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I

A NEW SPECIES OF CORAMBE FROM THE PACIFIC COAST OF NORTH AMERICA

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The Nudibranch genus *Corambe* forms a group concerning whose structure, life history, affinities and distribution, much remains yet to be learned. The general features of its organization seem to ally it to the phanerobranchiate Dorids, and in that group more especially to the Goniodorididæ. It has been placed by Bergh in his System (1892) in a separate family, the Corambidæ, and he indicates its probable close relationship to the little known, older genera *Hypobranchiæa* A. Adams, and *Doridella* Verrill, rather characteristically reducing them to synonymy with his own, later genus. While these two are unknown from an anatomical point of view, it is reasonably certain that they should be united with *Corambe* in the same family at least. In doing this we recognize the priority and correctness of the name proposed by P. Fischer (1883), and use it instead of the later one by Bergh. The family diagnosis given by Fischer has been slightly modified in the light of later information than was then available. Should future studies establish the generic identity of *Corambe* with either or both *Hypobranchiæa* and *Doridella,* the name given by Bergh would, of course, be cancelled in favor of the earlier one.

Family Hypobranchiæidæ P. Fischer, 1883.

Fischer, P., 1883. Manuel de Conchyliologie, Fasc. VI, p. 530.

Body, notæum, and rhinophores doridiform, branchiæ posterior, below the notæum margin and above the foot; anus median, posterior, between notæum and foot; reproductive openings anterior on right side; radula narrow, multiserial.

Genus 1. **Hypobranchiæa** A. Adams, 1847.

Adams, A., 1847. Proc. Zool. Soc. London, pp. 23-24.

Type: Hypobranchiæa fusca A. Adams.

Yellow Sea.

Genus 2. **Doridella** Verrill, 1870.

Verrill, A. E., 1870. Amer. Journal Science and Arts, I, p. 408.

Type: Doridella obscura Verrill.

Vineyard Sound; Long Island Sound.

Genus 3. **Corambe** Bergh, 1871.

Bergh, R., 1871. Verh. k. k. zool.-bot. Ges. Wien, XXI, pp. 1293-1294.

Type: Corambe sargassicola Bergh.

Sargasso Sea.

Genus 4. **Corambella** Balch, 1899.

Balch, F. E., 1899. Proc. Bost. Soc. Nat. Hist., XXIX, p. 151.

Type: Corambella depressa Balch.

Cold Spring Harbor, Long Island.

The present paper deals with the third of this list of genera, being a description with anatomical details of a new species of *Corambe* from the Pacific Coast of North America, for which the name *Corambe pacifica* is here proposed. Our grateful acknowledgments are due to Professor Walter K. Fisher, Director of the Hopkins Marine Station, Pacific Grove, California, for the free use of the facilities afforded by that laboratory during the prosecution of the greater portion of this study. We are also greatly indebted to Mrs. Olive H. MacFarland for her generous cooperation in the preparation of the figures which illustrate this account.

Corambe Bergh, 1871

Corambe Bergh, R., 1869. Bidrag til en Monographi af Phyllidierne. Naturh. Tidsskrift, 3 R, 5 B, p. 359; footnote.

Corambe Bergh, 1871. Beiträge zur Kenntnis der Mollusken des Sargassomeeres. Verh. d. k. k. zool.-bot. Gesellschaft Wien, Bd. XXI, pp. 1293-1297, Taf. XI, Fig. 21-27, Taf. XII, Fig. 1-11.

Corambe Kerbert, C., 1886. Over het Geslacht Corambe Bergh. Tijdschrift der Nederlandsche Dierkundige Vereeniging, 2 Sér., D. 1, Afl. 2, pp. 5-6. (Abstract in Bull. Sci. du Nord, 2 Sér., 9, 1886, pp. 136-138.)

Corambe Fischer, P., 1888. Note sur la présence du genre Corambe Bergh, dans le bassin d'Arcachon (Gironde). Bull. Soc. Zool. France, T. 13, No. 9, pp. 215-216.

Corambe Fischer, H., 1889. Note préliminaire sur la Corambe testudinaria. Bull. Soc. Zool. France. T. 14, No. 10, pp. 379-381.

Corambe Fischer, H., 1891. Sur l'anatomie du Corambe testudinaria. C. R. Ac. Sci. Paris, CXII, pp. 304-307.

Corambe Fischer, H., 1891. Recherches anatomiques sur un Mollusque appartenant au Genre Corambe. Bull. Sci. de la France et de la Belgique. T. XXIII (Sér. IV, Vol. II), pp. 358-398, Pl. IX-XIII.

Corambe Fischer, H., 1896. Note sur la distribution du Genre Corambe. Jour. Conchyl. Vol. XLIII, pp. 235-236.

Corambe Bergh, R., 1892. System der Nudibranchiaten Gasteropoden. Wiesbaden. Semper's Reisen im Archipel der Philippinen. Wissenschaftliche Resultate. Malacologische Untersuchungen, Bd. III, H. 18, pp. 166-168.

Corambe Vayssière, A., 1901. Étude comparée des Opistobranches des Côtes Françaises de l'Océan Atlantique et de la Manche avec ceux de nos Côtes Méditerranéennes. Bull. Sci. France et Belgique, T. XXXIV, p. 296.

Corambe Vayssière, A., 1913. Mollusques de France et des régions voisines. T. I., Paris, p. 363.

Body doridiform, oval, depressed; notæum somewhat convex, its margin wide, flattened, rounded in front, deeply notched in the median line behind, everywhere extending beyond the foot; rhinophores retractile within sheaths, the stalk bearing an inner pair of wing-like, lateral expansions, and surrounded by an outer sheath, free above, united to the stalk below, and deeply cleft or entirely free behind; foot emarginate in front, rounded behind, smaller than the notæum, which completely conceals it.

Branchiæ posterior, of a few separate, pinnate plumes symmetrically arranged on either side of the median line between the notæum and the foot; anus median, posterior, between the two groups of branchial plumes; tentacles short, nearly concealed by the notæum.

Pharyngeal bulb armed with two lateral thickenings at the buccal aperture; radula narrow, its rhachis naked, the innermost, lateral tooth large, bearing a denticulate hook, the outer laterals few, small, with a simple hook; buccal ingluvies connate with the pharyngeal bulb. Glans penis unarmed.

The genus *Corambe* is first mentioned by Bergh in 1869 in a brief footnote in a paper upon the Phyllidiidæ. The description, "a dorid-like mollusk with strong mandibles, with numerous (24) rows of teeth, with four laterals upon either side of a median series," can scarcely be taken as an adequate diagnosis of the genus, since there are neither mandibles nor median teeth present, nor could the form be identified by this statement alone. In 1871, however, the same author published a more extended diagnosis, based upon a study of a single specimen of the genotype, *Corambe sargassicola* Bergh, taken upon drifting seaweed in the Central Atlantic in 42° 50′ N. Lat., and 46° 20′ W. Long. The description is in many details quite inaccurate and incomplete, probably owing to the lack of material. A second species, *Corambe batava,* from the Zuider-Zee, was described by Kerbert in 1886 in a very fragmentary manner. In 1889 H. Fischer described a third species, *Corambe testudinaria* from the Bay of Arcachon, and in 1891 published an excellent anatomical account, which forms the actual basis of our knowledge of the genus. In the opinion of Vayssière (1913), these three species are identical, forming the single species *Corambe sargassicola* Bergh, which is not at all unlikely, though the accurate information respecting the species described by Bergh and by Kerbert, necessary to certainty in this regard, is lacking.

The new species of *Corambe* discussed in the present paper, differs markedly from the ones previously described. It has been taken by the authors in two widely separated localities, Monterey Bay, California, and at Nanaimo, British Columbia. In each instance the habitat is the same: *Membranipora* colonies upon the large kelps and *Zostera,* from which surroundings the minute animal is scarcely distinguishable. Its resemblance to a young colony of the bryozoan of similar size is even more perfect.

The species of the genus at present may be listed as follows:

1. *Corambe sargassicola* Bergh, 1871.
2. *C. batava* Kerbert, 1886.
3. *C. testudinaria* Fischer, 1889.
4. *C. pacifica* MacFarland & O'Donoghue, new species,

in which summary the first three are assumed to be valid and distinct species, in the absence of positive knowledge to the contrary.

Corambe pacifica MacFarland & O'Donoghue, new species.

Animal (Pl. 1, fig. 1) elliptical, flattened, disk-like, slightly arched in the central region of the body, the notæum everywhere extending beyond the foot, its margin wide and thin, with a deep, median, circular notch behind, elsewhere entire.

Foot rounded equally in front and behind, its anterior margin, beneath the head, with a deep, median notch revealing the mouth in the angle.

Head small, covered entirely by the notæum, its angles prolonged into short, blunt tentacles, directed outward and forward, their tips showing beyond the notæum margin, when the animal is crawling freely.

Rhinophores retractile into low, entire, thin-margined sheaths, the blunt, tapering tip of the stalk projecting above an incomplete, inner envelope, to which it is attached in the anterior, median line below, above free, the sheath-like expansion sloping rapidly downward behind to the rear of the stalk, with which it merges. Within this envelope the stalk bears a lower, plate-like expansion on either side, revolute backward, and inserted behind, above the more external sheath; a low, keel-like ridge, or plate, on the median, posterior side of the stalk.

Anal opening posterior in the median line, immediately below the notch of the notæum margin; close to it at its right and slightly above is the single, renal opening, a minute pore. Reproductive openings three, close together, far forward on the right side, between the notæum and the foot.

Branchiæ a series of simple, pinnate plumes, ranging in number in mature individuals from six to 12 or 14 on each side, decreasing in size from behind forward, borne on either side of the anal opening, between the foot and the notæum, and limited to the posterior third of sides of body. A single, median plume is usually situated immediately above the anus. Lamellæ of longest plumes 10 to 20 in number, opposite in arrangement upon sides of horizontally flattened shaft; at the insertion of the branchiæ a series of large, simple, alveolar glands, mostly alternating with the bases of the plumes, and co-extensive with them.

Color of dorsum a pale, translucent gray ground, the central area marked out by the pale, yellow-orange liver showing through the integument. Surrounding this central area is a whitish zone, determined largely by the foot showing through from below. Outside this zone and equal to it in width is the nearly transparent notæum margin. This marginal zone is marked with irregular, continuous and discontinuous lines of clear baryta-yellow, arranged radially. Toward the center of the dorsum these lines become broken up into dots of color, and are more irregularly scattered. These radial lines with their cross connections resemble the walls of the zooecia of *Membranipora* to a very marked extent. Between the superficial, baryta-yellow markings are larger and smaller flecks, in general radial in arrangement, and lying deeper in the integument. These are largest and most numerous in the second zone, and become smaller and more rounded in the central area. The central and major portion of each fleck is terra cotta in color, and is usually edged with an incomplete line of black. Around the rhinophore bases they may form an almost continuous ring, but are usually clearly separate. Scattered small, black flecks may also occur in the median area. In darker specimens the terra cotta spots are larger and more numerous, especially in the median region, their borders deepening to a greenish color, where not black. Foot clear gray, with a narrow, white, marginal line. Rhinophores clear, translucent gray, the sheath either the same or with a few small spots of terra cotta, baryta-yellow, or black.

Radula formula 38-40 x (4-5 + 1 + 0 + 1 + 4-5). Median tooth wanting. First lateral large, compressed, consisting of a slightly curved hook rising from the anterior angle of a large, erect base, the hook bearing three to seven denticles upon its inner margin. Upper posterior angle of the base of the first lateral thickened and pointed, forming a second, minor hook directed backward. Inner face of the base with a low, recurved, wing-like lamina, arising behind and below the lowermost denticles, and curving downward to the insertion of the base. Outer, lateral teeth, usually four, decreasing in size progressively outward, each consisting of a broad, rounded base bearing a slightly curved, simple, pointed hook. Rows of teeth not exactly opposite each other in the lateral halves of the radula.

Pleural ganglia not fused with the cerebral ones, but united to them by short connectives.

Length in life up to 13 mm., width up to 10 mm.

Habitat: Upon brown kelps, mainly *Macrocystis pyrifera* (Turn.) Ag. and *Nereocystis luetkeana* P. & R., and upon *Zostera marina* L., bearing incrustations of *Membranipora villosa* Hincks colonies, upon which the mollusks feed. Monterey Bay, California. Nanaimo, British Columbia.

Holotype: No. 634, Mus. Calif. Acad. Sci., collected May 21, 1928, by F. M. MacFarland, in **Monterey Bay, Pacific Grove, California.** *Paratypes* are deposited in the U. S. National Museum, the British Museum, the Biological Station at Nanaimo, B. C., the Hopkins Marine Station, Stanford University, and in the authors' private collections.

The careful study of *Corambe testudinaria* by H. Fischer (1891) renders unnecessary a detailed account of the anatomy of this new species, save as regards certain features of pronounced difference found by us. Detailed dissections were made and supplemented by serial sections from material imbedded in paraffin and in celloidin and stained in various ways.

Habitat: The animals are seldom found separated from the *Membranipora* colonies, and then probably through accident. They have been seen actively feeding upon the colonies of *Membranipora villosa,* which seem to be their chief food.

One of us (O'Donoghue, 1926) has described in detail the ravages of *Corambe* upon the bryozoan colony. "When young, even less than one mm. long, this mollusk has been seen inside the zooecium, from which it has eaten all the living matter. A more common point of attack, and the only one by larger *Corambe,* is the growing edge of the colony which is either not protected by a chitinous covering, or else by one so thin that it affords no protection. This method of wounding produces a very characteristic indentation of the growing edge. If of short duration, it is surrounded by the growing zooecia, and all that is left of the point of injury is an area looking like a misshapen zooecium. However, if the attack is made at one place by several small *Corambe,* or the animal remains a long time in the same place and grows considerably, the injury will be correspondingly greater and perhaps permanent. So prevalent are these attacks that it is rare to find under natural conditions an uninjured colony of, say, 10 mm. in diameter." But few traces of diatoms in the alimentary canal, such as Fischer cites, have been found, though they may be present at certain times of the year. Since the hard parts of the bryozoan do not appear to be eaten, it is not surprising to find no trace of them. The animals are sluggish, except when removed from the surface of the host, when they tend to move around rather actively, until they find their usual surroundings again.

External characters: The general color of the dorsal aspect is a clear, translucent gray, veined and dotted with pale yellow or greenish yellow. The central area of the notæum is thickly set with light garnet-red or terra cotta spots, located deep below the surface. The edges of these flecks usually appear deeper in color than the center, at times becoming greenish or black. Intermingled with these spots are flecks of black and baryta-yellow. Toward the margins the baryta-yellow flecks tend to unite into irregular, radial lines, sometimes in pairs, but usually single. Occasionally a series of irregular, longitudinal lines is developed in the median region. The foot is of clear gray, with a narrow, white, marginal line. Its central and posterior region is occupied by a vaguely defined, darker, greenish area, due to the denser viscera showing through the integument. The branchial plumes are transparent gray with a few scattered flecks of garnet upon them. The young forms have no color pattern, but are a pale, almost transparent gray, with the black eye spots clearly showing.

Notæum: The notæum is very thick, slightly less so in the median area than at the sides. In general, its surface is smooth, or slightly roughened, the color markings exaggerating the impression of a tuberculate surface. The low, cuboidal epithelium of the dorsal surface secretes a thick, cuticular layer, which shows distinct stratification in sections. Its thickness varies markedly in different specimens, sometimes being merely a moderate layer (Fig. 4), in others presenting a thickness six to 10 times the height of the cells producing it (Fig. 3). Without doubt the dorsal cuticle of the notæum is periodically shed as a continuous sheet, and renewed, lines of cleavage parallel to the surface being shown in sections, and the detached, entire cuticle is frequently found in the aquariums, while animals still covered with the partially free cuticle are not uncommon. This phenomenon was also noted by Fischer (1891) in *C. testudinaria,* and appears to be without a parallel in other nudibranchs. Imbedded in this cuticular layer are abundant, conical, spine-like structures, in sections staining more strongly than the surrounding cuticle, and more resistant than it. These are the products of special, large, epithelial cells, occurring at intervals in the epidermis, each one of which secretes above it this cuticular modification. In those cases in which the general cuticle is but thin, these spines project freely above the surface, giving it a minutely roughened texture. Where the cuticle has become much thickened, two or three such spines may be seen in sections, one above the other, the lowermost and smallest resting upon the cell which has produced the series, the superimposed ones elevated above it in the order of their formation, and being cast off by the successive moultings of the cuticle, probably associated with growth periods (Fig. 3). A similar structure has been described by MacFarland (1918) for the palatal spines of a Tectibranch, *Dolabella agassizii* MacF. Toward the margin of the notæum these spines are increased in number, and are often closely crowded, while toward the central areas they are less numerous. Scattered among the cuticle-secreting cells are numerous, giant, mucous cells, the pear-shaped cell-body lying below the general epithelium and prolonged as a duct to its surface, from whence it is continued by a slender canal through the thickness of the cuticle.

The wide notæum margin conceals the head entirely. The angles of the latter are prolonged into short, blunt tentacles somewhat triangular in form. The tips of these tentacles may project beyond the notæum margin when the animal is crawling freely, or may be entirely concealed. The same is true of the tips of the gills at the posterior end.

The rhinophores (Fig. 2) are retractile within low, entire sheaths. The axis of the rhinophore is prolonged into a tapering, blunt tip, and bears two pairs of revolute lamellæ. The outer pair of these (*o*) are united into a sheath-like structure, fused in front lengthwise to the greater portion of the stalk, being free only at the upper one-fourth, there encircling the rhinophore in a collar-like form, the margins curving downward around to the posterior face of the stalk, where they terminate a short distance apart. Within this outer investment the second pair of laminæ (*i*) are inclosed. Each arises from the side of the stalk as a thin plate curving backward, united below with the stalk, and their free, posterior margins terminate above those of the outer pair. In the median line, behind, a single, thin, keel-like ridge extends from near the tip of the rhinophore downward, dying away as the stalk of the latter enlarges toward the bottom of the inner, lateral pair of lamellæ. Since these laminæ are attached to the stalk of the rhinophore, are retracted with it, and bear the same relation to it as the plates of the common, perfoliate clavus of the nudibranch rhinophore, they cannot be termed sheaths, that designation being restricted to the elevated margin of the opening of the notæum, into which the rhinophore is withdrawn. This misuse of terms is committed by Bergh (1871, 1892), and also by Fischer (1891).

Branchiæ: The branchiæ (Fig. 5) are located at the posterior end of the body, attached to the under surface of the notæum above the foot, and arranged symmetrically in a single, horizontal row on either side of the anus, and usually united above it by a single plume. They vary in number on each side up to 12 or 14 in the largest individuals. They are simply pinnate plumes consisting of a flattened, tapering axis, upon either side of which is borne a series of oppositely arranged, respiratory lamellæ, varying in number up to 20. In the smallest, most anterior gills the plates are reduced to one or two, or the whole organ may be represented by the rhachis alone as a slight projection from the body wall. The branchiæ increase progressively in length and in the number of lamellæ toward the posterior end of the animal, the largest being usually the pair adjacent to the anal opening, or the second or third pair from it. The series extends forward not more than one-third of the length of the foot. In a specimen of 6.8 mm. body length the length of the plumes ranged from 0.25 mm. for the shortest to 0.95 mm. for the longest, which were the third pair from the posterior end of the series. In these last the lamellæ reached 20 in number. In *Corambe testudinaria,* as described by Fischer, the number of branchiæ is fewer, four to seven, and the number of lamellæ on each side of the rhachis is much fewer (up to four). The lamellæ are also arranged alternately upon the sides of the stalk, whereas in the present species they are opposite. The most anterior gill is stated by Fischer to be located nearly midway of the body length, which is decidedly farther forward than in our species, despite the greater number of plumes present in the latter. The tips of the posterior gills are visible at times beyond the notæum margin, but ordinarily they are concealed, save below the median notch. A kind of respiratory movement has been noted in animals under observation in aquariums. The posterior end of the mantle is raised well away from the substratum and the gills protruded to their fullest extent at irregular intervals. This reaction occurs more frequently when the water has been standing for some time. Movement of minute particles suspended in the water indicate a strong current laterally toward the sides of the body, beneath the no-

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tæum margin, and backward past the gills and through the elevated, median, dorsal notæum notch.

Bergh (1871) describes and figures in his Figs. 23 and 24 of Plate XI and Fig. 1 of Plate XII for *Corambe sargassicola* Bgh., an entirely different type of gill, made up on either side of a group of thin, horizontal lamellæ, 13 to 15 in number, obscurely arranged in an upper, wider and longer, and a lower, narrower and shorter set. No intimation of a pinnate arrangement is given, though later (1892, p. 165-166) he indicates this as a generic character, evidently following the more reliable observations of Fischer.

Just above the line of insertion of the branchiæ is a series of simple, alveolar glands, most of which alternate in position with the insertion of the gill stalks (Fig. 5, *g*). They are spherical in form, and are composed of large, clear, pyramidal cells extending from the basement membrane almost to the opening of the gland, leaving but a small lumen (Fig. 6). Each gland opens to the external surface through a very short and narrow duct near the base of the gill. No trace of the single, branched, median gland, described and illustrated by Fischer, is here present, though it is probably represented by this series of simple glands coextensive with the branchial insertion. When floating at the surface, the animal produces a very abundant, mucous secretion. Structurally, these glands appear to be of a mucous nature, but whether they contribute largely to this film of secretion or not has not been determined. As a rule such secretions are produced by the pedal glands to aid in adhesion or floating.

Alimentary tract. The mouth is revealed in ventral view by the triangular notch in the anterior margin of the foot. The external lips are rather thick and glandular, and lead into a short, oral tube, the cuticle of which is but slightly thickened. The inner lips, surrounding the opening into the cavity of the pharyngeal bulb, are but slightly developed and show a moderate thickening of the cuticle on the sides, and ventrally extending into the bulb. No clearly differentiated, lateral plates, such as are described by Bergh (1892), can be made out. The pharyngeal bulb (Pl. 3, fig. 11) bears a thick-walled, muscular crop (*c*) above, such as is characteristic for the Goniodoridæ. The posterior part of the radula sack forms a prominent median ridge (*r. s.*) upon the hinder face of the bulb. The radula is very small, attaining a length of but 0.25 mm. in a large specimen. Its dorsal surface is deeply grooved longitudinally in the median line. There are from 38 to 40 transverse rows of teeth present in large specimens. The half rows are not exactly opposite each other in the two sides of the radula, which, together with the minute size of the elements, renders the count of the rows difficult and often uncertain. The dental formula for the older part of the radula is $4+1+0+1+4$, in the younger portion, in the sheath, the laterals are frequently increased by one, giving a formula of $5+1+0+1+5$. The rhachis is very narrow and destitute of median teeth, the innermost lateral (Figs. 15, 16) is relatively large and quite different from the remaining ones. In form it somewhat resembles that of *Acanthodoris*. From a roughly quadrilateral, compressed, basal portion a strong, somewhat curved hook arises at the anterior, upper angle. The hook is nearly equal to the base in height, is directed obliquely inward and backward, and is terminated by a blunt point. On the lower half of its inner margin is borne a series of four to seven pointed denticles. From the upper half of the inner face of the base a narrow, recurved, wing-like extension (Fig. 16, *w*) projects downward, curving beneath the base as a ridge across to the opposite side. The posterior margin of the base is thickened, and its outer, upper angle (Fig. 15, *a*) forms a low, compressed, triangular hook, pointed backward. From the oldest, most anterior teeth of the radula backward, there is a steady increase in the dimensions of the teeth, but the relative proportions remain about the same. In an average first lateral tooth the total height from insertion line on the basement membrane to the tip of the hook is 0.09 mm., while the height of the hook itself is 0.04 mm., and the greatest length of the base is 0.05 mm. The outer, lateral teeth, four to five in number (Figs. 12, 13, 14), consist of a rounded base, which is prolonged obliquely upward and backward as a simple, tapering, pointed hook, triangular in outline and rounded above, and below supported by a lamina, which dies away before the tip is reached. The outer laterals tend progressively to be more and more compressed, and the fifth, when present, is usually reduced to a small, flattened plate. In length in an average row the second lateral measures 0.03 mm., the third 0.026 mm., the fourth 0.025 mm., the fifth 0.022 mm., and the outermost 0.012 mm.

The single pair of salivary glands form a compactly rounded mass lying upon the upper face of the pharyngeal bulb, at either side of the beginning of the œsophagus. They are alveolar in type, but slightly branched, and are composed of large cells, which leave but a small, irregular lumen, leading by a rather wide duct into the cavity of the bulb, lateral to the radula. Their staining character and general cytological structure indicate that the secretion is predominatingly mucous in nature.

The strikingly thin-walled œsophagus, lined with ciliated, columnar epithelium throughout its extent, leads directly downward and backward to the anterior end of the stomach. Into it open at once the very wide, biliary passages of the liver. These are five in number, an anterior and a posterior lateral pair, and a single, posterior, median one, which bifurcates into the posterior lobe of the liver. This organ presents a ventral, median, undivided portion from which project five lobes, an anterior and posterior one on either side, and a single, median, posterior one, which last shows a median, posterior notch externally, corresponding with the subdivision of its inner cavity. The right, anterior, paired lobe is quite small, its space being largely occupied by the anterior, genital complex, against the posterior face of which it extends as a narrow strip. Its fellow on the opposite side is large, nearly equalling the whole of the anterior genital mass in size. The posterior, lateral pair is likewise large and well developed. The walls of the liver are composed of a single layer of cuboidal, granular cells lining the roomy lumen of the gland and the numerous short and wide sacculations opening into it. This cavity is strikingly large, with relatively simple ramifications, and communicates widely with the cavity of the stomach, so freely in fact, that it is difficult to fix the boundaries of the anterior portion of the stomach, its contents passing readily into the cavity of the liver, where the main, digestive changes probably take place. What gives solidity and compactness of appearance externally to the organ, in fact, is the thick layer of the ovotestis, which invests the dorsal and lateral faces of the liver completely. Divested of this covering, the liver would present five, slightly ramified, broad and irregular tubes, resembling more the branched arrangement of the Aeolids rather than the compact liver of the Dorids. The median, dorsal surface of the ovotestis-liver mass is occupied by a wide depression passing its full length, in which are contained the stomach and intestine, the heart and pericardium, and the kidney. No "biliary cyst" can be distinguished.

Between the adjacent liver lobes well developed, muscular septa unite the notæum and the foot and extend from the lateral body wall inward as far as the cleft between the lobes permits. Similar incomplete partitions are also found extending obliquely inward between the sides of the pharyngeal bulb and the liver on the left, and the anterior, genital complex on the right.

Dorsally, the stomach is clearly marked off, appearing as a retort-shaped sack, broadest at the left of the median line and narrowing into the rather slender intestine as it curves to the right, thence passing straight backward to the anus in the posterior, median line. Its wall is made up of cuboidal, ciliated cells, surrounded by a layer of circular muscle fibres and connective tissue. The epithelium of the intestine is the same, but its layer of muscle is very thin, and at times apparently absent. At the anus, however, the circular muscle is thickened into a well-developed sphincter, as noted by Fischer (1891).

The anal opening is situated in the median line of the body at the posterior end, immediately below the notch in the notæum. Close by, at the right and slightly above it, is the minute opening of the renal organ. Neither structure is conspicuous externally.

Nervous System: Close behind the salivary glands is the central, nervous system. The ellipsoidal, cerebral ganglia (Pls. 2, 3, figs. 8, 10, *c*), the largest of the group, are in contact along their inner faces, but are not fused, being connected by a distinct, broad, cerebral commissure above the œsophagus. Below the latter they are also connected by a delicate, sub-œsophageal commissure, recognizable in sections. From the anterior portion of the cerebral ganglia are given off the nerves to the rhinophores and the eyes, each bearing an elliptical ganglion close to its origin (Figs. 8, 10, *c.1, c.2*), and three other pairs (Figs. 8, 10, *c.3, c.4, c.5*) to the bûccal tentacles, and the mouth and head region. From the fifth of these, as a basal branch, or very close to its origin, is given off the cerebro-buccal connective, which passes beneath the œsophagus to the buccal ganglion (Fig. 10 *c.b.c, b*). The optic nerves are rather short, the eyes small and deeply buried below the integument, behind and medial to the rhinophores. The nearly spherical statocysts lie close in the outer angle between the cerebral and pedal ganglia. They measure ca. 0.03 mm. in diameter, and contain many ellipsoidal statoliths, 0.002 mm. by 0.003 mm. in diameter. Lateral to the œsophagus are the spherical, pedal ganglia (Figs. 8, 9, 10, *p*), second in size to the cerebral pair, and joined to them by short, cerebro-pedal connectives (Fig. 10, *c. p. c*). The pedal ganglia are united below the œsophagus by the usual, well developed, pedal commissure (Fig. 9, *p. c*), and also by a distinct, more slender, parapedal commissure (Fig. 9, *pp. c*) separated some distance from the main, pedal one. These commissures are very much shorter than those figured by Fischer (1891) for *C. testudinaria.* From the pedal ganglia are given off the stout, anterior, median, and posterior pedal nerves, distributed to the corresponding regions of the foot, the latter two either arising separately, or from a common stalk, which soon bifurcates.

Immediately behind the cerebral ganglia and slightly below them are the distinct pleural ganglia (Figs. 8, 9, 10), united with the cerebral and pedal ganglia by the cerebro-pleural and pleuro-pedal connectives respectively (Fig. 10, *c-pl. c, pl.-p. c*). As a rule in the Nudibranchiata the pleural ganglia are fused more or less completely with the cerebral pair, there being varying degrees to which this fusion is indicated externally. In *Corambe testudinaria* Fischer (1891), figures (l. c. Figs. 20, 21, 22) the cerebral and pleural (pleuro-palleal) ganglia as fused in a common, supra-œsophageal complex, as indicated by an external, transverse groove, and by the cerebro-pedal and pleuro-pedal connectives, arising from the fused, ganglionic mass. In the present species, however, the separation of the pleural from the cerebral ganglia is equally clear and unmistakable. This difference in such fundamental structures in two allied species of the same genus is very remarkable, and appears without a parallel, so far as we are aware, in the Nudibranch literature.

Uniting the pleural ganglia below the œsophagus is the visceral loop (Figs. 8, 9, *v. c*), bearing a ganglionic enlargement a short distance from its right end, which gives rise to a single nerve, dividing into a stronger, right and a more slender, left branch. The left one bears two small ganglia at a short interval apart, from each of which fine nerves arise and pass backward to the viscera. The right nerve breaks up into a number of fine rami, which apparently pass mainly to the reproductive organs. From the pleural ganglia themselves anterior and posterior nerves arise. On the left side the posterior, pleural nerve is usually single, on the right it arises as either two, separate roots (Figs. 8, 10, *pl. 2, pl. 2a, pl. 2b*), or as a single one (Fig. 9). The one on the right side sends an anastomosing branch at once to the anterior, pleural nerve (Figs. 8, 9, *pl. 1*). The anterior pleural nerve arises on the left side from the cerebro-pleural connective (Fig. 10, *pl 1*), close to its union with the pleural ganglion usually, but receiving fibres from both cerebral and pleural ganglia. In some cases, as in Fig. 9, it may be given off from the ganglion directly. It divides at once into two branches which pass to the dorsum.

Excretory System: The kidney consists of a roomy, thin-walled sack, mainly lying below the heart, and above the ovo-testis and liver. The semi-diagrammatic Fig. 17 of Plate 3 represents the reno-pericardial system in outline, in its relation to the posterior portion of the body, as seen in longitudinal section. In its maximum width it extends across the full diameter of the visceral cavity. Anteriorly it narrows abruptly to about one-fourth of its greatest width, and is prolonged forward, slightly to the left of the median line, to a point approximately opposite the middle of the anterior, genital complex, where it terminates in an irregular, blunt tip. Below, in the region of its greatest width, it sends a keel-like prolongation downward (Fig. 17, *v*) into the dorsal, median furrow of the ovo-testis. The surface of its wall is simple and smooth, save for a small number of low, lateral and dorsal folds, which appear in front of the cardiac region. Its lining epithelium is made up of clear, cuboidal to columnar cells with basal nuclei. The renal syrinx (Fig. 17, *s*) is relatively large and is cylindrical in form. It opens through the pericardial floor at the right of the median plane, below the ventricle of the heart, is directed downward, backward, and to the right, narrowing into the slender, reno-pericardial tube (Fig. 17, *r.p. t*), which recurves in a loop at the right of the median, ventral lobe of the kidney to pass forward in contact with its right ventral wall, opening into its anterior prolongation well in front of the pericardium, and a short distance behind the pharyngeal bulb. The syrinx is lined with clear, cuboidal cells bearing very long cilia. Posteriorly, the wider portion of the kidney-sack narrows abruptly into a short, narrow, renal tube which opens externally (Fig. 17, *r*) above, and slightly to the right of the anus (Fig. 17, *a*; Fig. 5). The kidney differs from that of *C. testudinaria* as described by Fischer (1891), chiefly in its somewhat different outline, the local folds in the renal epithelium, and in the ventro-anterior, rather than anterior opening of the reno-pericardial tube into the renal sack.

Reproductive System: The ovotestis, in a mature individual, forms a thick covering completely concealing the dorsal and lateral surfaces of the liver, its main lobes corresponding in number and outline to those of the latter organ. From each lobe a branch of the hermaphroditic duct arises by the union of several tributaries from the follicles of the ovotestis. These unite dorsally into the main duct near the median line, which passes forward to the inner face of the anterior, genital complex, made up of the nidamental or mucus, and albumen glands and the related ducts. This complex occupies the right, anterior quadrant of the body cavity. It is trapeziform in shape, as seen from above; its outer, longer face is convex, conforming to the contour of the body wall; its inner face, one-half as long, is flattened against the left, anterior lobe of the liver-ovotestis below; its posterior face is directed obliquely outward and backward in close contact with the almost rudimentary right, anterior lobe of the liver-ovotestis; while the anterior face slopes obliquely forward and outward in contact with the vaginal duct and penis. Upon the anterior, inner face the slender, hermaphroditic duct dilates into the ellipsoidal hermaphroditic ampulla, from the upper extremity of which a short duct continues into the cavity of the albumen gland, giving off at right angles the vas deferens. The latter has a thick, glandular wall, loops downward around the hermaphroditic ampulla upon the median face of the complex to its dorsal border, thence describes a free loop obliquely backward in front of the stomach, returning in a series of close turns, caused by the varying tension of the retractor muscle of the penis, which is inserted upon it immediately at the right of the central nervous system. The penis extends obliquely forward close to the right of the pharyngeal bulb in front of and parallel with the vaginal duct and the duct of the nidamental-albumen gland complex, to its external opening far forward on the right side of the body near the head. In its retracted condition this organ is made up of an eversible preputium, a rather thin-walled, muscular sack, at the bottom of which arises the glans penis. In its everted position, as shown in Fig. 7, *p* of Plate 2, it extends from the external opening as a cylindrical structure, terminated by the bluntly conical glans (*g*), and usually showing a few slight, circular rugæ, while near the base of the glans proper is frequently found a more prominent ring-like thickening. The organ is entirely unarmed.

Immediately behind the external opening of the penis sack is the vaginal orifice, and slightly below it is that of the duct from the accessory glands. The vagina (Fig. 7, *v*) passes inward along the upper and medial border of the genital mass, curves outward and describes a loop upon its upper, posterior face, recurving to the median plane, where it opens into the thin-walled, ovoid spermatotheca (Fig 7, *s*). Near its entrance the much more slender, vaginal duct (Fig. 7, *vag.* d) emerges, passes forward in a short, straight course, receives the duct of the quite small, ovoid spermatocyst (Fig. 7 *s. c*), and passes into the interior of the accessory gland complex, opening into the irregular lumen of the albumen gland close to the entrance of the oviduct. The cavity of the nidamental gland is relatively roomy and simple, is connected by a short, ciliated passage with the albumen gland lumen, and opens externally by a wide, short duct, which parallels the penis and vagina, its separate opening being slightly below them. Fischer (1891) was unable to find a spermatocyst in *C. testu-*

dinaria, but, with this exception, our results as to the general organization of the reproductive system are in agreement. The nidosomes are common upon the *Membranipora* colonies and the adjacent surface of the kelp. Each consists of a narrow, somewhat flattened band coiled in a close spiral of from one to three turns, attached by one margin. Each nidosome contains from 500 to 1500 capsules, and each capsule contains but a single egg. The larger the animal the more capsules there are in the nidosome. It is not known whether one animal can lay more than one nidosome at a time or in a season.

Blood gland: Immediately behind the pharyngeal bulb, in contact with the central, nervous system, is located the blood gland, resting on the œsophagus. It is discoidal, nearly circular in outline, with quite fine lobulations.

The anatomy of the heart and the vascular system does not appear to differ materially from that described for *Corambe testudinaria* Fischer by that author, and hence need not be repeated here.

The following comparative tabulation indicates the most significant differences between our species and that of Fischer:

Corambe testudinaria Fischer	**Corambe pacifica** MacF. & O'D.
Maximum size 4 mm. long, 3.5 mm. wide.	Maximum size 13.0 mm. long, 10.0 mm. wide.
Branchiæ 4 to 7 on each side, the most anterior situated midway of body length in large specimen.	Branchiæ up to 14 on each side, the most anterior situated at 1/3 of body length from posterior end.
Branchial lamellæ few, up to 4 in number, alternate on shaft of gill.	Branchial lamellæ up to 20 in number, opposite on shaft of gill.
A single, posterior, branched, median gland opening externally above renal pore.	A series of simple, alveolar glands at bases of gill plumes.
Radula 30-35 × (4 + 1 + 0 + 1 + 4)	Radula 35-40 × (4−5 + 1 + 0 + 1 + 4−5)
A median, cuticular plate in front of radula.	Absent. General cuticular thickening only.
Liver tri-lobed.	Liver five-lobed.
Cerebral and pleural ganglia fused.	Cerebral and pleural ganglia separate.
No spermatocyst.	Spermatocyst present.

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January 29, 1929

Plate 1

Fig. 1. Dorsal view of large, living *Corambe pacifica* MacF. & O'D. ×5.

Fig. 2. Rhinophore from behind. *o*, outer lamina, *i*, inner lamina. ×35.

Fig. 3. Transverse section of epidermis and cuticle of notæum. The cuboidal epithelium below secretes a thick cuticle, which is periodically shed, becoming split off by a cleft parallel to the epithelial layer. Large, special cells of the epithelium produce blunt, conical spines in succession, three generations of such spines being seen in the figure. ×800.

Fig. 4. Transverse section of epithelium of notæum from near the margin. The cuticle is much thinner than in Fig. 3, it having been shed more recently. Three cuticular spines and a large, unicellular gland are shown. ×800.

Fig. 5. Posterior end of animal, as seen from the ventral aspect. The foot has been removed by a cut through the body wall above it, along the curved lines uniting *a—a*. The branchial plumes are seen in place, the ventral surface of the notæum margin, with the median, posterior notch, lying behind them. A single, median plume, just above the anal opening, and ten lateral ones on either side are present. At the bases of the branchiæ the series of alveolar glands, *g*, shows through the integument. The intestine and renal sack open externally near the median line. ×28.

Fig. 6. Section of alveolar gland, situated at the base of the branchial plumes. ×590.

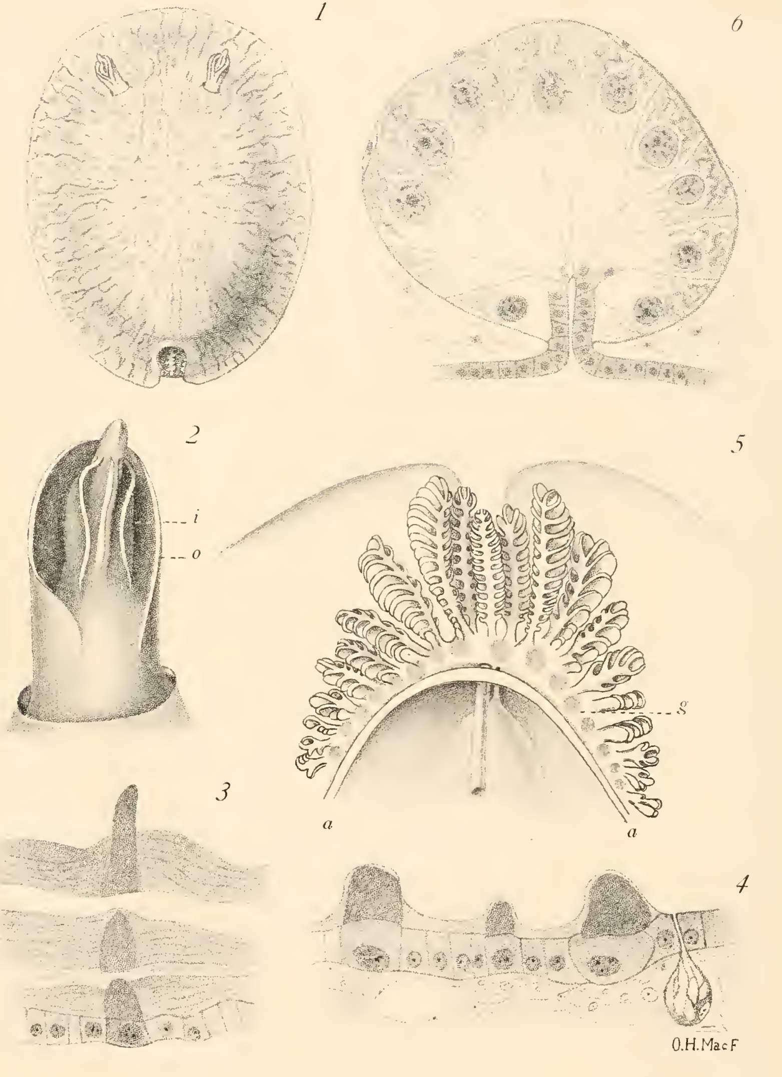
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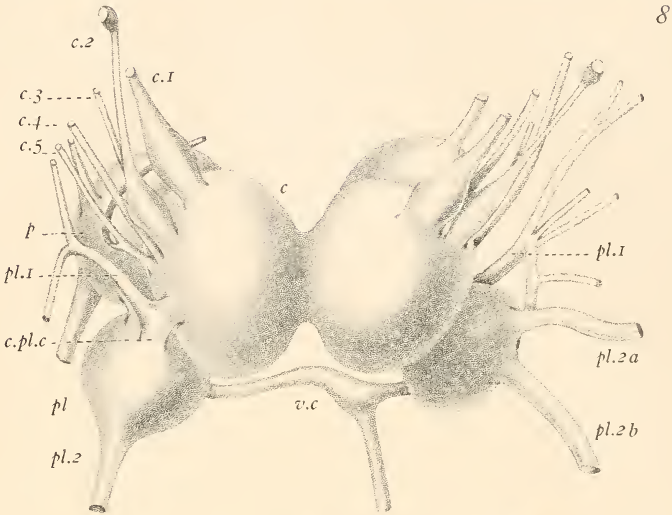
PLATE 2

Fig. 7. Portion of Reproductive System. *v. d*, Distal part of vas deferens, extending into the everted preputium, through the wall of which its terminal portion is faintly seen. The everted preputium, tipped by the conical glans, *g*, forms the penis, *p*. Close to the right of the base of the penis is the external opening of the vagina, *v*, which leads inward to the spermatotheca, *s*; the short and narrow vaginal duct, *vag. d*, continues on into the accessory gland complex, and receives the duct of the spermatocyst, *s. c*, close to its entrance. ×16.

