	316
Coriander	644 (640)	Elm family	228
Cornbind	259	Enchanters-nightshade	637
Corona-de-Cristo	585	Endive	870
Cosmos	966	Eriogonum	245 (246, 248-250, 252)
Cota	964	Eryngo	642
Cottagrass	99	Escoba-colorada	458
Cotton	579 (561)	Escobita	831
Cottontop	141	Esparto	125
Cottonwood	214 (13, 15, 20, 215, 216)	Estafiata	1002 (960)
Covena	193	Evening-primrose	624 (620)
Cow-parsnip	657	Evening-primrose family	620
Cowslip	665	Evening-snow	723
Cow-tobacco	816	Everlasting	938 (870)
Coyote-melon	863	Fairyduster	413
Crabgrass	141	Fall-witchgrass	142
Cranesbill	505	False-buffalograss	139
Creambush	392	False-camomile	998
Creamcups	334	False-dandelion	1031
Creosotebush	512 (13)	False-dragonhead	775
Cress	338 (346)	Falseflax	360
Crested-coralroot	214	False-hellebore	188 (186)
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Fern family	26	Hares-ear-mustard	370
Fernleaf	832	Hawkbitt	1021
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Figwort	805	Hedgenettle	776
Figwort family	799	Heliotrope	742 (740)
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Flannelbush	580	Himalaya-berry	396
Flat-sedge	156	Hoarhound	772
Flax	510	Hogpotato	428
Flax family	510	Hollyfern	28
Fleabane	923	Hollygrape	332
Fleur-de-lis	206	Holygrass	140
Flowering plants	45	Honeysuckle	857 (842, 852, 858)
Fluffgrass	98	Honeysuckle family	852
Foambush	391	Hop	229
Forget-me-not	740	Hopbush	554
Four-o'clock	286 (287)	Hophornbeam	221
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Foxglove	800 (812)	Hoptree	516
Foxtail	111	Horned-pondweed	75
Foxtail-millet	148	Hornwort	315
Fragrant-bitterweed	984	Hornwort family	315
Fremontia	580	Horsebean	426
Fringe-pod	363	Horsebrush	1005
Fritillary	194	Horsenettle	795
Frogs-bit family	77	Horsetail	42
Gaillardia	989	Horsetail family	43
Galleta	131 (13)	Horsetail	42
Gamagrass	154	Horseweed	923
Garlic	189	Huisache	416
Gentian	676	Hummingbird-trumpet	621
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Geranium family	505	Indian-bean	501
Germander	769	Indian-blanket	989
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Giantreed	97 (78)	Indian-corn	154
Ginseng	638	Indian-grass	152
Ginseng family	638	Indian-hemp	685
Globe-amaranth	284	Indian-lettuce	301
Globe-artichoke	1015	Indian-mallow	563
Globemallow	566	Indian-millet	123
Globethistle	870	Indianpipe-weed	247
Goatnut	547	Indian-plantain	1005
Goatsbeard	1023	Indianroot	655 (235)
Golden-aster	898	Indianwheat	842
Goldenglow	951	Indigo	449 (412)
Goldenhead	897	Indigobush	453 (452)
Goldenpea	433	Inkberry	858
Goldenrod	900 (870)	Iodinebush	276
Goldentop	96	Iris family	205
Goldeye-grass	202	Ironwood	466 (13)
Goldfern	34	Jackass-clover	373
Goldfields	974	Jacobs-ladder	726
Golondrina	535	Jerusalem-artichoke	870
Gooseberry	384 (386)	Jerusalem-oak	265
Goosefoot	263 (265)	Jimmyweed	908
Goosefoot family	261	Jimsonweed	797 (798)
Gourd	860	Johnsongrass	152 (78)
Gourd family	860	Jointfir	70
Grama	136 (78)	Jointfir family	70
Granadilla	588	Jojoba	547
Grandfathers-beard	404	Joshua-tree	198
Granjeno	228	Jumping-bean	534
Grape	560	Junco	584
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Grapefern	25	Junegrass	106
Grapefruit	514	Jungle-rice	147
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Licorice	491	Mountain-balm	739
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Loosestrife	619 (668)	Mules-ears	952
Loosestrife family	618	Mullein	801
Lotebush	555	Musk-thistle	1015
Lovage	649	Mustard	351 (338, 352, 353)
Lovegrass	93	Mustard family	337
Love-lies-bleeding	281	Muttongrass	90
Lucerne	440	Nailwort	312
Lupine	434	Navajo-tea	964
Madder	845	Needlegrass	124
Madder family	845	Nettle	230
Madroño	662 (21)	Nettle family	229
Maidenhair	35	Nievitás	748
Maize	78 (154)	Nightshade	793 (796)
Mala-mujer	532	Ninebark	390
Mal-de-ojos	566	Nogal	221
Malefern	30	Nonesuch	441
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