Fig. 8. Central Nervous System in dorsal view. *c*, Cerebral ganglia; *c. 1*, rhinophore ganglion and nerve; *c. 2*, optic ganglion, optic nerve, and eye; *c. 3*, *c. 4*, *c. 5*, nerves to buccal tentacles and mouth region; *p*, pedal ganglia; *pl*, pleural ganglia, distinctly separate from the cerebral pair, to which they are joined by the cerebro-pleural connective, *c-pl. c;* *pl. 1*, first, pleural nerve, *pl. 2*, second, pleural nerve of left side; *pl. 2a*, *pl. 2b*, rami of second, pleural nerve of right side; *v. c.*, visceral commissure, uniting the pleural ganglia below the œsophagus. ×122.

Fig. 9. Postero-ventral view of Central Nervous System, the severed œsophagus, *o*, being left in place. *p. c*, pedal commissure, *pp. c*, parapedal commissure, the other abbreviations as in Fig. 8. In this dissection the first, pleural nerve of the left side, *pl. 1*, arises directly from the ganglion, and not from the cerebro-pleural connective, as in Fig. 8, while on the right side the second, pleural nerve arises from a single root, dividing at once into *pl. 2a*, and *pl. 2b*, with anastomosing branches to *pl. 1*, as in Fig. 8. ×122.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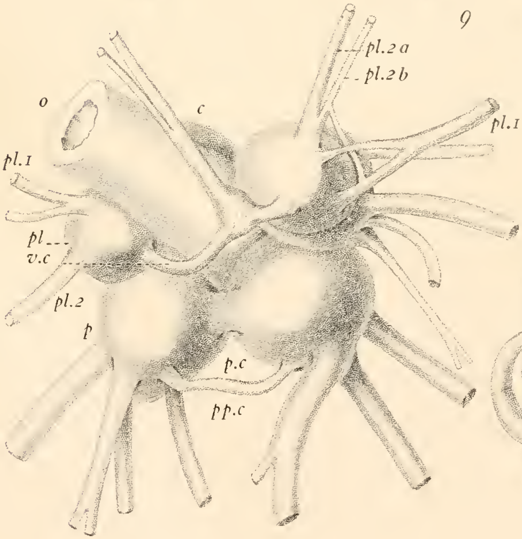
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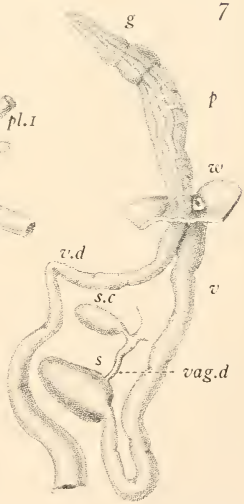
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O.H.MacF

PLATE 3

Fig. 10. Central Nervous System from the left side. *b*, Buccal ganglia; *c-b. c*, cerebro-buccal connective; *c-p. c*, cerebro-pedal connective; *c-pl. c*, cerebro-pleural connective; *pl-p. c*, pleuro-pedal connective. Other abbreviations as in Figs. 8 and 9. × 122.

Fig. 11. Pharyngeal bulb in side view. *m*, mouth; *o*, œsophagus; *c*, muscular crop; *r. s*, radula sack. ×24.

Fig. 12. Third, lateral tooth from above. ×580.

Fig. 13. Second, lateral tooth from below. ×580.

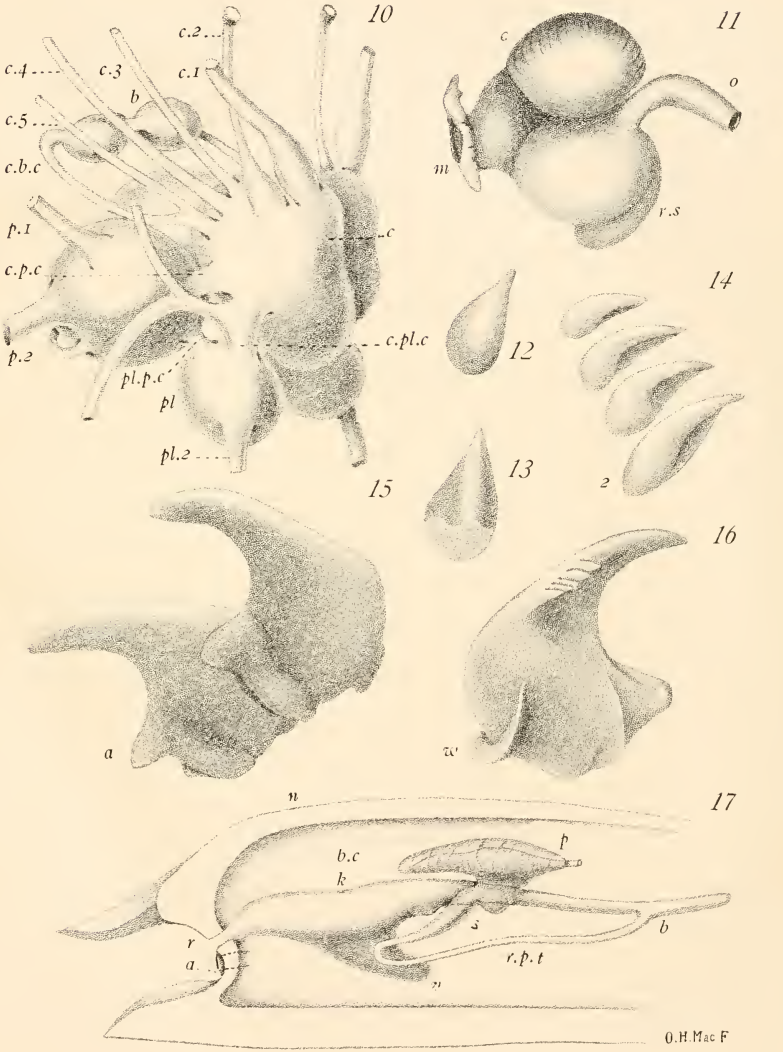
Fig. 13. Second, lateral tooth from below. ×580.

Fig. 14. Second (*2*) to fifth, lateral teeth of radula, obliquely from above. ×580.

Fig. 15. Outer faces of first, lateral teeth of two, successive rows of radula. *a*, Small hook at upper, posterior angle of base. ×580.

Fig. 16. Inner face of first, lateral tooth of radula. *w*, winglike, basal ridge. ×580.

Fig. 17. Diagram of renal organ in its relation to the pericardium, as seen in longitudinal, perspective view. *n*, notæum, cut lengthwise in the median line, through the posterior, median notch on the left; *b. c*, body cavity; *a*, anus; *p*, pericardium, containing the heart; *s*, renal syrinx, opening into the pericardium below the ventricle of the heart, and narrowing distally into the reno-pericardial tube, *r.p.t*, which loops forward to open into the anterior prolongation of the kidney sack, *k*, at *b*; *v*, median, ventral extension of kidney sack; *r*, external, renal pore.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II

A NEW BIRD FAMILY (GEOSPIZIDÆ) FROM THE GALAPAGOS ISLANDS

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The expedition that was sent by the California Academy of Sciences to the Galapagos Islands during 1905 and 1906, secured a collection of birds numbering over 8000 specimens. Gifford (1913) reported upon the species (mostly water birds) from the Columbiformes to the Pelecaniformes (as entered in Sharpe's "Hand-List of Birds"), while Loomis (1918) covered the Tubinares of the expedition in his "Review of the albatrosses, petrels, and diving petrels." The remainder of the collection (nearly 6000 skins), comprising all of the land birds except the one species of pigeon, remained untouched until the middle of 1927, when I began their study. A large part of the land-bird population of the Galapagos is comprised in the "ground finches" of the genera *Geospiza, Cactospiza,* and *Camarhynchus* (with which must be included *Pinaroloxias,* of Cocos Island), and the "creepers" *(Certhidea),* and of these there are more than 4000 specimens at hand. A preliminary survey of the collection sufficed to show that the extensive series of specimens available would in many cases shed new light upon unsettled questions, and would probably necessitate the description of some new forms. It became evident, too, that there were specimens in the collection representing undescribed species that were of interest and importance beyond that attaching to mere "newness" alone. The specimens referred to are unfortunately few in number, comprising four skins representing three different forms, but they are all so trenchantly different from any bird previously discovered upon the Galapagos that their peculiar features may be discussed without considering the possibility of their representing some previously unknown phase of an already described species.

As regards most of the slightly differentiated and hitherto unrecognized island races that for one reason or another it may seem desirable to distinguish by name, the publication of their descriptions can await completion of the entire study. But the appearance of the exceptional birds above referred to suggests some questions that it seems to me well to have stated at once, for discussion, and, on my part, for consequent correction if I have read my facts wrongly.

The two most conspicuous groups of Galapagos land birds, those most abundant in species and individuals, have of late years been generally referred to two continental families. The so-called "ground finches," referred to one genus *(Geospiza)* or to several, according to the views of different students, are regarded (and always have been, heretofore) as belonging to the Fringillidæ (finches), as, curiously enough, has been also the Cocos Island *Pinaroloxias inornata*. The "creepers" *(Certhidea)*, after tentative assignment to the Fringillidæ and Cœrebidæ, have lately been regarded as belonging with the Mniotiltidæ (American wood warblers), largely as the result of studies by Lucas (1894) and Ridgway (1902).

My own conclusions are that the "ground finches" of the Galapagos Islands and Cocos Island *(Geospiza,* etc.) are *not* of the Fringillidæ, that the "creepers" *(Certhidea)* are *not* of the Mniotiltidæ, but that these two groups are very closely related to each other (far more nearly than either is to any continental family), and that the two together should be regarded as forming one family, a family that is confined to the Galapagos Archipelago and Cocos Island. This family will assume the name Geospizidæ, after *Geospiza* (Gould, 1837, p. 5), the first genus described in these groups.

This opinion is contrary to most of those previously held by others, but the facts now available all point so unreservedly in one direction that I feel no hesitation in arriving at the conclusion expressed. The characters of the several newly discovered forms that are here given names supply so unequivocally just the evidence needed to corroborate certain tentative conclusions that can be arrived at from many features found in common among the diverse species of this group, as to make the joining of these species under one family name a course that it seems to me is well-nigh inevitable.

The family Geospizidæ can not be defined to entire satisfaction at present, but the group may be roughly characterized, on the basis of external features, as follows: An assemblage of Passerine forms of small and medium size (wing 48.0 to 95.0 mm.). Wing rather short and rounded; tail rounded, much shorter than wing. Tarsus and toes long, outstretched feet extending beyond tip of tail. Rictal bristles obsolete. Bill extremely variable in relative length, depth, and width. Feathers on lower back and rump long, dense, and fluffy. Coloration unlike in adult male and female (except in *Cactospiza* and some forms of *Certhidea),* but with great variability on different islands in the number of males of any given form that ever attain "adult" plumage. Color of bill varies seasonally and with age, being black or dusky in adults of both sexes during the breeding season, yellowish or otherwise light colored in adults at other seasons and in the young. Confined to the Galapagos Islands and Cocos Island.

As a necessary preliminary to further discussion, names may here be given to the several newly discovered species to which reference is made. First, it will be seen that I am reviving here the name *Cactospiza,* proposed by Ridgway (1896, p. 546) as a subgenus (type, *Cactornis pallida* Sclater & Salvin), but, as it seems to me, deserving of full generic recognition. The species of *Cactospiza* are distinguished by relatively long, slender bill, with the line of the gonys slightly convex. In the slender-billed species of *Geospiza* the line of the gonys is straight or slightly concave. *Cactospiza* is further distinguished by having no black in the plumage in any stage, and in that the sexes are alike in every respect. In the other genera of Geospizidæ the sexes are unlike in every case except in some forms of *Certhidea.* The genus *Cactospiza* will include *pallida* in its several subspecific forms, *heliobates,* and *giffordi.*

Intergradation between *Certhidea* and *Cactospiza* is definitely shown in *Cactospiza giffordi,* but *Cactospiza* can not be said to occupy middle ground between *Certhidea* and *Camarhynchus.* To place the species *pallida, heliobates,* and *giffordi* in the genus *Camarhynchus* would, therefore, in the light of their recognized leaning toward *Certhidea,* give a false idea of relationships, an impression that can be avoided by the generic segregation of these several forms.

Cactospiza giffordi*, new species

Type: Male adult, No. 7522, Mus. Calif. Acad. Sci., collected by E. W. Gifford (orig. No. 1900), January 18, 1906, on **Indefatigable Island, Galapagos Archipelago.**

Characters: Evidently nearly related to the *pallida-heliobates* group, but much smaller and with more slender bill than any other described form in that group.

Description of type and only known specimen: In rather worn plumage. Above brownish, about as in the darker examples of *pallida,* with an olivaceous tinge. Top of head slightly darker than dorsum. A poorly defined superciliary stripe of yellowish from nostril to posterior corner of eye. Sides of head dirty brownish; a poorly defined grayish spot on lower eyelid. Remiges and rectrices dusky, with narrow edgings of greenish olive; under wing coverts strongly tinged with yellow. Under parts of body and lower tail coverts plain, unstreaked; whitish, strongly tinged with yellow. Sides of breast and flanks grayish brown. On chin and throat irregular flecks of the tawny color characteristic of the throat color in species of *Certhidea.* Bill black; feet dusky. "Testicles very large" (collector's notation on label). For measurements see table, page 42.

*Named for Edward Winslow Gifford, Curator of the Anthropological Museum, University of California, who did a large proportion of the ornithological field work upon the California Academy of Sciences expedition of 1905-1906 to the Galapagos Islands, and who has published reports upon some of the birds collected.

Camarhynchus conjunctus, new species

Type: Male adult, No. 7713, Mus. Calif. Acad. Sci., collected by R. H. Beck, February 28, 1906, on **Charles Island, Galapagos Archipelago.**

Characters: Intermediate in certain outstanding features between *Camarhynchus* and *Certhidea.* In measurements and in bulk lies between the maximum reached in *Certhidea* and the minimum in other species of *Camarhynchus.* The bill in particular is intermediate in shape and size between those of typical *Certhidea* and typical *Camarhynchus.*

Description of type: In fresh, unworn plumage. Upper parts generally dull olive green, feathers of pileum with dusky centers, giving a blackish appearance to top of head. Sides of head like back; eyelids and faint superciliary line pale yellowish. Remiges and rectrices dusky, edged with olivaceous. Greater and middle wing coverts like back, narrowly edged with yellowish, producing two poorly defined wing bars. Below greenish yellow, paler than back. Sides of breast and flanks, and lower tail coverts, tinged with brownish; middle of belly pale yellowish. Chin and throat indistinctly marked with tawny of the same shade as is characteristic of the throat patch in species of *Certhidea.* Feathers of throat and upper breast black-centered, producing a streaked appearance, the general effect of which is of poorly defined black lines surrounding a rather nebulous tawny throat patch. "Bill black; legs dark brown; testes large" (collector's notation on label).

A second specimen, also an adult male, collected by Beck on the same day, is in rather more worn plumage. Color of upper parts is about as in the type, but below it is paler colored, more whitish and with less of the greenish hue. The black streaks on the breast are obscurely indicated, and the tawny on the throat is washed out and but faintly discernible. The rufous is more widespread than on the type, though, spreading to the sides of the head and invading even the superciliary line. "Bill black; iris dark brown; legs dark brown; testes large." For measurements see table, page 42.

Camarhynchus aureus, new species

Type: Male adult, No. 8121, Mus. Calif. Acad. Sci., collected by E. W. Gifford (orig. No. 1944), January 25, 1906, on **Chatham Island, Galapagos Archipelago.**

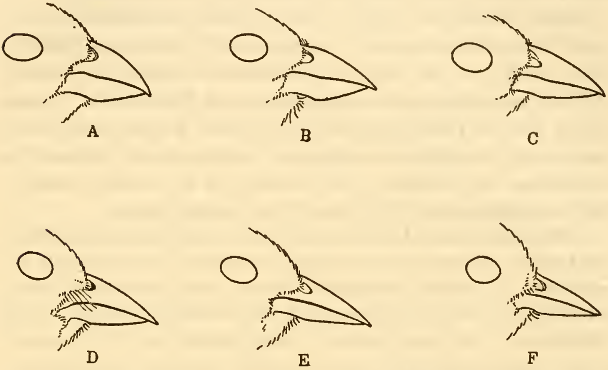
Characters: Generally similar to *Camarhynchus conjunctus* but with slightly heavier bill and more uniform coloration.

Description of type and only known specimen: In rather worn plumage. Upper parts faded, but evidently originally dull olive green. Remiges and rectrices dusky, narrowly edged with olivaceous. Closed wings, including coverts, uniform with back. There are faint indications of light tips to the greater and middle wing coverts, and in fresh plumage there may have been discernible wing bars. Below, from bill to and including lower tail coverts, almost uniformly pale yellow, broken only by a slightly mottled appearance on the breast, where the blackish bases of the feathers show through, and with sides of breast and flanks slightly darker. The yellow of the under surface spreads over the sides of neck and face, over cheeks and ear coverts, to meet a broad yellow superciliary line that extends from bill and forehead back to a point well behind the eye. Bill blackish, with edges of upper and tip of lower mandible slightly paler. Feet and legs blackish. For measurements see table, page 42.

These two new forms from Charles and Chatham islands, *conjunctus* and *aureus,* appear to be closely related, and it might be that adequate series of the two would show plumage variation that would bring them even closer together than is indicated by the scanty material now available. The differences apparent in the skins at hand, however, especially as two rather widely separated islands are represented, are such as to justify the present separation of the two forms.

In these two puzzling species *(conjunctus* and *aureus)* resemblance to *Certhidea* lies in general size and form and in certain peculiarities of markings. Resemblance to *Camarhynchus* appears in the more finch-like bill and in general coloration, which in *conjunctus* and *aureus* is very close to the unstreaked "immature" plumage of *Camarhynchus prosthemelas.* There may be significance in the fact that *C. prosthemelas* *salvini* from Chatham Island is strongly tinged with yellow, just as is the one specimen of *C. aureus* from that island.

It is a debatable point as to whether *conjunctus* and *aureus* should not be segregated together in a separate genus. Such a genus would have to be based upon the combination of certain characters, some of which in other species occur in



Drawing by Mrs. Frieda Abernathy

Species of *Camarhynchus* and *Certhidea* showing intergradation in bill structure between the two genera. Slightly larger than natural size.

A. *Camarhynchus prosthemelas prosthemelas* (No. 7756).
B. *Camarhynchus aureus* (No. 8121).
C. *Camarhynchus conjunctus* (No. 7713).
D. *Certhidea ridgwayi* ? (No. 4862).
E. *Certhidea ridgwayi* (No. 4643).
F. *Certhidea olivacea* (No. 4538).

Camarhynchus, some in *Certhidea,* and the genera already described in the Geospizidæ are so nearly arbitrary in their nature that it seems to me undesirable to add another genus of uncertain definition.

In Gould's (1837) first account of the Galapagos "finches," *Geospiza* is described as a new genus and *Cactornis, Camarhynchus,* and *Certhidea* as subgenera under *Geospiza,* inferentially as of the Fringillidæ, as they are spoken of collectively as "ground finches." Of *Certhidea* the comment is made (in the third person, as written presumably by the secretary of the Society) "that although he confidently believed that it should also be referred to the same group with the three former, yet in its slighter form and weaker bill it has so much the appearance of a member of the *Sylviadæ,* that he would by no means insist upon the above view being adopted until the matter shall have been more fully investigated."

Sclater & Salvin (1873, p. 16) placed *Certhidea* in the family Cœrebidæ, whence it was removed by Ridgway (1896), who, partly on the basis of anatomical studies by Lucas (1894), considered it as belonging to the *Mniotiltidæ,* a conviction that he (1902) has since repeated. Lucas found various points of difference between *Certhidea* and species of Cœrebidæ, but affinity with Mniotiltidæ is founded mainly upon resemblances in the bones of the palatal region.

Then Snodgrass (1903) published a most important paper, the results of careful comparative study of the anatomy of *Geospiza, Cocornis (=Pinaroloxias),* and *Certhidea,* with descriptive matter and figures that merit careful scrutiny. His conclusions, reached through examination of the internal anatomy of these birds, are essentially the same as those to which I have been led by comparison of external features, but he did not push his argument to its logical outcome. His closing remarks on the structure of the skull read as follows: "All that the writer here intends is simply to call attention to the fact that there is a gradation in the skull characters of these three genera, progressing by almost equal steps from one extreme to the other. If any phylogenic theory can be based on this fact then the classification of the three genera accepted at present cannot be correct, for *Certhidia* is regarded as a member of the Mniotiltidæ and *Geospiza* and *Cocornis* are placed in the Fringillidæ. The *Geospizæ* as birds have certainly a most Fringillid appearance. The same, however, cannot be so positively asserted concerning the skull of even the least modified species."

The alternatives, apparently regarded as inevitable, of placing these diverse groups either all in the Fringillidæ or all in the Mniotiltidæ, were so baffling as to cause Snodgrass to stop with the presentation of his really conclusive argument, and to refrain from proposing any change from the formerly accepted but obviously false arrangement. I do not know that anyone has followed up the matter since.

Now as to externals. There are of course superficial features in which *Certhidea* resembles species of Mniotiltidæ and of Cœrebidæ; and the obvious dissimilarities between *Certhidea* and some forms of *Geospiza* and *Camarhynchus* are such as at first sight to render apparently ridiculous any assertion of close relationship between those groups. Let us see, however, what external features they have in common. Despite considerable differences in size, the largest *Geospiza* at one extreme, *Certhidea* at the other, and the host of intermediate forms between, they are all very similar in proportions. They all have rather short, rounded wings, rather short tail, and long legs (toes in every case reaching beyond tip of tail in the prepared skin); Ridgway's (1901, 1902) diagnoses of the genera *Geospiza, Camarhynchus,* and *Certhidea* read surprisingly alike in describing the details of those parts. The proportions described, too, are not commonly found, if found at all, in the Mniotiltidæ or in American species of Fringillidæ. Then, there is a peculiar texture of plumage that is common to the several Galapagos forms, something well nigh impossible to describe but obvious to any one handling specimens, and accompanying this there is a peculiarly thick growth of long, loose feathers on the lower back and rump of all the species concerned, such as I do not find at least in North American birds of the families to which they have been relegated.

The color of the bill in *Geospiza* and related genera, and in *Certhidea,* sometimes black, sometimes light colored, has been described as an irresponsibly variable feature, not to be correlated with anything else. Without going into details, which are voluminous and complicated, it may suffice here to say that the observed facts justify the conclusion that in all these birds, *Geospiza* and *Certhidea* alike, the bill in adults of both sexes is black during the breeding season, light colored at other seasons, and light colored in the young.

In *Geospiza* a uniformly or nearly uniformly black plumage in the male, in *Camarhynchus* a black-headed plumage in the male, in *Certhidea* a chestnut-throated plumage in the male, are regarded as the most "perfect" or "fully mature" condition of plumage. In each of these groups, taking any one form on the several islands on which it may occur, the "perfect" plumage (black, black head, or chestnut throat, as the case may be) will be found in varying abundance on different islands, numerous (perhaps always present) on one, scarce on another, unknown on a third. This is a peculiar phenomenon that certainly seems like another link in the chain holding these diverse forms together.

In some forms of *Certhidea* the juvenal plumage is plain colored and unmarked below, as in the adult, but in the young of *Certhidea ridgwayi* the lower parts are heavily streaked with dusky, just as in young of species of *Camarhynchus.*

Nests and eggs of *Certhidea* have been described often with reservations that are significant in the light of the close relationship that I believe is now demonstrated to exist between *Certhidea* and *Camarhynchus.* Snodgrass & Heller (1904, p. 349) make the following statement: "We shot a female of *C. olivacea olivacea* at Iguana Cove, Albemarle, from a nest containing three eggs. The nest was exactly like that of *Geospiza fuliginosa* and the eggs were identical in size and coloration with those of the same species. . . Hence, since we have no other examples we hesitate in ascribing this nest to *Certhidea.*" There are other statements in literature (see Rothschild & Hartert, 1902, p. 385) likewise bearing evidence as to the similarity in nesting habits of the two groups of birds. Gifford (1919, p. 242) says of *Pinaroloxias inornata:* "This species combines the habits of a ground-feeding finch with those of a tree-feeding warbler." *Pinaroloxias,* further, combines the bill structure of *Certhidea* with the coloration of *Geospiza.*

Now, added to these suggestive characters found in common in *Geospiza* and *Certhidea,* comes the discovery of the several species above described, which appear to be connecting links between the two groups. It will be noted that, curiously, there are two separate points of contact between the "creepers" and the "ground finches." At one point, through *Camarhynchus conjunctus,* there is what appears to be close connection between *Certhidea* and the group comprised in the black-headed *Camarhynchus;* at the second, through *Cactospiza giffordi,* connection between *Certhidea* and the plain colored species of *Cactospiza. Camarhynchus conjunctus* and *C. aureus* in general appearance are closely similar to *C. prosthe-*

melas, so much so that the type specimen of *C. aureus* was entered as *prosthemelas* in the field note book of the collector. *Cactospiza giffordi,* despite its small size, is obviously like *C. pallida.* Yet in *conjunctus* and *giffordi* both there is most unexpectedly displayed traces of the characteristically Certhidean cinnamon-tawny throat patch. As regards the type specimen of *C. giffordi,* it is suggestive that the note book of the collector, E. W. Gifford, contains the following comment: "I obtained one bird at about 350 feet elevation which seemed to be intermediate between *Certhidea* and *Geospiza pallida.* It was feeding like a *Geospiza pallida* on a branch of a tree."

If further evidence in the shape of debatable specimens were needed it is found in a bird from Charles Island (No. 4862, Mus. Calif. Acad. Sci., female [immature?], May 29, 1906. See fig. D, p. 35.) This specimen is like comparable examples of *Certhidea ridgwayi* of Charles Island in color and plumage, but the bill (not a variable feature in *Certhidea)* is larger than in that species, being as heavy as, and a little longer than, in *Camarhynchus conjunctus* of the same island (see table of measurements). After careful study I do not know whether this bird is an example of *Camarhynchus conjunctus* (of which plumage stages and amount of variation are unknown) or of *Certhidea ridgwayi.* In other words, here is a specimen which I find myself unable to allocate, whether to the Fringillidæ or the Mniotiltidæ, as these families were formerly defined among Galapagos birds.

Both Rothschild & Hartert (1899) and Snodgrass & Heller (1904) dissent from Ridgway's (1896, 1901) division of the "ground finches" into the several genera, *Geospiza, Platyspiza,* and *Camarhynchus,* claiming that intergradation of one sort or another necessitates the grouping of the whole aggregation under one generic name, *Geospiza.* The intermediates here described demonstrate further, pretty clearly it seems to me, the impossibility of drawing a line, or of expressing a clear definition of characters, dividing those genera from *Certhidea.* Logically, according to the standards adopted by the authors cited above as opposing Ridgway's treatment, all of these diverse forms, from the enormously large-billed *Geospiza magnirostris* down to the most delicate *Certhidea,* should be placed in the one genus, *Geospiza.* Furthermore, I believe that it would be possible, on the criterion of individual variation producing overlapping of characters between forms on different islands, to indicate a line of slightly differentiated subspecies under one specific name, that would include most of the described forms of the several genera, and that would extend through the extremes of bill structure and of color characters throughout the genera *Geospiza, Camarhynchus,* and *Certhidea*. This statement is novel only in the inclusion of *Certhidea* in the closely linked chain of forms, for Ridgway long ago made precisely the same assertion regarding *Geospiza.* In upholding the recognition of slightly differentiated local forms he says: "No other course, indeed, is practicable; for were 'lumping' once begun there could be no end to it, unless purely arbitrary limits were given to the species recognized, and if followed to a logical conclusion might easily end in the recognition of a single variable species, equivalent in its limits to the genus." (Ridgway, 1896, p. 468.)

I feel, myself, that however logical and consistent it may be demonstrated to be to lump genera in this long list of diverse forms (fifty or more in number), it would not be desirable to do so. The course that I, personally, prefer to follow, is, first grouping the "finches" and "creepers" alike under the one family, Geospizidæ, to recognize at least the genera *Geospiza, Cactospiza, Camarhynchus,* and *Certhidea.* It will be admittedly impossible to formulate entirely satisfactory definitions of these genera, but their recognition will afford convenient lines of demarcation between sections of a long list of species otherwise too unwieldy for satisfactory treatment. To group all of these diverse forms under one generic name would, it seems to me, defeat the purpose of nomenclature of giving us convenient handles to grasp. To recognize the genera indicated is admittedly indefensible on grounds of logic and consistency, and it will cause grief and indignation in the compiler of books and the arranger of "keys" for identification. It will, however, suit the convenience of whomever wishes to discuss in speech or writing the birds and the problems involved, and that, to my notion, should be regarded as an important function of our nomenclature.

Indication of relationships in nomenclature is of first importance, perhaps, but all of the known facts in the relationships of these birds can not be expressed in their names. To divide the Geospizidæ into as many genera as I propose to do may give an exaggerated impression of the taxonomic remoteness of some species, but to lump them under a lesser number would assuredly give an even more erroneous impression of close connection between what are really distantly related forms.

I feel that common family relationship of *Geospiza, Cactospiza, Camarhynchus, Pinaroloxias* and *Certhidea* is demonstrated beyond question, but the further problem as to the closest continental relative of the family Geospizidæ is not so easily settled. *Certhidea* is sufficiently unlike any of the Fringillidæ, and *Geospiza* and *Camarhynchus* sufficiently unlike any of the Mniotiltidæ, to debar either of those groups from consideration as having supplied the immediate ancestor of the Geospizidæ. The general situation is apparently much the same as we find in the Drepanididæ of the Hawaiian Islands. In each case there has been wide divergence in bill structure among closely related species, and in the Hawaiian Islands, too, birds with sparrow-like bills were at first relegated to the family Fringillidæ. Only after hot discussion were these apparent "finches" conceded to be Drepanids and listed alongside their slender-billed relatives.

On the Hawaiian Islands species are mostly sharply differentiated, while on the Galapagos Islands, where we may be viewing results after a lesser period of isolation, we are troubled with innumerable intermediate stages. Strangely enough our strongest first feeling toward the existence of these equivocal races and individuals is not one of gratitude for light shed upon relationships, but of resentment at the havoc they create among our carefully ordered schemes of classification, and at the breaches they make between supposedly separated compartments in which we strive to arrange species and higher groups. In the Geospizidæ of the Galapagos (as in the Drepanididæ of the Hawaiian Islands) I think that we must realize that we are contemplating a group of birds that has been isolated on its island home since a remote period of time, and that has developed such distinctive group characters of its own as to have made it well nigh impossible now to recognize the nearest collateral mainland stock, if in fact there is today a corresponding terminal to a parallel line of descent upon the neighboring continent.

TABLE OF MEASUREMENTS IN MILLIMETERS

C.A.S. No.	Sex Age	Species	Locality	Date	Wing	Tail	Culmen	Gonys	Depth of bill at base	Width of bill at base	Tarsus	Middle toe with claw
7522[1]	♂ ad.	Cactospiza giffordi.......	Indefatigable Id.	Jan. 18, 1906	64.0	41.5	13.5	8.2	6.5	5.0	22.5	17.0
8121[1]	♂ ad.	Camarhynchus aureus....	Chatham Id.....	Jan. 25, 1906	58.0	35.0	9.0	6.0	5.5	5.5	21.0	16.5
7713[1]	♂ ad.	Camarhynchus conjunctus	Charles Id......	Feb. 28, 1906	59.0	40.0	10.0	6.2	5.2	5.0	20.0	15.0
7714	♂ ad.	Camarhynchus conjunctus	Charles Id......	Feb. 28, 1906	58.2	38.5	9.5	6.0	5.8	5.0	21.0	17.0
4862	♀ (im?)	Certhidea ridgwayi?.....	Charles Id......	May 29, 1906	54.5	39.5	10.5	6.0	5.2	5.0	19.0	15.0

[1]Type

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III

A CONTRIBUTION TO OUR KNOWLEDGE OF THE NESTING HABITS OF THE GOLDEN EAGLE

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Early in the spring of 1916, my friend, the late Dr. John Van Denburgh, announced to me that he was preparing to again take up one of his boyhood hobbies, and to build up his oölogical collection, which at that time, contained a representative series of sets of the birds around Los Gatos, the site of his father's home. He seemed to be greatly interested in securing eggs of the Golden Eagle *(Aquila chrysaëtos)*, regarding which he had carefully studied the available literature. I was asked to accompany him on his collecting trips, as he was none too good a climber, though I must confess that I am far from being one myself. Our activities commenced in April, 1916, and extended through a period of years, to and including the spring of 1922. The following notes cover our observations upon seven pairs of eagles during that time, all within Santa Clara and San Benito counties, California. For convenience I shall designate by numbers the different pairs of birds with which we became acquainted.

January 29, 1929

Pair Number One

On April 30, 1916, we left San Jose quite early in the morning and motored to Almaden and then to the Uvas Creek country. Here, by the roadside, we met a small boy. Upon being asked if he knew where there were any birds' nests, he said that he did not, but did know where there was an eagle's nest! He agreed to show it to us, and said that his sister had one of the eggs. With the boy in the tonneau of our machine we quickly reached his home, where the egg was soon in evidence. It was a very handsome eagle egg, but blown through two large, irregular holes at its ends. A price having been agreed upon, Dr. Van Denburgh was in possession of his first egg of the Golden Eagle.

Taking the boy and his two brothers in the machine with us, we started for the nest. This, the boys said, had been found by their father's hired man, who climbed to it, took the two eggs, broke one in descending, and blew the remaining one. We crossed a low range of hills, and, as we were descending, the boys pointed out the nest, clearly visible from the well-traveled road, and but a few yards distant from it. It was indeed a surprise to us to find that the eagle had chosen a site so exposed to view and so close to human habitation. The large deciduous oak in which it was situated grows upon the side of a steeply-rounded hill, one of the first to rise above the level of the floor of the valley. Higher on the hill are a number of smaller white oaks and a little scattering sagebrush. The tree is a large one and originally had three main limbs, but one of these had fallen. Partly as a result of this mutilation, there are but few sheltering branches and the nest is but little hidden from view.

This nest, which I shall call No. 1a (plate 4, fig. 1), is built upon a horizontal branch close to one of the main limbs of the tree at a height of about 40 feet. It is not a very large one, quite shallow and about 2½ feet in diameter. We had heard that eagles sometimes lay a second set when their first eggs of the year have been taken, and we hoped that these birds had done so. With much slipping and sliding on the grass we climbed the hill until we were level with the nest, when from the top of a small oak we could look directly into it, perhaps 50 yards away. Although we had seen the eagles circling about the neighboring hills, there were no eggs to reward us; the nest was empty.

We next visited it on March 2, 1917, when we found it apparently in good repair, but empty. No eagles were seen. We did not return until March 25, when we found it still unoccupied. The season being now well along, we decided that the birds did not intend to use the nest this year, and that they probably had another in the vicinity, although we had seen no eagles about. We determined to make a careful search, and, separating, went in different directions, where the large trees grew. Dr. Van Denburgh went over the hill immediately behind the old nest and a mile or more towards the north. He had not gone far when he flushed an eagle from one of the lower branches of a large oak, but, although he searched far and wide, could find no nest.

I, fortunately, was more successful. Crossing the road to a clump of large live oaks about half a mile to the south of the original nest, I found a large mass of sticks and branches which I thought might be an eagle's nest. Climbing to it, I found that it contained no eggs, but it seemed to be just ready for use, being lined with grass. This nest I shall call No. 1b (plate 4, fig. 2). No eagles were seen near it. Returning on March 31, we found the old nest (1a) still empty, but as we quietly passed under the new one (1b) and reached the trunk of the tree, we saw an eagle arise in the nest. When we spoke she sailed away. Climbing the tree I found one very light-colored egg. We left it, hoping for more. This nest was situated about 25 feet above the ground, and the climb was an easy one. It proved to be quite large, more than three feet in diameter, commanding a most extensive view toward the north and east. April 1 we returned to this nest just before dark. Again we found but the one egg and left it. April 6, 1917, found us back again. As the nest still contained only the one egg, we concluded that no more would be laid, and took it. Incubation was well begun. On April 24 both nests (1a, 1b) were empty.

Sunday, March 3, 1918, we went up to the highest point on the road. Leaving the machine there, we climbed the fence, walked across the pasture, and reached the tree which had held nest 1b. Much to our surprise nothing remained of it except some scattered rubbish on the ground. Not a stick was to be seen at the site of the nest in the tree, although this nest had been a particularly large one and so firmly built that one could stand in it with perfect safety. Returning to the automobile we rode down the steep, winding road, and were soon close to nest 1a. Finding it unoccupied we left, having seen no eagles about.

We did not return again until April 7, when we arrived at nest 1a at 7:35 P. M. As we approached we heard a horned owl hooting, and soon saw it sitting in the eagle's nest. When we were quite close the owl flew. Climbing to the nest, I found nothing in it but a lining of lichen, which seemed to be fresh. No eagles were seen. On April 20 we again inspected this nest, but found it empty and saw no eagles or owls. On May 4 we found this nest still empty; nest 1b had not been rebuilt. We spent several hours thereabouts, but saw no eagles until just as we were leaving, when both birds appeared circling low over the hill behind the site of nest 1b. It is probable that they constructed another nest in the vicinity.

In March, 1919, nest 1a still remained, but 1b was entirely gone. One eagle was seen. This locality was not visited again until April 25, 1922. Nest 1a had disappeared. Careful and extended search revealed no nest although one eagle was seen two or three times during this visit, and also May 4, 1922.

Pair Number Two

We became acquainted with this pair on the Johnson Ranch, about 4½ miles southeast of Hollister. This ranch, then farmed under lease by Joe Pacheco, lies on a series of low, rolling hills and is mostly grain fields and pasture with a few white oaks scattered about. As we approached the ranch we saw an eagle circling low over the hills perhaps a half a mile away. Through the hills winds a small stream known as Churchill Creek. At one point on this creek is a small clump of willows, and several of the oaks grow near it. We were told that many years ago the eagles had a nest (2a) in a large white oak at the edge of this stream and perhaps a quarter of a mile from Pacheco's house and barns, a nest that was very difficult to reach owing to the great size of the tree. Finally, the tree fell and the eagles selected another large white oak on a hillside a few hundred yards away. Here they built anew, in a situation which commanded a much more extensive view than they could have enjoyed from their former site in the creek bottom, and it was to this nest that we were led March 3, 1917. I shall call it No. 2b.

Although no bird was flushed from the nest on our approach, preparations were under way to climb to it, when a new one was discovered near the top of a large oak some 200 to 300 yards away. This tree grew in the creek bottom, perhaps 20 feet from the stream, and close to a clump of willows at its edge. From the point at which we stood, near nest 2b, this new one, which I shall call 2c, looked like a huge brown ball near the top of the leafless oak. We walked across the pasture, and following a fence along the edge of a grain field, approached it. When we had reached the level ground on which the nest-tree grew, and were not more than 50 to 60 feet from it, the bird arose and flew silently away. We did not see it again.

This nest, 2c,is situated 45 feet from the ground. It rests firmly in a large crotch not far from the top of the tree, and is about 2½ feet in each of its dimensions. Our rope ladder was only 20 feet long, but it served to carry me past the most difficult part of the huge tree, my arms and knees carrying me up the remaining 25 feet. After some delay occasioned by the great size of the nest, the two eggs it contained were lowered, one at a time, with can and string, and when they reached the ground safely we rejoiced in the possession of a beautiful set of eggs of the Golden Eagle.

With our treasures safely packed, we walked back to the machine. On the way we met Pacheco, who told us that the eagles had used another nest (2b) in 1916. He said that he had taken a young eagle from that nest and kept it some time, but, as it would eat nothing but ground squirrels and had to have a squirrel every day, he soon tired of his pet and put it back in the nest, where, under the care of its parents, it completed its growth.

In the machine on the way back to town, our guide said that so far as he knew eagles never laid a second set the same year when their eggs had been taken, although they continued to use the same nest or nests during subsequent years. Notwithstanding this statement by one whose knowledge of eagles is great, we determined to investigate this matter ourselves, for we had heard rumors that eagles sometimes do depart from this rule. So, very appropriately as it turned out, the first of April found us back again on the Johnson Ranch.

Leaving the machine at the house, we walked up through the fields and met Pacheco. He said that the eagles were nesting again, that he had seen the bird a couple of days before on the nest where we had taken two eggs on March 3. We walked to the tree with high hopes of a second set. Armed this time with 50 feet of ladder, it was more easy to negotiate the climb. Alas for our hopes! I found it empty. We were about to conclude that we had come too soon, when, on the ground close to the trunk of the tree, we discovered what appeared to be the contents of a fresh eagle's egg. As there was no shell to be found and as we found nearby other unmistakable evidence of his activities, we were forced to conclude that we were too late instead of too early—that some other oölogist had been there just before our visit.

Two photographs of this nest (2c) were taken. One (plate 5, fig. 4) shows the general location in the tree and the situation of the latter, in a grain field, with a fence on one side, and Churchill Creek with its clump of willows on the other. On April first the leaf-buds were just swelling on the bare twigs and the nest was plainly visible from a distance. The second photograph (plate 5, fig. 3) was taken from the ground directly below the nest. It shows the arrangement of the great limbs and the huge nest resting on them where they fork.

Leaving this nest we went up the hill to examine nest 2b. On the way we found a sparrow hawk persistently sitting in a cavity in a white oak tree which recently had been chopped into, doubtless by our unknown fellow craftsman. Nest 2b showed no signs of recent occupation by the eagles. Its appearance is shown in two photographs taken April 1, 1917 (plate 5, figs. 1, 2). The large deciduous oak, with a trunk 13 feet in circumference at the base, is situated in a hillside pasture, near a gully. The second photograph shows the nest and the twisted, rough-barked limbs. The nest is double, a more recent portion partly covering the older platform. We have since learned from Joe Pacheco that this nest (2b) was occupied later in 1917 and that one young eagle was reared there. If his observation and memory are correct this eagle must have made three layings that year.

Late in February of the following year, we again visited this region, but found that recent rains had made the roads so difficult to travel that we did not attempt to reach the Johnson Ranch at that time. Saturday, March 2, 1918, found us eating an early breakfast at Hollister. Leaving town at 7 A. M., a short drive through the rolling hills in the crisp morning air brought us to Pacheco's house. Leaving the machine near his barn we walked up Churchill Creek to nest No. 2c, from which we had secured a set of eggs the previous year, and arrived under it without having seen any eagles on the way. We put up the ladder and I climbed to the nest, finding it water-soaked and without any fresh lining, but otherwise in excellent condition.

We concluded that the eagles were probably using nest 2b, and, going up the hillside to examine it, reached the tree at 9 o'clock. We had been standing there talking for perhaps a minute when the bird slowly arose in the nest, seemed to step to its edge, and then sailed away. We did not see it again during this visit. With the aid of the ladder I quickly reached the nest and at half-past nine we had two nice eggs safely packed away. One, the lighter-colored egg, weighing 4¼ ounces, was either fresh or infertile, while the more heavily blotched egg, weighing 4¾ ounces, contained an embryo so well developed that eye pigment and small bones were evident on blowing it.

Still seeking to find whether or not these birds would lay a second set this year we left town on April 6, and, arriving at the Johnson Ranch at 5:45 P. M., we visited nest 2b. We walked under the nest and talked loudly, but the bird did not leave until we threw a clod up into the tree. Again she seemed to arise in the nest and step to its edge before sailing away. Rain began falling as we put up the ladder. Having secured a second set of two eggs, we were down and away at

6:35. The whiter egg of this set weighed 4¼ ounces, while the more heavily blotched one was one-eighth of an ounce heavier. Both eggs contained small embryos, apparently of about the same age.

On Saturday, March 1, 1919, we again returned to the Johnson Ranch. In the distance we saw an eagle soaring. As we walked along Churchill Creek numerous mud-turtles slipped into the water from the opposite bank where they had been sunning themselves. The leaf-buds of the deciduous oaks were much more swollen than we had found them on March 3, 1917, or March 2, 1918, and altogether spring seemed somewhat earlier than in those years. We went at once to nest 2b, on the hillside; only to find it empty. There was no fresh lining and green grass six or seven inches tall was growing from it. This nest, as I have mentioned, is a double one, a newer portion resting in part upon an older one. The newer portion has diameters of about four or five feet, while the whole structure has a long diameter of more than seven feet and a depth of about five feet. The accumulation of such a mass of material must have required a great number of trips on the part of the birds. While we were examining this nest we saw an eagle flying away from the other one (2c). When first seen it was about 50 feet from the nest, but we had no doubt that it had just left it. As we were too far away to have frightened the eagle we concluded that it probably was engaged in repairing the nest. However, we thought it best to investigate.

We went down the hill and across the field. When nearly under the nest (2c) we whistled and shouted and clapped our hands until we felt certain that it was unoccupied. We then threw the weight over a limb about half way up to the nest and hauled up the rope ladder. Starting up the tree I reached a point about five feet below the nest, when the eagle arose, looked down at me, opened its beak widely, uttered a curious sort of hiss, stepped to the edge of the nest and flew off. Instead of going out of sight immediately, however, as these eagles usually do, this bird circled about within one or two hundred yards of us, so that we had an excellent view of its plumage. This seemed to be in fine condition, but was pale and quite grayish, especially about the head. We concluded that this bird, which had just left the nest, was a very old female, but of course we could not be certain as to the sex. A few seconds later the mate appeared and both birds circled quite close to us. The second bird was much darker than the first. This was just the reverse of what we had observed at nest 3b on March 4, 1917.

The eagles circled about silently for a few minutes and then disappeared. Meanwhile, I had reached the nest and found that it contained two eggs. The nest seemed larger than it was two years before, doubtless growing with repairs. It had a depth of four feet, with horizontal diameters of four and four and a half feet, the nest cavity being about 18 inches in diameter and about six inches deep. It was freshly lined with grass. Resting on the top of the nest, at one side of the cavity, was a sprig of live oak covered with fresh green leaves. On our previous visits the nests of this pair of birds had not been decorated in this manner. We have found, however, fresh leaves in those of other pairs (see 3 and 5), and this habit of nest decoration or marking seems to be a common one. The two eggs, of quite different styles of coloration, were lowered to the ground and packed away. One is heavily blotched and resembles an egg of the second set of 1918. In the other egg the pigment is more evenly spread as a heavy suffusion about the smaller end. This egg is similar to one of the first set of 1918. The blotched egg weighed just 4½ ounces, while the other was about one-tenth of an ounce lighter. Incubation in the blotched egg had progressed so far that the eye pigment and vertebral cartilages were evident on blowing. The formation of the embryo had begun in the other egg, but was much less advanced, no eye pigment or cartilage having been formed.

On March 29, 1919, four weeks after collecting the set from nest 2c, we again motored to the Johnson Ranch, where we arrived about 6 P. M. Joe Pacheco came out to meet us, to report that he had seen the eagle on nest 2b about five days before, where she remained even when he rode under the tree. Nevertheless, he thought that we would find that she had not finished laying. We walked to the hillside tree without having seen an eagle, and no bird left the nest. On climbing up, it was found to contain one egg. The nest was lined with grass and a twig of fresh eucalyptus leaves lay on it. We left it undisturbed and returned to the machine through a gentle shower of rain, the eagles still remaining unseen. On April 10, 1919, we returned. The single egg was found on end in a somewhat mussed and apparently abandoned nest. No eagles were seen. The egg is a very small one, weighing only 4.1 ounces, and was fresh.

We did not visit this pair of eagles again until March 13, 1920, when we arrived at the Johnson Ranch at about three in the afternoon. We went at once to the nest on the hill (2b), which we found unoccupied, thoroughly wet by recent rains, and showing no renewal of its lining. While I was at the nest one of the eagles came sailing over from the south, inspected us, and passed on toward the flat where the tree which contains the other one (2c) is situated. The eagle, however, did not visit that tree but sailed on out of sight to reappear later over the hill near nest 2b. Feeling reasonably certain that we would find something in nest 2c, we descended to the flat and walked over to the tree which contains the nest. Shouting and clapping failed to frighten any bird from it, but our experience in former seasons made us realize that eagles sometimes sit too persistently to be flushed this way, so we prepared to climb. While we were thus engaged two men rode up on horseback and said that they had seen an eagle carrying fresh green twigs to this nest two days before. We found that this observation on their part was probably correct, for on reaching it we were disappointed to find that it contained no eggs, although it had been freshly lined and held a number of fresh leafy twigs of eucalyptus. Only the one eagle was observed during our visit and we were in doubt as to whether the nest was about to be used or had already been robbed; or whether the old female eagle had met with some catastrophe and the green trimmings had been placed in the nest by the male, as in instances previously noted.

Circumstances prevented our return until February 27, 1921, when we found the nest on the flat (2c) unrepaired, while the one on the hill (2b) contained green leaves and fresh lining of dry grass not yet pressed into position. On March 18 both nests appeared as on March 6, except that the green leaves in nest 2b were no longer fresh. One eagle was observed flying near on each of these visits.

Returning March 3, 1922, we found conditions as on February 27, 1921. The hillside nest (2b) contained unarranged fresh lining material of dry grass, fresh live oak leaves and a eucalyptus twig with fresh leaves. The lower nest (2c) was unrepaired. One eagle was seen soaring near. On March 19 the lining of dry grass in nest 2b was found pressed into a well-formed cavity. The green oak and eucalyptus leaves were still present and a small branch of wild rose, with the delicate fresh leaves just beginning to wilt, was in the nest. While it is possible that the nest had been robbed within a day or two, we were inclined to believe that eggs had not yet been laid. The season appeared to be very late.

April 4, 1922, we found both birds flying near the nest late in the afternoon. Returning to the ranch house we met Joe Pacheco, who said that on March 10 two men appeared at his house at 6 A. M. with two eggs which they had taken from this nest. April 15 we visited nest 2c and found it relined, with well-formed cavity and a branch of fresh eucalyptus leaves. This nest seemed just ready for use, but contained no eggs. On April 20 this nest (2c) was found in the same condition as on April 15, except that the green leaves were somewhat dried. On May 13 nest 2c was still empty. Nest 2b contained a small branch with fresh green leaves.

Pair Number Three

Our experience with our second pair of eagles having increased our desire to know more of these birds, we gladly accepted the offer of our guide to lead us to other nests. On March 4, 1917, we set out in our machine for the Flint Hills. The road which we first tried was blocked by a deep mudhole which we could not pass. Taking the main road to San Juan, we finally turned down a lane which led us to the flats by the river. The San Juan River here is quite wide. It did not, at this time, entirely cover its sandy bed. We removed our shoes and socks, rolled up our trousers and prepared to wade across. The water was quite shallow, nowhere more than a foot deep, but the sand seemed to "drop out" under our feet, often letting us down another foot or more. As there had been a heavy frost during the night, the water was icy cold and we were indeed glad when we reached the opposite bank and could warm our aching feet.

The river here runs along the edge of the hills, which are furrowed by a number of small gulches or canyons. The hills are, in the main, bare pasture lands and grain fields, but here and there are a few trees, live and white oaks, which grow singly or in small groups, usually in the hollows or canyons. The first canyon we encountered held nothing of interest, so we passed on over a low hill to the second one. Well up on the side of this canyon stands a large, solitary live oak, and in the top of this tree, perhaps 30 feet from the ground, was an eagle's nest. It seemed not to have been used for some time, but was still fairly well preserved. I shall call it nest 3a.

Passing on over the hill to the next canyon, we came upon the eagle, sitting quietly on one of the posts of a wire fence, and but little disturbed by our presence. When we were quite near, it flew a short distance and lit on the ground, where it remained for some time. Our guide called our attention to its pale head and general coloration, saying that this pallor was characteristic of very old birds. On the floor of the canyon, close to the river, is a group of four or five large live oaks, and as we drew near we saw a nest well up in the tallest of them. We walked under the trees but not until we shouted and clapped our hands did the eagle leave the nest. Then she flew slowly and came to the ground near her mate on the hillside nearby.

This nest, which I shall call 3b, is one of the smallest we saw. It was about two by two and one-half feet in diameter and contained comparatively little material. It was built on the main trunk of the tree where the latter curves more or less horizontally and forks before turning upwards again. Its height above the ground was 35 feet. While preparing to climb up to it, we discovered on the ground underneath large pieces of shell of an eagle's egg. These fragments seemed to be but a few days old, for they were glazed with albumen. Our hopes of getting a nice set were considerably lowered, and our guide said it was hardly worth while to climb for one egg. However, I climbed to the nest and discovered that it contained two beautifully marked eggs. These were so completely covered with eucalyptus leaves that I could not see them as I looked down into the nest. Two or three small eucalyptus trees growing on the bank of the river a few yards away furnished a ready supply of these leaves, but we were unable to understand the eagle's reason for using them in this manner. Also, we wondered about the broken egg on the ground. How did it get thrown from the nest? Should we otherwise have gotten a set of three eggs, or was the third egg laid to take its place? The eggs taken were both fresh.

April 1, 1917, found us again approaching the home of this pair of eagles. Nest 3a, on the hillside, appeared still in its somewhat dilapidated condition as we passed it. We had thought that the eagles might repair it and lay a second set there. Walking on, we soon reached the tree which contained the other nest (3b), from which we had secured eggs just four weeks before. Thus far we had seen no eagles, but when we shouted the eagle arose in the nest and, after a momentary pause, flew off over the hill. We did not see the bird again. Going up to the nest, another beautiful set of two eggs was found. It contained fresh eucalyptus leaves, as on our former visit, but the eggs were not completely hidden by them. Incubation had begun in one egg, while the other was fresh.

The following year, on Saturday, March 2, 1918, we returned to these nests. Nest 3a appeared much more dilapidated than in 1917; probably not more than half of it remained. The eagles evidently did not intend to use it. Nest 3b was reached shortly after and appeared just as it had in 1917. We saw no eagles but decided to climb to it. It was found apparently ready for use and contained two eucalyptus twigs covered with fresh leaves, the larger of them about a foot long. These we left undisturbed. There were no eggs.

Leaving this nest we walked over the hills and up a long canyon, toward the home of pair number four. The hills were bare and we passed very few trees on the way. A little after noon we came upon a large live oak growing on the side of the canyon, from which, when we had nearly reached it, a large eagle flew. Our first thought was that the eagles had moved up here from their old site near the river, but careful search revealed no sign of a nest either in this tree or in others farther up the canyon. We returned to the nest by the river (3b) on March 16. It still contained the same eucalyptus twigs, somewhat dried, but nothing else, so it appeared that the eagles were not going to use it after all. The fresh leaves found March 2 had made us almost certain that they would. Our final visit to these nests, in 1918, was about four in the afternoon of April 6. No eagles were seen, but as we approached nest 3b a pair of Western Red-tailed Hawks *(Buteo borealis calurus)* circled about screaming. We found the nest had been newly lined with moss and contained two eggs of this hawk.

On March 2, 1919, we returned to the home of our third pair of eagles and found that not a stick remained of either nest 3a or 3b. In March, 1920, we looked again for a nest of this pair of eagles but were unable to find one. Only the old male eagle was seen. On February 27, 1921, we visited this locality again but there was not a trace of a nest in either tree. The old male was again seen.

On March 18, 1921, we determined to make one more attempt to find a new nest. Nothing had been done at either of the old nesting places, but in a small canyon between them we flushed the pale old eagle and his dark mate, both of which flew silently over the hill and disappeared. We looked again in every tree and found nothing in that canyon or elsewhere, until the search seemed hopeless. As a last chance we looked on a hillside, close to the road, where there were a few trees so small that it had seemed useless to examine them, and here we found a large nest only 25 feet above the ground (plate 4, fig. 3; plate 6, fig. 1). The tree showed unmistakable signs of having been climbed recently, so we were not surprised to find the nest empty.

March 3, 1922, found us again approaching this nest (3c). When distant about a third of a mile, we observed a large bird perched on the top of the tree which contained the nest. We had covered half this distance when the bird, which proved to be the pale old male, flew down close to inspect us. He then flew back over the tree and disappeared beyond. When we arrived within 50 yards of the nest the dark female arose from the nest and quickly flew from view. An easy climb revealed two beautifully marked eggs resting on a fresh lining of dry grass. The nest, constructed of oak branches and twigs, is about three by four feet in diameter and two feet deep, its cavity being about five inches below the rim. The tree is a small white oak. Both eggs were perfectly fresh. One is almost covered with red pigment and weighed 4½ ounces. The other egg is white with a few small blotches at one end and weighed 4⅜ ounces. These eggs are of the same type as those secured in 1917, and probably were laid by the same dark female. This nest may have been built in 1918 and overlooked by us because of its improbable situation.

April 4, 1922, we found this nest (3c) empty and no eagles in sight. After photographing it we went on and examined the trees where the other nests had been, but found nothing. The old male flew near us when we were close to the site of the nest 3b. On April 20 we returned and again found nothing at the sites of any of the nests we had seen previously. One old eagle flew by while we were near nest 3b. We gave up the search and went on to examine a Red-tail Hawk's nest farther down the river. About an eighth of a mile beyond the location of nest 3b we found a large nest about 35 feet up in an old cottonwood tree. On looking closely we made out the tail and wing tips of a large bird protruding over the edge. On the ground below we found a number of dead sticks and twigs and a sprig of fresh, green, live oak leaves. After we had shouted and clapped our hands the eagle left and sailed away. Returning a half hour later we found the eagle again on the nest, this time faced in the opposite direction, and, as before, she left with reluctance. We found the nest (3d) to be about three feet in diameter and a foot and a half high, lined with dry grass on which lay two eggs. The blotched egg weighed 4⅝ ounces, the yellowish one 4⅜ ounces. Both were moderately advanced in incubation, the leg bones being about a half inch in length. June 3, 1922, we again visited this nest (3d). Both this nest and No. 3c were empty, and no eagles were seen about them or at the site of nest 3b.

January 29, 1929

Pair Number Four

Our acquaintance with our fourth pair of eagles began on the afternoon of March 4, 1917. Leaving the home of pair number three, we turned from the river and went over the hills and up a long narrow valley, where there were few trees. On went our guide up the valley, and then, turning to the left over a bare hill, he led us into a deep gulch with numerous large live oak trees. He went directly to one of the largest of these, and following him we saw a huge nest built far out on a nearly horizontal limb some 40 feet above the ground. A few moments' inspection sufficed to show us that the eagle's nest, which I shall call 4a, was not occupied.

Two or three hundred feet farther up the gulch we found a still larger tree. Fifty feet from the ground was another large nest (plate 7, fig. 3), again built well out on a horizontal limb, and we could just see the eagle crouching low upon it. Soon she arose and flew away. As our ladder was not long enough to reach it we resolved to return later to this nest, 4b.

Accordingly, a week later, on March 11, we again tramped over the hills to this gulch, but this time from another direction. On the way over, in a large live oak tree on a hillside near the lower end of this gulch, we found the remains of a still older eagle's nest, one that evidently had not been used for many years. As it was not more than a quarter of a mile from those in the gulch above, it was probably built by the same birds. I shall call this nest No. 4c. It was about 30 to 35 feet above the ground. When we arrived at nest 4b the old eagle was not at home; the nest contained two large, pale eggs. This nest was three feet in diameter and lined with dry grass. The eggs were not covered. Incubation had been well begun in both. We saw one eagle in the distance, circling over the hills. On April 15 we returned, but found the nest empty and no eagles visible. This ended our observations for the year.

On March 2, 1918, we arrived at nest 4b. It seemed to be in good repair, so, although we had seen no eagles, we decided to make the climb. It was found to be empty and showed no preparation for use. Nest 4a was much more dilapidated than a year before, and of nest 4c there now remained only a few sticks. Leaving this gulch, we wandered up a long canyon running towards the northwest. After we had traveled a mile or more, we saw what we thought was a Red-tailed Hawk's nest in a small tree well up on the steep south side of the canyon.

We climbed up hill until we were above the nest and could look into it. It contained no eggs, but a lot of downy feathers were sticking to the twigs and branches of which it was made. We saw no birds about and left convinced that this was a hawk's nest and would soon contain eggs. We returned to this nest (4d) March 17, 1918. Having found nest 4a still unrepaired and 4b still unoccupied, we went to the canyon towards the northwest, expecting to collect a set of Red-tailed Hawk's eggs from the nest found two weeks before. We walked up the bottom of the canyon and then straight up the side of the hill to the nest. When we had approached within about 40 feet of it, a beautiful, dark-plumaged eagle arose and sailed away. We could hardly believe our eyes, for it did not seem reasonable to find so large a bird on so small a structure, and we had no idea that it could be other than that of a Red-tailed Hawk.

This nest was built at a height of about 18 feet, in a small deciduous oak which grew well up on the steep side of the canyon. The situation of the tree made the nest seem quite high and the view from it was very extensive (plate 4, fig. 4). Climbing higher up on the hillside, we were able to look into the nest and to see that it contained two eggs. There was much more down in and about it than we had seen in any other eagle's nest. On the ground below the tree was a lot of débris, either material wasted during its construction or the remains of some earlier platforms.

The two eggs which this nest contained were unusually large. The only other eggs which we had taken before were those secured from nest 4b on March 11, 1917. Because of similarity in size of the eggs and because the nests are only about a mile apart we concluded that they belonged to the same pair of eagles. The two eggs taken March 17, 1918, are very dissimilar in appearance. One is quite heavily blotched. The other is entirely white, except for a few faint markings which may be either nest stains or very slight pigmentation.

The blotched egg weighed just five ounces, while the white one weighed just a quarter of an ounce less. Both eggs were fertile, and in both incubation was well advanced, but more so in the blotched egg. This would indicate that in this instance the egg first laid was larger and more heavily pigmented than the second one. Our last visit during 1918 was on April 7, when we found all three nests (4 a, b, d) unoccupied.

On the second of March, 1919, we returned and found nest 4a represented by a mere hatful of sticks. Nest 4c had entirely disappeared. Nest 4b, where we secured eggs in 1917, was not reduced in size, but looked ragged and deserted. Having made sure that it was not occupied, we left without climbing to it. Looking back we saw two eagles circling over the hill beyond. We did not visit nest 4d, which had contained eggs the previous year.

On March 16 we returned for the purpose of inspecting nest 4d. As we approached the nest an eagle circled down towards us, coming quite close three or four times, and then flew farther up the canyon. Nest 4d was empty and showed no signs of occupancy. As we walked up the canyon the eagle again appeared but quickly passed from view. Two weeks later, March 30, we returned to this canyon and looked for a new nest but found none, although we saw an eagle leaving the canyon as we entered it. Nest 4d was empty and unrepaired.

The following year on March 14, 1920, we climbed up over the hill from the south and entered the canyon within 100 yards or so of nest 4d. An eagle appeared from somewhere near us, and, apparently in a state of excitement, crossed to the opposite side of the canyon, where it lit upon the ground. We found nest 4d deserted and much the worse for wear, but although we searched carefully we could find no other in the canyon. We did not visit the other canyon, where nests 4b and 4c were located. In 1921, the site of nest 4d was visited and the last remnants of the nest found on the ground under the tree. Search revealed no other in this neighborhood although one eagle was seen.

On March 2, 1922, we again entered this canyon from the west. Approaching nest 4b, we flushed the eagle. The nest was found to contain one egg, which we left undisturbed. Ten days later, March 12, we returned to nest 4b hoping to find two eggs, but fresh marks of climbing-irons showed that we were too late. As we departed, an eagle circled about us several times, 50 to 60 feet above our heads.

Pair Number Five

On Sunday, March 11, 1917, we arose early and, having had breakfast, were a few minutes later on our way in the automobile, bound for the Flint Hills. In the first canyon that we entered we came upon a screaming pair of Red-tailed Hawks and soon found their nest. It was situated well up in a large oak tree in a position which made it difficult of access. We decided a visit to it would take too much time, so proceeded on our way.

Perhaps a mile farther on we came to another canyon with a considerable growth of live oak trees. We were walking along the edge of this canyon, seeking an easy place to cross, when an eagle suddenly flew from a small tree on the opposite bank at a distance of perhaps 40 yards from us. A second glance showed us a nest, from which the eagle had flown. The tree is a small one, and the nest only 25 feet above ground at its base, but the fact that the tree grows close to the edge of the bank of the canyon adds 30 to 40 feet to the apparent height of the nest. The eagle silently disappeared down the canyon, and did not return while we were about. We scrambled across the canyon and around on the bank above, taking a picture from a point nearly level with the nest.

The climb to the nest was an easy one. It was lined with dry grass and some gray moss, and contained two well-blotched eggs. It was very large and probably had been in use many years. I shall call it nest 5a (plate 6, fig. 2). Incubation was well started in both eggs. On the afternoon of April 1 we returned to the nest of our fifth pair of eagles. This we found empty, though its lining was in good order, as if ready for a second set. One eagle flew down the canyon while we were there. In consequence, we made a final visit on April 15, but found the nest empty.

The following year we returned to this nest (5a) on March 3, 1918. The eagle left the nest as we approached. Two beautifully marked fresh eggs rewarded us. These are of the same type as those secured the previous year but are more heavily blotched. The one having the larger blotches weighed 4.9 ounces, the other 4.8 ounces. The freshly blown shell of the first egg weighed ¾ oz. On March 17, just two weeks later, we were again in this canyon. No eagle left the nest. From the hill above we saw a whitish object in the nest, but were not certain what it was. Climbing to the nest, one very dirty, weather-stained egg was found. The nest was wet and disordered and seemed deserted. We concluded that the egg was part of the first set and probably had been laid soon after our visit of March third. The egg weighed 4.7 ounces, and was fresh. On April 7, 1918, this nest was empty. We saw one eagle fly down the canyon.

March 2, 1919, we arrived at this gulch in the morning during a heavy shower. The eagle was not on the nest. I climbed up to it and found that it contained a lot of fresh lining materials, dry grass and lichen, not yet arranged and packed down. There were also a few small twigs of live oak with fresh green leaves. It appeared certain that the nest would be used later. We left without seeing any eagles, but on returning late in the afternoon, when the sky had cleared, we found them both flying over the canyon. On March 16 we again visited this nest. Arriving at noon, we walked across the pasture, where for half a mile we could be seen from the nest. We crossed the canyon within 100 feet of it, shouted, and clapped our hands. Climbing up on the bank above the nest we tried to look through the branches. We concluded that the nest was empty but decided to climb up to it. Just as I reached the base of the tree, off flew the eagle and silently disappeared. I found two eggs lying in the central cavity of the nest, which was lined with lichen with an inner layer of green live oak leaves. The cavity measured about 12 by 15 inches, with a depth of about four inches. The whole nest had diameters of five and four and one-half feet, and was about two feet deep. The egg which is more heavily marked at the small end weighed 4.25, while the other weighed 4.05 ounces. Incubation had just begun in the heavier egg. The lighter one was fresh.

On March 13, 1920, we again visited the canyon occupied by pair number five. An old eagle almost immediately flew up the canyon, passing over the nest on the way. We walked over toward the nest and crossed the canyon at the usual point, talking and shouting as we went. Then we climbed the hillside to a point just above the nest and perhaps 50 feet from it. Standing here, we could see the eagle sitting on the nest and watching us. As we walked closer, she arose and flew silently away. On climbing to the nest it was found to contain two eggs, which were considerably nest-stained and much less handsomely marked than any previously obtained from this pair. The nest was lined with grass and a few green oak leaves.

In March, 1921, this nest showed no signs of repair or occupancy, and, although one eagle was seen flying in the canyon, no other nest was discovered. On March 2 and 12, 1922, careful examination of this canyon revealed no new nest, although one eagle was seen. The old nest was unrepaired and seemed deserted.

Pair Number Six

Our friend and guide had told us of another nest which, to his personal knowledge, had been used by the eagles for 30 years, though during this period there were some years, he believes, when they did not lay in it. He visited this nest with his son on March 11, 1917, and secured two eggs in which incubation was fairly well advanced. Unfortuntely one of these eggs was broken, but the remaining one he gave to Dr. Van Denburgh. This egg is of a type quite different from those of any other pair of birds investigated by us. On April 15, 1917, we visited this nest (plate 6, fig. 3). It is built in a great live oak which grows well up on the south side of a deep gulch, about 1½ miles south of Sargents. The main road, about 300 yards away, may be seen from it. It was nearly dark when we reached the foot of this tree, but we soon convinced ourselves that it was not occupied.

The next year, 1918, we returned to this nest, which I shall call 6a, on the morning of February 22. It appeared to have been damaged by the winter storms, and a considerable portion of it was on the ground. No eagles were about, and we concluded that the birds did not intend to use it. We climbed to the top of the hill and went down another canyon, which we thought would lead us to nest 5a. We had walked perhaps half a mile when, as we had expected, Dr. Van Denburgh pointed out a nest, some 300 yards ahead of us. At that distance it could not be seen clearly, but I had scarcely time to say that I thought it was the nest with which we were familiar when we saw an eagle leave it and fly off over the hill. As we drew nearer the situation looked less familiar. The trees seemed much too large and the bank too low according to our memory of nest 5a. However, it was not till we reached the base of the tree that we recognized it to be one in which we had found the nest of a Red-tailed Hawk in 1917. Nest 5a was in another canyon about a mile beyond. The hawk's nest had entirely disappeared; not a stick of it remained. The eagle's nest was a few feet higher in the tree and was built on much larger limbs. On the ground below were numerous dead oak branches and twigs, evidently dropped in constructing the nest. The structure seemed large enough to have been in use several years, yet we knew it to be a new one, as there had been none there the year before. From the fact that the bird left while we were still so far away, we concluded that she had not laid, and that she probably was completing the lining of the nest when we discovered her. We left without climbing to the nest, which I shall call 6b.

On March 3, 1918, we returned, arriving under the tree at 8 o'clock in the morning. The bird was at home and did not fly until we threw a stick up into the tree, but there were no eggs. We then walked on to the next canyon to inspect nest 5a. Returning later to nest 6b we found no eagle on it. Two weeks later, March 17, we found no eagle at nest 6b. Climbing up to the nest it was found to be still empty. We did not return again until April 7. Nest 6a was ragged and deserted. Nest 6b was empty, but on the ground beneath it we found the remains of a broken eagle's egg.

The season now was so far advanced that we had no further expectation of adventures with eagles. We had, however, found the nest of a Red-tailed Hawk near the upper end of this canyon and decided to visit the canyon again in hopes of getting a set of eggs. Therefore, April 20 found us again in this canyon. As we passed under the eagle's nest (6b) we noted that it was unoccupied. Some 300 yards up the canyon, an eagle circled down towards us, and then turned and flew away. We went on to the Red-tail's nest, found it empty, and returned to the place where we had seen the eagle. A little higher on the hillside is a group of large live oaks. We had examined these trees several times in 1917 and 1918 and were certain that there was no nest in them. However, we had scarcely entered this little grove when we saw a big nest well up in one of the largest trees, and, as soon as we clapped our hands, off went the eagle. On climbing to the nest I found it to contain a nice pair of eggs. Incubation was well advanced. I shall call this nest 6c. These eggs, taken from nest 6c on April 20, 1918, are of the same type as those secured March 11, 1917, from nest 6a. The fragments of an egg found under nest 6b also were of this type. It is probable that this pair of eagles deserted their old nest and moved a mile or more to another canyon, where they not only laid twice, but actually built two nests.

Returning in 1919, we examined these three nests (6a, b, c) on March 1 and 2. All three looked deserted. I climbed to nest 6c only, which was found empty and unrepaired. It measured about five by three and a half feet over all, and about two feet in depth. We saw no eagles in either canyon. On March 16 we returned and photographed these nests. Nest 6a is shown well out on a nearly horizontal limb which hangs over the canyon. Nest 6b (plate 7, fig. 4) may be seen well up in a large live oak which grows from the side of another canyon. As we entered the lower end of this second canyon, on the morning of March 16, we saw two eagles soaring well up in the canyon near the group of trees in which nest 6c is located. This group of live oaks is shown in the photograph (plate 6, fig. 4). The nest does not show. It is near the top of the tree and at the extreme right of the central group. The eagles quickly disappeared, and we found these nests (6b, c) still unrepaired.

After making a wide circle over the hills we entered the upper end of the first canyon, in which nest 6a is located. This canyon near its upper end, high on the hillside, becomes broad and shallow and has but few trees. As we walked down the canyon an eagle circled to meet us and then sailed off towards the left. Lower in the canyon are many trees, growing in two main groups that are separated by an area of open pasture. Nest 6a is in the lower group of trees. We had searched through the upper group twice in 1918 and were certain there was no nest there in March of that year. We now decided to search both groups again, and Dr. Van Denburgh started for the upper grove while I set out for the lower one. We had walked only a few yards when Dr. Van Denburgh saw the eagle sweep down close to a large tree near the edge of the upper group, and a few moments later he saw a nest in the tree. As he called me, a second eagle left the nest; both birds departed silently and we did not see them again.

The tree is a large one but so well provided with branches that the 40-foot climb was not difficult. I soon reached the nest, looked over the edge, and with some excitement reported three eggs. I shall call this nest 6d (plate 7, fig. 1). It was very large, about 3½ feet deep with extreme diameters of about six and five feet. Its central cavity, about a foot in diameter and seven inches deep, was lined with dry grass, and held also a cluster of fresh oak leaves. The eggs are rather small and elongate, of the same type as those taken from nest 6c in 1918, but much more beautifully blotched. They weighed 4.02, 4.01 and 3.99 ounces, respectively. The egg with the greatest weight was most heavily pigmented, and the lightest one least so. The lightest egg was infertile. Incubation in the other two eggs was well advanced, but had progressed further in the heavier egg, in which the bones were quite firm. From conditions in this set it would seem that the first egg laid is the largest and most pigmented.

March 14, 1920, we again returned to the haunts of this pair of eagles, and ascending the canyon which contains nests number 6a and 6d, both were found unoccupied and showing no evidence of any repairs having been made. The former was very dilapidated, and the latter had been twisted out of position by the winter storms. One eagle was observed soaring over the top of the hill, but nowhere in the canyon did we find any other evidence of occupancy. This being so, we decided to see whether or not the eagles had moved back to the second canyon, in which nests 6b and 6c had been built during 1918. From the opposite side of the canyon nest 6b appeared to be in excellent condition, but although we shouted and clapped our hands, no bird left it until we crossed the canyon, when the eagle quietly arose and flew away. We did not see the bird again. After some delay and difficulty the nest was reached and found to contain a set of three poorly marked eggs of the same general type as those secured from this pair in previous seasons. As we were successful here, we did not visit nest 6c.

None of the nests of pair six showed any signs of repair or occupancy when visited by us in 1921, and no new nests were found. On March 2, 1922, nest 6d contained dry grass not yet pressed into shape. While descending the canyon we found a nest which we were quite certain must have been built since our visit in March, 1921. On climbing to this one, 6e, I found it to be in poor shape and unlined. One eagle was seen fllying about at the lower end of the canyon. Nest 6b was found to be in a good state of preservation, but unrepaired. There was no nest at the site of nest 6c. On March 12 conditions were unchanged at nests 6b, d, and e. On March 18 there was no change in the lining of nest 6d, and 6e seemed unoccupied. On April 15 and 25, 1922, nests 6d and 6e were unoccupied and no eagles were seen.

Pair Number Seven

About two o'clock in the afternoon of March 3, 1922, Dr. Van Denburgh and I arrived at the foot of a steep hill three and a half miles northwest from the town of San Juan. At the top of this hill rises a huge rock about 140 feet high, the upper portion of which forms a perpendicular cliff 95 feet high, facing a little west of north. Fifty feet below the top of this cliff is a recessed ledge upon which we had seen a nest two years before. The top of the rock is nearly level, and its southern end is buried in the earth of the hill-top, so that one can easily walk out to the brink of the precipice (plate 7, fig. 2). The earth hill itself is quite steep. We spent 45 minutes climbing to the top, and only 15 minutes returning to the automobile.

Just below the top of the hill we flushed a large dark eagle from the ground. At the base of the rock, below the nest, we found a number of dead oak branches and twigs, the freshly broken ends of which showed that they had been brought to the nesting place very recently. We lowered the rope ladder from the top of the rock until it hung directly in front of the nesting ledge. When the bottom of the 50-foot ladder reached the foot of the cliff the top of the ladder was about five feet above the nest. About 15 feet up from the bottom of the cliff is a ledge upon which two men can stand. We both climbed to this ledge and Dr. Van Denburg held the ladder while I climbed the remaining 30 feet to the nest. It proved to be a large one, about four by five feet, and freshly lined with dry grass, which had not yet been arranged and pressed down to form a cavity. As I descended I noticed old holes which had been drilled in the rock near a cleft which extended up from the ledge on which we stood. Later we noticed little steps cut in the rock below this ledge. These holes and footholds lead us to believe that this is the same nesting place that was robbed by J. R. Chalker in 1887 and 1888, as described in "The Ornithologist and Oologist" (XII, No. 6, 1887, pp. 86-88; XIII, No. 8, 1888, p. 120).

On March 12 we visited this nest again and took photographs of the rock. One eagle soared about the hill and rock as we approached, and at one time flew within a few feet of the nest. This was found to be in much the same condition as on March 3. We returned on March 18. As we drew near, an eagle left the nest and disappeared over the top of the hill. Having climbed to the nest I discovered one beautiful egg rather evenly covered with small red spots. The dry grass had been smoothed and pressed down, forming a slight central cavity. The nest was without any down or green decorations. We departed again without seeing the eagle.

April 4 we returned to the rock. When we were about 100 yards away the eagle left the nest and silently flew straight down the valley. We found but the one egg, evidently a complete set. This egg weighed 4½ ounces. Incubation was well begun, small bones being just distinguishable on blowing.

On May 4, 1922, we found this nest, which I shall call No. 7a, empty, and no eagles about. This proved to be our last journey in quest of the eggs of the Golden Eagle.

All of the eggs mentioned in this paper and tabulated below are now in the collection of the California Academy of Sciences.

Museum Number	Field Number	Number of Eggs in Set	Date Collected
4643	1a	1	March ?, 1916
4649	1b	1	April 6, 1917
4650	2b	2	March 2, 1918
4654	2b	2	April 6, 1918
4660	2b	1	April 10, 1919
4644	2c	2	March 3, 1917
4656	2c	2	March 1, 1919
4645	3b	2	March 4, 1917
4648	3b	2	April 1, 1917
4663	3c	2	March 3, 1922
4665	3d	2	April 20, 1922
4646	4b	2	March 11, 1917
4651	4d	3	Mar. 3-17, 1918
4647	5a	2	March 11, 1917
4652	5a	2	March 17, 1918
4657	5a	2	March 16, 1919
4661	5a	2	March 13, 1920
4662	6b	3	March 14, 1920
4655	6c	2	March 20, 1918
4658	6d	3	March 16, 1919
4664	7a	1	April 4, 1922

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 1. Nest 1a.
Fig. 3. Nest 3c.

Fig. 2. Tree containing nest 1b.
Fig. 4. Nest 4d.

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Fig.1

Fig.2

Fig.3

Fig.4

Fig. 1. Nest 2b.
Fig. 3. Nest 2c.

Fig. 2. Distant view, nest 2b.
Fig. 4. Distant view, nest 2c.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 1. Nest 3c.
Fig. 3. Nest 6a.

Fig. 2. Distant view, nest 5a.
Fig. 4. Oak grove containing nest 6c.

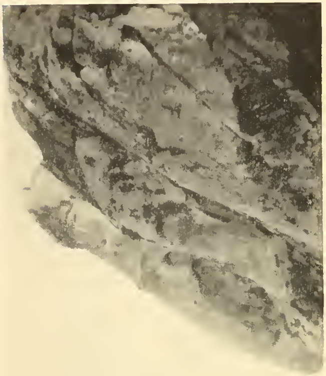

Fig.2

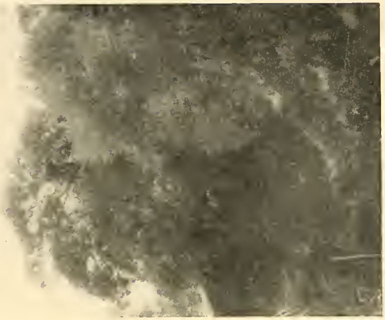

Fig.4

Fig.1

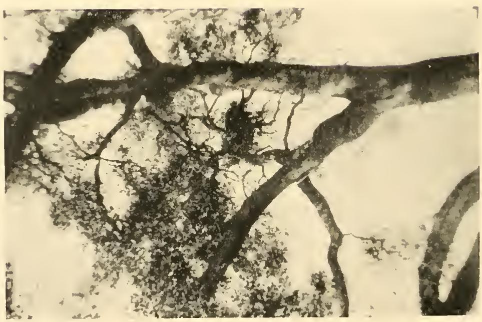

Fig.3

Fig. 1. Nest 6d.
Fig. 3. Nest 4b.

Fig. 2. Nest 7a.
Fig. 4. Nest 6b.

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IV

MARINE MIOCENE AND RELATED DEPOSITS OF NORTH COLOMBIA

BY

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Contents

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Introduction

The marine Eocene deposits of northern Colombia have already been described in earlier papers[1] and therefore require only general notice here. For the most part they occupy a broad synclinal area between the north coast of Colombia and the spurs of the northern Andes lying to the south. In the midst of this general syncline which extends for more than 160 miles, there are pronounced anticlinal folds extending parallel with its axis and also with the coast.

On the southern border of this syncline the Eocene rocks outcrop in an irregular zone following the contours of the preexisting ranges and spurs, while upon its northern limb they outcrop in disconnected areas along the Caribbean coast from the west flank of the Sierra Nevada de Santa Marta to the Gulf of Urabá. A large area of these rocks, for example, lies west of the Rio Magdalena, extending north from Arjona nearly to the sea, and to the southwest for an unknown distance. The "Arjona group" mentioned in a former paper[2] occupies this area. Farther to the southwest other areas of Eocene are found in the Coloso range, in the Cerro de Cispata near Lorica, in the Cerros de las Palomas, and in other districts about the head of the Rio Sinú.

Wherever they are found the Eocene rocks are highly folded and are traversed by faults. In some cases they are much compressed and distorted, but they are sufficiently fossil bearing for identification.

Post-Eocene Sequence

The Eocene deposits of Colombia are for the most part, especially in the central areas of the syncline, overlaid by a sequence of strata of great thickness. In some places these later beds overlap the borders of the trough and along its coastal side flank it for many miles. While the succeeding divisions of this sequence are largely the result of reconnaissance, and only qualitative study can be claimed for them, yet it is believed that the more important series are properly distinguished, and their position in the column is undoubtedly

[1]Anderson, F. M., Proc. Calif. Acad. Sci., Vol. 17, 1928, pp. 1-29.
[2]Anderson, F. M., Bull. Amer. Assoc. Petrol Geol., Vol. 10, 1926, p. 387.

correct. The maximum thickness of the post-Eocene formations is as much as 8,000 feet, of which the major part is referred to the Miocene, and the remainder, some 3,000 feet, may be largely, if not wholly, Oligocene in age. There is as yet only an imperfectly defined boundary between the two, while in some localities there is evident unconformity, and this may later prove to be the general condition.

In the Carmen-Zambrano section, elsewhere described,[3] between the proved Eocene and the fossiliferous Miocene above, there is a great body of clays, sandy shales and calcareous concretionary beds that were tentatively classed as Oligocene. Some of the shale in this interval appears to be equivalent to the "Bombo shales" of Beck,[4] while some of the strata may be lowermost Miocene, as described later.

The lower and major part of this sequence, as it occurs here and at other points along the Colombian coast, has been given in this paper the name of "Poso series," from the fact that in the Sinú region, where it was first recognized, and at other points on the north coast, various wells had been drilled into it for petroleum. It is well known to contain many seepages of oil and gas, and other evidences of having commercial possibilities as a source of petroleum.

West of the area of the Arjona rocks referred to above, as to the east of Turbaco, a later series of considerable thickness outcrops over a wide zone, in contact with the Eocene on the east and fossil bearing Miocene on the north and west. This series is here highly folded into a succession of anticlines extending from the railroad northeasterly for some miles. The gas vents, mud volcanoes, or the "Turbacos" of von Humboldt, have their origin in this series of rocks.

Its stratigraphic position is between the Eocene and the Miocene, and will doubtless find a place in the Poso series as described later, though whether the complete series is represented here is not known.

In the column drawn by Elfred Beck (p. 463), the "Huertas series" 1,000 feet in thickness, is divided into two nearly equal parts by the semblance of an unconformity, though it is not mentioned as such.

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[3] Anderson, F. M., Proc. Calif. Acad. Sci., vol. 17, 1928, p. 11.
[4] Beck, Elfred, Econ: Geol., vol. 16, 1921, pp. 463-465.

The upper portion of the "Huertas series," as shown by the fossils, and as observed by the present writer, is properly Miocene, belonging to a group which will be described later.

The lower portion immediately overlies the "Bombo shales," with which it appears to have stratigraphic continuity. The "Bombo shales" have been shown to be of Oligocene age, though this determination applies to not more than 500 feet of strata.

The Poso series. For the purpose of recording some observations made in the Tertiary districts of north Colombia in 1914-1915, and at later dates, and to call out further discussion of the subject, the following pages have been selected from personal notes, reports of assistants, and from various data obtained by the writer, covering the general region of the Rio Sinú and its environs, which describe in some detail the formations that, in the light of present evidence appear to intervene between the Eocene and the Miocene series.

From a report by Bruce G. Martin (1914) on the San Sebastian district, the following is taken:

> "Unconformably overlying the San Sebastian chert (Eocene), is a series of arenaceous and argillaceous sediments to which the name 'Poso series' is applied. These beds consist of hard to medium soft, coarse-grained, gray sandstone, and sandy clays and a small amount of limestone. Nearly all types and colors of sandstone and clay appear to be represented in this series. The lithology and sequence of beds can be best described by giving a cross-section at right angles to the strike."

Extending easterly from the Cerro de San Sebastian, Mr. Martin's condensed section follows:

d. Alternating hard coarse sandstone and medium grained, sandy shale	1000 feet
c. Medium soft, fine grained, bluish gray sandstone and clay, with some concretionary limestone lenses	1500 feet
b. Medium coarse, hard gray sandstone, and medium soft, blue or gray sandstone	900 feet
Total	3400 feet

Unconformity

a. San Sebastian cherts, etc. (Eocene).

His report then continues:

"In the San Sebastian section all the beds have been folded into a monocline which dips rather steeply toward the southeast. The sequence of beds, as here exposed, continues northward for several miles. In a general way these stratigraphic divisions will hold true for the whole area."

Both Mr. Martin and John H. Ruckman described a similar series between the villages of Cocorilla and Purissima. Mr. Ruckman says in part, concerning this district:

"The oldest rocks in the district are undoubtedly the cherts and hardened sandstones of the San Sebastian series (Eocene) which also make up practically the entire mass of the Cerro de Cispata. Overlying these, and in turn hidden by later deposits, there exists a series of very considerable thickness. . . . . The concretion-bearing shale and limestone on the Lorica-San Antero road represents its lower limit. Upon the limestone are sandstones containing many large, purplish concretions. They also contain considerable limestone in layers, as well as small bits of limestone, possibly representing inclusions from strata beneath. . . . .This series of limestones, shales and sandstones is probably, in part at least, equivalent to the Poso series [of Martin]. Overlying the Poso series and overlapping it unconformably upon the San Sebastian cherts, there is a rather thin deposit of chert conglomerate, gravels and poorly consolidated sands. They are not well exposed northwest of Cocorilla, but are unquestionably identical with those farther south near the San Sebastian hills. Fossils obtained from these beds are comparatively recent forms, suggesting correlation with the La Popa (Miocene) group." . . . .

Mr. Martin, later describing the district bordering on the Cispata Bay, and about the north end of the Cerro de Cispata, says:

"The rocks of this district belong to two formations; the oldest geologically is the chert formation which makes up the main mass of the Cispata hills. . . . . This formation occupies the central part of the hills and probably underlies the chert conglomerate exposed in the small hill immediately north of San Antero. Unconformably upon this chert lies a varying thickness of chert conglomerate and gravelly sandstone. This conglomerate and sandstone appear to be several hundred feet thick along the east slope of the Cispata hills. The size of the chert fragments decreases in going from the base upwards. The sandstone overlying the conglomerate consists almost entirely of small grains of chert. . . . . Overlying the conglomerate and cherty sandstone, probably conformably, is a thick series of sandstones, sandy clays, and variously colored soft shales. . . . . The upper portion of the series consists mainly of medium soft, argillaceous sandstone with a small amount of thin-bedded shale interstratified with it. These latter beds are well exposed along the crest of the San Antero hills. Another belt of medium hard sandstone occupies a narrow area near the central part of the map, at the gas springs. The gas escapes from this member of the series. . . . . The two largest areas of limestone occur in the south central part of the district. The medium soft, argillaceous sandstone is represented in yellow, the clays and shales in citrine, the basal sandstone and conglomerate in brown, and the chert in red. A peculiar feature of the series is the great lithologic variation." . . . .

The Poso series was followed southward up the valley of the Rio Sinú to above Monteria and along the east flank of the Cerros de las Palomas, where sandstones predominate in great thickness. At a locality 12 miles northwest of Cereté the formations are almost exclusively sandstones, often very siliceous, as if derived from underlying cherts. They stand at high angles with a strike of N. 70° E., and a dip of not less than 45° to the northwest. Mr. K. D. White, who visited this district after the writer's visit, says, in part:

"All exposures of rock seen were phases of sandstone. In fact, no outcrops of pure shale were found. The lowest bed, forming the center of the anticline, is massive gray, micaceous sandstone, with interstratified layers of grit, also massive in bedding. The grit members have layers of conglomerate that are typically millstone grit. The entire series is ferruginous; above the grit beds the sandstones become finer grained, more compact and siliceous. Many seepages of petroleum issue from these sandstones." . . . .

Concerning a locality some 12 miles west of Cereté, Mr. Martin says:

"All the rocks observed are of sedimentary origin. They consist of shale, soft, sandy clays, fine and coarse grained sandstone, and conglomerate. . . . Thin layers of conglomerate and grit can be seen closely associated with fine sandstone and clay. The colors of these rocks vary from very light gray through blue, gray and yellowish gray to brown. . . . . The rocks are well stratified in general, although in places the strata are so greatly crushed that the bedding could not be distinguished from fracture planes. The inclination of the strata varies considerably. . . . . Owing to [this fact] no well defined folds could be distinguished. In the vicinity of the gas and oil springs, where more detailed work was done the beds have been crushed and twisted to such a degree that it becomes impossible to recognize any definite structure. . . . . The oil here appears to be seeping from greatly crushed clay shale and fine-grained sandstone. Some of the rock fragments have a strong odor of petroleum. The gas springs consist of eight or ten small vents from which small quantities of inflammable gas, water and mud are escaping. . . . . Small mud cones from one to three feet high have been built up about the vents." . . . .

Farther south and nearly west of Monteria, on the east flank of the Palomas range, the beds are less sandy and show a disposition to become shaley, but they exhibit the same structural conditions as before. Mr. Martin, who worked in this district, reports in part:

"The younger beds consist of grits, massive sandstone, soft shaley sandstone, and soft mudstones. The grits and massive sandstone are hard and usually thick-bedded. The shaley sandstones and mudstones are thin-bedded and greatly fractured. . . . . The rocks are so arranged that three or four distinct lithologic divisions can be distinguished." . . . .

His report divides the strata of this district as follows:

1. An upper shale and sandstone member	1500 feet
2. A sandstone and grit member	2000 feet
3. A basal shale member	1500 feet
Total	6000 feet

The upper member of this section is probably later in age than the Poso series, and may be Miocene. The lower members are undoubtedly referable to this series. They are of a dark bluish or gray color, are considerably indurated, and are much folded and faulted. The strike is N. 20° E., and the inclination is from 45° to 75°.

There are two or more closely folded anticlines in the area examined and several seepages of petroleum and gas. Concerning these structures, Mr. Martin's report continues:

"Along the axes of the folds the strata are often vertical. In going across the strike away from the axis the inclination gradually decreases, until dips as low as 10° are sometimes found. . . . . The sequence of beds is similar over the entire area. Near the axis shales occur in every case. The petroleum [and gas] usually comes out with more or less acrid or sulphurous water, and accumulates on the spot as black asphaltum, the gas springs often forming small mounds of mud, or 'mud volcans'."

After an excursion made into the Palomas range, some 30 miles southwest of Monteria, Mr. Ruckman reported:

"Many interesting seepages of oil and gas were found together with many mud volcanoes, characteristic of this region. . . . . No igneous or schistose rocks were observed, while jasper and chert occur only as float from the Palomas range."

After describing the sedimentary beds from which the oil and gas were issuing, the report continues:

"This series [of strata] . . . . is almost certainly Mr. Martin's 'Poso series.' It is made up of a highly folded series of fine, thin-bedded, or massive, micaceous sandstone, and fine, rather hard, blue-black shale containing calcareous concretions and occasional lenses of limestone. Fragments of chert and limestone, similar to those in the Cerro de Cispata, forming several types of conglomerate were noted along the streams draining the Palomas mountains. The petroleum of all the seepages noted was associated with the shale. . . . . On the Quebrada Matamoras there is a very fine seepage of light oil. The oil comes directly from the shale, and evaporates, leaving only a stain on the shale. . . . . The seepages extend for 600 feet along the creek, issuing with some gas. The bedrock is almost entirely shale standing nearly vertical, the lowest dip being 45° toward the Palomas mountains, suggesting an overturn."

Rocks of the Poso series occur also near San Andres, though not in the thickness noted in the foregoing quotations. At a point on the San Andres-Momil road, some three miles east of the former place, an outcrop of these beds was noted in 1915. They consist of thin-bedded, dark, sometimes greenish-gray clay shales and nodular, or concretionary, limestones. In places they are gravelly, with pebbles of hard, dark, siliceous rocks, such as occur in the underlying Tofeme member of the Eocene. These shales have a strike of N. 30° E., and dip rather steeply to the southeast. They are overlaid by a brown or rusty-colored sandstone having a similar strike and dip, which, upon further observation, appears to rest unconformably upon the older series. These sandstone beds are fossiliferous, and belong unquestionably to the Miocene (Tubera) group, later described. These two formations are probably represented by the two portions of the "Huertas series" of Beck.

On the coastward side of the Palomas range, the Cerro de Cispata, and the Coloso range, the Poso series is exposed in many localities. At the west foot of the Coloso range there is a series of somewhat indurated, dark clay shales, sandstones, and hard conglomerate, without fossils, as far as observed, folded into a sharply compressed syncline in which the aggregate thickness of strata is not less than 2,500 feet. This section was visited by Mr. Martin and the writer in 1914, and the conclusion was reached that the series was identical with the Poso series of his earlier report. The strike of the beds is roughly parallel with the general line of the coast, or nearly northeast and southwest. Seepages of oil were found here issuing from shales near the base of the series, as is usually the case.

Similar beds occur about Cispata Bay to the north and west of the Cerro de Cispata, and here too are found seepages of gas smelling of petroleum.

The same series outcrops near Paso Nuevo and at other points along the coast. A few miles to the southeast of Monitos, beneath the sandy beds of the Miocene, which here follow the coast, standing at a high angle, there are hard, dark-colored shales and sandstones, also highly inclined (60° to 75°), striking parallel to the coast line, and overlying the Eocene. Their observed thickness was estimated at 1,500 feet, though it is probably more. Beneath are fossiliferous beds of Eocene age, and above are the Miocene sandstones with molluscan fossils.

The shales here described have elsewhere been called the "Monitos shales," probably representing the Oligocene.

Crossing the Rio Canalete somewhat above its mouth, and extending thence into the hills to the east of Cordoba, on the Rio Cordoba, there is a series of dark clay shales and sandstones from which issue many seepages of light oil. This series is not only highly folded and perhaps faulted, but, moreover, the strata are much crushed and crumpled and in places reduced to a structureless complex. Overlying these beds along the coast and extending to the Bay of Arboletes, there are steeply inclined Miocene sandstones and shales with many well preserved fossils.

Near the Bay of Arboletes and near the contact of the two sedimentary series is the great "mud volcano" of this district, rising about 75 feet above the coastal terrace, and covering some 40 acres of area. Much gas escapes from the pool of mud at the top, smelling strongly of petroleum. Not far away outcrop the underlying shales in which are found seepages of oil, and which are probably the source of the gas. The same body of shales extends along the coast for some miles toward the Gulf of Urabá. That this series of shales and standstones from which issue the oil and gas belongs to the Poso series there can scarcely be a doubt, although no fossils were found in it.

A nearly parallel zone of the same series of strata crosses the Quebrada del Aguila, a tributary of the Rio Canalete, about 15 miles east of the Bay of Arboletes. The locality is known as El Aguila, and is on the coast side of the Palomas range. Here hard sandstones and shales are well exposed, though much broken and faulted, and standing at a high angle. Five or six miles south of El Aguila similar shales and sandstones are exposed in the bed of a small stream, and are less broken by faulting. The strike is about N. 30° E., and the dip is not less than 75° to the northwest. About 1,000 feet of strata are exposed here, from which seepages of oil and gas are issuing. Three miles to the north are the mud volcanoes of San Diego, which cover not less than 40 acres of area. These vents have brought to the surface many fragments of hard sandstone, calcite, limonite, lignite and other mineral débris. The water escaping with the gas is slightly saline.

Many other examples of these formations could be given, though they seem unnecessary. One of their chief characteristics is the presence in them of seepages of petroleum and gas, and the accompaniment of the well-known mud volcanoes of this region. This characteristic, together with their frequent stratigraphic position between Eocene rocks below and often fossiliferous Miocene beds above, serves for their identification even where stratigraphic evidence is not complete.

The oil is believed to be largely indigenous, though in part it may have originated in the underlying Eocene formations, which contain foraminiferal and other organic strata, and in some places are bituminous, though to a less degree than the strata of the Poso series.

Structures. The structural conditions of the Poso series have been already suggested in the foregoing notes and quotations. As a whole the series is highly folded, if not faulted, and it has been much denuded subsequent to its folding. In the range of foothills west of the Rio Sinú, where the series was most studied, there are found two or more somewhat compressed anticlines with intervening synclines on the east slope of the Palomas range, and as many on the westward, or coast slope of the same. Such a fold is found in the vicinity of

Arboletes Bay, and another farther inland. Still others are known in the vicinity of El Aguila and the Lorencita.

Within these highly folded areas of the Poso series other strata both older and younger are involved, and in such cases the boundaries are often uncertain. In fact it would not be easy to disentangle the several series even were the country less covered with jungle and more accessible by roads than it is.

The amount of faulting that has affected these Tertiary areas is not known, though there are many evidences that faulting even on a large scale has disturbed various sections of the country. One such fault has long been recognized, and appears in the section drawn by Beck (p. 465). This is probably the fault that traverses the west foot of the Coloso range, and is known as the "Bolivar fault." The full extent of this fault has not been ascertained, though it is not confined to the locality of the Coloso range. It extends from here southward toward Monteria, and northward toward San Cayetano, and may even connect with the faulting west of Arenal and of Usiacuri.

Stratigraphic relations. The stratigraphic relations of the Poso series to the beds above and below have already been suggested in the foregoing paragraphs. Near Lorica in the Cerro de Cispata as well as in the Cerro de San Sebastian, the Poso series is found resting unconformably upon, or against, the cherts and other rocks of the Eocene. Along the west foot of the Coloso range the Bolivar fault complicates the problem by cutting the formations near the line of boundary between the Eocene and the Poso series, yet the lithologic contrast in the two is easily recognized. Also in the conglomerates of the latter are found many pebbles and boulders of the cherts that characterize the former. No other source than the strata of the Eocene appears to be possible for the pebbles of chert and jasper found in the conglomerates of the Poso series, and this fact, in the absence of direct evidence as to the age of the latter, is sufficient to show that this series is at least post-Eocene.

On the other hand, the Eocene is often richly fossiliferous in both Mollusca and Foraminifera, while the Poso series, with the exception of certain genera of the latter, is rather poor in fossil remains. In the section drawn by Werenfels[5] for the district of Toluviejo, which possibly applies equally well to that of the lower Sinú valley, the "Toluviejo series," with its fauna of *Lepidocyclina* and *Numulites* species, is tentatively placed by him in the upper Eocene, though most of the genera mentioned in his text seem to have been found in the middle Oligocene of Santo Domingo.[6] The "Pacini shales" of his section, for which he estimates a thickness of over 3,200 feet, are possibly in part within the Poso series of the present paper, and, moreover, he assigns them to the Oligocene. The lower part of the Poso series, as found near San Antero, consists of calcareous concretionary shales as shown by Mr. Ruckman.

The stratigraphic relations of his several "series," one to the other, are not stated by Werenfels, nor are they indicated in his section. It is not possible, therefore, to fix their position in the scale of the present plan with much confidence, though some suggestions may be offered regarding them. The correlation of the lower part of the Beck column with his "Pacini shales" appears to be erroneous, since the Tofeme formation of Beck is undoubtedly Eocene in age, as shown in a former paper.[7] May it not be possible that the "Toluviejo series" of Werenfels is only the lower part of the Poso series, and that the "Pacini shales" correspond to the upper part?

R. H. Liddle has given a "Composite geologic column" for western Venezuela,[8] in which the "Oligocene" strata of the Maracaibo basin are shown as having a maximum thickness of 5,500 feet, of which the Paují shales, the lower part, constitute more than half.

Only a few mollusks and Foraminifera (chiefly *Lepidocyclina)* are mentioned to "indicate that the formation is of marine and not of deltaic origin."

This group is followed historically by an uplift and erosion interval, while upon it, in some places, rests 1,000 feet of massive coralline limestone and sandy beds, the San Luis formation. Overlying this group is that of the Agua Clara shales,

[5] Werenfels, A., Eclogae geol. Helvet., vol. 20, 1926, pp. 81-83.

[6] Vaughan, T. W., and Woodring, W. P., Geol. Surv. Domin. Rep., Mem. vol. 1, 1921, pp. 107, 108, etc.

[7] Anderson, F. M., Proc. Calif. Acad. Sci., vol. 17, 1928, p. 4.

[8] Liddle, R. A. The Geology of Venezuela, etc. 1928, pp. 54, 241, etc.

sometimes 1,500 feet in thickness. These are described as "dark-gray, sandy, micaceous, locally very fossiliferous shales, which gradually become more sandy toward the top," and passing without visible structural break into the Cerro Pelado formation (Miocene) consisting of "massive or flaggy and shaley sandstones interbedded with arenaceous lignitic shale." Each of these groups is discussed at length in the body of the book, and some indications given as to the faunas of each, together with notes as to their correlations.

Without offering any final judgment as to the faunas and the correctness of the correlations, it may be remarked in passing that the lists of molluscan genera and species given as representing the Agua Clara formation suggest its Miocene age, rather than Oligocene, and its equivalence, in part at least, to the Tubera group described later. These remarks do not apply, however, to the whole of the San Luis formation, which, according to Liddle, seems to be conformably overlaid by the Agua Clara group.

Concerning the Paují shales, and possibly a part of the San Luis formation, with the large Foraminifera *Lepidocyclina* species, there should be less question as to their Oligocene age. Their stratigraphic body and their fauna both seem comparable to the middle Oligocene of Santo Domingo, as described by Vaughan and Woodring.[9]

Along the Colombian north coast the Poso series described in the preceding pages is regarded as directly comparable to the latter, and therefore, also to the Paují shales and related strata of western Venezuela.

Age of the Poso series. Unconformable relations between the Poso series and the underlying Eocene have already been shown at the type locality of the former near San Sebastian, and in the Cerro de Cispata northwest of Lorica. In the conglomerates of the Poso series on the east slope of the Cerros de Las Palomas are found the cherts and other rocks of the underlying Eocene. Such facts are noted in other parts of the country.

[9] Vaughan, T. W., and Woodring, W. P., Geol. Surv. Domin. Rep., Mem. vol. 1, 1921, pp. 107-108.

Similar relations between the Poso series and the overlying Miocene were also pointed out in certain localities. Local evidence of such unconformity was found near Lorica as is shown in the report of Mr. John H. Ruckman, and near San Andres as noted on a preceding page.

As for the definite assignment of the Poso series to the Oligocene at the present time there is some reservation. It may be in part Miocene, though there are reasons for believing that the larger part of it is older. The series as a whole is clearly post-Eocene as has been said, and in view of the occurrence of undisputed Oligocene in other Antillean regions it should be expected to occur here also in commensurate volume.

The general absence of molluscan fossils, which are abundant in the Miocene of north Colombia, the more varied lithology of the Poso series, as contrasted with the known Miocene, the frequent occurrence of petroleum or its indications, not observed in the Miocene, and other features that could be mentioned, all suggest not only a different but older age than the Miocene of either of the groups that are described below.

The Miocene Series

Regarding the occurrence of Miocene deposits in Colombia, there is more satisfactory evidence than that regarding the Oligocene. On the geologic map of North America Willis shows later Tertiary deposits widely distributed over the northern parts of South America, particularly in the valley of the Orinoco, about Lake Maracaibo and in the valleys of northern Colombia, extending far into the interior of the country, along the Magdalena, the Cauca, the San Jorge and the Cesar rivers, about the Gulf of Urabá and along the west coast. Thence they extend into other countries bordering the Caribbean Sea.

The areas actually covered by Neocene deposits in Colombia are much smaller than that shown on the map, and strictly are confined to relatively narrow zones along the coasts and along some of the larger rivers. For example, marine deposits of Neocene age do extend along the valley of the Magdalena in more or less continuity to the delta areas at the mouths of the Rios Sogamoso and Carare, where marine deposits give place to only partly marine in the Oponcito group. Above this the Miocene deposits are continuous but transitional in character until they connect with the non-marine deposits of the Barzalosa group of the upper Magdalena previously described.[10]

A part of the marine Miocene strata of northern Colombia has already been described in earlier papers, though not the entire series. In fact, no complete statement of the marine sequence or of its distribution can be made at present. As for their distribution, the known Miocene deposits extend eastward from the Gulf of Urabá along the Colombian coast to the Sierra Nevada de Santa Marta, and beyond this range they occur again near Rio Hacha, and according to accounts they extend from there southward into the valley of the Rio Cesar, very possibly to its mouth where it connects with the Magdalena. At any rate they are believed to fill the entire valley above its mouth.

Washburn and White[11] have given a thick section of Tertiary sediments as occurring in the valley of the Rio Cesar, a large part of which is given a position between the lower Tertiary and the late Pliocene, but as no reference is made to fossils, it is impossible to conjecture what portion of the Miocene column is represented in the section.

Huntley and Mason[12] also give an immense section of presumably marine Miocene strata (after Bossler) as occurring in southwestern Colombia along the Pacific coast. Some of the sandy shales contain fossils, but there is no attempt to indicate what part of the Miocene they represent, if, indeed, it is known.

Eastward from the Gulf of Urabá the marine Miocene deposits are not quite continuous, and are, moreover, involved with older formations and are known only in part, as will be shown later.

Along the lower stretches of the Magdalena north of Mompos fossiliferous marine Miocene deposits underlie most of the surface, but in turn are also overlaid by later deposits, partly land-laid and partly marine. From the Magdalena the

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[10] Anderson, F. M., Bull. Geol. Soc. Am., vol. 38, 1927, pp. 612, etc.

[11] Washburn, C., and White, K. D., Tr. Am. Inst. Min. Met. Eng., vol. 68, 1923, p. 1026.

[12] Huntley, L. G., and Mason, S., Tr. Am. Inst. Min. Met. Eng., vol. 68, 1923, p. 1018.

Miocene deposits extend westward into the valley of the Rio San Jorge, and from there they pass into the valley of the Sinú, which they occupy in part. About the lower Sinú valley they enter into the composition of the lower hills near the coast, and possibly connect with the deposits along the coast about the Gulf of Morrosquillo. Miocene deposits overlie the Poso series near San Onofre and southward from this village toward Tolu and the Bay of Cispata. Along the coast to the southwest of Cispata Bay they appear again near Punta Piedras, Monitos, Bruquelles, Mangle, the Bay of Arboletes and farther toward the Gulf of Urabá, and along the Atrato river.

In all these points beyond the Bay of Cispata the strata stand at a high angle dipping toward the sea, and with a strike nearly parallel with the coast line. For the most part they appear to be only sparingly fossiliferous, though enough fossils have been found for the definite determination of the middle part of the Miocene. On the Quebrado de Murindo, a tributary of the Rio Canalete, some 15 miles from the coast, fossiliferous beds occur, standing at high angles, as will be described later, from which numerous molluscan species have been obtained.

In the districts about the lower Magdalena the Miocene deposits attain a great development, and a thickness much in excess of that found by the writer in other parts of the Colombian coast. In a former estimate of an incomplete section to the west of the river the thickness was given as 5,400 feet, or more. Other writers have given the thickness of the Miocene series in certain parts of the country as near 8,000 feet, but without detailed information as to the strata or the contained faunas.

Later study of the section in the district west of Barranquilla necessitates some modification of the divisions formerly proposed, since the apparent thickness is somewhat increased by faulting.

Briefly, three distinct groups of strata have been recognized here as shown below, of which the central group constitutes at least half the entire series as known at present. They are approximately, as follows:

Galapa (La Popa) group	1650 feet
Tuberá group	2650 feet
Las Perdices group	1000 feet
Total	5300 feet

Las Perdices group. In the earlier statement[13] referred to above there is a brief description of some 400 feet of strata outcropping near Las Perdices; about 15 miles west of Barranquilla, which appeared to be of Miocene age, but which also appeared to be separated from the overlying Tubera group by a disconformity. No definite name was proposed for these beds, but in the present paper the above name is proposed. The group as here exposed consists of clay shales, sandy shales and hard cherty, or siliceous beds and some sandstone.

The shales contain at this locality a few species of Mollusca, scales of fishes and bone fragments, sponge spicules and numerous Foraminifera, as mentioned in the former account. Samples of these shales were examined by Dr. G. Dallas Hanna, and his note regarding these forms is here included for completeness:

"The shales contain a very considerable number of fossils, the groups being represented about as follows in order of abundance: (1) Radiolaria; (2) Diatomaceæ; (3) Foraminifera; (4) Sponges; other organisms are scarce. There has been pyritization to a considerable extent and many of the chambers of the fossils are filled with iron sulphide. A great many of the diatoms have been replaced entirely and internal casts of the frustules are abundant. *Coscinodiscus* was the only genus definitely identified in this group. Many of the genera and some of the species of Radiolaria are the same as have been found in the famous deposit on Barbados Island and which Payne has put definitely in the Miocene. Some of the genera are: *Stylodictya*, *Histiastrum*, *Stylosphæra* and *Eucyrtidium*. Foraminifera are scattered rather sparingly through the mass of the material, the common genera being: *Globigerina*, *Orbulina*, *Lagena*, *Truncatulina*, *Cassidulina*, *Nodosaria*, *Anomalina*, *Frondicularia*, *Plectofrondicularia* and *Bolovina*. It is believed that these organisms offer a means whereby a definite correlation can be made with strata of known age elsewhere. This preliminary examination indicates that the formation lies very close to the base of the Miocene, if, in fact, it is not the lowermost part of the sediments of that period."

A few miles to the north of this locality and west of Puerto Colombia, similar shales are exposed along the sea cliffs for a mile or more, with a strike of nearly east to west, and a dip

[13]Anderson, F. M., Proc. Calif. Acad. Sci., vol. 16, 1927, p. 88.

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toward the south of 40° to 60°, and are here overlaid by fossiliferous sandstones of the succeeding group, which also dip southward. The underlying shales contain a variety of micro-organisms, among which are Foraminifera, scales of fishes, the following molluscan fauna and coral:

Cancellaria, new species.
Mitra mauryæ Anderson, new species
Scobinella morierei(?) (Laville)
Polinices prolactea Anderson, new species
Psammobia (*Gari ?*)
Turris albida (Perry)
Cassis (*Phalium*) *dalli* Anderson, new species
Drillia eupora Dall
Dentalium granadanum Anderson, new species
Cyathomorpha sp.

While most of the species are new, and therefore not at present serviceable for correlation, yet they are definitely of Miocene aspect; a few of them indicate a low position in this series. From the stratigraphic evidence they clearly belong beneath the Tuberá group, and are regarded as a northward extension of the Las Perdices group.

Some 10 miles to the west of Barranquilla, and extending to the southwest, the lowest beds of the Miocene are brought to the surface along the axes of a series of anticlinal folds, faulted in part, extending from near Puerto Colombia to the vicinity of Cienega de Oro, a total distance of over 100 miles. Beds believed to be Oligocene are also brought up beneath the Miocene.

Near the village of Usiacuri the lowest beds exposed consist of clay shales, shaley sandstone, and calcareous layers, in all some 600 feet in thickness which constitute a distinct stratigraphic group. These strata are here rather poor in molluscan remains, though microscopic marine organisms have been noticed in some of them. From such remains as have been found they are believed to be Miocene in age, and in part equivalent to those exposed along the beach west of Puerto Colombia, and at Las Perdices, or in other words to represent the Las Perdices group, as described above.

Near the top of this group at Usiacuri, springs of sulphurous water issue from the strata, which give to this village its repute as a health resort. The water is bottled and sold in the neighboring towns as a health beverage. Here the lower group terminates above by a lithologic change in the character of the sediments, which become suddenly more sandy, and at the same time they also acquire a rich fauna of marine Mollusca.

The line of separation between the Las Perdices group and the succeeding group here is probably near the springs of sulphurous water, or immediately below the village, which is situated on the east flank of the fold. No angular unconformity in the strata was found here, though it is suggested by the lithologic change, the abrupt appearance of the marine Mollusca, and by the springs of sulphurous water.

The thickness of the Las Perdices group is not at present known, though between Usiacuri and the axis of the fold to the west the exposed thickness of strata is probably not less than 1,000 feet. In other parts of the country it is believed to be greater.

From a comparison of the three localities thus far studied it can be said that a disconformity is indicated, and that it probably can be fully demonstrated by further work in this field.

Olsson described a disconformity between the Uscari formation of Costa Rica and the overlying Gatun,[14] and an overlap of the latter upon the older rocks of the region. Similar relations exist with regard to the Tuberá group as was shown by Mr. Ruckman's account of the district about the lower Sinú valley. The stratigraphic position of this disconformity in the Colombian Miocene seems to be lower than the base of the Gatun group as found in the Canal Zone. However, this disconformity has not been shown to exist in the Canal Zone, unless the Emperador limestone should prove to belong properly to a higher horizon than has usually been conceded for it. Vaughan has suggested that it may possibly find a place among the equivalents of the Langhian (Burdigalian) of Europe.[15] May it not also be possible that the Uscari formation of Olsson and the Las Perdices group of the present paper, when fully known, will find a similar place in the sequence of Antillean stratigraphy?

The Tuberá group. In the earlier paper to which reference has been made the writer gave a brief summary of the

[14] Olsson, A. A., Bull. Am. Pal., vol. 9, 1922, p. 784.
[15] Vaughan, T. W., Bull. Geol. Soc. Am., vol. 35, 1924, p. 731.

Colombian marine Miocene deposits as found in the vicinity of the lower Magdalena valley. On the basis of its fossil zones it was divided into horizons, lettered respectively from M to T in ascending order.

The name *Tuberá group* was first suggested for this sequence of strata in 1926[16] but without any definite delimitation. Later the name was employed in a more definite treatment,[17] and while recognizing the three distinct fossil horizons, namely M - N, P, and R, the faunal contents of only the lower, M - N, was given, consisting of some 64 species of Mollusca. A tentative correlation of this and the succeeding horizons was suggested, but without elaboration, since for the two upper horizons no faunal lists were given.

The sequence of strata embraced in the Tuberá group has a thickness of not less than 2,650 feet. It consists for the most part of incoherent sandstones and sandy shales, divisible into some local lithologic members, though none that seems to have any great areal extent. No conspicuous and essentially organic members have been discovered.

The fossil horizons probably have greater geographic range and stratigraphic value. The group is well represented about Tuberá mountain and its environs, whence the name. Of the sequence forming this group, horizon M - N is, at its type locality, confined to the lower 550 feet. Horizon R falls within the upper 600 feet, while horizon P occupies a position near the middle, and is probably embraced within a stratigraphic range of 300 to 400 feet.

Between these several horizons the beds are somewhat barren of fossils, in the immediate district about Tuberá mountain, and in fact as far as known elsewhere along the coast.

In its geographic distribution the Tuberá group extends over a wide region, and it appears to represent the more usual facies of the Colombian Miocene, whereas the older group has been definitely detected only within restricted areas. Within the limits of north Colombia this group has been recognized at such distant points as the Gulf of Urabá, Arboletes Bay, Rio Canalete, Lorica, San Andres, Zambrano, El Banco, Turbaco, Cartagena, Punta Pua, Tuberá mountain, and along the

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[16]Anderson, F. M., Bull. Amer. Assoc. Petrol. Geol., vol. 10, 1926, pp. 387 & 399.
[17]Anderson, F. M., Proc. Calif. Acad. Sci., vol. 16, 1927, pp. 87-90.

west flank of the Sierra Nevada de Santa Marta. However, it is believed to extend much farther, as into the valleys of the Rio San Jorge and the Rio Cesar. Only a few of the localities in which the group occurs can be considered in detail at the present time.

Local occurrences. Among the several districts in which the Tuberá group has been proved is that of the upper drainage of the Quebrada Murindo, a tributary of the Rio Canalete draining the west slope of the Las Palomas range. The district lies some 12 to 15 miles from the coast and somewhat farther from Monteria. Mr. K. D. White, who visited this district, describes in detail a sharply folded anticline traversing it in a north to south direction, on the opposite sides of which he gives stratigraphic sections respectively 3,000 and 5,000 feet in thickness. Of these B - B is much the less complete, since it does not reach the axis of the fold. Section C - C crosses the axis upon which are found various seepages of oil, not found on the other.

Of the latter section some 2,300 feet of the lower part is not fossiliferous. Fossils are found throughout section B - B, but through only the upper part, 2,700 feet, of section C - C. These sections are respectively represented by the numbers 354 and 355, from which were obtained the following partial lists of species:

Loc. 354 (C. A. S.)	Loc. 355 (C. A. S.)
Pitaria tryoniana (Gabb)	*Pitaria cora* (Brown & Pilsbry)
Cardium dominicense Gabb	*Cardita scabricostata* Guppy
Cardium venustum (?) Gabb	*Cardium lingualeonis* (?) Guppy
Chama scheibei Anderson	*Cyclinella gatunensis* Dall
Pecten vaginulus (?) (Dall)	*Tellina cibaoica* (?) Maury
Cyclinella gatunensis Dall	*Arca trinitaria* Guppy
Conus consobrinus Sowerby	*Polinices subclausa* Sowerby
Conus molis Brown & Pilsbry	*Oliva gatunensis* Toula
Turritella altilira Conrad	*Potamides avus* Brown & Pilsbry
Fusinus henekeni (Sowerby)	*Bullaria paupercula* Sowerby
Terebra cirra Dall	*Strombus proximus* Sowerby
Serpulorbis sp.	*Strombina* sp.

Many other species could be added to these lists, but the number is perhaps sufficient. The lithologic character of the strata from which they come is similar to that of the Tuberá group, and is in contrast with the underlying barren beds in which the seepages of oil occur along the axis of the fold.

Near San Andres the Tuberá group is represented by sundry localities, containing representative species, as the following:

Loc. 302 (C. A. S.), four miles south of San Andres
Cylichnella gatunensis Dall
Mactrella elegans (Sowerby)
Natica guppyana Toula
Architectonica gatunensis (?) Toula

Loc. 303 (C. A. S.), three miles east of San Andres
Chione walli Guppy
Tellina gatunensis (Toula)
Surcula servata Conrad
Arca sp.

Loc. 350 (C. A. S.) Arboletes Bay
Tivela mactroides (Born)
Cardium lingualeonis Guppy
Cardium haitense Sowerby
Chione mactropsis (Conrad)
Bullaria paupercula (Sowerby)
Olivella indivisa Guppy
Potamides avus Brown & Pilsbry
Bittium adele Dall

At the hamlet Jesus del Monte, between Carmen and Zambrano, near the base of the Miocene were obtained:

Turris albida (Perry)
Cancellaria sp.
Arca sp.
Natica guppyana (?) Toula
Turritella altilira (?) Conrad
Glycymeris sp.

At the village of El Banco on the Rio Magdalena, some 170 miles above Barranquilla, a zone of crystalline rocks crosses the course of the stream. On the east flank of this zone at the mouth of the Rio Cesar, and immediately beneath the village, there are soft yellowish brown sandstones overlaid by blue clay shales forming a part of a thicker series which presumably rests upon the pre-Tertiary crystalline rocks, which crosses the river to the west. The sandstones have a gentle dip, 6° to 8°, to the eastward. One stratum is largely composed of broken and decomposed marine shells, but beneath this are standstones from which better preserved fossils may be obtained. Only a few species were collected, but a number of genera were recognized in these beds, including, *Arca, Glycymeris, Chione, Ostrea, Anomia, Pecten, Olivella, Turritella, Terebra, Phos, Polinices* and many others. None of the species characteristic of the lower horizon of the Tuberá group were found, while nearly all of them were such as are found abundantly in the higher beds, horizon P of this group.

In view of the occurrence of the older crystalline rocks to the west, and the easterly dip of the Miocene beds, this occurrence may be regarded as belonging to the Tertiary area of the valley of the Rio Cesar, rather than to that of the lower Magdalena. The crystalline rocks here may be interpreted as forming a connecting link between the pre-Tertiary area of the Sierra Nevada and that of the Cordillera Central, as stated elsewhere.

Comparison of horizons. At most places in Colombia where the Miocene beds have been noted by other writers they have been indiscriminately mentioned as representing the Gatun formation of the Canal Zone, though the definite basis for this view has not been given. However, in truth, most of the accessible exposures do represent horizons above that of M - N, the lowest part of the Tuberá group. Whether this fact is due to overlap of the later horizons beyond the limits of the lower, or to other circumstances of deposition can not now be stated.

On the basis of faunal content only the middle portion of the Tuberá group should be regarded as the equivalent of the Gatun formation of the Canal Zone. The expansion of the name "Gatun" to include all of the Miocene sequence, even where the sequence is a conformable series, does not appear to the writer as justifiable.

The number of molluscan species obtained from the entire group by the writer has not exceeded 165, though from lists published by Dr. Pilsbry and others the total number could be considerably increased. Of the entire number obtained 38 species are added in the present contribution as new species, and doubtless many others will subsequently be found.

The stratigraphic range of many of these forms is of course not known at present. Some of them doubtless range throughout the Miocene while others are of short stratigraphic duration.

For the purpose of correlation a list of 86 of the better known species have been selected from the total number as being most representative. This list segregates the species as to horizons, as far as known at present. Little more than a tentative attempt is claimed for the segregated lists as they here appear.

Species	Tuberá Group			Other Regions		
	M-N	P	R	Cercado	Gatun	Tampa
Terebra sulcifera Sowerby	*					
Terebra gatunensis Toula				*	*	
Terebra cirra Dall				*		
Terebra haitensis Dall		*		*		
Terebra bipartita Sowerby						*
Conus sewalli Maury		*		*	*	
Conus imitator Brown & Pils	*	*			*	
Conus molis Brown & Pils	*	*	*	*	*	
Conus recognitus Guppy		*	*	*	*	
Conus planiliratus Sowerby	*					
Conus stenostomus Sowerby	*			*	*	
Turris albida (Perry)	*	*		*	*	
Drillia eupora Dall						*
Cancellaria dariena Toula		*			*	
Cancellaria guppyi Gabb		*		*		
Cancellaria cossmanni Olsson		*			*	
Turritella altilira Conrad	*	*			*	
Turritella perattenuata Heilp	*					
Turritella fredeai Hodson	*	*				
Turritella mimetes Brown & Pils		*			*	
Turritella gatunensis Conrad		*			*	
Turritella cartagenensis Brown & Pils		*				
Crucibulum gatunense (Toula)		*			*	
Architectonica granulata (Lamarck)		*			*	
Architectonica quadriseriata (Sow.)		*		*	*	
Natica guppyana Toula	*	*			*	
Natica cuspidata Guppy	*					
Polinices subclausa Sowerby		*	*	*	*	
Calliostoma grabaui Maury	*		*	*		
Calliostoma olssoni Maury		*	*			
Oliva cylindrica Sowerby	*	*		*	*	
Oliva sayana Ravenel		*	*		*	
Oliva brevispira Gabb	*	*		*		
Marginella ballista Dall		*				*
Marginella conformis Sowerby		*			*	
Mitra dariensis Brown & Pils		*			*	
Mitra longa Gabb	*	*		*	*	
Scobinella morierei (Laville)					*	
Fasciolaria kempi (Maury)	*	*			*	
Fusinus henekeni (Sowerby)			*	*		
Murex domingensis Sowerby		*		*		
Murex mississippiensis Conrad		*				*

Species	Tuberá Group			Other Regions		
	M-N	P	R	Cer-cado	Ga-tun	Tam-pa
Typhis siphonifera Dall..................		*				*
Distortrix simillima (Sowerby)...........		*	*		*	
Cyprea henekeni Sowerby...............	*				*	
Cyprea gabbiana Guppy.................		*				
Malea ringens (Swainson)...............		*	*		*	
Sconsia lævigata (Sowerby)..............	*	*		*	*	
Strombina chiriquiensis Olsson...........		*			*	
Serpulorbis papulosa Guppy..............	*	*				
Serpulorbis granifera (Say)..............		*				
Petaloconchus sculpturatus Lea..........	*	*			*	
Arca patricia Sowerby..................	*	*		*?		
Arca macdonaldi Dall..................	*	*			*	
Arca actinophora Dall..................		*			*	
Arca dariensis Brown & Pils..............		*			*	
Arca lloydi Olsson......................		*			*	
Glycymeris jamaicensis Dall.............	*	*				
Glycymeris carbasina Brown & Pils.......					*	
Glycymeris lamyi Dall..................		*			*	*
Ostrea megadon Hanley.................	*	*				
Pecten mortoni Ravenel.................	*	*			*	
Pecten demiurgus Dall..................	*					
Pecten pinulatus Toula..................	*				*	
Pecten bowdenensis Dall................		*				
Spondylus bostrychites Guppy...........	*			*		*
Crassatelites densus Dall................	*	*				*
Venericardia brassica Maury............	*					
Cardita arata (Conrad).................	*					*
Cardita scabricosta Guppy..............	*	*	*	*	*	
Echinochama antequata Dall............	*	*		*	*	
Cardium domingense Gabb..............		*			*	
Cardium lingualeonis Guppy.............	*	*				
Cardium gorgasi Hanna.................	*		*		*	
Cardium serratum Linnæus..............		*			*	
Cardium venustum Gabb................		*				
Dosinia delicatissima Brown & Pils........		*			*	
Dosinia acetabulum (?) Conrad..........		*			*	
Clementia dariena (Conrad).............	*	*			*	
Cyclinella gatunensis Dall...............			*		*	
Cyclinella cyclica (Guppy)...............		*				
Antigona caribbeana Anderson...........	*	*			*?	
Antigona blandiana (Guppy).............	*	*				
Callocardia gatunensis Dall..............		*			*	

Species	Tuberá Group			Other Regions		
	M-N	P	R	Cercado	Gatun	Tampa
Pitaria circinata (Born)			*		*	
Pitaria cercadica Maury	*		*	*		
Macrocallista maculata Linnæus	*	*			*	*
Chione nuciformis Heilprin		*				*
Chione mactropsis (Conrad)	*	*			*	
Chione latilirata (Conrad)	*	*				
Tellina dariena Conrad		*			*	
Tellina gatunensis (Toula)	*	*			*	
Semele sardonica Dall		*				*
Mactrella elegans (Sowerby)	*					
Labiosa gibbosa (Gabb)		*	*			
Labiosa gardneræ Spieker		*	*			

Galapa-La Popa group. In the table of correlations here included, above the uppermost horizon of the Tuberá group there is a considerable sequence of beds the exact position of which in the column may be subject to debate. On account of their apparent conformity with the Tuberá group they are here regarded as of Miocene age, though they may be younger. Such beds are found in the neighborhood of Galapa to the south of Barranquilla, and also at the base of La Popa hill near Cartagena. Near Galapa they consist of little consolidated beds of calcareous sandstone, while at La Popa hill and about the Harbor of Cartagena they consist of well-stratified but somewhat incoherent sandy shales and clays with calcareous layers of marl.

In the former locality the strike is generally N. 20° E. and the dip is easterly. The thickness is not definitely known, though an estimate of 1,650 feet is believed to be conservative. They are rich in marine fossils, among which *Pecten* predominates although *Dosinia, Cardium,* and various gastropod forms have been found.

The La Popa formation found in the vicinity of Cartagena has an aggregate thickness of 1,000 feet, or more, though it is not well exposed. The structural condition exhibited in these deposits is at variance with those of Galapa, in that the district is traversed by east to west faults that produce scarps of some prominence, as seen in the south face of La Popa hill itself, and in the north face of the hill of Cospique on the east side of the Harbor.

In the syncline lying between the Tuberá-Piojo uplift and the coast similar beds are found of which the contained fossils cannot now be given.

These beds do not appear to cover the general areas of the older Miocene, but are local and are, as far as known, confined to districts near the present coast. None have been observed far inland. Not only are they conformable upon the Tuberá group in the districts where they have been observed, but they participate in the structural features of the latter.

From the fact that they are not coextensive with the Tuberá group, but are local in their occurrence, it may well be surmised that they do not form a continuous series with it, but may be separated from it by an unconformity the significance of which should not be overlooked. Possibly an uplift of the land areas near the close of the Miocene excluded the sea from the larger part of the region previously covered by it. For these reasons it would be well to reserve final judgment as to the proper position of the Galapa group until more data are obtained than the writer possesses at the present.

Pliocene Deposits

Contrary to the view expressed in the preceding paragraphs, the late Miocene epoch has often been regarded as one of uplift for the general region of the Caribbean. This was at one time apparently the view of Dr. Vaughan,[17a] in whose conception an extensive emergence of land areas in late Miocene time was followed by warping and local submergence during the Pliocene, concerning which he says in part:

> "Subsequent to the Miocene there have been many oscillations of the West Indian area, and during perhaps Pliocene time there was profound deformation."

In the same paper Dr. Vaughan regards the Toro limestone of the Canal Zone as of Pliocene age, and with it classes

[17a] Vaughan, U. S. Nat. Mus. Bull. 103, 1919, pp. 608-609.

also certain deposits of Limon, Costa Rica, and others far to the east. Concerning the district about the lower Magdalena with which the present paper deals, he says (p. 594):

"Mr. George C. Matson collected at Barranquilla, Colombia, some fossils that belong to a fauna younger than that obtained around Usiacuri, and may be of Pliocene age."

The rocks classed tentatively as Pliocene by the present writer are abundant around Barranquilla and the mouth of the Magdalena. A good section is found along the railroad between Puerto Colombia and Salgar. The strata here undulate, but on the whole dip 10° eastward along the shore. The following sequence is the result of careful study of the beds exposed here:

d. Upper coral limestone	250 feet
c. Incoherent sandstones	350 feet
b. Lower coral limestone	160 feet
a. Sandy clay shales	150 feet
Total thickness	910 feet

These limestones contain a great variety of corals and many Mollusca including *Cyprea,* two species of *Codakia,* many species of *Pecten,* oysters, and various gastropods. The coral limestones resemble that in the quarries at Barranquilla, and, in fact, their connection is not difficult to trace on the surface. In these quarries which are worked for lime, there is a greater variety of corals than on the beach, and also of Mollusca. Here and in most places the corals and shells are largely reduced to the condition of soft marls in which are some harder layers and lenses of coral rock. These beds may be followed along the Galapa road for many miles, where they are almost always horizontal in attitude. They seem to have been at one time more extensive toward the west but have suffered much denudation, leaving the limestone more or less local in its present occurrence.

Quite similar beds cover the top of La Popa hill near Cartagena, but here rise to an elevation of some 500 feet above the sea and have an inclination of about 15° or more toward the north. They form here a distinct reef, 75 to 80 feet in thickness, resting upon marly shale of about equal thickness which is underlaid by the sandy shales of the La Popa formation. Beds of the same character cover the top of the hill of Cospique, and occur also at Turbaco at an elevation of about 500 feet above the sea. Corals and molluscan shells are abundant in all of these points, and are usually reduced to characteristic marl.

These supposed Pliocene deposits with coralline reefs of the sort here described occur at intervals along the Colombian coast, apparently not always resting upon the same horizon of the Miocene. Such beds are found on the island of Terra Bomba, Isla de Baru, Bayunca, and at points beyond the Bay of Cispata.

The general attitude of these coral reefs and the associated beds does not appear to be harmonious with the underlying Miocene. They were not observed above an altitude of 500 feet, while the Miocene often rises to much greater heights. The deposits appear to be in some respects, and in some places, unconformable upon the underlying Miocene, though a clear case of unconformity was not found.

With regard to age there are some general stratigraphic facts that may be mentioned. Elevated beaches and late Quaternary deposits of beach origin skirt the hills near sea level, and Quaternary gravels form old valley floors in many parts of the country and along the coasts. Such deposits are nearly always horizontal, and clearly have no relation to the supposed Pliocene deposits, except to show their distinctly more recent origin.

Only a few of the fossil corals so abundant and varied in these deposits have received any attention. Three species only have been noted from the reef on La Popa hill. On a visit to Cartagena in 1898 the Princess Theresa von Bayern personally went to the summit of La Popa hill and collected four specimens of coral from the reef that caps the same. These corals were left at the Academy of Sciences at Munich, and were later described by Herr Johanes Felix, under the following names:

Orbicella theresiana Felix
Isastræa turbinata Duncan
Stephanocœnia fairbanksi (?) Vaughan

Concerning the first of these species Dr. Vaughan says that it is "probably a synonym of *Solenastrea bournoni* M. Edwards & Haime." Felix was unable to reach any conclusion as to age from his study of these corals, though he thought they were probably Miocene.

Correlations

While exact correlations of the Colombian Tertiary groups and horizons with others of the Caribbean and Central American regions can not yet be made with complete confidence, a tentative attempt, based upon known facts may be well worth while.

On the whole the Miocene series and groups seem to correspond fairly well with those of Santo Domingo, as for example the Yaque group, with the possible exception of its lowest member, the Baitoa formation, containing species of *Orthaulax* and associated forms. The fauna of the Las Perdices group is not yet well known, but with further search it may well prove to be the equivalent of the Baitoa, as suggested in the accompanying table. Horizon M - N of the Tuberá group lacks the species that characterize the Baitoa formation, and that are found in similar lower Miocene deposits of the Gulf Coast which have been correlated with it. On the other hand, a comparative study of its fauna shows horizon M - N of the Tuberá group to be more closely related to the Cercado formation of the Yaque group than to any of the others, as the following statements will show.

Of the 64 molluscan species thus far found in this horizon, only 15 appear in the list from the Gatun formation given by Brown & Pilsbry, as enumerated by Vaughan.

Of the species found in the Cercado formation, according to Maury, something more than 5 per cent are found also in the recent Antillean fauna. Of the 64 species of horizon M - N, not more than four are also found in the living faunas of the Pacific and Caribbean seas, and the number may be less. In any case it will not exceed 7 per cent of recent species, and this estimate is liberal.

Horizon P of the Tuberá group shows even stronger resemblance to the Gatun formation of the Canal Zone. Of the

Correlation Table

		Canal Zone	Costa Rica	Jamaica	Santo Domingo	North Colombia	Florida	Europe
Pliocene		Limon Bay limestone (MacDonald)	Limon, Monk. Point, Bocas conglomerate (Olsson)		Las Matas stage	Top of La Popa, Cartagena. Salgar and Barranquilla marl	Caloosahachee marl, etc.	
Miocene	Upper		"Upper Gatun" (Olsson)		Cerro de Sal (South side)	Galapa group, Base of La Popa, Arbolete (in part) T....... 1650′	Jacksonville formation	Sarmatian
	Middle	Gatun beds 500 ft. (MacDonald)	"Typical Gatun" (Olsson)	Bowden marl	Yaque Group: Mao Clay, Mao Adentro limestone	Tuberá Group: S....... 200′; R....... 600′		Tortonian
					Yaque Group: Gurabo formation (Sconsia lævigata)	Tuberá Group: Q....... 450′; P....... 400′		Helvetian
	Lower		"Lower Gatun" (Olsson)		Yaque Group: Cercado formation (Aphera islacolonis)	Tuberá Group: O....... 450′	Alum Bluff: Unconformity; Shoal River; Oak Grove	Upper Langhian
			Unconformity			Tuberá Group: M-N.... 550′; 2650′	Alum Bluff: Chipola marl (Orthaulax sp.)	Lower Langhian
		Emperador limestone ?	Uscari stage (Olsson)		Yaque Group: Baitoa format'n (Orthaulax sp.) Bulla conglom.	Las Perdices group 600′-800′	Tampa beds (Orthaulax sp.)	Aquitanian
Oligocene		Culebra ? Bohio conglomerate		Trelawny limestone	Cervicos limestone	Poso Series ?	Marianna limestone	Chattian

86 species contained in the foregoing lists from the Tuberá group, 37 are common to horizon P and the Gatun group, and of these 24 do not appear in the older beds of horizon M - N. Among the species not found in horizon M - N, but which appear to characterize the next fossil horizon and the Gatun as well, as found at the Spillway, are the following:

Malea ringens (Swainson)	*Clementia dariena* (Conrad)
Sconsia lævigata (Sowerby)	*Callocardia gatunensis* Dall
Distortio simillima (Sowerby)	*Arca actinophora* Dall
Mitra dariensis Brown & Pilsbry	*Arca dariensis* Brown & Pilsbry
Conus sewalli Maury	*Tellina dariana* Conrad
Cancellaria dariana Toula	*Dosinia delicatissima* Brown & Pils.
Crucibulum gatunense (Toula)	*Cardium domingense* Gabb
Turritella mimetes Brown & Pilsbry	*Cardium serratum* Linnæus

To these others could be added, but are perhaps unnecessary. An indirect evidence of their equivalency gives even better support.

Although A. A. Olsson[18] appears to have expanded the "Gatun group" to include beds both higher and lower than the strata found at the Spillway of the Canal, he counts no less than 334 species, of which he says about 13 per cent are identical, or closely related, to recent species. Of the 117 species found in horizon P, 15 are represented in the recent faunas on the two sides of the Isthmus, or about 12.8 per cent, a figure very close to that of Olsson.

Continuing the parallel comparisons, it can perhaps be shown that the equivalents of the Bowden fauna are to be found in horizon R of the Tuberá group, and above it, though this is not apparent in the foregoing lists.

The correlations suggested in the table for the series older and younger than the Miocene are tentative only, and have been sufficiently discussed in the preceding pages, the former under the heading of Stratigraphic relations of the Poso series, and the latter under other appropriate headings, to which little can be added here.

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[18] Olsson, A. A., Bull. Amer. Pal., vol. 9, 1922, pp. 183, 188, etc.

Description of Species

On the following pages are noted most of the species that have been recognized in the marine Miocene groups of north Colombia, but without any claim of supplying an exhaustive list of the same. Without the aid of large collections of material from these groups that are available for comparison in other institutions of the country, much reliance has necessarily been placed upon published figures and descriptions which presumably were intended to be adequate for this purpose. Some of the Miocene forms from the Carribbean region have, unfortunately, been illustrated by unsatisfactory figures, but where this is the case the author of such has little ground for complaint if other writers fail to recognize his species. In many such cases later writers have gratuitously supplied better figures, and where this has been done recourse has been had to them. Photographic illustrations are thus available in the valuable contributions of Miss Maury, A. A. Olsson, W. P. Woodring, Dr. Pilsbry and his co-workers, and by others, so that one need not often go astray in his determinations of the better known forms.

As might have been expected from the backward state of paleontologic study in the marine Miocene of South America, some new species have been brought to light, and when the material has justified it these new forms have been entered in the lists with proper description. In addition, a few forms already known from other Antillean regions have been illustrated with, or without description when this has seemed desirable.

The order in which the species have been taken up is almost without regard to any scheme of taxonomy, but merely that of a convenient arrangement of the forms noted.

March 29, 1929

Gastropoda

1. **Terebra sulcifera** Sowerby

Terebra sulcifera Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 47; Miocene, Santo Domingo.—Guppy, (part) Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 525, pl. 29, fig. 8; Loc. as above.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 186, pl. 3, fig. 12; Loc. as above.

This species is the largest of the Terebras found in the Caribbean Miocene, one incomplete specimen of 10 whorls measuring 95 mm. in length and 22 mm. in width near the base. If complete, this specimen would have a length of over 120 mm. In size, as well as in the sculpture of the mature shell, this form resembles *T. petiti* Maury (not *T. petitii* Kiener), though the younger shells clearly have the sculpture described by Maury for *T. sulcifera* Sowerby, and these features are shown in the younger whorls of all the examples.

This species was found at Loc. 267, C. A. S., in horizons M - N and R, and accordingly at the base and near the top of the Tuberá group, and presumably its range is throughout the same.

2. **Terebra clethra** (?) Maury

Terebra clethra Maury, Monog. Foss. Ter. Brazil, vol. 4, 1925, p. 198-9, pl. 10, fig. 3; Lower Miocene, Rio Pirabas.

Maury's type of this species was either of a small and rare form, or it was the earlier whorls of a larger species. The figure is said to have been drawn from a cast. Two specimens found near Usiacuri, Loc. 306, both incomplete, are 65 mm. in length, if entire. In form and ornamentation they resemble Maury's type too nearly to permit their separation at present.

3. **Terebra gatunensis** Toula

Terebra (Oxymeris) gatunensis Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 705, pl. 25, fig. 14; Gatun formation, Canal Zone.

Terebra gatunensis, Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 339, pl. 22, fig. 2; Gatun formation, C. Z.—Maury, Bull. Am. Pal. vol. 5, 1917, pl. 4, fig. 5; Cercado de Mao, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 208, pl. 1, figs. 4, 5, 6; Gatun stage, Canal Zone.

This species was found in the clay shale near the top of the Tuberá group, horizon R, to the west of the Tuberá mountain.

4. **Terebra cirra** Dall

Terebra (*Acus*) *bipartita* SOWERBY, variety *cirrus* Dall, Proc. U. S. Nat. Mus., vol. 18, No. 1035, 1895, p. 38. River Amina, Santo Domingo; Miocene.

Terebra (*Oxymeris*) *bipartita* DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, pl. 59, figs. 13, 28, 29; Miocene, Santo Domingo.

Terebra cirra DALL, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 189, pl. 3, fig. 17; Miocene, Santo Domingo.

This species has been found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group, and at Loc. 306, C. A. S., at the eastern border of Usiacuri village at about the same horizon. It has been collected also at Loc. 299, C. A. S., two miles southwest of Baranoa; Loc. 325 and 325-A, C. A. S., all representing horizon P of the Tuberá group, of the Colombian Miocene.

5. **Terebra haitensis** Dall

Terebra (*Hastula*) *haitensis* DALL, Proc. U. S. Nat. Mus., vol. 18, 1895, p. 35.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 35, pl. 59, fig. 30; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 207, pl. 1, fig. 3; Gatun Stage, Costa Rica.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 194, pl. 4, fig. 4; Cercado de Mao, Miocene, Santo Domingo.

This species has been obtained at Loc. 299, southwest of Baranoa, and at Loc. 351, C. A. S., near Punta Pua, both near the middle of the Tuberá group of the Colombian Miocene.

6. **Terebra bipartita** Sowerby

Terebra bipartita SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 47; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 187, pl. 3, fig. 14; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal. vol. 9, 1922, p. 207, pl. 1, figs. 1, 2; Miocene, Costa Rica.

Terebra (*Acus*) *bipartita* SOWERBY, DALL, Proc. U. S. Nat. Mus., vol. 18, 1895, p. 38; not *T.* (*Oxymeris*) *bipartita* (Sow.) Dall, 1903, pl. 59, figs. 13, 28, 29, loc. cit.

This species has been found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group, 20 miles north of Cartagena.

7. Conus sewalli Maury

Conus sewalli Maury, Bull. Am. Pal., vol. 5, 1917, p. 201, pl. 5, fig. 3; pl. 6, fig. 3; Cercado de Mao, Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 220; Gatun Stage, Canal Zone, Panama.

Excellent examples of this shell were obtained at the Spillway of the Canal in 1914; it has since been found at two localities in northern Colombia, namely, Loc. 304, C. A. S., four miles east of Santa Rosa, and at Loc. 351, C. A. S., near Punta Pua. Both are at central horizons of the Tuberá group.

8. Conus veatchi Olsson

Conus veatchi Olsson, Bull. Am. Pal., vol. 9, 1922, p. 216, pl. 2, figs. 5, 8; Gatun Stage, Canal Zone, Panama.

Only a single imperfect example of this species was found, and it was obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, at the west foot of Tuberá mountain.

9. Conus imitator Brown & Pilsbry

Conus imitator Brown & Pilsbry, Proc. Acad. Nat. Sci., Phila., vol. 63, 1911, p. 342, pl. 23, fig. 4; Gatun formation.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 217, pl. 2, fig. 6; Gatun Stage, Canal Zone, Miocene, Costa Rica.

This species was found at various localities in the Colombian Miocene. In many respects it resembles *C. chipolanus* Dall, from a low horizon of the Gulf Coast. It occurs at Loc. 267, C. A. S., horizon M - N; Loc. 325-A, C. A. S., near Cibarco; Loc. 351, C. A. S., near Punta Pua; most of these are at central horizons of the Tuberá group.

10. **Conus molis** Brown & Pilsbry

Conus molis Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 343, pl. 23, fig. 1; Miocene, Canal Zone.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 200, Cercado de Mao, Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 214, pl. 2, figs. 1, 2; Miocene, Costa Rica.

This species occurs quite abundantly in the Tuberá group of the Colombian Miocene, but can not be regarded as a horizon marker. It has been obtained at Loc. 267, C. A. S., horizon M - N; horizon P, and horizon R; also at Loc. 299, near Baranoa; Loc. 304, C. A. S., near Santa Rosa; and Loc. 351, C. A. S., near Punta Pua. Its occurrence is therefore at nearly all horizons of the Tuberá group.

11. **Conus granozonatus** Guppy

Conus granozonatus Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 5; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 222, pl. 3, fig. 15; Gatun Stage, Costa Rica.

A single good specimen of this species was obtained at Loc. 351, C. A. S., near Punta Pua. It is slightly larger and more robust than appears in either Guppy's or Olsson's figures, although in other respects the identification is satisfactory.

12. **Conus recognitus** Guppy

Conus solidus Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45; Miocene, Santo Domingo; not *C. solidus* Sowerby, Conch. Illust., 1841, pl. 56, No. 76.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 1; Miocene, Jamaica.

Conus recognitus Guppy, Proc. Sci. Assn. Trinidad, 1867, p. 171.—Guppy, Geol. Mag., vol. 1, 1874, p. 409; new name proposed.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 527.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1583.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 209, pl. 7, fig. 9; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 218, pl. 2, fig. 9; Miocene, Costa Rica.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 327, pl. 19, fig. 2; Miocene, Santo Domingo.

This species is one of the most abundant in the Tuberá group of the Colombian Miocene. Like *C. molis,* it is not regarded as a horizon marker, since it is found at various levels. It has been obtained at Loc. 267, C. A. S., horizons

P and R, and at Loc. 325-A, and 351, C. A. S., the latter of which is central in the Tuberá group.

13. **Conus planiliratus** Sowerby

Conus planiliratus Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 44. —Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 7; Miocene, Santo Domingo.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1583.

A single specimen of *C. planiliratus* was obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group. It has not been found at any other horizon, as far as known.

14. **Conus stenostomus** Sowerby

Conus stenostomus Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 44; Miocene, Santo Domingo.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 2.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 203; Cercado de Mao, Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 214, Gatun Stage, Canal Zone.

Only a single good example of this species was obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, at the west foot of Tuberá mountain. According to Olsson, it occurs in the Gatun Stage of Port Limon, and Maury lists it from the upper Miocene of Springvale, Trinidad Island.

15. **Conus concavitectum** Brown & Pilsbry

Conus concavitectum Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 341, pl. 23, figs. 5, 6; Gatun formation, Canal Zone.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 215; Gatun Stage, Canal Zone.

Three specimens of this species were obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, which horizon is believed to closely represent the Gatun horizon of the Canal Zone, Panama.

16. **Conus burckhardti** (?) Böse

Conus burckhardti Böse Bull. Inst. Geol. de Mex., No. 22, 1906, p. 50, pl. 5, figs. 39, 40.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 224, pl. 3, figs. 4, 5; Miocene, Gatun Stage, Panama.

A single specimen of *Conus* that seems referable to the Mexican species was obtained at Loc. 351, C. A. S., near Punta Pua. In this example the spire is distinctly different from that of Böse's species in having the upper surface of the whorls rounded, or somewhat angulated along a median line, thus forming a succession of sloping steps, rather than a smooth, regular slope. In most respects, however, the shell closely resembles the Mexican form. A number of well preserved examples of *C. burckhardti* was obtained at the Spillway of the Canal in 1914, though none of them show the form of spire noted in the present example.

17. **Conus consobrinus** (?) Sowerby

Conus consobrinus SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45. —GUPPY, Geol. Mag., vol. 1, 1874, p. 409, pl. 17, fig. 3.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 203, pl. 6, figs. 5, 6; Miocene, Santo Domingo.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 330, pl. 20, figs. 7, 7a, 7b; Miocene, Santo Domingo.

Two examples of a *Conus* found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, closely resemble Sowerby's species, although there are some differences of sculpture in the last whorl. In our examples the minute beads on the spiral ribs are rounded instead of being elongated, as in Sowerby's form. The lines of growth are arcuate, and in other respects the characters are nearly identical with those of Sowerby's species.

18. **Conus tortuosopunctatus** Toula

Conus (*Cheliconus*) *tortuosopunctatus* TOULA, Jahrb. der K. K. Geol. Reichs., Wien, Bd. 61, 1911, p. 507, pl. 31, fig. 21, b.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 226, pl. 3, figs. 6, 11; Gatun Stage, Canal Zone.

It would appear from the figures given by Toula and Olsson that the height of spire in this species is variable, as is so often the case. In our examples the spire is intermediate in height between the extremes found in these figures. In other respects the identification is completely satisfactory. These samples come from Loc. 351, C. A. S., near the middle of the Tuberá group, probably near the horizon of P, at Tuberá mountain.

19. **Conus tuberacola** Anderson, new species

Plate 9, figures 4, 5

Shell of medium size, probable height of holotype (incomplete) 54 mm., width 3.4 mm., spire high, concavely turrited, earlier whorls coronated; last two or three whorls smooth, but slightly excavated above; sides of older specimens smooth, in younger shells the sides are adorned with minute spirally arranged beads, chiefly on the lower half of the shell; aperture narrow. The shoulders of the last whorl sharp and abrupt; lines of growth strongly curved.

This shell resembles *C. consobrinus* Sow., only in sculpture, but is relatively wider, has less strongly developed granulations on the sides. It also differs from *C. toroensis* Olsson in relative width and in form of spire.

Holotype: No. 4623, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, **near base of the Tuberá group,** where it appears to belong, and where several fair-sized specimens were obtained; Miocene of Colombia.

20. **Conus crenospiratus** Anderson, new species

Plate 9, figures 6, 7

Shell small, height of holotype 17 mm., width 10 mm., with graceful outline, low spire and somewhat rounded sides; in size, form and sculpture it recalls *C. isomitratus* Dall, from the Chipola beds of Florida; upper surface of the whorls flattened; sutures distinctly incised, but unlike Dall's species, the shoulders of the whorls are tuberculated, forming on the inner side of the suture a wavy, or crenulated line; body whorl ornamented by spiral lines, which become obsolete near the shoulder, but become stronger on the lower third of the whorl; spiral threads are here flattened, or slightly concave in section, having the appearance of being double.

Holotype: No. 4624, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., **near Punta Pua,** near the middle of the Tuberá group, Colombia; Miocene.

21. Turris albida (Perry)

Pleurotoma albida PERRY, Conch. Expl., 1811, pl. 32, fig. 4.—DALL, Bull. Mus. Comp. Zool., Harvard College, vol. 18, 1889, pp. 72-73.—Trans. Wag. Fr. Inst. Sci., vol. 3, 1890, p. 28, pl. 4, fig. 8a.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 343; Miocene, Canal Zone.

Turris albida, DALL, Bull. U. S. Nat. Mus., No. 90, 1915, p. 38, pl. 5, fig. 13; pl. 14, fig. 7; *Orthaulax pugnax* zone, Lower Miocene, Miss., and Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 230, pl. 4, figs. 1, 2; Gatun Stage, Canal Zone, Panama.

This species has been obtained at Loc. 267, C. A. S., horizon M - N, at Loc. 351, C. A. S., near the middle of the Tuberá group, and at Loc. 266, C. A. S., on the Quebrada Juan de Acosta, near the top of the Tuberá group. Its range is, therefore, throughout the entire group, and it can not, accordingly, be regarded as a horizon marker.

22. Drillia eupora Dall

Drillia eupora DALL, Bull. U. S. Nat. Mus., No. 90, 1915, p. 42, pl. 5, fig. 3, Tampa Bay, Florida.

Among the fossils collected from the Las Perdices shale one mile west of the pier at Puerto Colombia, Loc. 267, C. A. S., horizon L, is an incomplete example of *Drillia* which includes most of the spire. One whorl is missing, though the axis itself is complete. When entire, the shell was composed of at least 13 whorls, including the nuclear portion, forming an elongated, narrow, gently tapering spire. The penultimate whorl has 18 vertical ribs of the form described by Dr. Dall, crossed by revolving threads, five in number, and a subsutural collar bordered by a carinated ridge. The resemblance of this shell to Dall's figure, reinforced by his description, permits no other identification. This species does not appear to have been recognized before in the Miocene of the Caribbean borders, though doubtless subsequent work will reveal its presence in other parts of the region.

23. **Cancellaria karsteni** Anderson, new species

Plate 10, figures 7, 8, 9

Shell of moderate size, biconic in outline, heavy ribbed on the last whorls, spinose on the shoulders; height of holotype 33 mm., width of body whorl 22 mm.; spire high and sharp, forming somewhat more than half height of shell; surface marked by heavy vertical ridges, of which there are about nine on last whorl; these crossed by low revolving threads, with occasional intermediary lines; shoulders of whorl armed with strong spines, rising from the vertical ribs, pointing upward and outward; upper surface of body whorl concave, rising on preceding whorl in a sort of clasping collar with wavy border; aperture somewhat quadrilateral; outer lip angulated near shoulder, and also midway between shoulder and terminus of canal; inner lip thinly calloused, bearing three oblique plications; umbilicus closed.

Holotype: No. 4630; *paratype:* No. 4631, Mus. Calif. Acad. Sci., from Loc. 267 (C. A. S. Coll.), horizon P, at the **north end of Tuberá mountain, Colombia**; Miocene. It is also found at Loc. 305, C. A. S., near Turbaco, near the middle of the Tuberá group, Colombia; Miocene.

24. **Cancellaria hettneri** Anderson, new species

Plate 10, figures 5, 6

Shell large, height of holotype 42 mm., width 28 mm., somewhat biconic in outline, heavily ribbed on the body whorl with irregular ridges extending to the base; spire high, subconic; upper slope of whorl rising in a collar, not quite clasping, but slightly channelled or flattened above; surface ornamented by revolving threads of three orders, heavy, intermediate and light; shoulders of whorls showing low spines directed outwardly; aperture subquadrate, narrowed above, terminating below in a straight canal; umbilical chink distinct, but closed.

This species is allied to *C. harrisi* Maury, but is more coarsely sculptured, larger, and more spinose.

Holotype: No. 4629, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., from horizon P, **north slope of Tuberá mountain, Colombia**; Miocene. Two good specimens were obtained at this locality.

25. **Cancellaria dariena** Toula

Cancellaria dariena Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 704, pl. 28, figs. 1, 2; Gatun formation, Canal Zone.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 345, pl. 24, figs. 1-4.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 32; Gatun formation, Canal Zone.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 252, pl. 6, fig. 8; Gatun Stage, Costa Rica.

This species has not been found abundantly in the Colombian Miocene, but it has been obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group.

26. **Cancellaria scheibei** Anderson, new species

Plate 10, figures 1, 2, 3, 4

Shell large, robust, ovate in outline, smooth, with low spire; height of holotype 54 mm., greatest width 40 mm.; spire low, conical, sloping up from rounded shoulders; suture distinctly channelled; whorls about five, the younger three obscurely cancellated; aperture subovate, narrowed above, terminating below in a narrow, slightly curved canal; outer lip sharp, lirate within near the outer edge; inner lip strongly calloused, bearing three plications, the upper two being more widely separated, with three elongated beads on the pillar intervening.

Holotype: No. 4627, Mus. Calif. Acad. Sci., from Loc. 306, C. A. S., from **near Usiacuri, Colombia**; *paratype:* No. 4628, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., near Santa Rosa, Colombia; Miocene.

This form remotely resembles *C. lævescens* Guppy, but is larger, smoother, more rounded, and has plications that are distinctly different from Guppy's species. It is more nearly related to *C. solida* Sowerby,[19] found living on the Pacific

[19] Sowerby, J. de C., Proc. Zool. Soc. Lond., vol. 2, 1832, p. 50.—Sowerby, Thes. Conchy., vol. 2, p. 440, pl. 92, fig. 4.

coast from Panama to the Gulf of California. The essential difference may be one of descent, and of senility in the living form. The earlier form is larger, more robust, has a more rugose columella, with bead-like denticles intervening between the plaits, as already described.

This shell is apparently not abundant, but it has been obtained at Loc. 304, C. A. S., near Santa Rosa; Loc. 306, C. A. S., near Usiacuri; Loc. 325-A, C. A. S., near Cibarco. It has not yet been found at the lowest horizon of the Tuberá group, though a near ally does occur there.

27. **Cancellaria codazzii** Anderson, new species

Plate 14, figures 4, 5, 6, 7

Shell of medium size, height of holotype 30 mm., width 18 mm., biconic in outline, with numerous vertical ribs extending from suture to base; spire high, with five whorls below nuclear ones; nuclear whorls three, quite smooth; surface beautifully cancellated, with revolving threads at nearly equal intervals crossing the numerous vertical ribs in low, rounded bead-like nodes; upper surface of whorls slightly concave, rising in a collar-like expansion, not clasping; concave surface bearing a few revolving threads; suture distinctly channelled; shoulder of whorl not coronate, but bearing a wavy cord; aperture ovate, terminating in a narrow canal; outer lip simple, lirate within; inner lip not distinctly calloused, bearing three oblique plications on the pillar.

Holotype: No. 4645; *paratype:* No. 4646, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., **near Cibarco, Colombia**; Miocene, near the middle of the Tuberá group.

This shell is named in honor of Agostino Codazzi, explorer, surveyor, writer, and author of the first authentic map of Colombia.

28. **Cancellaria cibarcola** Anderson, new species

Plate 14, figures 1, 2, 3

Shell of medium size, resembling in most respects *C. scheibei,* but smaller and less rotund. Its three nuclear whorls are quite smooth; its disposition toward a truly cancellated sculpture in the young stages is more pronounced than in the preceding, and the spiral threads often show clearly on the fifth whorl below the nuclear ones. In outer form it recalls *C. lævescens* Guppy, from which, however, it is readily distinguished by the arrangement of the plaits on the pillar. Two elongated denticles intervene between the upper and second plait which are widely separated. The internal lirations of the outer lip extend deeply into the interior, and the spiral threads become more distinct at the base of the body whorl. These features serve to distinguish this species from either of the preceding. Height of holotype 32 mm., width of body 22 mm., height of aperture 25 mm.

Holotype: No. 4643; *paratype:* No. 4644, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., **near Cibarco, Colombia**; Miocene.

This shell is found at all of the lower horizons of the Tuberá group, and is a fairly abundant form. It has been obtained at Loc. 267, C. A. S., horizons M - N, P and R; Loc. 299, 304, 325-A, and 351, C. A. S., the latter representing a central horizon in the Tuberá group.

29. **Cancellaria cossmanni** Olsson

Cancellaria cossmanni OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 253, pl. 6, figs. 9, 11; Gatun Stage, Costa Rica.

This species has not been found abundant in Colombia. A single specimen was obtained at Loc. 325-A, near Cibarco, about the middle of the Tuberá group. Its range is not known.

30. **Cancellaria moorei** (?) Guppy

Cancellaria moorei GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 289, pl. 17, fig. 7; Miocene, Jamaica.

A single specimen that seems referable to Guppy's species was obtained at Loc. 306, C. A. S., at the east border of Usiacuri village above the middle of the Tuberá group. In spite of the fact that this species has not often been recognized in the faunas of the Caribbean region outside of the Bowden beds, the resemblance of the sample from Loc. 306 to Guppy's original figure does not permit of any other determination at present.

31. **Cancellaria guppyi** Gabb

Cancellaria guppyi Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 236; Miocene, Santo Domingo.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 228, pl. 10, figs. 7, 8; Cercado de Mao, S. Domingo.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 333, pl. 22, fig. 7; Loc. as above.

In his Revision of Gabb's Tertiary Mollusca Dr. Pilsbry figures the type (or a lectotype) of this species. The rotund form and regularly cancellated sculpture are its striking characteristics. A single specimen was found at Loc. 267, C. A. S., horizon P, near the middle of the Tuberá group.

32. **Turritella altilira** Conrad

Plate 17, figures 4, 5

Turritella altilira Conrad, Pac. R. R. Repts., vol. 6, 1857, pt. 2, p. 72, pl. 5, fig. 19; Miocene, Isthmus of Panama.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 358, pl. 27, figs. 2, 3; Gatun formation, Canal Zone.—Olsson, Bull. Am. Pal., vol. 9, 1922, pp. 321, 322, pl. 14, figs. 4, 8, 9, 14; Miocene, Canal Zone.—Hodson, Bull. Am. Pal., vol. 11, 1926, p. 214, pl. 26, figs. 1, 4, 7, etc.; pl. 27, figs. 2-7; Miocene, North Venezuela.

This shell is abundant in the Colombian Miocene. It is interesting to note that both Maury[20] and Olsson[21] regard *T. tornata* Guppy, as a varietal form of this species, and that Cossmann admits[22] that his *T. guppyi* is the equivalent of *T. tornata,* all of which beliefs seem to be well founded. Toula, furthermore,[23] regards his *T. gabbi* as being nearly related to *T. altilira* and *T. tornata.*

The species occurs plentifully at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, and in higher horizons of the same. It has been found also at Loc. 351, C. A. S., near Punta Pua, and at Loc. 305, C. A. S., near Turbaco, and at

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[20] Maury, C. J., Bull. Am. Pal., vol. 10, 1925, pp. 382-383.

[21] Olsson, A. A., Bull. Am. Pal., vol. 9, 1922, p. 323.

[22] Cossmann, M., Rev. Crit. de Pal., 1909, p. 225.

[23] Toula, F., Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 695.

Loc. 354, Quebrada de Murindo, a tributary of the Rio Canalete.

Plesiotype: No. 4658, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, **base of Tuberá mountain, Colombia**; Miocene.

33. **Turritella perattenuata** Heilprin

Turritella perattenuata HEILPRIN, Trans. Wag. Fr. Inst. Sci., vol. 1, 1887, p. 88, pl. 8, fig. 13; Pliocene, Caloosahatchie beds, Florida.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1900, p. 316, pl. 16, figs. 5, 9; Loc. as above; —var. *præcellens* PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 36, pl. 5, fig. 12; Miocene, near Cartagena.

This species has not often been listed among the forms found in the Miocene of the Caribbean region but it nevertheless occurs at a number of Miocene horizons in Colombia. It has been found abundantly at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at Loc. 347, C. A. S., near Turbaco, and in the uppermost beds of the Miocene near Galapa; it occurs also in the position of horizon P, at Loc. 306, C. A. S., near Usiacuri. It is therefore found at most of the fossil horizons of the Tuberá group.

34. **Turritella fredeai** Hodson

Plate 17, figure 1

Turritella robusta GRZYB. var. *fredeai* HODSON, Bull. Am. Pal., vol. 11, 1926, p. 13, pl. 5, fig. 3; pl. 6, fig. 5; pl. 7, figs. 1, 6, 7; Miocene, Northern Venezuela. Not *T. robusta* Gabb, Geol. Surv. Calif., Pal. vol. 1, 1864, p. 135, pl. 21, fig. 94; Cretaceous of California. Not *T.* (*Haustator*) *robusta* Grzyb., upper Zorritos, Peru.

Turritella abrupta SPKR., ANDERSON, Proc. Calif. Acad. Sci., vol. 16, 1927, p. 89; horizon M, Tuberá group, Colombia. Not *T. robusta*, var. *abrupta* Spieker, Johns Hopkins Univ. publ., Geol. No. 3, 1922, p. 85, pl. 4, fig. 6; Zorritos formation, northern Peru.

Plesiotype: No. 4175, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., **near Punta Pua, 20 miles north of harbor of Cartagena, Colombia**; Miocene.

Spieker's form from northern Peru has been renamed by Hanna & Israelsky[24] as *T. supraconcava,* as explained below.

[24] Hanna, G. D. & Israelsky, M., Proc. Calif. Acad. Sci., vol. 14, 1925, p. 59.

When the writer listed the Colombian form as probably identical with the Peruvian of Spieker, Hodson's recent paper had not yet reached us. A comparison of the Colombian forms with Hodson's figures clearly shows their identity, while his illustrations serve as well to distinguish the northern form from the Peruvian. The specific name *"robusta"* had already been employed at the date of Spieker's writing, and Hodson's form must take the name of his supposed variety.

This species has been found at Loc. 267, C. A. S., horizon M - N, the lowest horizon of the Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, also in a low horizon. It occurs, however, in higher beds, as at Galapa, near the top of the Miocene section.

35. **Turritella mimetes** Brown & Pilsbry

Turritella mimetes BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 357, pl. 27, fig. 1; Miocene, Canal Zone.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 321, pl. 14, fig. 5; Gatun Stage, Canal Zone.

This species is not uncommon in the Gatun group of the Canal Zone where it was obtained by the writer in 1914. It occurs also at Loc. 325, C. A. S., near Baranoa, near the middle of the Tuberá group.

36. **Turritella gatunensis** Conrad

Turritella gatunensis CONRAD, Pac. R. R. Repts., vol. 6, 1857, pt. 2, p. 72, pl. 5, fig. 20; Miocene, Isthmus of Panama.—TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 694; Miocene, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 358, pl. 27, figs. 4, 5, 9; occurrence as before.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 320, pl. 14, figs. 12, 13; Miocene, Costa Rica, etc.

This shell was obtained at the Spillway in considerable numbers by the writer in 1914, and has since been found plentifully in the Tuberá group of Colombia. It occurs at Loc. 267, C. A. S., horizons P and R. It has been obtained also at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group, and at Loc. 305, near Turbaco, about central in the group, and at Loc. 306, near Usiacuri, in a position near the middle of the section.

37. **Turritella cartagenensis** Brown & Pilsbry

Turritella cartagenensis Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 34, pl. 5, fig. 13; Miocene, near Cartagena.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 385, pl. 42, fig. 13; Miocene, Trinidad Island.

? Turritella bifastigata, Hodson, Bull. Am. Pal., vol. 11, 1926, pp. 48-50, pl. 30, figs. 1-6; Miocene, northern Venezuela.

This is one of the most abundant forms of *Turritella* found in the Tuberá group. Hodson has described and figured varieties of a *Turritella* under the name *T. bifastigata* Nelson, from the Miocene of northern Venezuela. The type of Nelson's species came from the Tertiary (probably Miocene) of Peru, but was described without any illustration whatever. Hodson's figure (pl. 30, fig. 1) is from a lectotype not supplied by Nelson. It should be pointed out, however, that the varieties, supposedly of this *Turritella,* as figured by Hodson are such as would include *T. cartagenensis* Brown & Pilsbry, which itself shows variations of the same character.

This species has been obtained from Loc. 306, C. A. S., near the village of Usiacuri; Loc. 351, C. A. S., near Punta Pua; Loc. 353, C. A. S., near the Bay of Cartagena; and Loc. 325-A, near Cibarco. Its vertical range is nearly central in the Tuberá group.

38. **Crucibulum (Dispotæa) gatunense** (Toula)

Plate 13, figures 4, 5, 6

Capulus ? gatunensis Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 692, pl. 25, figs. 1, 2; Gatun formation, Canal Zone.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 360; Gatun formation, Canal Zone.

Two good examples of this hitherto imperfectly known species were obtained from the Spillway of the Canal in 1914, and are now in the collections of the California Academy of Sciences. The coiled apex is smooth, showing only faint lines of growth, but two mm. below the apex the shell becomes corrugated, at first by irregular squamose vertical threads, radiating downward, interrupted by uneven lines of growth. These radial markings become more irregular with growth,

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forming a roughened, granular, radially marked surface. The outline of the base is sub-elliptical, with sharp, faintly crenulated margin. Toula's samples did not permit him to see the interior of the shell, but in ours the interior is clearly exposed in both examples. The shell possesses a well formed internal cup, semilunar in outline, attached to the wall of the shell on about one-third of its periphery, or in fact, is formed by the wall of the shell itself. This feature places it in the sub-genus *Dispotæa* (Say) Conrad, as has been stated by Dall.

Plesiotypes: Nos. 4639, 4640, Mus. Calif. Acad. Sci., from Loc. 323, C. A. S., **Gatun locks at Spillway, Panama**; Miocene.

A somewhat fragmentary example of this species was found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group.

39. **Architectonica granulata** (Lamarck)

Solarium granulatum Lam., An. s. Vert., vol. 7, 1822, p. 3.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1892, p. 329.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 295, pl. 23, fig. 3; Miocene, Santo Domingo.

Cadran (=*Solarium*) *granulatum*, Kiener, Icon., vol. 1, 1873, p. 4, pl. 2, fig. 2.

Solarium gatunense Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 693, pl. 25, fig. 3; Miocene, Canal Zone.

Architectonica granulata, Dall, Proc. U. S. Nat. Mus., vol. 37, p. 232; living, Lower California to Panama.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 326, pl. 13, figs. 10-12; Miocene, Canal Zone, etc.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 388, pl. 40, fig. 1; Miocene, Trinidad Island.

This species occurs abundantly in the Tuberá group of the Colombian Miocene. Good examples have been obtained at the following places in northern Colombia:

Loc. 266, C. A. S., Juan de Acosta creek, near Puerto Colombia; Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 299, C. A. S., near Baranoa, near the middle of the Tuberá group; Loc. 305, C. A. S., near Turbaco; and finally, Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group. It thus appears that the vertical range of this species is confined to the middle part of the Tuberá group.

40. **Architectonica quadriseriata** (Sowerby)

Solarium quadriseriatum Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1850, p. 51, pl. 10, figs. 8a, b, c.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 291.—Guppy, Geol. Mag., vol. 1, 1874, p. 438; Miocene, Santo Domingo.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1585; Miocene, Florida.

Architectonica quadriseriata, Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 228.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 389; Miocene, Trinidad Island.

Good examples of this species were obtained at the Spillway of the Canal in 1914, and it has since been found at Loc. 305, C. A. S., near Turbaco, and at Loc. 325-A, C. A. S., near Cibarco, in both places near the middle of the Tuberá group, or at horizon P.

41. **Natica guppyana** Toula

Natica (*Stigmaulax*) *guppyana* Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 696, pl. 25, fig.6; Miocene, Canal Zone.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 360.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 328, pl. 13, figs. 13-15; Gatun beds, Canal Zone, Panama.

A large number of samples of this species was obtained at the Spillway of the Canal in 1914, and are now in the collections of California Academy of Sciences. Equally good specimens have since been obtained from various localities in northern Colombia, as the following:

Loc. 267, C. A. S., horizon M - N, west foot of Tuberá mountain; Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 325, C. A. S., near Usiacuri village; Loc. 325-A, near Cibarco; and Loc. 351, C. A. S., near Punta Pua.

In most of these localities the samples came from a horizon near the middle of the Tuberá group.

42. **Natica cuspidata** Guppy

Natica cuspidata Guppy, Agr. Soc. Trin. and Tobago, Ppr. No. 454, 1910, p. 5, pl. 2, fig. 4; Reprint, Bull. Am. Pal., vol. 8, 1921, p. 162, pl. 8, fig. 4; Miocene, Trinidad I.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 391, pl. 40, figs. 9, 10; Loc. as before.

Two examples of this seemingly rare shell were found in the lowest horizon, M - N, of the Tuberá group, at Loc. 267, C. A. S., associated with many heavy shelled littoral species.

43. **Polinices subclausa** Sowerby

Natica subclausa Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 51; Miocene, Santo Domingo.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 290, pl. 18, fig. 8.—Guppy, Geol. Mag., vol. 1, 1874, p. 437.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 519; Loc. as before.

Polinices subclausa, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1585.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 360.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 300, pl. 23, fig. 14; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 329, pl. 13, figs. 16, 17; Miocene, Canal Zone, Panama.

In 1914 the writer obtained a few samples of this species at the Spillway of the Canal. Since then others have been obtained at Loc. 266, C. A. S., Arroyo Juan de Acosta, near the top of the Tuberá group, and at Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain.

44. **Polinices stanislas-meunieri** Maury

Polinices stanislas-meunieri Maury, Bull. Am. Pal., vol. 5, 1917, p. 300, pl. 23, figs. 15, 16; Miocene, S. Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 329, pl. 13, fig. 7; Gatun Stage, Canal Zone.

A large number of samples of this species has been found in the Tuberá group. It occurs in the following localities:

Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 325, C. A. S., east border of Usiacuri village; Loc. 325-A, C. A. S., near Cibarco, and Loc. 351, C. A. S., near Punta Pua.

45. **Polinices prolactea** Anderson, new species

Plate 14, figures 8, 9

Shell of moderate size, subglobose, with low spire, open umbilicus, conspicuous callus, highly polished; aperture sublunar, narrowing behind to a subacute angle; callous rather heavy on the posterior part of the inner lip; narrowing to a thin line near the anterior part of the aperture; surface marked by lines of growth, and near the base of the shell by faint spiral striations, not always visible.

Several good examples of this species were obtained at Loc. 267, C. A. S., in the Las Perdices beds below the Tuberá group, a mile west of Puerto Colombia.

Holotype: No. 4648, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon L, **Los Perdices group, Puerto Colombia**; Miocene.

The nearest ally of this shell is *Polinices lactea* (Guilding), now living in the neighboring Bay of Cartagena. G. B. Sowerby has described a similar near relative from the coast of Chile as *Natica solida.*[25]

46. **Ampullaria tuberacola** Anderson, new species

Plate 16, figures 1, 2, 3

Shell subovate, at least when full grown, deeply perforate, spire low in mature shells, whorls five or six, shell thin and with a deficiency of calcareous matter; umbilicus open, funnel-form, angulated on the borders in adult shells; suture distinct and slightly impressed; upper surface of the whorls rounded and convex; shoulder of last whorl sharply rounded, sides sloping toward the narrow base, making the form of the shell somewhat conical; height of holotype 52 mm., greatest width 48 mm.

Holotype: No. 4655; *paratype:* No. 4656, from Loc. 267, C. A. S., from horizon R, **Tuberá village, Colombia**; Miocene.

The younger shell is more nearly sub-globose and bears a strong resemblance to *A. (Pomus) canaliculata* Lam., from Tropical America. Two examples of this shell were found at Tuberá village, Loc. 267, C. A. S., associated with many strictly marine forms, such as *Conus recognitus, Malea ringens, Ficus colombiana,* etc. It is quite probable that these non-marine shells were brought into this association by streams from a neighboring shore to the southwest.

[25] Geol. Observ. Darwin, Append. pt. 2, p. 612, pl. 3, figs. 40, 41.

47. **Calliostoma grabaui** Maury

Calliostoma grabaui Maury, Bull. Am. Pal., vol. 5, 1917, p. 319, pl. 24, fig. 19; Zone G, Rio Gurabo, S. Domingo.

This species has been obtained at Loc. 267, C. A. S., horizons R and M - N; Loc. 306, near Usiacuri village, and Loc. 325, C. A. S., lower in the section; Loc. 351, C. A. S., near Punta Pua. Its vertical range is, therefore, almost throughout the Tuberá group.

48. **Calliostoma olssoni** Maury

Calliostoma (Eutrochus) olssoni Maury, Bull. Am. Pal. vol. 10, 1925, p. 399, pl. 43, figs. 6, 14; Upper Miocene, Trinidad Island.

This elegant little shell has been obtained from various localities in the Colombian Miocene, as at Loc. 266, C. A. S., Arroyo Juan de Acosta; Loc. 299, C. A. S., near Baranoa; Loc. 306, C. A. S., Usiacuri village, etc. Its vertical range is confined to the upper part of the Tuberá group.

49. **Calliostoma tropica** Anderson, new species

Plate 16, figures 6, 7

Shell small, conical; height of holotype 17 mm., width 15.5 mm., finely beaded, abruptly truncate below; spire sharply conical, sloping evenly to the basal border with which it forms an angle of about 80 degrees; whorls 7 to 8 in number, sculptured with 6 to 8 finely beaded threads, crossed by lines of growth; sutures marked only by a slight depression at the border of the preceding whorl; base flattened, marked by 8 to 10 flat revolving threads, also beaded, but wider than the spiral threads on the upper slope; aperture ovate in outline; umbilicus closed. The species is characterized by its high conical spire and regular even slope, and also by its abruptly flattened base and finely beaded ornamentation. It is closely related to *Calliostoma derbyi* Maury from the Lower Miocene of Brazil.

Holotype: No. 4168, Mus. Calif. Acad. Sci., from Loc. 267, horizon M - N, **Tuberá mountain, Colombia**; Miocene.

50. **Oliva cylindrica** Sowerby

Oliva cylindrica Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45; Miocene, Santo Domingo.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 67, pl. 10, figs. 14, 14a; Zone G, Rio Gurabo, Santo Domingo.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 335, pl. 23, figs. 2, 3; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 88, pl. 7, fig. 1; Gatun Stage.

Oliva gatunensis Toula, Jahrb. der K. K. Geol. Reichs., 1909, Bd. 58, p. 702, pl. 25, fig. 12; Gatun formation, Canal Zone, Panama.

Cossman seems to have given the first adequate description of this species in 1913 but it is not at present available. Maury has given two good figures, upon which much reliance is placed.

Good examples were obtained at Loc. 299, C. A. S., three miles southwest of Baranoa, and at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group.

51. **Oliva sayana** Ravenel

Oliva sayana Ravenel, Cat., 1834, p. 19.—Mazyck, Nautilus, vol. 28, 1915, p. 139.

Oliva sayana var. *immortua* Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 33, pl. 5, fig. 6; Miocene, near Cartagena, Colombia.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 261, pl. 7, figs. 6, 7; Gatun Stage, Costa Rica.

This species and variety were obtained at Loc. 267, C. A. S., horizon R, at Tuberá village, near the top of the Tuberá group of the Colombian Miocene.

52. **Oliva brevispira** Gabb

Oliva brevispira Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 215; Miocene. Santo Domingo.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 232, pl. 10, figs. 16, 17; Loc. as above.—Pilsbry, Proc. Acad. Nat. Sci., Phila., vol. 73, 1921, p. 335, pl. 23, fig. 4 (Type); Miocene, Santo Domingo.

This species has been obtained at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, and at Loc. 325-A, near Cibarco, about the middle of the same group. Its range is at least from the basal beds to the middle of the Tuberá group of the Colombian Miocene.

53. **Oliva tuberaënsis** Anderson, new species

Plate 17, figures 2, 3

Shell large, thick, robust in form, spire high and accuminate; height of hollotype 87 mm., width 37 mm., height of aperture 65 mm., thickness of shell at outer lip 5 mm.; suture clean and incised; aperture expanding gradually toward the anterior end, narrowed at the top into a cleft; outer lip smooth, simple and gently arcuate; inner border of aperture slightly calloused, a little depressed near the middle, and bearing oblique ridges below.

Holotype: No. 4172; *paratype:* No. 4174, Mus. Calif. Acad. Sci., from Loc. 267-R of Tuberá group; *paratype:* No. 4173, Mus. Calif. Acad. Sci., from Loc. 267-C, C. A. S., **Tuberá group, Colombia**; Miocene.

This species resembles most nearly *O. couvana* Maury from the Springvale group of the Miocene of Trinidad, but it has a larger, thicker and relatively heavier shell, and more ovate outline. The external calluses are wider, and the plications are more pronounced, as judged by Maury's figures. Our species differs from *O. proavia* Pilsbry & Johnson in a somewhat similar manner, not forgetting Maury's comparison.

This shell is fairly abundant in horizon R of the Tuberá group, and it was obtained also at horizon M - N, at Loc. 267, C. A. S., and very probably it will be found at intervening horizons.

54. **Marginella ballista** Dall

Marginella ballista DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, p. 47, pl. 4, fig. 6; Miocene, Tampa Silex beds, Florida.

This Floridan species has not before been cited from the Miocene of the Caribbean region, although beds equivalent in age and ecologic conditions probably exist at many points therein. The form and surface features of our shell are too nearly like those figured and described by Dall to warrant any other determination of it.

Dall has also described a varietal form of the same which he compares to *M. incrassata* Nelson, with which our species was for a time tentatively identified. Its identity with the Floridan form seems to be supported by the possession of four oblique plications, as well as by the thickened outer lip and low spire. A single example of this species was found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, in the Tuberá group.

55. **Marginella christinelladæ** Maury

Marginella christinelladæ MAURY, Bull. Am. Pal., vol. 5, 1917, p. 234, pl. 11, fig. 6; Zone B, Miocene, Rio Gurabo, Santo Domingo.

More than a dozen good examples of this species were obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, and it was also found at horizon R, at Tuberá village, and therefore at the middle and near the top of the Tuberá group.

56. **Marginella coniformis** Sowerby

Marginella coniformis SOWERBY, Quart. Jour. Geol. Soc., Lond., vol. 6, 1928, 1849, p. 42; Miocene, Santo Domingo.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 288, pl. 17, fig. 2; Miocene, Trinidad Island.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 348, pl. 24, fig. 12; Gatun formation, Canal Zone.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 234, pl. 11, figs. 5, 5a; Miocene, Santo Domingo.

This species was obtained at the Spillway of the Canal in 1914, and since then at Loc. 267, C. A. S., horizon P of the Tuberá group, on the north slope of Tuberá mountain at a horizon believed to be the equivalent of the Gatun formation.

57. **Mitra dariensis** Brown & Pilsbry

Mitra dariensis BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 346, pl. 24, fig. 9; Gatun formation, Canal Zone.—OLSSON, Bull. Am. Pal. vol. 9, 1922, p. 273, pl. 6, fig. 25; Gatun Stage, Canal Zone.

Several good specimens of this species were obtained at the Spillway of the Canal in 1914, and since then it has been found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group.

58. **Mitra longa** Gabb

Mitra longa Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 219.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 346, pl. 24, fig. 11.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 238, pl. 11, figs. 11, 11a; Miocene, Santo Domingo.—Pilsbry, Proc. Acad. Sci. Phila., vol. 73, 1921, p. 339, pl. 24, fig. 3 (Type); Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 273, pl. 6, fig. 10; Gatun Stage, Canal Zone.

Good examples of this species were found at Loc. 267, C. A. S., horizon M - N, and Loc. 351, C. A. S., near Punta Pua, in the latter case near the middle of the Tuberá group; it is believed to belong to both of these horizons. It occurs at Gatun, according to Olsson.

59. **Mitra mauryæ** Anderson, new species

Plate 8, figures 4, 5

Shell moderate in size, height of holotype, incomplete, 32 mm., width 10 mm., somewhat biconic in form; spire a little longer than the body whorl; suture slightly impressed; whorls rounded above and slightly convex below the shoulders; body whorl obversely pyriform; spire (incomplete) consisting of six whorls; sculpture cancellated; aperture long and narrow; canal long and straight; outer lip thin, not lirate within columella bearing four plications, the larger above, slightly more distant than the others; surface ornamented by 20 vertical ribs on the penultimate whorl, crossed by seven spiral threads, the two forming a cancellated sculpture very similar to that of *M. syra* Dall. This latter species, from the Silex beds of Tampa, Florida, is its nearest ally, though only one-half the length of the Colombian form, and with a somewhat more uniform taper to the apex.

Holotype: No. 4619, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon L, gray shales along the beach **one mile west of Puerto Colombia**; Miocene.

This species is known from only a single slightly imperfect specimen obtained from the gray shales along the beach a mile west of Puerto Colombia at Loc. 267-L, C. A. S. These shales underlie the Tuberá group, and probably form a part of the Las Perdices group.

60. **Scobinella morierei** (?) (Laville)

Plate 8, figures 6, 7

Euchilodon morierei (Lav.) in Cossmann, Jour. Conch., vol. 61, 1913, p. 34, pl. 3, figs. 6, 7.

Scobinella morierei, Olsson, Bull. Am. Pal., vol. 9, 1922, p. 251, pl. 4, figs. 3, 4; Gatun Stage, Canal Zone.—Maury, Bull. Am. Pal. vol. 10, 1925, p. 345, pl. 34, figs. 1, 8; Miocene, Trinidad Island.

A single but beautifully preserved example of this interesting species was found in the clay shales, underlying the Tuberá group a mile or more west of Puerto Colombia, associated with *Turris albida, Mitra mauryæ* (n. sp.), *Phalium dalli* (n. sp.), *Dentalium granadanum* (n. sp.), and others.

This example is larger and more robust than the figures given by Olsson, but otherwise is not easily distinguished from the form found in the Canal Zone. The ratio of length to width is less, being more nearly 3 : 1 in greatest width. The aperture is relatively wider, and the columellar plications are different, though the difference seems hardly to be specific in value. The species has not been found in higher beds in Colombia, as far as known.

Plesiotype: No. 4620, Mus. Calif. Acad. Sci., from Loc. 267-L, gray shales along the beach **one mile west of Puerto Colombia**; Miocene.

61. **Fasciolaria olssoni** Anderson, new species

Plate 8, figures 1, 2, 3

Shell large, thick, robust, biconic in form, smooth, showing lines of growth and faint spiral markings; length of holotype (without apex) 79 mm.; greatest width 57 mm.; paratype with six whorls; spire high, subconic, acuminate; upper surface of the whorls concave, terminating above in a clasping collar; suture distinct above the collar; shoulder of body whorl bearing five or more rounded tubercles, forming short broad ridges below, but none above the shoulder; aperture oval, terminating above in an acute angle, below in a narrow straight canal; inner margin of aperture evenly calloused, outer lip lirate within, margin unknown; umbilical chink closed; pillar slightly twisted, bearing three rounded plications.

The largest example of this shell, although not complete, measures 113 mm. in length, and 71 mm. in width. The tubercles do not develop on the shoulders until about the fifth whorl, and become stronger on older shells.

Holotype: No. 4617; *paratype:* No. 4618 (C. A. S. type coll.), from Loc. 267-P, C. A. S., **Tuberá mountain, Colombia;** Miocene.

The surface of the older shells become much pitted by worm borings. This species is possibly the one listed and figured by Olsson as *F. gorgasiana* (Brown & Pilsbry).[26]

This shell is fairly plentiful in the Tuberá group of the Colombian Miocene, and has been collected at Loc. 267, C. A. S., horizons P and R, and at other points which represent the horizon of the Gatun formation of the Canal Zone.

62. **Fasciolaria kempi** (Maury)

Siphonalia kempi Maury, Bull. Am. Pal., vol. 4, 1910, p. 138, pl. 5, fig. 5; Chipola marls, Florida Miocene.

Fasciolaria kempi Maury, Bull. Am. Pal., vol. 5, 1917, p. 245, pl. 12, fig. 4; Miocene, Santo Domingo.

This shell is not rare in the Tuberá group of the Colombian Miocene, and has been collected at Loc. 351, C. A. S., horizon near M - N, and at Loc. 305, C. A. S., near Turbaco.

63. **Fusinus henekeni** (Sowerby)

Fusus henekeni Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 49; Miocene, Santo Domingo.—Guppy, Geol. Mag. Lond., vol. 1, 1874, p. 439.—Guppy, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 524, pl. 28, fig. 6; Miocene, Haiti.—Maury, Bull. Am. Pal., vol. 5, 1917 p. 242, pl. 12, fig. 1; Cercado de Mao, Miocene, Santo Domingo.

Two examples of this species were found at the village of Tuberá in the upper part of the Tuberá group, Loc. 267, C. A. S., horizon R. The rounded longitudinal ribs are pronounced on every whorl, from the nuclear to the body whorl, all of which are crossed by the strong spiral cords and lines described for this species.

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[26] Olsson, A. A.—Bull. Am. Pal. vol. 9, 1922, p. 227, pl. 8, fig. 9; Gatun Stage, Canal Zone.

64. **Fusinus magdalenensis** Anderson, new species

Plate 15, figures 1, 2, 3

Shell large, height of holotype, incomplete, 110 mm., width 44 mm., fusiform, with high spire and long canal; spire consisting of nine whorls below the nuclear stage, the earlier ones only showing vertical ribs; spire sculptured by 10 to 15 strong revolving ridges, of two alternating ranks; body whorl containing 14 such ridges, only a few of which are of secondary rank; canal long and somewhat recurved near the terminus; pillar calloused throughout, and ornamented externally by spiral threads and cords alternating as above; spiral cords sharply ridged at the top.

This shell bears some resemblance to *F. henikeni* (Sow.), var. *veatchi* Maury, but it is larger, has fewer and coarser spiral cords, longer and more recurved canal, and a clearly more calloused pillar. It is not unlike a large and strongly marked species from the Gulf of California, namely, *Fusinus dupetitthouarsii* (Kiener), and it may well be a precursor of the same.

Holotype: No. 4651, Mus. Calif. Acad. Sci., from Loc. 267, horizon P, **north slope of Tuberá mountain, Colombia;** Miocene.

65. **Melongena propatulus** Anderson, new species

Plate 11, figures 1, 2

Shell large, heavy, height of holotype, incomplete, 108 mm., greatest width 91 mm., spire low and rounded, body pyriform or conical below the rounded shoulder, almost spineless, or having only few and inconspicuous spines on the shoulder of the whorl; holotype bearing two small, tubercle-like spines at the base, near aperture; whorls five; spire low but acuminate, rounded below the three nuclear whorls which form the apex; suture covered by an elevated collar; aperture ovate, notched behind, slightly notched on the shoulder; outer lip showing a disposition to form crenulations; inner lip broadly calloused; canal broad, as in *M. patulus;* pillar broad, and flattened below; surface marked by strong, flat spiral cords, crossed by strong wavy lines of growth; spiral cords stronger near the base, one or more cords bearing a few small tubercles.

This shell has its closest ally in *M. patulus,* living on the Pacific coast and in the Gulf of California. Careful comparison has been made with good examples of this species in the collections of the California Academy of Sciences, and with *M. melongena* Linn. from the Caribbean region. It differs from both.

Holotype: No. 4632, Mus. Calif. Acad. Sci., from Loc. 267, horizon R, **Tuberá village, Colombia**; Miocene; embedded in sandstone near the top of the Tuberá group.

66. **Solenosteira hasletti** Anderson, new species

Plate 16, figures 7-A, 8

Shell not large, height of holotype 48 mm., width 30 mm., thickened, biconic in outline, spiney, not nodose; spire pagoda-like, with 5 or 6 whorls more or less concave above, the whorls culminating above in a collar clasping the preceding one; suture completely covered; surface marked by numerous revolving threads; on the upper slope four or five of these are heavier, with interspaces occupied by three to five finer threads, all of which, under the lens, appear beaded; lower slope ornamented in the same manner, but with more numerous heavy threads; periphery of each whorl supporting about seven strong spines that point upward and outward, buttressed by a low ridge beneath and above; aperture ovate, with narrow angle above forming a notch; outer lip slightly angulated, somewhat lirate within; inner lip symmetrically curved; pillar calloused near the aperture, recurved without; canal long and slightly recurved; umbilical area calloused, but showing a decided depression.

This shell is not unlike *Solenosteira alternata* (Nelson) from the Zorritos formation of Peru, but it is more strongly sculptured, and considerably more spinose in its mature form. It is found in many parts of the Tuberá group, and was obtained at Loc. 267, C. A. S., in horizon M - N, and horizon P. It is named in honor of Mr. Thomas D. Haslett.

Holotype: No. 4169, Mus. Calif. Acad. Sci., from Loc. 267—M-N, **Tuberá group, Colombia**; *paratype:* No. 4170, C. A. S., from Loc. 305, C. A. S., Turbaco, Colombia; *paratype:* No. 4171, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., from four miles east of Santa Rosa, Colombia, on ranch of Mrs. Gomez; Miocene.

67. **Solenosteira santærosæ** Anderson, new species

Plate 13, figures 7, 8, 9, 10

Shell of medium size, height of holotype, incomplete, 47 mm., width 35 mm., subconic in form, spinose, spiral sculpture pronounced; whorls five to seven below the nucleus; upper slope of whorls broad, bearing about seven strong ridges extending to the clasping sutural collar, sculptured by numerous revolving lines; lower slope abrupt and concave downward, crossed by numerous revolving lines or threads, among which appear a few stronger cords near the center of the lower surface; shoulders set with strong spines, sloping downward on the body whorl, but upward on the younger whorls; suture concealed by a clasping collar; pillar thick and short, reflexed; aperture ovate, narrowed above and at the canal; canal reflexed; umbilicus large; general appearance of the shell slouching and depressed.

Holotype: No. 4641, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., **4 miles east of Santa Rosa**; *paratype:* No. 4642, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., horizon P, near Turbaco, Colombia; Miocene.

This species is not infrequent in the Tuberá group of the Colombian Miocene. It has been obtained at Loc. 299-A, C. A. S., near the middle of the group, at Loc. 304, and at Loc. 305, C. A. S., lower down in the group, though not at the lowest horizon.

68. **Phos tuberaensis** Anderson, new species

Plate 9, figures 1, 2, 3

Shell of medium size, or large; spire high, somewhat turrited; height of holotype 50 mm., width of body whorl 26 mm., whorls seven in number, convex, ornamented chiefly by spiral lines; two nuclear whorls smooth; next four whorls bearing low, rounded vertical ribs, and about 12 slightly raised spiral threads; upper slope of whorls concave; shoulders tuberculated; body whorl having 10 low ribs, crossed by spiral threads, heavier on base of shell; aperture oval, narrowed above; canal short, reflexed; outer lip sharp, lirate within; pillar bearing one anterior plication, not crusted.

Holotype: No. 4621, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **on the north slope of Tuberá mountain, Colombia**; *paratype:* No. 4622, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., near Turbaco, Colombia; Miocene.

This shell resembles *Phos subsemicostatus* Brown & Pilsbry, but it is larger, has a more rugged sculpture and prominent tubercles.

It is not unlikely that the two species are nearly allied, though they are not identical.

This species is not rare in the Tuberá group, and the type was obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain. It has been found also at Loc. 305, near Turbaco.

69. **Phos turbacoensis** Anderson, new species

Plate 15, figures 6, 7

Shell large, heavy, strongly sculptured; spire high, acuminate, heavily ribbed; whorls nine in number, concave above, with slightly elevated collar; costate below the shoulder, having 12 heavy ribs which are crossed by five or six heavy revolving threads below the shoulder; shoulder slightly tuberculate; body whorl irregularly ribbed, and ornamented with strong spiral threads with wide interspaces; interspaces sometimes containing intermediary lines; pillar short with one anterior plication; aperture arcuate-ovate; outer lip sharp, lirate within; pillar not calloused; canal short, reflexed; three nuclear whorls smooth; following six becoming gradually more strongly sculptured; height of holotype 55 mm., width of body whorl 27 mm., height of aperture 26 mm.

Holotype: No. 4654, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., **near the village of Turbaco, Colombia;** Miocene.

This shell resembles *Phos veatchi* Olsson, but it is larger, more strongly sculptured, and has a higher spire.

70. **Phos baranoanus** Anderson, new species

Plate 16, figures 4, 5

Shell rather large, conico-ovate, spire high, acuminate; whorls nine in number, convex; suture distinct, not impressed; two nuclear whorls smooth; next five whorls bearing small vertical ribs and four to eight spiral threads, producing a finely cancellated sculpture; last two whorls smooth, showing growth lines, but almost no spirals, except on the base; aperture arcuate-ovate, narrow above; outer lip sharp, lirate within; inner lip not crusted; pillar bearing a single anterior plication; canal reflexed. Height of the holotype is 51 mm., width 21.5 mm.

This shell is not rare in the Tuberá group, and has been obtained at Loc. 325-A, C. A. S., near Cibarco; Loc. 299, near Baranoa; Loc. 325, near Usiacuri; and at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain.

Holotype: No. 4657, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., horizon P, on the **north slope of Tuberá mountain, Colombia**; *paratype:* No. 4657-A, Mus. Calif. Acad. Sci., from Loc. 299, C. A. S., near Plott's well S. W. of Baranoa, Colombia; Miocene.

71. **Murex domingensis** Sowerby

Murex domingensis SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 49, pl. 10, fig. 5; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 265, pl. 16, figs. 3, 4, 5, 6; Cercado de Mao, Miocene, Santo Domingo.

A single specimen of this shell was found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, near the middle of the Tuberá group.

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72. **Murex mississippiensis** Conrad

Murex mississippiensis Conrad, Jour. Acad. Nat. Sci. Phila., vol. 1, 1848, p. 116, pl. 11, fig. 30.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1890, p. 130.—Dall, Bull. U. S. Nat. Mus. No. 90, 1915, p. 73, pl. 5, fig. 10; Tampa Silex beds, Miocene, Florida, etc.

A single example of this shell was obtained at Loc. 351, C. A. S., near Punta Pua, some 20 miles north of Cartagena, in the lower part of the Tuberá group.

73. **Typhis siphonifera** Dall

Plate 9, figure 8

Typhis siphonifera Dall, Bull., U. S. Nat. Mus., No. 90, 1915, p. 77, pl. 13, fig. 9; Tampa Silex beds, Tampa, Florida.

Typhis lingulifera Dall, var. *costaricensis* (?) Olsson, Bull. Am. Pal., vol. 9, 1922, p. 304, pl. 10, figs. 22, 29; Miocene, Costa Rica.

A single example of this interesting species was found at Loc. 325-A, C. A. S., near Cibarco, a few miles north of Usiacuri, and near the middle of the Tuberá group. A careful comparison of this well preserved specimen with Dall's figure and description leaves no room for doubt as to its determination, although the spire is slightly higher in our specimen. In this example the spire consists of seven whorls, including the two that form the nucleus. The specimen bears some resemblance to *T. linguifera* Dall, but the latter has long and incurved spines where the varices meet the shoulder of the whorl, giving it a decidedly spiney appearance. The tubes arising from the shoulder in the interspaces between the spines form a distinguishing mark.

Plesiotype: No. 4625, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., **near Cibarco, Colombia**; Miocene.

74. **Distortrix simillima** (Sowerby)

Triton simillima Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 48; Miocene, Island of Haiti.

Persona simillima, Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 288, pl. 17, fig. 13; Miocene, Jamaica.

Distortio (*Distortrix, Persona*) *gatunensis* TOULA, Jahrb. d. K. K. Geol. Reichs., Bd. 58, 1909, p. 700, pl. 25, fig. 10; Gatun formation, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 356, pl. 26, fig. 8; Gatun formation, Canal Zone.

Distortrix simillima, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 271, pl. 17, figs. 4, 5; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 305; Gatun Stage, Canal Zone.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 368; Miocene, Trinidad Island.

A good number of examples of this shell was obtained at the Spillway of the Canal in 1914, and since then it has been collected at Loc. 267, C. A. S., horizons P and R, and later at Loc. 325-A, near Cibarco, all of which represent a horizon near the middle, or in the upper part of the Tuberá group of the Colombian Miocene. It has not been found in the lowest horizon of the same.

75. **Cypræa henekeni** Sowerby

Cypræa henekeni SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45, pl. 9, fig. 3; Miocene, Santo Domingo.—GABB, Am. Phil. Soc. Trans., vol. 15, 1873, p. 235.—GUPPY, Geol. Mag. Lond., vol. 1, 1874, p. 440. —GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 528.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 356.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 278, pl. 19, fig. 4; Miocene, Santo Domingo.

Two good examples of this species were obtained at Loc. 267, C. A. S., horizon M - N, at the west base of Tuberá mountain, in the lower part of the Tuberá group, and it has not yet been found higher in the group.

76. **Cypræa (Pustularia) gabbiana** Guppy

Plate 15, figures 4, 5

Pustularia nucleus, GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 236. (Not of Linnæus).

Cypræa pustulata, GUPPY, Geol. Mag. Lond., vol. 1, 1874, p. 440. (Not of Lamarck).

Cypræa gabbiana GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 528, pl. 29, fig. 10; Miocene, Santo Domingo.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1890, p. 165.

Cypræa (*Pustularia*) *gabbiana*, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 280, pl. 19, fig. 12; Miocene, Santo Domingo.

A single well preserved example of this species was obtained at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group. The species is doubtless related to *C. pustularia* Lam., found in the Gulf of California, though it is narrower, and has more numerous transverse bars upon the bucal surface.

Plesiotype: No. 4653, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., horizon P, **near Punta Pua, Colombia**; Miocene

77. **Ovula (Neosimnia) puana** Anderson, new species

Plate 9, figures 9, 10

Shell small, length of holotype, broken, 20 mm., width 10 mm., biconic, smooth, bearing a subcentral, angular hump, but little elevated; aperture narrow, outer lip apparently simple, inner lip smooth and polished.

Holotype: No. 4626, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., **near Punta Pua, Colombia,** near the middle of the Tuberá group; Miocene.

This species is nearly related to *Ovula emarginata* Sowerby, from the Bay of Panama, but it differs in the elevation of the transverse hump.

Only a single specimen of this shell was obtained at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group. It is herein included only for the purpose of making the record as complete as our material will permit.

78. **Malea ringens** (Swainson)

Plate 12, figures 1, 2, 3, 4, 5, 6

Cassis ringens SWAINSON, Blith. Catal. 1822, App. p. 4.—SOWERBY, Tankerv. Catal., 1825, App. 21.

Dolium ringens (SWAINS.) REEVE, Conch. Icon., vol. 5, 1849, pl. 4, fig. 5; living, Payta, Peru.

Malea ringens (SWAINS.) CONRAD, Pac. R. R. Repts., vol. 6, 1855, pt. 2, p. 72, pl. 5, fig. 22; Miocene, Gatun, Panama.

This species has not recently been listed from the Miocene of the Caribbean region, although Conrad reported it from

Panama Miocene beds as early as 1855. It was obtained by the writer at the Spillway of the Canal in 1914, and since then at a number of points in the Tuberá group of the Colombian Miocene. The identity of the fossil Colombian species with the living form from the Gulf of California is shown in the illustrations presented herein. It differs from the more common form, *Malea camura* Guppy, in having a higher spire, narrower and flatter revolving ribs, as is illustrated in Maury's figure of the latter, and a longer canal. The outer lip is not preserved in most of our fossil examples, but it appears to be represented in Toula's figure (pl. 30, fig. 7),[27] which agrees with some of our material from Gatun. In the Colombian Miocene it was obtained at the following localities:

Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 267, C. A. S., horizon R, Tuberá village, near top of group; Loc. 299, C. A. S., near Baranoa, near middle of the group; Loc. 305, C. A. S., southeast of Turbaco, Depart. de Bolivar; Loc. 351, C. A. S., near Punta Pua, near the middle of the group.

Its range is, therefore, through the upper part of the Tuberá group of the Colombian Miocene.

Plesiotype: No. 4633, Mus. Calif. Acad. Sci., recent shell from **Bay of Panama**; *plesiotype:* No. 4634, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, Tuberá mountain; *plesiotype:* No. 4635, Mus. Calif. Acad. Sci., from Loc. 299, C. A. S., horizon P, near Plott's well, S. W. of Baranoa, Colombia; Miocene.

79. **Cassis (Phalium) dalli** Anderson, new species

Plate 14, figures 10, 11, 12, 13

Shell small, height of holotype, young shell, 13 mm., width 11 mm., globose, coronated, with moderate or low spire; shell ornamented by fine spiral sculpture covering the entire body, crossed by lines of growth; aperture lunate, outer lip thin on the two examples found; canal short and recurved. The spire of this species consists of two smooth nuclear whorls, followed by three rapidly expanding whorls which are tabular above,

[27] Toula, F., Jahrb. d. K. K. Geol. Reichs., Bd. 61, 1911, p. 500.

angulated on the shoulder and convexly rounded below. The angles of the shoulder bear 12 to 13 flattened spines, elongated laterally, forming a distinct corona. This shell bears a certain resemblance to *P. moniliferum* (Guppy), but has a much finer sculpture, only a single row of tubercles, a lower spire, and is of smaller size.

Holotype: No. 4649; *paratype:* No. 4650, Mus. Calif. Acad. Sci., from Loc. 267-L, Las Perdices group underlying the Tuberá group **a mile or more west of the Pier at Puerto Colombia**; Miocene.

This species is represented by two examples from Loc. 267, C. A. S., horizon L, the gray shales of the Las Perdices group underlying the Tuberá group a mile or more west of the pier at Puerto Colombia. It has not been found at any higher horizon.

80. **Cassis (Phalium) moniliferum** Guppy

Cassis monilifera Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 17, fig. 8; Miocene, Jamaica.

Phalium moniliferum Maury, Bull. Am. Pal., vol. 5, 1917, p. 274, pls. 18, figs. 4, 5; 19, fig. 1.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 307, pl. 12, fig. 11; Miocene.

This species was obtained at the Spillway of the Canal in 1914, but has not yet been certainly recognized in the Miocene of Colombia.

81. **Sconsia lævigata** (Sowerby)

Cassidaria lævigata Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 47, pl. 10, fig. 2.

Cassidaria sublævigata Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 27, fig. 9.

Cassidaria lævigata, Guppy, Geol. Mag. Lond., vol. 1, 1874, p. 439.—Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 525.

Sconsia lævigata, Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 356.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 275, pl. 19, fig. 2; Cercado de Mao, Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 308.

This species was obtained at the Spillway of the Canal in 1914, and since then it has been collected at Loc. 267, C. A. S., horizon M - N, and at Loc. 351, C. A. S., near Punta Pua, in the latter case from near the middle of the Tuberá group of the Colombian Miocene. It has not been found at any higher horizon, as far as known.

82. **Ficus colombiana** Anderson, new species

Plate 13, figures 1, 2

Shell medium or large, pyriform, graceful in outline, sculpture decussated, suboval; height of holotype 41.5 mm., width 29 mm., height of paratype (incomplete) 59 mm., width 42 mm.; spire low, even in young shells; upper slope gentle, curving gracefully to the sides; nuclear whorls smooth; sculpture consisting of spiral cords widely spaced, with four or five intermediary lines, the central of which is stronger than the others; aperture wide, suboval; pillar slightly curved.

Holotype: No. 4636; *paratype:* No. 4637, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **Tuberá mountain, Colombia**; Miocene.

The nearest ally of this species is *Ficus decussata* (Wood) from the Bay of Panama, Magdalena Bay and the Gulf of California. The principal difference in these species seems to be in the general outline and sculpture. The fossil species is more robust, has a shorter pillar and canal, and a much coarser sculpture. It differs from *F. carbasea* (Guppy), in its more rounded outline as well as in sculpture.

This species is represented by four good examples from Loc. 267, C. A. S., two of which came from horizon P, and two from horizon R, and accordingly from the middle and upper part of the Tuberá group. Other examples have been found at other localities in the middle part of the same group.

83. **Strombina chiriquiensis** Olsson

Strombina chiriquiensis Olsson, Bull. Am. Pal., vol. 9, 1922, p. 302, pl. 10, figs. 14, 24; Miocene, Costa Rica.

This species was found abundantly at Loc. 325-A, C. A. S., near Cibarco, near the middle of the Tuberá group of the Colombian Miocene.

84. **Dentalium granadanum** Anderson, new species

Plate 13, figure 3

Shell large, subcircular in section, gently curved, tapering very gradually; both ends complete when found, but subsequently broken; surface sculptured by 24 rounded but irregular longitudinal ribs, with no intermediate lines, the ribs continuing to the basal end of the shell; length of incomplete holotype not less than 55 mm.; greatest width 11 mm. When complete this shell was not less than 100 mm. in length. Its nearest ally seems to be one from Costa Rica described by Olsson as *D. uscarianum,* coming from the Uscari stage of the Miocene. Its resemblance, however, to *D. mississippiensis* Conrad[28] should be pointed out also.

Holotype: No. 4638, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon L, Las Perdices group, **Puerto Colombia**; Miocene.

A single example was obtained from the gray shales of the Las Perdices group below the Tuberá group, a mile west of Puerto Colombia.

85. **Serpulorbis papulosa** (Guppy)

Vermetus papulosa Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 292, pl. 17, fig. 3; Miocene, Santo Domingo.—Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 519; occurrence as above.

Serpulorbis papulosa (Guppy) Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1585.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 291, pl. 22, fig. 10; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 317, pl. 12, fig. 1; Gatun Stage, Costa Rica.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 376, as above.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 377, etc.; Springvale horizon, Miocene, Trinidad Island.

Examples of this species have been obtained at Loc. 267, C. A. S., horizon M-N, and at Loc. 351, C. A. S., near Punta Pua, in the latter case from near the middle of the Tuberá group of the Colombian Miocene.

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[28] Jour. Acad. Nat. Sci. Phila., vol. 1, 1848, p. 112, pl. 11, fig. 1.

86. **Serpulorbis granifera** (Say)

Serpula granifera SAY, Jour. Acad. Nat. Sci. Phila., vol. 4, 1824, p. 154, pl. 8, fig. 4.—Reprint, Bull. Am. Pal., vol. 1, 1896, p. 330, pl. 8, fig. 4; Miocene, Maryland.

Vermetus granifera, MARTIN, Md. Geol. Surv., 1904, p. 232, pl. 54, figs. 14, 15.

Serpulorbis granifera, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1892, p. 303.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 291, pl. 22, fig. 9; Miocene, Santo Domingo.

Examples of this species were obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group.

87. **Petaloconchus sculpturatus** H. C. Lea

Petaloconchus sculpturatus LEA, Trans. Am. Phil. Soc., vol. 9, 1845, p. 233, pl. 34, fig. 3.

Petaloconchus domingensis SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 51, pl. 10, figs. 8, a, b, c.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 359; Gatun formation, Canal Zone.

Petaloconchus sculpturatus, GABB, Trans. Am. Phil. Soc., vol. 25, 1875, p. 240; Miocene, Santo Domingo.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 519.

Vermetus (*Petaloconchus*) *sculpturatus,* DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1892, p. 305.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 377; Miocene, Santo Domingo.

Petaloconchus sculpturatus, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 318, pl. 14, figs. 10, 15; Miocene, Canal Zone.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 378, pl. 41, figs. 2, 4, 7; Miocene, Trinidad Island.

This species occurs frequently in the Tuberá group of the Colombian Miocene. It has been obtained at Loc. 267, C. A. S., horizon M - N, and Loc. 351, C. A. S., near the middle of the group, and at Loc. 325-A, also near the middle of the group. It occurs at higher horizons as well, at other localities.

PELECYPODA

88. Yoldia pisciformis Brown & Pilsbry

Yoldia pisciformis BROWN & PILSBRY, Proc. Acad. Nat. Sci., Phila., vol. 17, 1917, p. 38, pl. 6, fig. 3; near Cartagena, Colombia.

This species is abundant about Tuberá mountain in the middle part of the Tuberá group, as at Loc. 267, C. A. S., horizons P and R, Tuberá group, and it has also been found at Loc. 304, C. A. S., four miles east of Santa Rosa, near the Colombian coast.

89. Arca (Scapharca) patricia Sowerby

Arca patricia SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1850, p. 52; Miocene, Santo Domingo.—WOODRING, Science, vol. 62, 1925, pp. 518, 519.

Although Gabb was very confident that he had found and identified Sowerby's species, *Arca patricia* with the living *Arca grandis* Brod. & Sowerby, it appears that his confidence was not well grounded in fact. W. P. Woodring has summarized the matter pertaining to the former species, including under it the following as synonymous:

Arca (Anadara) grandis (BROD. & SOW.), GABB, 1873.
Scapharca (Argina) tolepia DALL, 1898.
Scapharca arthurpennelli MAURY, 1917.
Arca (Argina) tolepia (DALL), PILSBRY, 1922, etc.

This species has been found in the Tuberá group of the Colombian Miocene at three different localities, and in fact seems to be quite common. In all of the examples the ribs number about 30, are slightly nodose, and the shell has the form and hinge characters described by Dall for his *Scapharca tolepia*. It occurs abundantly at Loc. 267, C. A. S., in horizons M - N, and P, Tuberá mountain; Loc. 305, C. A. S., near Turbaco; and at Loc. 265, C. A. S., near Punta Paralillas, north of Monitos, on the Colombian coast. At the last point it was almost the only fossil found, but was sufficient to confirm the Miocene age of the strata, determined as such on other grounds.

90. **Arca (Noetia) macdonaldi** Dall

Arca (*Noetia*) *macdonaldi* Dall, Smiths. Misc. Coll., vol. 59, 1912, p. 9.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 366, pl. 25, figs. 4-7; Miocene, Costa Rica.

According to Dall this species is nearly related to *Arca trinitaria* Guppy, from the Miocene of Trinidad Island. Examples of it were found at Loc. 323, C. A. S., at the Spillway of the Canal in 1914, and subsequently at Loc. 267, C. A. S., horizons M - N, and P, of the Tuberá group, Tuberá mountain, and at Loc. 299, C. A. S., near Baranoa, Colombia. It is one of the abundant forms of this group.

91. **Arca (Scapharca) actinophora** Dall

Arca (*Scapharca*) *actinohpora* Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 647, pl. 33, fig. 26; Monkey Hill, Canal Zone.

This species was collected at the Spillway of the Canal in 1914, and subsequently at two separate localities in the Colombian Miocene, as at Loc. 267, C. A. S., horizon P, Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, some 20 miles north of Cartagena. At the latter locality three or four good examples were obtained which agree in all essentials with those of the Gatun formation.

92. **Arca (Scapharca) dariensis** Brown & Pilsbry

Arca (*Scapharca*) *dariensis* Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 362, pl. 22, fig. 10; Gatun formation, Canal Zone.

This species was found abundantly at the Spillway of the Canal in 1914, Loc. 323, C. A. S., and has since been found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, in the middle of the Tuberá group. It appears to belong to the group of *Arca (Scaph.) inequilateralis* (Guppy) from the Miocene of Trinidad.

93. **Arca (Arca) occidentalis** Philippi

Arca (*Arca*) *occidentalis* Philippi, Abbild. und Beschreib., vol. 3, 1847, p. 29, pl. 4, figs. 4, a, b; living, Caribbean Sea.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 327, pl. 29, fig. 3; Zone H, Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 353, pl. 22, fig. 1; Miocene, Costa Rica.—Woodring, Mioc. Moll. Bowden, Jamaica, Carnegie Inst. Publ. No. 1925, p. 29, pl. 2, figs. 8, 9; Bowden beds, Jamaica.

This species has been obtained abundantly in the Bay of Cartagena and has been collected from the Miocene beds of Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena. It is a variable form and it would be surprising if it did not persist from the lower Miocene into the living fauna.

94. **Arca (Anadara) usiacurii** Anderson, new species

Plate 19, figure 6; plate 20, figure 6; plate 21, figure 4

Arca grandis BROD. & SOW., PILSBRY (in part), Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 404; Miocene, near Cartagena, Colombia.

Arca grandis ? waringi F. & H. K. HODSON, Bull. Am. Pal., vol. 13, 1927, p. 7, pl. 7, figs. 1, 4; Miocene, N. Venezuela.

Shell large, solid and heavy; nearly equivalve; length of holotype 105 mm., height 103 mm., thickness of valve from hinge plane to back 50 mm.; radial ribs 27 in number, slightly flattened, heavy, beaded on the anterior surface, and less strongly so elsewhere; intercostal spaces nearly equal in width to the ribs, marked by strong lines of growth; cardinal area broad, forming a nearly symmetrical triangle crossed by four to six grooves in fully grown specimens, sloping to the outer angles of the area, but not quite meeting on the median line; hinge heavy, set with about 48-58 thin, close-set, often branching teeth, which in the center are vertical, but toward the ends curve outwardly and are often broken by an oblique line; margin of shell strongly denticulate within, showing about 23 broad denticulations.

Holotype: No. 4158, Mus. Calif. Acad. Sci., from Loc. 306, C. A. S., at the **northeast border of the village of Usiacuri, Colombia**; *paratype:* No. 4159, Mus. Calif. Acad. Sci., from Loc. 267 M - N, C. A. S., Tuberá group, Colombia; Miocene.

This species is even more nearly related to *Arca grandis* Brod. & Sow. than is the form figured by Pilsbry as such, and by Maury as *Arca patricia* Sowerby[29] for which the name *Arca patriarcha* is here proposed. A comparison of the hinges and cardinal areas clearly shows several marked differences. The branching of the cardinal teeth near the ends of the hinge in the Colombian species is a distinctive mark. Although Dr.

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[29] Bull. Am. Pal. vol. 5, p. 337, pl. 27, fig. 1.

Pilsbry had in his collection nine specimens from the Colombian coast (p. 404) he seems not to have noted the points in which they doubtless differ from the Dominican species or from the form living at Panama and other Pacific points.

This species is found in many parts of the Colombian marine Miocene associated with other purely marine forms. The holotype was obtained from Loc. 306, at the northeast border of the village of Usiacuri, more than 1,000 feet above the base of the group, where it is very abundant. The paratype comes from the uppermost part of horizon M - N of the Tuberá group, though it is abundant in higher horizons, as P and Q, and in still higher beds near the village of Usiacuri.

95. **Arca (Anadara) patriarcha** Anderson, new name

Arca grandis Brod. & Sow., Gabb, Trans. Amer. Phil. Soc., vol. 15, 1873, p. 253 (in part); Miocene, Santo Domingo.

Arca grandis Brod. & Sow., Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1922, p. 404, pl. 40, fig. 1; Miocene, Santo Domingo. Not *Arca grandis* Brod. & Sow.; living, Bay of Panama, etc.

Arca patricia Sowerby, Maury, Bull. Am. Pal., vol. 5, 1917, p. 337, pl. 27, fig. 1; Caimito, Rio Caña, Santo Domingo.

This species has not yet been correctly reported from Colombia, although it appears to be quite abundant in the Miocene of Santo Domingo. As shown by the figure supplied by Maury the cardinal teeth are not numerous, and are correspondingly very coarse. It lacks many of the details of form and dentition given for *Arca grandis* Brod. & Sow., and for *Arca (Anadara) usiacurii* Anderson.

96. **Arca (Scapharca) auriculata** Lamarck

Arca auriculata Lam., An. s. Vert., vol. 6, 1819, p. 43; living fauna.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 647; Miocene, Bowden, Jamaica.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 339, pl. 28, fig. 3; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 362, pl. 22, fig. 3; Miocene, Costa Rica.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 201, pl. 4, fig. 2; Miocene, Trinidad Island.

This species has been found living in the Bay of Cartagena, and fossil in the Tuberá group of the Colombian Miocene, as at Loc. 267, C. A. S., horizon M - N, the lowest member of the group. A careful comparison of the fossil and living examples shows the fossil form well within the range of variation in the living shells.

97. **Arca (Scapharca?) veatchi** Olsson

Arca veatchi Olsson, Bull. Am. Pal., vol. 9, 1922, p. 361, pl. 23, figs. 1-3; Gatun Stage, Miocene, Costa Rica.

This species has been obtained from Loc. 267, C. A. S., horizon M - N of the Tuberá group of the Colombian Miocene. The species appears to be nearly related to, though not identical with *Arca patricia* Sowerby, as understood in this paper.

98. **Arca (Scapharca) medioamericana** (Olsson)

Arca medioamericana Olsson, Bull. Am. Pal., vol. 9, 1922, p. 360, pl. 23, figs. 4-6; Miocene, Costa Rica.

Olsson has described this species as a variety of *Arca golfoyaquensis* Maury, but the specific differences seem so evident, both as to form and ornamentation, that it should be regarded as distinct. The species seems more closely related to *Arca actinophora* Dall, while Maury's species seems to be nearer to *Arca dariensis* Brown & Pilsbry.

99. **Arca (Scapharca) inequilateralis** Guppy

Arca inequilateralis Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, p. 293, pl. 18, figs. 2, a, b; Miocene, Jamaica.

Barbatia (Diluvarca) inequalateralis Woodring, Mioc. Moll. Bowden, Jam., Carnegie Inst. Publ. No. 366, 1925, p. 45, pl. 5, figs. 1-3; Miocene, Jamaica.

This species has been obtained from Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, from near the middle of the Tuberá group, and from Loc. 299-A, C. A. S., between Cibarco and Chorrera, Tuberá group, Colombian Miocene.

100. **Arca cacica** Olsson

Arca cacica Olsson, Bull. Am. Pal., vol. 9, 1922, p. 362, pl. 24, fig. 1; Miocene, Costa Rica.

This species occurs at Loc. 299, C. A. S., near Baranoa, Colombia, in the central part of the Tuberá group, Colombian Miocene.

101. **Arca (Scapharca) hispaniolana** Maury

Arca (Scapharca) hispaniolana Maury, Bull. Am. Pal., vol. 5, 1917, p. 340, pl. 30, figs. 9, 10; Miocene, Santo Domingo.

A single specimen of this species was obtained from each of the following localities: Loc. 304, C. A. S., four miles east of Santa Rosa; Loc. 306, C. A. S., near Usiacuri; and Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, Colombia; all of them in the central part of the Tuberá group of the Miocene.

102. **Arca pittieri** Dall

Arca pittieri Dall, Smiths. Misc. Coll., vol. 59, 1912, pt. 2, p. 9; Miocene, Costa Rica.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 364, pl. 24, figs. 2-6; Gatun Stage, Miocene, Costa Rica.

This species has been obtained at Loc. 305, C. A. S., near Turbaco; Loc. 349, C. A. S., near Galapa; and Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena. The first two occurrences are at points low in the Tuberá group, though the last is probably near the top.

103. **Arca (Scapharca) lloydi** Olsson

Arca (Scapharca) lloydi Olsson, Bull. Am. Pal., vol. 9, 1922, p. 364, pl. 24 figs. 10-12; Gatun Stage, Miocene, Costa Rica.

This species was obtained at Loc. 323, C. A. S., at the Spillway of the Canal, in 1914; and since then at Loc. 267, C. A. S., horizon P; and Loc. 306, C. A. S., Usiacuri; and also at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena; all from the central part of the Tuberá group.

104. **Glycymeris jamaicensis** Dall

Glycymeris jamaicensis Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 608.—Woodring, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 24, pl. 2, figs. 1-3; Miocene, Bowden, Jamaica.

This species has been found abundantly at Loc. 267, C. A. S., horizon M - N, and at Loc. 351, C. A. S., horizon P, both of the Tuberá group of the Colombian Miocene.

105. **Glycymeris carbasina** (?) Brown & Pilsbry

Glycymeris carbasina Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 363, pl. 28, fig. 9; Gatun formation, Canal Zone.

This species has been doubtfully identified among the forms found in the lowest horizon of the Tuberá group. It appears to be related to the preceding from the Bowden beds of Jamaica.

106. **Glycymeris lloydsmithi** Brown & Pilsbry

Glycymeris lloydsmithi Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 39, pl. 6, fig. 6; Miocene, near Cartagena, Colombia.

Several good examples of this species were obtained from Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group of the Colombian Miocene.

107. **Glycymeris lamyi** Dall

Plate 22, figures 7, 8

Glycymeris lamyi Dall, Bull. U. S. Nat. Mus., No. 90, 1915, p. 122, pl. 20, figs. 11, 13; Tampa Silex beds, Tampa Bay, Fla., Lower Miocene.

Glycymeris canalis, Olsson (in part, not Brown & Pilsbry), Bull. Am. Pal. vol. 9, 1922, p. 349, pl. 18, figs. 4, 5; Miocene, Costa Rica.

Plesiotype: No. 4670, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., **near Cibarco, Colombia**; Miocene.

Dall's description and figures are sufficiently clear to enable one to recognize the species with considerable confidence. He seems to have had, however, only the young or immature shells upon which to base his description. His figures are almost twice natural size.

With further growth the number of primary ribs increases, and at the same time riblets appear on some of them. Superficially this species resembles *G. trilobicosta* Brown & Pilsbry, but it is not only larger, but has a narrower, less expanded outline near the beaks, and intermediary riblets which are lacking in *G. trilobicosta.*

Several good examples of this species were obtained at Loc. 351, C. A. S., and at Loc. 325, C. A. S., all in the central part of the Tuberá group of the Colombian Miocene.

108. **Glycymeris usiacurii** Anderson, new species

Plate 22, figures 3, 4

Shell small, sub-circular, moderately inflated; beaks small, median, a little prominent; primary ribs 15 in number, rounded, widest in the central part of the shell, separated by a groove containing a single intermediary riblet; ligamental area small, almost obsolete; line of the cardinal teeth rounded, not angular, set with eight teeth on each side of the median line, with a few rudimentary teeth near the middle; height of holotype 24 mm., length 24 mm., depth of single valve 7 mm.

This species outwardly resembles *G. canalis* Brown & Pilsbry, but unlike it has intermediary riblets, and not so many cardinal teeth in the hinge.

This form has been found plentifully at Loc. 325, C. A. S., a mile east of the village of Usiacuri, and nearly 2,000 feet above the base of the Tuberá group, of the Colombian Miocene.

Holotype: No. 4668, Mus. Calif. Acad. Sci., from Loc. 325, C. A. S., horizon P, near the village of Usiacuri, Colombia; Miocene.

109. **Ostrea haitensis** Sowerby

Ostrea haitensis Sow., Quart. Jour. Geol. Soc. Lond., vol. 6, 1850, p. 53.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 346, pl. 31, figs. 1, 2; Zone D, Gurabo, Miocene, Santo Domingo.—Hodson, F., Bull. Am. Pal., vol. 13, 1927, p. 21, pl. 10, fig. 7, pl. 11, fig. 4, and pl. 12, fig. 4; Oligocene-Miocene, State of Falcon, western Venezuela.

Ostrea vespertina (?), Jordan & Hertlein (not Conrad), Proc. Calif. Acad. Sci., vol. 15, 1926, p. 428; California Pliocene.

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Sowerby's species has some marked features of resemblance to *O. vespertina* Conrad (= *O. veatchi* Gabb) from the upper Tertiary of the California coast, though identity is not claimed. *Ostrea gatunensis* Brown & Pilsbry, and *O. costaricensis* Olsson apparently belong to the same group, and at least may be regarded as analogous, if not identical forms.

Ostrea haitensis has been found at Loc. 266, C. A. S., San Juan Acosta Creek, horizon R, and Loc. 351, C. A. S., near Punta Pua.

110. Ostrea megadon Hanley

Ostrea megadon HANLEY, Proc. Zool. Soc. Lond., 1845, p. 106; living, west coast of Peru.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 1586; Miocene, Santo Domingo, and Jamaica.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 347, pl. 34, fig. 3; Miocene, Santo Domingo.

Ostrea cerrosensis GABB, Geol. Surv. Calif., Pal. vol. 2, 1869, p. 35, pl. 11, fig. 61; Cedros Island, Pliocene.

This species was found abundantly at Loc. 299, C. A. S., west of Usiacuri; Loc. 306, C. A. S., three miles south of Baranoa; Loc. 347, C. A. S., near Turbaco; all of which are below the middle of the Tuberá group of the Colombian Miocene.

In this group of oysters should probably also be included *Ostrea messor* Maury from the Miocene of Trinidad.[30]

It is worthy of note that *O. megadon, O. haitensis,* and *O. vespertina* should be so often found associated in the same beds. The two former are found together in the lower Miocene of north Colombia, the first and last are found in the Pliocene beds of the California coast. *Ostrea vespertina* (= *O. veatchi* Gabb) occurs in the Pliocene of Cedros Island and in contemporaneous beds in the Imperial valley, California, and is reported as still living in the Gulf of California. *Ostrea megadon* occurs with the preceding on Cedros Island and in Pliocene beds of Ventura county, and is found living at Turtle Bay, Lower California.

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[30] Bull. Am. Pal. vol. 10, 1925, p. 233, pl. 10, figs. 3, 4.

111. Pecten (Amusium) mortoni Ravenel

Pecten mortoni Ravenel, Proc. Acad. Nat. Sci., Phila., vol. 2, 1844, p. 96; Miocene, South Carolina.—Tuomey & Holmes, Pliocene Foss, S. Carolina, 1857, p. 27, pl. 9, figs. 1, 2; pl. 10, figs. 1, 2.

Pecten (Amusium) mortoni, Clark et al., Maryland Geol. Surv., 1904, p. 372, pl. 99, fig. 1; Miocene, Maryland.

Brown & Pilsbry have described two species of *Amusium* from the Gatun formation of the Canal Zone, either one, or both of which may represent this species. The differences pointed out by these authors between *P. mortoni* Rav., and *P. (Amusium) luna* Brown & Pilsbry seem unimportant. Examples obtained from the Spillway of the Canal, 1914, and afterward from the Tuberá group, horizon M - N, are very similar, though the Colombian forms agree better with the characters of *P. mortoni* than do those from Gatun. In our specimens the ears are not depressed below the plane of the valve. The external surface is smooth, or marked only by faint lines of growth, the diameter of the largest example is 143 mm., though larger specimens were seen. The angle of divergence in the dorso-lateral lines is near 123°-125°, varying a little, as may be expected. The concentric growth lines nearly describe a circle, and the number of pairs of internal ribs is 22 to 24. The species is not rare in the Tuberá group of Colombia. The best examples were found at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group. It occurs also at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

112. Pecten (Plagioctenium) demiurgus Dall

Pecten comparilis Guppy, Geol. Mag., vol. 1, 1874. (Not Tuomey & Holmes, 1855).

Pecten (Plagioctenium) demiurgus Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 718, pl. 26, fig. 3.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 237, pl. 14, fig. 5; pl. 16, fig. 6; Miocene, Trinidad Island.

According to Maury, the shell, when full grown, sometimes measures as much as 75 mm. in altitude, and a little more in width. Ours are not so large, though larger examples were seen at the locality from which they came. It is abundant at Loc. 267, C. A. S., horizon M - N, near the base of the

Tuberá group. The gravelly beds of this horizon did not permit the extraction of the larger specimens. The proportions maintain in all of them.

113. **Pecten pinulatus** Toula

Pecten pinulatus Toula, Jahrb. der K. K. Geol. Reichs., vol. 61, 1911, p. 491 pl. 30, fig. 3; Miocene, Canal Zone.

According to Toula's description and statement, the shell resembles that of *Pecten cactaceus* Dall, from the younger Tertiary of Tehuantepec. Our examples show a decided resemblance to Dall's species in surface ornamentation, although they are not so large.

Two good examples were obtained from Loc. 267, C. A. S., horizon M - N, where it is not rare in the gravelly beds with the preceding.

114. **Pecten atlanticola** Anderson, new species

Plate 19, figures 3, 7

Shell small, nearly circular, or slightly oblique, appressed, left valve a little more convex than the right; ears long, subequal, the anterior right ear bearing six radial riblets, the others mostly smooth; radial ribs on the body of the shell 13 in number, rounded, with interspaces of nearly the same width as the ribs; ribs and interspaces crossed by distinct lines of growth; altitude of holotype 36 mm., length 40 mm., thickness 10.5 mm.

Holotype: No. 4661; *paratype:* No. 4661-A, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **north slope of Tuberá mountain, Colombia**; Miocene.

There is a strong resemblance, and evident relationship between this species and *P. prævalidus* Jordan & Hertlein,[31] from the Pliocene of Turtle Bay, Lower California.

Several good specimens of this species were obtained at Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain. As far as known this species belongs near the middle of the

[31] Proc. Calif. Acad. Sci., vol. 15, 1926, p. 435, pl. 29, figs. 2, 3.

Tuberá group of the Colombian Miocene, therefore near the Gatun horizon.

115. **Pecten (Euvola) bowdenensis** Dall

Pecten (*Euvola*) *bowdenensis* DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 713, pl. 29, fig. 1.—(?) BÖSE, Bol. Inst. Geol. Mex., No. 22, 1906, p. 27, pl. 1, figs. 8, 10.—WOODRING, Carnegie Inst. Wash., Publ. No. 266, 1925, p. 63, pl. 7, figs. 8, 9; Miocene, Bowden beds, Jamaica.

A single example of this shell was obtained from Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, from beds believed to be equivalent to the Gatun formation of the Canal Zone.

116. **Pecten macloskeyi** Anderson, new species

Plate 19, figures 4, 5

Shell small, height of holotype 25.5 mm., length 24 mm., basal part circular, equivalve, beaks high, the borders forming an angle below 90 degrees; ears long, the anterior right ear bearing four corrugated riblets, the others nearly smooth; surface ornamented by about 12 low, smoothly rounded ribs, with interspaces narrower than the ribs; ribs on left valve very low, though not absent; all ribs more distinct on the younger shells.

Holotype: No. 4662; *paratype:* No. 4663, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., **north slope of Tuberá mountain, Colombia**; Miocene.

This species is distinguishable from *P. atlanticola* by its smaller size, lower, more rounded ribs, narrower umbonal angle, and less circular outline.

Several good examples of this shell were obtained at Loc. 267, C. A. S., associated with *P. atlanticola,* from which it is readily separated. As far as known both mark the middle of the Tuberá group of the Colombian Miocene. It is named in honor of Mr. Downs McCloskey, whose active interest aided much in the study of the section and in the collections.

117. **Spondylus bostrychites** Guppy

Spondylus bifrons Sowerby, Quart. Jour. Geol. Soc. Lond., vol. 6, 1850 (not of Goldf. 1835); Miocene, S. Domingo.

Spondylus bostrychites Guppy, Proc. Sci. Soc. Trinidad, 1867, p. 176.—Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 257.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 758; 1903, p. 1586.—Bull. U. S. Nat. Mus., No. 90, 1915, p. 124, pl. 19, fig. 4; Silex beds, Fla.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 354.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 413; Miocene, Santo Domingo.

A number of examples of this species were obtained at Loc. 267, C. A. S., horizon M - N, along with many other heavy shelled littoral forms, as shown elsewhere.

118. **Spondylus gumanomocon** Brown & Pilsbry

Spondylus americanus Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 257 (not of Lamarck); Miocene, Santo Domingo.

Spondylus gumanomocon Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 64, 1912, p. 514.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 355.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 413, pl. 43, figs. 4, 5; Miocene, Santo Domingo.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 379, pl. 21, fig. 1; Miocene, Costa Rica.

Several examples of a *Spondylus* corresponding very closely to this form were obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group. They were associated with the preceding form and other littoral species. The probability of their identity with the above species is very great.

119. **Anomia mamillaris** Anderson, new species

Plate 16, figures 9, 10

Shell small, thin, smooth, translucent, circular in outline, convex; surface undulating, showing lines of growth, scaly near the umbones; umbone prominent, not quite central, inclining forward; height of holotype 22 mm., length 23 mm., depth of single valve 8 mm.

Holotype: No. 4165; *paratypes:* No. 4166 and 4167, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., from horizon M - N, **Tuberá group, Colombia**; Miocene.

Several good examples of this shell were obtained at Loc. 267, C. A. S., in the lowest horizon M - N, of the Tuberá group.

120. **Crassatellites berryi** Spieker

Crassatellites berryi Spieker, Johns Hopkins Univ. Publ. Geol., No. 3, 1922, p. 131, pl. 7, figs. 9, 10; Lower Zorritos, Peru.

This species is abundant at Loc. 267, C. A. S., horizon R, Tuberá village, north Colombia. As far as known it belongs only to this horizon, though its place in the Miocene of Peru is somewhat lower.

121. **Crassatellites (Scambula) densus** Dall

Crassatellites (*Scambula*) *densus* Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1472, pl. 39, figs. 9-12; Oak Grove, Florida.

This species was found plentifully in the lowest horizon M - N, of the Tuberá group at Loc. 267, C. A. S., near the western foot of Tuberá mountain, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

122. **Venericardia brassica** Maury

Venericardia terryi, var. *brassica* Maury, Bull. Am. Pal., vol. 10, 1925, p. 323, pl. 30, fig. 5; Miocene, Trinidad.

Miss Maury has described this species as a variety of *V. terryi* Olsson, from the Miocene of Costa Rica, which it somewhat resembles.

In view of its larger size, more prominent ribs, exceeding those of the Costa Rican species, our samples are regarded as distinct from the latter, though identical with the Trinidad species. Three well-preserved specimens were found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, Colombian Miocene.

123. **Venericardia trinidadensis** Maury

Venericardia trinidadensis Maury, Bull. Am. Pal., vol. 10, 1925, p. 323, pl. 30 fig. 6; Miocene, Trinidad Island.

A single valve of a venericard identifiable with the above was obtained at Loc. 305, near Turbaco, from a central horizon in the Tuberá group. Its range is not known.

124. **Cardita (Carditamera) arata** (Conrad)

Plate 20, figures 4, 5

Cypricardia arata Conrad, Foss. Sh. Ter. Form., 1832, p. 20, pl. 5, fig. 1; Miocene, North Carolina, etc.

Cardita (Carditamera) arata, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1413.—Maury, Monog. Serv. Geol. e Min. Brazil, 1925, p. 271, pl. 15, fig. 15; Miocene, Para, Brazil.

The shell is of moderate size, length 31 mm., height 18 mm., thickness 16 mm.; elongated subquadrate, rounded before, and somewhat truncated behind; beaks near anterior end but not terminal, strongly incurved and proximate; dorsal margin straight, ventral margin slightly arcuate; ribs 15 in number, with a tendency to become scaly, or even beaded, showing wavy lines of growth.

Plesiotype: No. 4164, Mus. Calif. Acad. Sci., from Loc. 267-B, C. A. S., horizon M - N, **Tuberá group, Colombia**; Miocene.

This description is here introduced in support of the identification of Conrad's species in the Miocene of north Colombia. Maury has stated that the species is found in the Chipola marls, associated with *C. vaughani* Dall, and in the lower Miocene of Para, Brazil, there is a very similar form. *C. arata* is said to be a widely distributed and abundant form, to which *C. floridana* Conrad, from the Pliocene of Florida is regarded as a successor.

Several examples of this species were found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group of the Colombian Miocene. A comparison with samples of Conrad's species from Florida shows the only essential difference to be in the slightly more beaded ornamentation of the ribs in the more recent form.

125. **Cardita (Glans) scabricostata** Guppy

Cardita scabricostata GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 293, pl. 18, fig. 10; Miocene, Jamaica.

Venericardia scabricostata, DALL (part), Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1428.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 362, pl. 33, fig. 1; Miocene, Santo Domingo.—WOODRING, Carnegie Inst. Wash., Publ. No. 266, 1925, p. 99, pl. 12, figs. 7-9; Miocene, Jamaica.

Although Dr. Woodring does not include Maury's form as coming within the range of Guppy's species, it appears that it should not be regarded as a distinct form, and that it should have at least a varietal rank there. We have several good examples from five different localities, all of which approach the form figured by Maury, more nearly than that of Woodring. It occurs at Loc. 267, C. A. S., horizons M - N, P, and R, Tuberá mountain; Loc. 306, near Usiacuri; Loc. 355, Murindo creek; and it was obtained at Loc. 323, C. A. S., at the Spillway of the Canal in 1914.

126. **Echinochama antiquata** Dall

Chama arcinella, GUPPY, Geol. Mag., vol. 1, 1874, p. 450 (not of Linnæus); Miocene, Bowden, Jamaica, and Santo Domingo.

Echinochama antiquata DALL, Trans. Wag. Fr. Inst. Sci., vol. 3 1903, p. 1404, pl. 54, fig. 9.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 390, pl. 28, fig. 8; Miocene, Costa Rica.

This species occurs abundantly at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, and at Loc. 351, C. A. S., in the middle part of the group, near Punta Pua, 20 miles north of Cartagena.

127. **Chama scheibei** Anderson, new species

Plate 22, figures 1, 2

Shell of moderate size, very inequal valves; height of holotype 43 mm., length 37 mm.; left valve inflated, right valve nearly flat; left valve with strongly recurved beak, right valve with smaller beak, less recurved; surface bearing only obsolete spines, if any, and only on the posterior part of left valve; right valve ornamented with wavy lamellæ following lines of growth; anterior part and umbone of left valve somewhat beaded. A faint depression extends from the beak near and parallel to the anterior margin.

A number of samples of this species were found at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, Colombian Miocene.

Named in honor of the late Dr. Robert Scheibe of the Comicion Cientifica Nacional, Bogota.

Holotype: No. 4667, Mus. Calif. Acad. Sci., from Loc. 267-B, C. A. S., horizon M - N, **Tuberá mountain, Colombia**; Miocene.

128. **Thyasira bisecta** (?) (Conrad)

Plate 21, figure 1

Venus bisecta CONRAD, Geol. U. S. Expl. Expd., 1849, p. 724, pl. 17, figs. 10, 10a; Miocene, Astoria, Oregon.

Cyprina bisecta CONRAD, Am. Jour. Conch., vol. 1, 1865, p. 153; locality as above.

Cryptodon bisecta, DALL, Proc. U. S. Nat. Mus., vol. 17, 1895, p. 713, pl. 26, figs. 2, 5; living, Alaskan coast and southward.

Thyasira bisecta, DALL, Prof. Ppr. U. S. Geol. Surv., No. 59, 1909, p. 118; Miocene, Astoria, Oregon.

According to Dall this species is found living on the Alaskan coast, in Puget Sound, and occurs in the Miocene of Oregon and perhaps of California. As no reference to its occurrence in the Caribbean region has been found, it seems well to record it here, even though doubtfully recognized. The species was found by K. D. White at Loc. 350, C. A. S., near Arboletes Bay in the upper Miocene beds of the Colombian coast.

Plesiotype: No. 4664, Mus. Calif. Acad. Sci., from loc. 350, C. A. S., **Canalete Point, north coast of Colombia**; Miocene.

129. **Diplodonta woodringi** Anderson, new species

Plate 22, figures 5, 6,

Shell small, circular in outline, suborbicular, moderately inflated in the umbonal area; anterior end more abruptly sloping than the rounded posterior; height of holotype 26 mm., length 25 mm., thickness 18 mm.; beaks somewhat central, recurved, prominent; lunule only faintly marked.

Holotype: No. 4669, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., **near Cibarco, Colombia**; Tuberá group, Miocene.

Two or three samples of this species were obtained, one from Loc. 325, C. A. S., and the other, the holotype, from Loc. 325-A, C. A. S., near Cibarco, about horizon P of the Tuberá group, not common.

This species is named in honor of Wendell P. Woodring, whose work in the Caribbean Miocene and later formations is deserving of highest praise.

130. **Erycina turbacoensis** Anderson, new species

Plate 22, figures 9, 10

Shell large, oval, depressed; length of holotype (incomplete) 46 mm., height 35 mm., thickness 12 mm.; length of paratype (cast) 59 mm., height 45 mm.; beaks subcentral, a little nearer the posterior end, low, curved forward; lunular area small, impressed; anterior dorsal margin nearly straight, anterior end produced, posterior shorter, rounded; surface smooth, ornamented only by indistinct lines of growth. The hinge on the right valve of paratype is distinct, showing normal character of *Erycina*.

In form and general characters this species resembles *Erycina fabulina* Dall, from the Oak Grove Miocene, but it is many times larger. The figure of *Semele sayi* Toula[32] resembles this species somewhat, but seems to have a more decided concentric sculpture.

This species was found at Loc. 305, C. A. S., near Turbaco, Colombia, in the lower part of the Tuberá group.

Holotype: No. 4671; *paratype:* No. 4672, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., **near Turbaco, Colombia,** in the lower part of the Tuberá group; Miocene.

[32] Jahrb. der K. K. Geol. Reichs., 1909, Bd. 58, pl. 28.

131. **Cardium (Trachycardium) dominicense** Gabb

Cardium (*Trachycardium*) *dominicense* Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 250.—Gabb, Jour. Acad. Nat. Sci. Phila., vol. 8, 1874, p. 344; Miocene, Costa Rica.—Pilsbry & Brown, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 367; Gatun formation, Canal Zone.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 421, pl. 25, figs. 8, 9; Miocene, Santo Domingo.

A single good example of this shell was found by K. D. White in the Miocene beds of the Rio Canalete, near the mouth of the Quebrada Murindo, in the district of Arboletes Bay, Colombia.

132. **Cardium (Trachycardium) puebloense** Anderson, new species

Plate 19, figures 1, 2

Shell of medium size, subquadrate, thick, equilateral, surface somewhat enamelled; length of holotype 40 mm., height 44 mm., thickness 36 mm.; umbones high and prominent, only slightly angulated behind; ribs 30 to 34 in number, nearly smooth, though showing lines of growth; margins smooth, denticulate within, the posterior margin slightly serrate. A peculiarity of the sculpture is the linear division of the rounded ribs, separated by V-shaped interspaces; the anterior 18 or 20 ribs are sometimes divided longitudinally by an elevated thread, the posterior 12 or 14 are so divided by a groove of equal strength; in either case the ribs are marked by V-shaped incremental lines. These lines are apparent even on very young shells. This species appears to be related to *C. lingua-leonis* of the Jamaican Miocene, as illustrated by Woodring.

Holotype: No. 4660, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon R, at the **village of Tuberá, Colombia**; Miocene.

The holotype was found at Loc. 267, C. A. S., horizon R, at the village of Tuberá.

133. Cardium (Trachycardium) lingualeonis Guppy

Cardium lingualeonis Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 293, pl. 18, fig. 7; Miocene, Jamaica.—Guppy, Geol. Mag., vol. 1, 1874, p. 422; (Not Guppy, vol. 32, 1876, p. 531).

Cardium (Trachycardium) lingualeonis, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1900, p. 1084; Miocene, Chipola river, Florida.—Woodring, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 136, pl. 18, figs. 12, 13; Miocene, Bowden, Jamaica.

This species occurs abundantly in the Tuberá group, having been obtained at the following places: Loc. 267, C. A. S., horizon M - N; Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena; in the latter of these places it occurs near the middle of the Tuberá group.

134. Cardium (Lævicardium) gorgasi Hanna

Cardium (Lævicardium) dalli Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 722, pl. 27, fig. 6; Gatun formation, Miocene.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 367; (not *C. dalli* Heilprin, 1887).

Cardium gorgasi Hanna, Proc. Calif. Acad. Sci., vol. 13, 1924, p. 160; new name proposed for the species.

Two examples of this species, measuring respectively 53 mm. and 45 mm. in height, were obtained at Loc. 267, C. A. S., horizon M - N, near the base of Tuberá group, and another from Loc. 266, C. A. S., near the top of the same group. It differs from *C. (Lævicardium) serratum* Linnæus in both form and ornamentation, is larger and a thinner form in which radial ribbing is present, though not prominent; while in the living form the radial markings are faint. In the fossil form the dorsal margin is elevated into a sharp ridge, slightly arched near the hinge, and the posterior end is produced and narrowed, while the living form is here distinctly rounded.

135. Cardium (Lævicardium) serratum Linnæus

Cardium serratum Linnæus, Syst. Nat. 1758, ed. 19, p. 680.

Cardium (Lævicardium) serratum, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1900, p. 1110; Miocene, Bowden, Jamaica.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 367; Gatun formation, Canal Zone.—Woodring, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 145, pl. 19, figs. 14 to 16; Bowden, Jamaica.

This species has been found at Loc. 305, C. A. S., near Turbaco, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, north coast of Colombia, near middle of the Tuberá group. The species is still living in the Caribbean waters, and was collected in the Bay of Cartagena and neighboring points in 1914.

136. **Cardium (Lævicardium) venustum** Gabb

Cardium venustum Gabb, Trans. Am. Phil. Soc., vol. 15, 1873, p. 251; Miocene, Santo Domingo.—Maury, Bull. Am. Pal., vol. 5, 1917, p. 213, pl. 36, fig. 9; as above.—Pilsbry, Proc. Acad. Nat. Sci., vol. 73, 1921, p. 421, pl. 25, figs. 2, 7; Miocene, Santo Domingo.

A good example of this shell was obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group.

137. **Dosinia delicatissima** Brown & Pilsbry

Dosinia delicatissima Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 64, 1912, p. 516, pl. 26, fig. 1; Miocene, Gatun formation.

Dosinia (*Artemis*) *acetabulum* (Conrad), Toula (?), Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 727, pl. 27, figs. 8, 8a.

Examples of this species were obtained at the Spillway of the Canal in 1914, and subsequently at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena. They are indistinguishable, and seem to conform satisfactorily to the figure and description of the species given by Brown & Pilsbry.

138. **Dosinia (Artemis) acetabulum** (?) (Conrad)

Artemis acetabulum Conrad, Foss. Sh. Tert. Format., 1833, p. 20, pl. 6, fig. 1; Miocene, Maryland.

Dosinia acetabulum Conrad, Foss. Med. Tert., 1838, p. 29, pl. 16, fig. 1.—Whitf., Monog. U. S. Geol. Surv., No. 24, 1894, p. 73, pl. 13, fig. 2.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 403; Miocene, Costa Rica.

Dosinia (*Artemis*) *acetabulum* (Conrad), Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 727, pl. 27, figs. 8, 8a; Gatun formation, Canal Zone, Panama.

A fossil species probably referable to the above was obtained at Loc. 267, C. A. S., horizon P, near the middle of the Tuberá group of the Colombian Miocene.

139. Clementia (Clementia) dariena (Conrad)

Meretrix dariena Conrad, House Doc. 129, 1855, p. 18; Miocene, Isthmus of Panama.—Pac. R. R. Repts., vol. 5, 1856, p. 328, pl. 6, fig. 55; occurrence as above.

Clementia dariena, Gabb, Jour. Acad. Nat. Sci. Phila., vol. 8, 1881, p. 344, pl. 44, figs. 16, 16a; Miocene, Santo Domingo.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1235, Sapote, Costa Rica.—Toula, Jahrb. der K. K. Geol. Reichs., vol. 58, 1908, pp. 725-727, pl. 27, figs. 9, 10; Gatun formation, Canal Zone.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 371, pl. 28, fig. 1.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 404; Miocene, Costa Rica.—Woodring, Prof. Ppr. U. S. Geol. Surv., No. 147-C, p. 34.

Good examples of this species were obtained at the Spillway of the Canal in 1914 and it has since been collected at many localities in north Colombia, as at Loc. 267, C. A. S., horizons M - N and P; Loc. 305, C. A. S., near Turbaco; Loc. 302, C. A. S., four miles south of San Andres; Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

140. Cyclinella gatunensis Dall

Cyclinella gatunensis Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1285, pl. 52, fig. 18; Miocene, Gatun, Panama.

Several good samples of this species were obtained from Loc. 323, C. A. S., at the Spillway of the Canal in 1914, and it has since been found at various places in north Colombia. It occurs at Loc. 267, C. A. S., horizon R, Tuberá village; Loc. 302, C. A. S., four miles south of San Andres, Dept. of Bolivar; upper horizon of the Miocene. As it has not hitherto been reported outside of the type locality its discovery in the Tuberá group is interesting.

141. Cyclinella cyclica domingensis Pilsbry & Johnson

Dosinia cyclica Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 582, pl. 26, figs. 15a, b; Miocene, Trinidad.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1285; probably Santo Domingo Miocene.

Cyclinella cyclica domingensis Pilsbry & Johnson, Proc. Acad. Nat. Sci., Phila., vol. 69, 1917, p. 200; Miocene, Santo Domingo.—Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 424, pl. 47, fig. 3; as above.

Three examples of this species were obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group, Colombian Miocene.

142. **Antigona (Ventricola) blandiana** (Guppy)

Venus blandiana Guppy, Proc. Sci. Soc. Trinidad, vol. 3, 1873, pp. 85-86, pl. 2, fig. 8.—Geol. Mag., vol. 1, 1874, p. 436, pl. 17, fig. 8; Miocene, Trinidad.

Antigona (*Ventricola*) *blandiana*, Woodring, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 157, pl. 21, figs. 5-9; Miocene, Bowden, Jamaica.

This species has been found in the Tuberá group at Loc. 267, C. A. S., horizons M - N and P, and at Loc. 351, C. A. S., near Punta Pua, north of Cartagena. The species is closely related to *Antigona fordi* Yates,[33] now living on the Pacific coast from Monterey Bay to Panama (Dall).

143. **Antigona caribbeana** Anderson

Antigona caribbeana Anderson, Proc. Calif. Acad. Sci., vol. 16, 1927, p. 90, pls. 2 and 3; Loc. 267, Horizon M - N, Tuberá group of Colombian Miocene.

This is perhaps the largest representative of the genus yet found in the Caribbean Tertiary deposits. It has commonly been regarded as the Miocene form of *Antigona multicosta* (Sowerby), but upon a careful comparison it can be easily distinguished by various characters, among which are the crenulations on the inner margin of the shell. It occurs plentifully in the basal beds of the Tuberá group.

144. **Callocardia (Agriopoma) gatunensis** Dall

Callocardia (*Agriopoma*) *gatunensis* Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1260, pl. 54, figs. 1, 15; Gatun formation, Panama.—Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 370; occurrence as above.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 407, pl. 32, fig. 1; Miocene, Costa Rica.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 298, pl. 27, figs. 5, 7; Miocene, Trinidad Island.

This species has been obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, and at Loc.

[33] Yates, Santa Barbara Nat. Hist. Soc. Bull. 2, p. 46.

351, C. A. S., near Punta Pua, 20 miles north of Cartagena. It occurs, therefore, near the middle of the Tuberá group.

145. **Pitaria (Lamelliconcha) circinata** (Born)

Venus circinata BORN, Test. Mus. Caes. Vind., 1778, p. 61, pl. 4, fig. 8; living in Caribbean waters.

Chione circinata, GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 250; Miocene, Santo Domingo.

Pitaria (Lamelliconcha) circinata, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1269; Gatun formation; Cumana, Venezuela, etc.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 379, pl. 37, fig. 1; Miocene, Santo Domingo. —Bull. Am. Pal., vol. 10, 1925, p. 301, pl. 27, figs. 12, 13; Miocene, Trinidad Island.

Pitar circinata, BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 370; Gatun formation, Canal Zone.

Pitaria circinata, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 408, pl. 31, figs. 3, 9; Miocene, Costa Rica.

Numerous examples of this species were obtained from the Bay of Cartagena in 1914, and it has since been collected at Loc. 267, C. A. S., horizon R, at Tuberá village, and from Pliocene beds on the Caribbean coast of Colombia.

146. **Pitaria cercadica** Maury

Pitaria cercadica MAURY, Bull. Am. Pal., vol. 5, 1917, p. 380, pl. 37, fig. 10; Miocene, Santo Domingo.

This species has been obtained at Loc. 267, C. A. S., horizon M - N, and horizon R, of the Tuberá group, and should be found also in intervening strata. It is believed to be closely related to *Pitaria albida* Gray (?), now living in the Bay of Cartagena.

147. **Pitaria acutecostata** (Gabb)

Callista acutecostata GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 250, Miocene.

Pitaria acuticostata, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 380, pl. 37, fig. 2; Miocene, Santo Domingo.

Pitar (Lamelliconcha) acuticostatus PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 422, pl. 47, fig. 10; occurrence as above.

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This species is found at Loc. 267, C. A. S., horizon R, Tuberá village. In size and form it approaches very near to *P. affinis* Sowerby, now living in neighboring waters.

148. **Tivela mactroides** (Born)

Venus mactroides Born, Test. Mus. Caes. Vind., 1778.

Cytherea mactroides, Reeve, Conch. Icon., 1863, pl. 5, figs. 18, a, b, c; living fauna, Caribbean region.

Tivela mactroides, Dall, Proc. U. S. Nat. Mus., vol. 26, 1902, p. 367; occurrence as above.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 295, pl. 26, fig. 8; pl. 27, fig. 3; Miocene, Trinidad.

Numerous examples of this shell were obtained from the Bay of Cartagena and near by points in 1914, and it has since been found fossil at Loc. 325-A, C. A. S., near Cibarco, a little above the middle of the Tuberá group. Comparison with the living form shows no essential difference in the fossil.

149. **Macrocallista (Chionella) maculata** (Linnæus)

Venus maculata Linnæus, Syst. Nat. 1758, ed. 10, p. 680; living.

Macrocallista (*Chionella*) *maculata*, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1256; Chipola beds, Florida.—Olsson, Bull. Am. Pal., vol. 9, 1922, p. 406, pl. 31, figs. 6, 7; Miocene, Costa Rica.—Maury, Bull. Am. Pal., vol. 10, 1925, p. 279, pl. 25, figs. 1, 4, 5; upper Miocene, Trinidad.

This species is found living in the Bay of Cartagena, and other Caribbean waters, and was found fossil at Loc. 267, C. A. S., horizon M - N, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, in the lower and central parts of the Tuberá group.

150. **Chione (Chamelea) nuciformis** (Heilprin)

Cytherea nuciformis Heilprin, Trans. Wag. Fr. Inst. Sci., vol. 1, 1887, p. 116, pl. 16, fig. 61; Pliocene, Florida.

Chione (*Chamelea*) *nuciformis*, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1300; Miocene, Tampa Bay, Florida.

This species has been obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group of the Colombian Miocene.

151. **Chione (Chione) walli** Guppy

Venus walli Guppy, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 581, pl. 26, fig. 16; Miocene, Trinidad.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, pp. 1291, 1587; Miocene, Trinidad, Bowden, Jamaica.—Spieker, Pal. Zorritos Format., Johns Hopkins Univ. Publ., Geol., No. 3, pp. 151, 154; Miocene, Peru.

Chione (*Chione*) *walli*, Maury, Bull. Am. Pal., vol. 10, 1925, p. 311, pl. 28, figs. 2, 11, 15; Miocene, Trinidad.

A species of *Chione,* probably referable to the above, was found at Loc. 267, C. A. S., horizons M - N and R of the Tuberá group. Its occurrence at both the bottom and top of the group makes it likely that it will be found also at intervening horizons.

152. **Chione (Lirophora) mactropsis** (Conrad)

Gratelupia (?) *mactropsis* Conrad, House Doc. 129, 1855, p. 18; Isthmus of Panama.—Pac. R. R. Repts., vol. 5, 1856, p. 328, pl. 6, fig. 54; Miocene, Isthmus of Panama.

Chione (*Lirophora*) *mactropsis*, Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1294; Gatun formation, Panama.

Chione mactropsis, Olsson, Bull. Am. Pal., vol. 9, 1922, p. 417, pl. 30, figs. 7, 8; Gatun formation, Canal Zone.

This species occurs abundantly in the Miocene at Gatun, and at Loc. 267, C. A. S., horizon M - N, Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

153. **Chione (Lirophora) latilirata** (Conrad)

Venus latilirata Conrad, Proc. Acad. Nat. Sci. Phila., vol. 1, 1841, p. 28.—Conrad, Foss. Sh. Med. Tert., 1845, p. 68, pl. 38, fig. 3; Miocene.

Chione (*Lirophora*) *latilirata*, Meek, Checkl. Mio. Foss. Am., 1864, pp. 9, 30.—Dall, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1298, pl. 42, fig. 3; Miocene.

Chione (*Lirophora*) *cartagenensis* F. & H. K. Hodson, Bull. Am. Pal., vol. 13, p. 63, pl. 31, fig. 4; pl. 35, fig. 6; Miocene, Colombia.

This species occurs at Loc. 267, C. A. S., horizon M - N of the Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

154. **Chione atlanticana** Anderson, new species

Plate 23, figures 5, 6

Shell of moderate size, subtriangular in outline; length of holotype 61 mm., height 51 mm., thickness 41 mm.; dorsal margin nearly straight, ventral margin broadly rounded, posterior angulated; beaks prominent; anterior slope short, projecting, forming angle with the ventral border; surface ornamented by raised concentric lamellæ, fluted on the ventral side as in *Chione guppyana* Gabb, as described by Pilsbry.[34]

The lunule is relatively large and bordered by a sharply defined groove; escutcheon moderately wide, bordered by ridges; inner border of shell finely crenulated.

Holotype: No. 4676, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **Tuberá mountain, Colombia**; Miocene.

This species is nearly related to *Chione guppyana,* but it differs from Gabb's species in being more nearly triangular in outline, straighter on the dorsal border, more prominent in front, and in lacking concentric lamellæ along the ventral margin.

This species has been obtained at Loc. 267, C. A. S., horizon P, where it was associated with *Pitaria circinata, Antigona caribbeana,* and *Clementia dariena.*

155. **Tellina costaricana** Olsson

Tellina costaricana OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 423, pl. 26, figs. 6, 9; Gatun Stage, Costa Rica.

This species is abundant at Loc. 267, C. A. S., horizons P and R, and also in the basal horizon M - N, of the Tuberá group of the Colombian Miocene.

156. **Tellina dariena** Conrad

Tellina dariena CONRAD, House Doc., 129, 1855, p. 18.—CONRAD, Pac. R. R. Repts., vol. 5, 1856, p. 328, pl. 6, fig. 53; Isthmus of Darien, Miocene.—GABB, Jour. Acad. Nat. Sci. Phila., vol. 8, 1881, p. 343, pl. 44, fig. 13.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 368.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 424, pl. 26, fig. 3; Gatun, Canal Zone.

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[34] Proc. Acad. Nat. Sci. Phila. vol. 73, 1921, p. 423.

Tellina rowlandi Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 728, pl. 28, fig. 11; Gatun, Canal Zone.

This species has been found at Loc. 304, C. A. S., near Santa Rosa, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

157. **Tellina gatunensis** (Toula)

Macoma (*Tellina*) *gatunensis* Toula, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 729, text figure 10, a; Gatun, Canal Zone.

Tellina gatunensis, Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 368; Gatun formation, Canal Zone.

Macoma gatunensis, Olsson, Bull. Am. Pal., vol. 9, 1922, p. 429; Gatun Stage, Costa Rica.

Several good examples of this species have been obtained from various localities in north Colombia, as at Loc. 267, C. A. S., horizons M - N and P; Loc. 303, C. A. S., about three miles north of San Andres, Dept. of Bolivar, etc. One of these examples exposes the hinge clearly, showing that it is a typical *Tellina* of the group *T. radiata* Linnæus, found in the West Indies. The occurrence of this species with many others of the Tuberá group at San Andres is to be specially noted.

158. **Tellina (Eurytellina) æquiterminata** (?) Brown & Pilsbry

Plate 23, figure 4

Tellina æquiterminata Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., vol. 64, 1912, p. 517, pl. 26, fig. 5; Gatun formation, Canal Zone.

A rather large *Tellina* was found at Loc. 304, C. A. S., four miles east of Santa Rosa, which in outline and general characters conforms to the above species, though in size it agrees more nearly with *T. radiata* Linnæus. The left valve is somewhat more concave in longisection than in *T. radiata,* and the sculpture is different. The surface is marked by undulations and finer concentric lines, which at the posterior end become lamellar. The growth lines form an obtuse angle on crossing the posterior angle of the shell. Approximate length 60 mm., height 35 mm., thickness 11 mm.

Plesiotype: No. 4675, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., horizon P, **four miles east of Santa Rosa, Colombia;** Miocene.

159. **Tellina (Eurytellina) æquicincta** Spieker

Tellina (*Eurytellina*) *æquicincta* SPIEKER, Paleont. Zorritos Form., Peru; Johns Hopkins Univ. Publ. Geol., No. 3, 1922, p. 158, pl. 10, fig. 3; Zorritos group, Miocene, Peru.

Two specimens of a *Tellina* were obtained at the village of Tuberá, Loc. 267, C. A. S., horizon R, which seem to be referable to this species. In form and sculpture the resemblance is striking, and there appears to be no reason for doubting their identity.

160. **Tellina (Eurytellina) cibaoica** (?) Maury

Tellina (*Eurytellina*) *cibaoica* MAURY, Bull. Am. Pal., vol. 5, 1917, p. 387, pl. 38, fig. 10; Zone H, Rio Caña, Santo Domingo.

A single specimen of *Tellina* was found at Loc. 304, C. A. S., east of Santa Rosa, that conforms to Maury's description and figure of this Dominican form. It seems to be related to *Tellina striata* Chemnitz, from the West Indian province.

161. **Tellina protolyra** Anderson, new species

Plate 21, figures 2, 3

Shell small, height of holotype 25 mm., length 34 mm., thickness 12 mm., partly elliptical, truncated behind, rounded in front, more broadly rounded on the ventral margin; peaks posterior to a central position, high, pointing forward, excavated in front forming a sort of lunule-like depression; inequivalve, the right valve being flatter and slightly concave in advance of the umbonal angle; posterior dorsal margin nearly straight, formed by a narrow carina-like ridge on either side, giving the posterior dorsal slope a groove-like character; surface ornamented by acute, elevated, concentric threads with relatively wide, concavely open interspaces, almost smooth, or faintly striated, and evenly spaced from beak to ventral margin.

This species is clearly related to *Tellina lyra* Hanley which is found living at Tumbez, Peru, which is probably a successor to our species. The examples of this species were all found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group of the Colombian Miocene.

Holotype: No. 4163, Mus. Calif. Acad. Sci., from Loc. 267-B, C. A. S., horizon M - N, of the **Tuberá group, Colombia;** Miocene.

162. **Semele claytoni** (?) Maury

Semele claytoni Maury, Bull. Am. Pal., vol. 5, 1917, p. 391, pl. 35, fig. 9; Miocene, Cercado de Mao, Santo Domingo.

A single specimen of *Semele* that seems referable to this Dominican species was found at Loc. 351, C. A. S., near Punta Pua, Colombia.

163. **Semele sardonica** Dall

Semele sardonica Dall, Bull. U. S. Nat. Mus., No. 90, p. 154, pl. 20, figs. 4 and 7; Miocene, Tampa Bay, Florida.

A single well preserved valve of a *Semele* was obtained at Loc. 351, C. A. S., near Punta Pua, Colombia, that is identifiable with Dall's species from the lower Miocene of Florida.

164. **Psammosolen sancti-dominici** Maury

Psammosolen sancti-dominici Maury, Bull. Am. Pal., vol. 5, 1917, p. 392, pl. 37, fig. 13; Miocene, Cercado de Mao, Santo Domingo.

A single determinable specimen of *Psammosolen* was obtained at Loc. 351, C. A. S., near Punta Pua, that seems to be referable to Maury's Dominican species.

165. **Mactra (Mulinia ?) atlanticola** Anderson, new species

Plate 20, figures 1, 2, 3

Shell of moderate size, length of holotype 50 mm., height 43 mm., thickness 33 mm.; robust, ventricose, smooth, ornamented only by concentric growth lines; beaks rather high, nearly central or a little in advance of central, curved slightly forward; anterior and posterior slopes straight, anterior end broadly rounded, posterior end more narrowly rounded; lunular area flattened, or somewhat concave under the beaks; shell not gaping behind, not angulated, but for the most part regularly rounded.

Holotype: No. 4161; *paratype:* No. 4162, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the **west end of Tuberá mountain, Colombia;** Miocene.

The nearest known related species is *Mulinia densata* Conrad, in the upper Miocene of California, although it has a heavier and more solid shell than the Colombian examples here described.

Several good specimens of this species were found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the west foot of Tuberá mountain. There is an outward resemblance to other Caribbean forms, but the hinge reveals its generic class.

166. **Mactrella (Harvella) elegans** (Sowerby)

Plate 21, figures 5, 6

Mactra elegans Sowerby, Tank'v. Catal. Append. (116), p. ii, pl. (i), fig. 3; living at Panama and Pacific points.—Carpenter, Rept. Brit. Ass'n. Adv. Sci., 1857, pp. 174, 227; living at Panama and other points.

Harvella pacifica Conrad, Amer. Jour. Conch., vol. 3, 1867, p. 192; vol. 5, p. 108, pl. 12, fig. 2; living at Panama.

Mactrella (Harvella) elegans, Dall, Nautilus, vol. 8, 1894.

Conrad described *H. pacifica* as living at Panama, and attempted to distinguish his supposed new form from *H. elegans* (Sowerby) to which he refers as a Floridan species. Dall discredits Conrad's name, on the ground of lacking sufficient basis, at least until further evidence was found. Although Sowerby's original description has not been seen, in view of the known variability in such forms, it appears unlikely that Conrad's discrimination is sound. Two species so similar are not likely to occur together.

A comparison of the fossil species with representatives of the living form does not permit of any distinction that can be maintained in either form, size or sculpture.

A number of good samples of this species was found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the west foot of Tuberá mountain.

Plesiotypes: Nos. 4665 and 4666, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the **west foot of Tuberá mountain, Colombia**; Miocene.

167. **Labiosa (Ræta) gibbosa** (Gabb)

Ræta gibbosa Gabb, Amer. Jour. Conch., vol. 5, 1870, p. 30; Miocene, Peru.—Gabb, Jour. Acad. Nat. Sci. Phila., vol. 8, 1874, p. 264, pl. 35, figs. 8, 8a.

Two well preserved samples of this species were obtained at Loc. 267, C. A. S., horizon R, Tuberá village, near the top of the Tuberá group, and three of the same form were found at Loc. 351, C. A. S., near Punta Pua, some 20 miles north of Cartagena. In referring these to Gabb's Peruvian species identification is based entirely upon his description and figures, as no comparative material was available from his locality.

168. **Labiosa (Ræta) gardneræ** Spieker

Labiosa (*Ræta*) *gardneræ* Spieker, Johns Hopkins Univ. Publ. Geol., No. 3, 1922, p. 168, pl. 10, fig. 10; upper part of Zorritos, Miocene, Peru.

A number of samples of this species was obtained from different parts of the Tuberá group at the following points:

Loc. 267, C. A. S., horizon R, Tuberá group; Loc. 299, C. A. S., central part of the Tuberá group; Loc. 325, C. A. S., central part of the Tuberá group; Loc. 325-A, C. A. S., middle part of the Tuberá group.

The species seems, therefore, to range from the central to the upper part of the Tuberá group.

169. **Labiosa (Ræta) hasletti** Anderson, new species

Plate 23, figures 2, 3

Shell large, inflated in front, somewhat produced and narrow behind; height of holotype 47 mm., length, incomplete, 61 mm., thickness 39 mm.; test thin, somewhat nacreous; beaks a little in advance of central, prominent and rather heavy; posterior slope slightly concave; shell thickest a little in advance and above the median plane; umbonal ridges inclined forward; surface marked by strong concentric ridges, some of which are not continuous.

This species is related to *L. (Ræta) gibbosa,* but is thicker, less produced in front and relatively more produced behind. It has not the straight posterior slope of Gabb's species.

This species is abundant at Loc. 267, C. A. S., in horizon P, on the north slope of Tuberá mountain. It has been named in honor of Mr. Thomas D. Haslett, by whose courtesy and aid the investigation of this district was greatly facilitated.

Holotype: No. 4674, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **Tuberá mountain, Colombia**; Miocene.

170. **Periploma caribana** Anderson, new species

Plate 23, figure 1

Shell sub-nacreous, large, compressed, nearly circular in outline, and nearly equivalve; beaks relatively small, umbones not prominent, sub-central, crossed by an acute transverse ridge extending downward from the beaks; anterior end short, broadly rounded, quite closed; posterior slope straight at first, then rounded, narrower than in front; surface marked by undulating concentric ridges and lines of growth, the former stronger near the ventral margins; hinge not well known; height of holotype 61 mm., length 71 mm., thickness 27 mm.

This shell is apparently rare, though three specimens were found in the upper part of the Tuberá group. Its nearest relative is probably *Periploma peralta* (Conrad) from the St. Mary's formation at Cave Point, Maryland. Its distinctness from this species is very evident upon a careful comparison and study of Conrad's description and figure.

The three samples obtained were found at Loc. 267, C. A. S., at horizon R, Tuberá village.

Holotype: No. 4673, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon R, **Tuberá village, Colombia**; Miocene.

FORAMINIFERA

From the lowest horizon, M - N, of the Tuberá group a number of micro-organisms were obtained from the matrix of the larger mollusks which were submitted for determination to Mr. C. C. Church. His notes regarding these forms are as follows:

"The few Foraminifera obtained from this material are, for the most part, so poorly preserved that specific determination is practically impossible, although genera can be distinguished easily, and in the case of the large, well preserved *Amphistegina* the specific characters are quite clear.

"171. **Amphistegina lessoni** D'Orbigny

"This species is known from the Tertiary to the Recent and is a common form in the Miocene and Pliocene of the Atlantic coastal plain of the United States. It is known to exist at the present time in the tropical areas of the Atlantic, Pacific and Indian oceans, and is commonest in water of less than 30 fathoms in depth, but it also occurs at greater depths.

"The species is highly variable in form, and ranges from a thin complanate disc to a subspherical test. In the younger and smaller individuals the umbilical area is a pronounced boss of clear shell material.

"In the larger and flattened forms the umbilicus is not so prominent. The largest form noted is more than one millimeter wide and very thin. The material associated with the Foraminifera shows every indication of having been deposited in shallow water.

"172. **Quinqueloculina auberiana** (?) D'Orbigny

"There is not much doubt that this form belongs to the species here assigned, but the fact that there are no very complete, or well preserved specimens makes it necessary to indicate a possible error.

"173. **Lituotuba lituiformis** (?) (H. B. Brady)

"This genus is represented by a single individual which is not very well preserved. The name of the genus is after Cushman's latest classification, but it is best known as *Trochammina* PARKER & JONES."

Besides the Foraminifera listed above there are a few other microscopic forms which deserve some mention. Among these are three species, and perhaps as many genera, of Ostracoda; also several small or embryonic forms of bivalves and gastropods.

California Academy of Sciences Localities

Following is a brief description of the fossil localities referred to in the preceding text, notes, tables, etc., and are of record in the Museum of the California Academy of Sciences:

Locality 265 (C.A.S.).	Punta Piedras, three miles south of Paso Nuevo, Department of Bolivar, Colombia; marine Miocene.
Locality 266 (C.A.S.).	Quebrada San Juan de Acosta, near Puerto Colombia, Department of Atlantico, Colombia; marine Miocene.
Locality 266-A (C.A.S.).	Falls in small creek, two miles west of Tuberá mountain, Department of Atlantico, Colombia; marine Miocene.
Locality 267 (C.A.S.).	Tuberá mountain, Dept. of Atlantico, Colombia; M - N, 1.5 miles west of Tuberá village; P, 1 mile west of Tuberá village; R, Tuberá village, near summit of the mountain.
Locality 296 (C.A.S.).	East border of Usiacuri village, Dept. of Atlantico, Colombia; 2000 feet above the base of the Tuberá group.
Locality 297 (C.A.S.).	Three miles west of Barranquilla, Colombia; coralline limestone, Pliocene.
Locality 298 (C.A.S.).	One mile east of Usiacuri village, Dept. of Atlantico, Colombia; top of Tuberá group, Miocene.
Locality 299 (C.A.S.).	Three miles southwest of Baranoa, Dept. of Atlantico, Colombia; west flank of the Usiacuri anticline, near well of Wm. Plotts; Miocene.
Locality 302 (C.A.S.).	Ranch of Sr. Banda, four miles south of San Andres, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
Locality 303 (C.A.S.).	Two miles east of San Andres, Dept. of Bolivar, Colombia; Miocene.
Locality 304 (C.A.S.).	Four miles east of Santa Rosa, Ranch of Sra. Gomez, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
Locality 305 (C.A.S.).	Near Turbaco, 16 miles east of Cartagena, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
Locality 306 (C.A.S.).	Usiacuri village, Dept. of Atlantico, Colombia; middle of Tuberá group, Miocene.
Locality 323 (C.A.S.).	Gatun Locks, Gatun, Canal Zone, Panama, Miocene.
Locality 325-A (C.A.S.).	Between Chorrera and Cibarco, Dept. of Atlantico, Colombia; near middle of Tuberá group, on west flank of Usiacuri anticline, Miocene.
Locality 325-B (C.A.S.).	East of Usiacuri village (same as Loc. 306), Dept. of Atlantico, Colombia, Miocene.
Locality 347 (C.A.S.).	La Popa Hill, near Cartagena, Colombia; top of Miocene.
Locality 348 (C.A.S.).	Village of Turbaco, Dept. of Bolivar, Colombia, Pliocene.

Locality 349 (C.A.S.). From four to five miles southwest of Barranquilla Colombia; top of the Miocene.

Locality 350 (C.A.S.). Arboletes Bay, Dept. of Bolivar, Colombia; upper Miocene.

Locality 351 (C.A.S.). Near Punta Pua, 20 miles north of Cartagena, Dept. of Bolivar, Colombia; Tuberá group, Miocene.

Locality 353 (C.A.S.). Near Cospique Hill, Cartagena harbor, Colombia.

Locality 354 (C.A.S.). Quebrada de Murindo, above Pedro de Claver, Dept. of Bolivar, Colombia; Tuberá group, Miocene.

Locality 355 (C.A.S.). Quebrada de Murindo, 30 miles west of Monteria, Dept. of Bolivar, Colombia; Tuberá group, Miocene.

Locality 356 (C.A.S.). Pedro de Claver, Quebrada de Murindo, 30 miles west of Monteria, Dept. of Bolivar, Colombia, Miocene.

Locality 357 (C.A.S.). Emory Wood Company's camp, Rio Canalete, west of Monteria, Dept. of Bolivar, Colombia; Miocene.

Plate 8

Fig. 1. *Fasciolaria olssoni* Anderson, new species. Holotype No. 4617 (C. A. S. type coll.), Loc. 267 C. A. S., horizon P, Tuberá group; Tuberá mountain; p. 131.

Figs. 2, 3. *Fasciolaria olssoni* Anderson, new species. Paratype No. 4618 (C. A. S. type coll.), front and rear views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 131.

Figs. 4, 5. *Mitra mauryæ* Anderson, new species. Holotype No. 4619 (C. A. S. type coll.), front and rear views; Loc. 267, C. A. S., horizon L, Las Perdices group, one mile west of Puerto Colombia; p. 130.

Figs. 6, 7. *Scobinella morierei* (?) (Laville). Plesiotype No. 4620 (C. A. S. type coll.), front and rear views, Loc. 267, C. A. S., horizon L, Las Perdices group, one mile west of Puerto Colombia; p. 131.

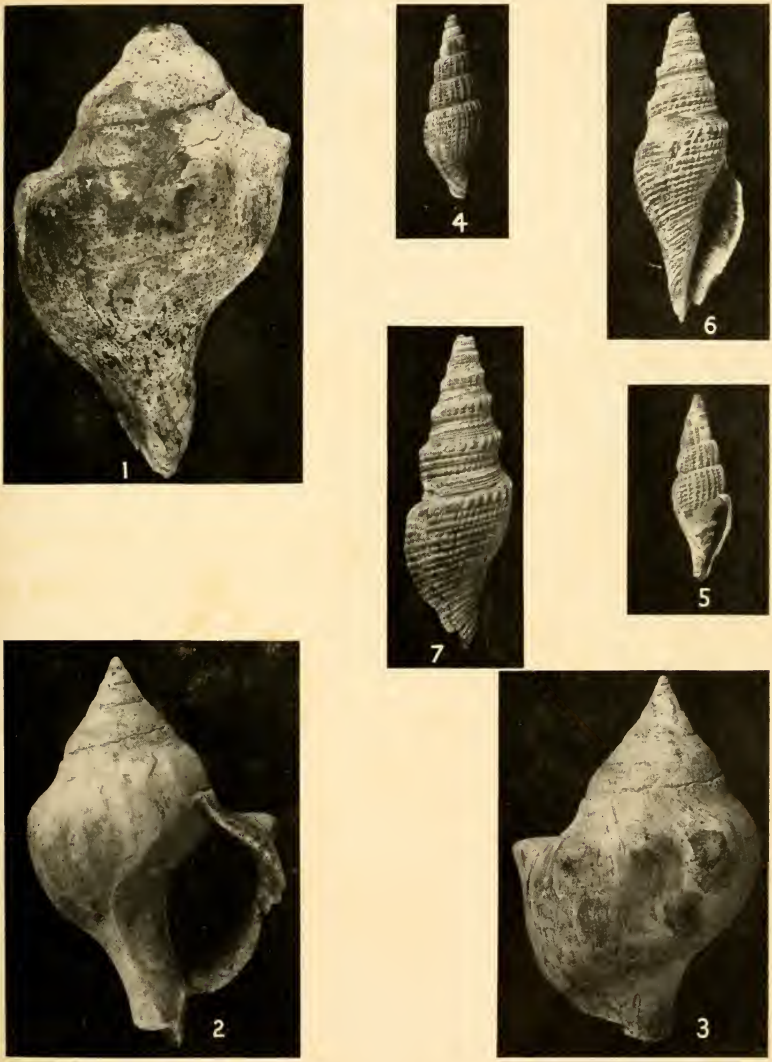

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Plate 9

Figs. 1, 2. *Phos tuberaënsis* Anderson, new species. Holotype No. 4621 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 135.

Fig. 3. *Phos tuberaënsis* Anderson, new species. Paratype No. 4622 (C. A. S. type coll.), Loc. 305, C. A. S., near Turbaco, 14 miles east of Cartagena; p. 135.

Figs. 4, 5. *Conus tuberacola* Anderson, new species. Holotype No. 4623 (C. A. S. type coll.), front and top views; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 112.

Figs. 6, 7. *Conus crenospiratus* Anderson, new species. Holotype No. 4624 (C. A. S. type coll.), front and top views, X2; Loc. 351, C. A. S., horizon P, Tuberá group, near Punta Pua, 20 miles north of Cartagena; p. 112.

Fig. 8. *Typhis siphonifera* Dall. Plesiotype No. 4625 (C. A. S. type coll.), X2; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco, a few miles north of Usiacuri, Colombia; p. 138.

Figs. 9, 10. *Ovula* (*Neosimnia*) *puana* Anderson, new species. Holotype No. 4626 (C. A. S. type coll.), front and rear views, X2; Loc. 351, C. A. S., horizon P, Tuberá group, near Punta Pua, north of Cartagena; p. 140.

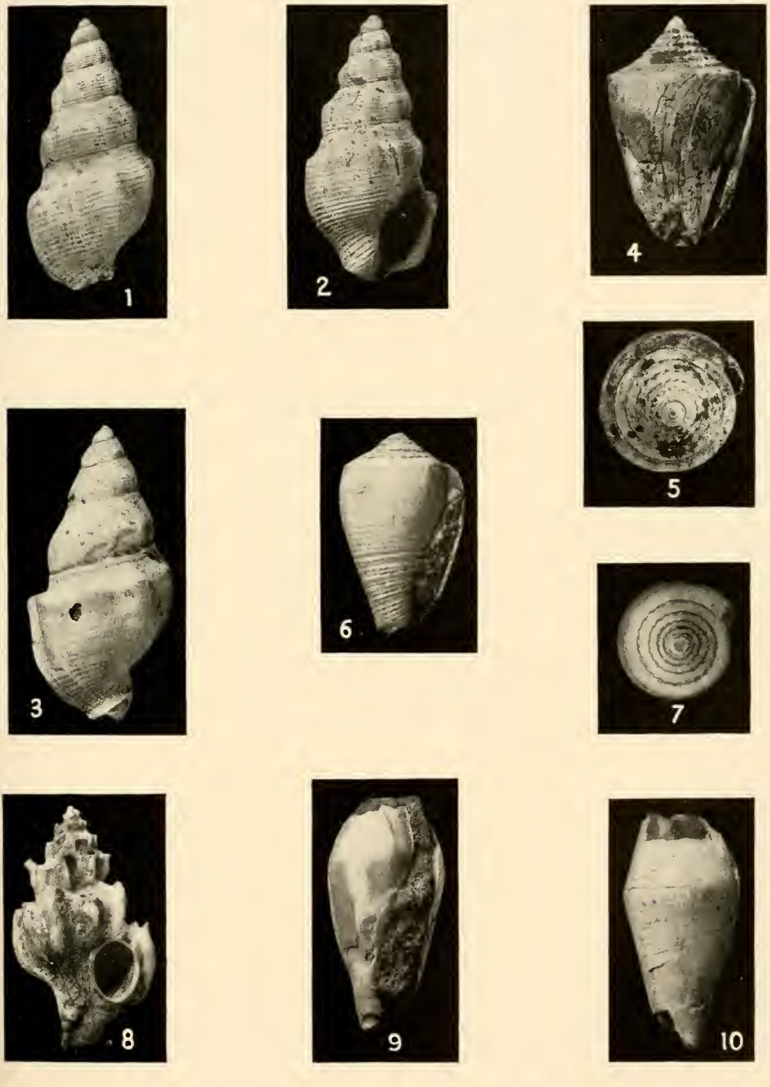
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PLATE 10

Figs. 1, 2. *Cancellaria scheibei* Anderson, new species. Holotype No. 4627 (C. A. S. type coll.), front and rear views; Loc. 306, C. A. S., horizon P, Tuberá group, near Usiacuri village; p. 114.

Figs. 3, 4. *Cancellaria scheibei* Anderson, new species. Paratype No. 4628 (C. A. S. type coll.); 3, front view, 4, slightly rotated to show plaits; Loc. 304, C. A. S., horizon P, Tuberá group, near Santa Rosa; p. 114.

Figs. 5, 6. *Cancellaria hettneri* Anderson, new species. Holotype No. 4629 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 114.

Figs. 7, 8. *Cancellaria karsteni* Anderson, new species. Holotype No. 4630 (C. A. S. type coll.), rear and front views; Loc. 305, C. A. S., horizon P, Tuberá group, near Turbaco, 14 miles east of Cartagena; p. 114.

Fig. 9. *Cancellaria karsteni* Anderson, new species. Paratype No. 4631 (C. A. S. type coll.), view showing columellar plaits; Loc. 267, C. A. S., horizon P, Tuberá group, Tuberá mountain; p. 114.

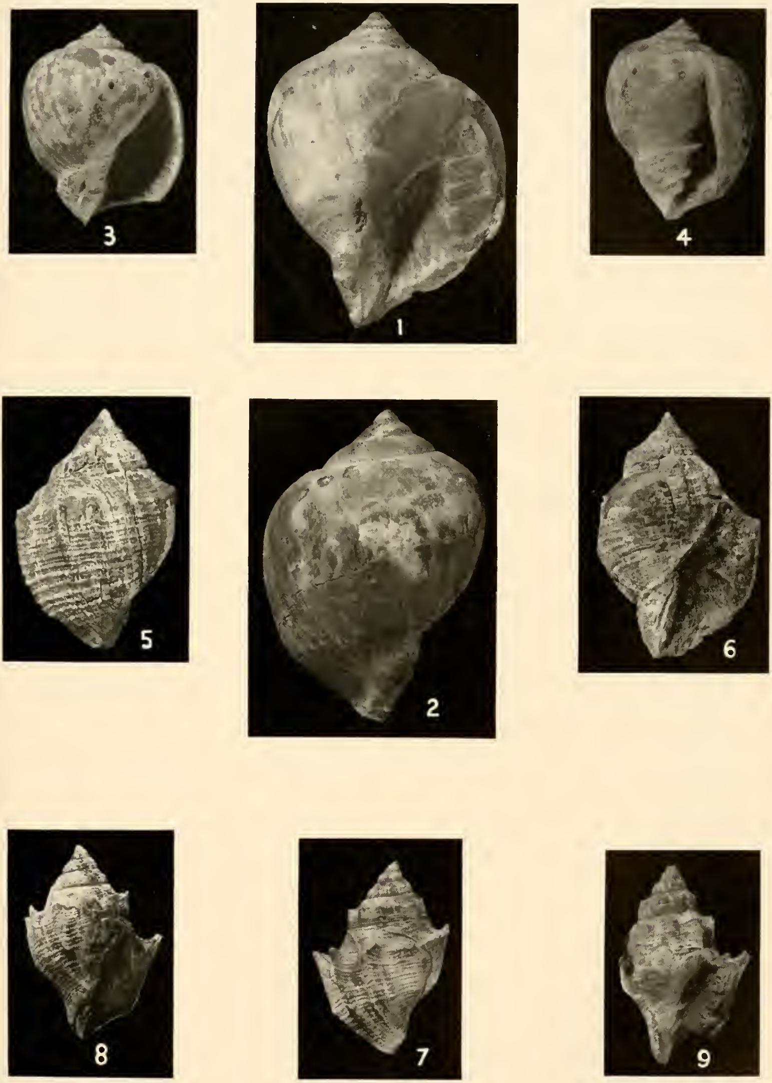
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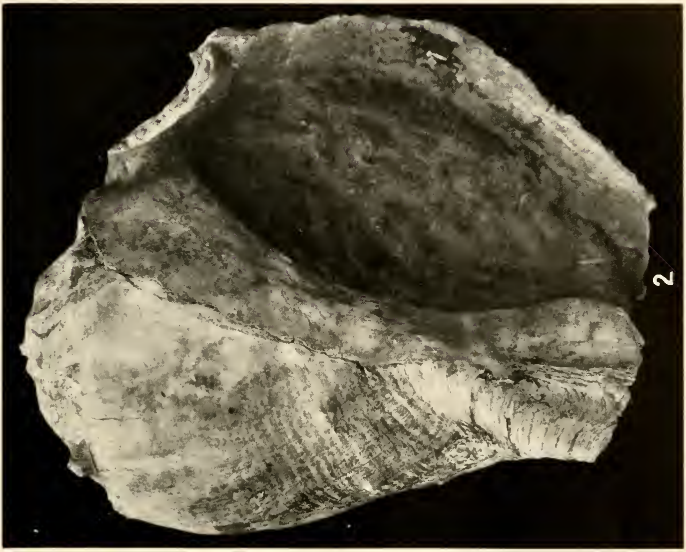
Plate 11

Figs. 1, 2. *Melongena propatulus* Anderson, new species. Holotype No. 4632 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 133.



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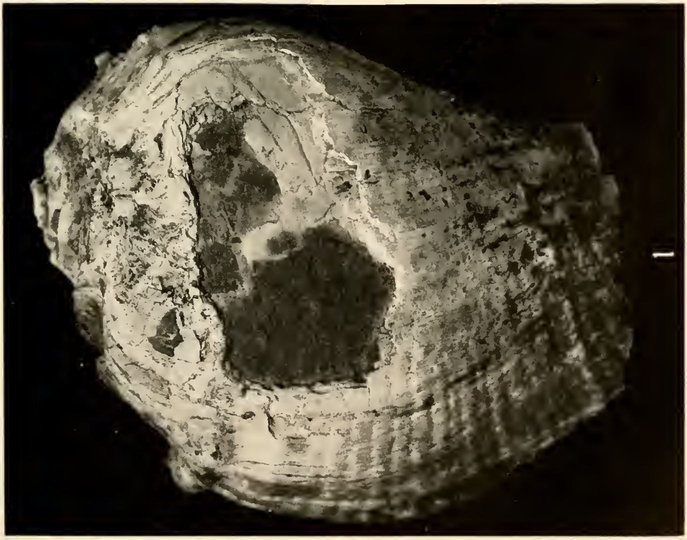

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Plate 12

Figs. 1, 2. *Malea ringens* (Swainson). Plesiotype No. 4633 (C. A. S. type coll.), rear and front views of mature shell, Bay of Panama, Hemphill collection; recent; p. 140.

Figs. 3, 4. *Malea ringens* (Swainson). Plesiotype No. 4634 (C. A. S. type coll.), front and side views of mature shell, outer lip missing; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 140.

Figs. 5, 6. *Malea ringens* (Swainson). Plesiotype No. 4635 (C. A. S. type coll.), rear and front views of younger shell; Loc. 299, C. A. S., near Plotts' well, southwest of Baranoa, Colombia; p. 140.

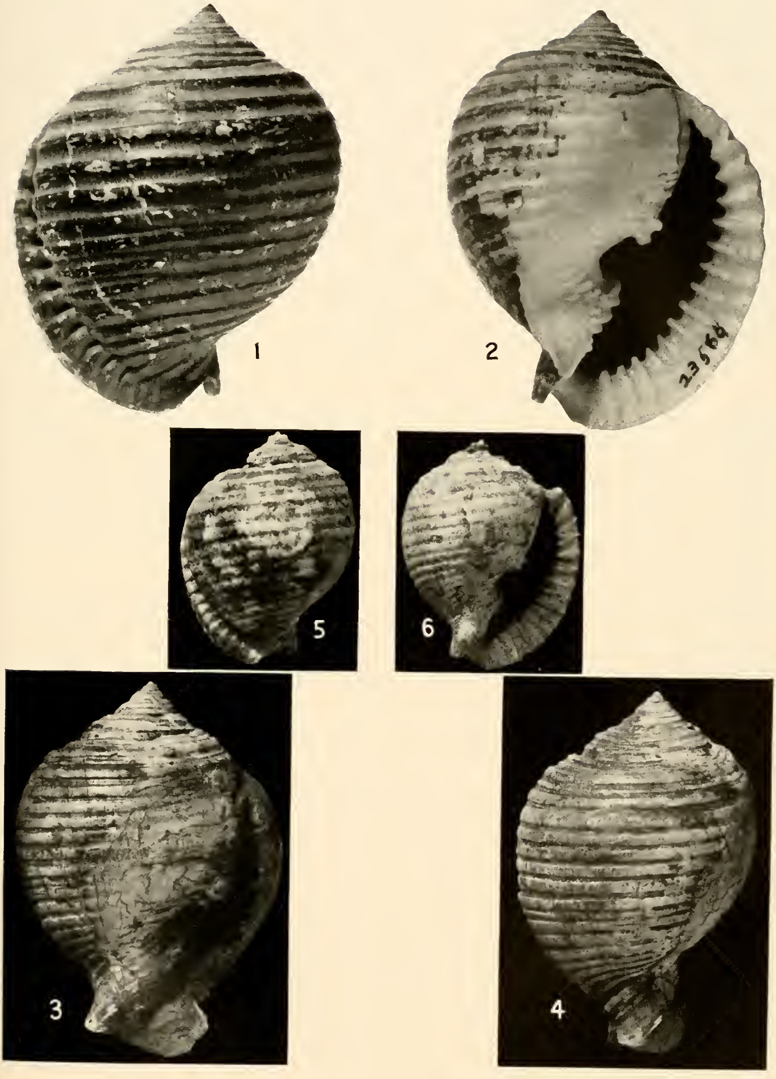
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Plate 13

Fig. 1. *Ficus (Pyrula) colombiana* Anderson, new species. Holotype No. 4636 (C. A. S. type coll.), aperture view; Loc. 267. C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 143.

Fig. 2. *Ficus (Pyrula) colombiana* Anderson, new species. Paratype No. 4637 (C. A. S. type coll.), Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 143.

Fig. 3. *Dentalium granadanum* Anderson, new species. Holotype No. 4638 (C. A. S. type coll.), broken shell, parts joined with clay, outer layer of shell missing in part; Loc. 267, C. A. S., horizon L, Las Perdices group, west of Puerto Colombia; p. 144.

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Fig. 6. *Crucibulum (Dispotæa) gatunense* (Toula). Plesiotype No. 4640 (C. A. S. type coll.), side view of smaller shell, X2; Loc. 323, as above; p. 121.

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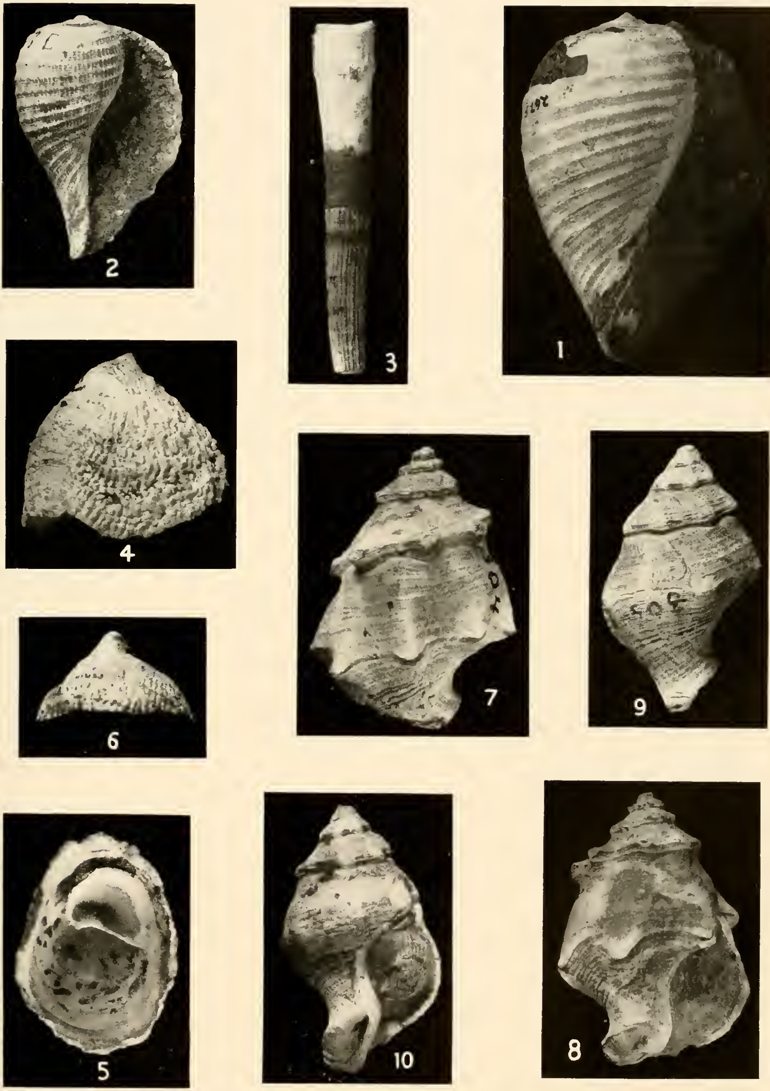
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PLATE 14

Figs. 1, 2. *Cancellaria cibarcola* Anderson, new species. Holotype No. 4643 (C. A. S. type coll.); 1, front view; 2, rotated to show columellar plaits; Loc. 325-A, C. A. S., horizon P, near Cibarco, Tuberá group; p. 116.

Fig. 3. *Cancellaria cibarcola* Anderson, new species. Paratype No. 4644 (C. A. S. type coll.), rear view of smaller shell; Loc. 325-A, as above; p. 116.

Figs. 4, 5. *Cancellaria codazzii* Anderson, new species. Holotype No. 4645 (C. A. S. type coll.), rear and front views; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco, north of Usiacuri village; p. 116.

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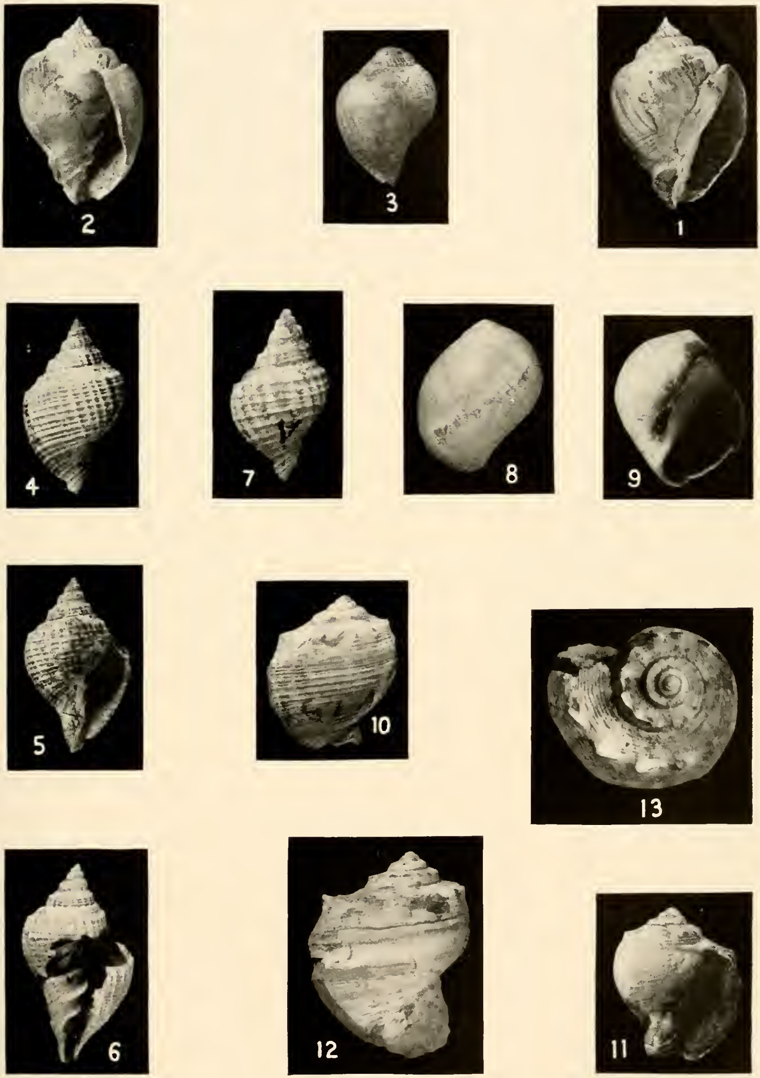
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Plate 15

Figs. 1, 2. *Fusinus magdalenensis* Anderson, new species. Holotype No 4651 (C. A. S. type coll.), front and rear views of incomplete shell; Loc. 267, C. A. S., horizon P, Tuberá group, Tuberá mountain; p. 133.

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Figs. 6, 7. *Phos turbacoënsis* Anderson, new species. Holotype No. 4654 (C. A. S. type coll.), front and rear views; Loc. 305, C. A. S., horizon P, Tuberá group, near Turbaco, 14 miles east of Cartagena; p. 136.

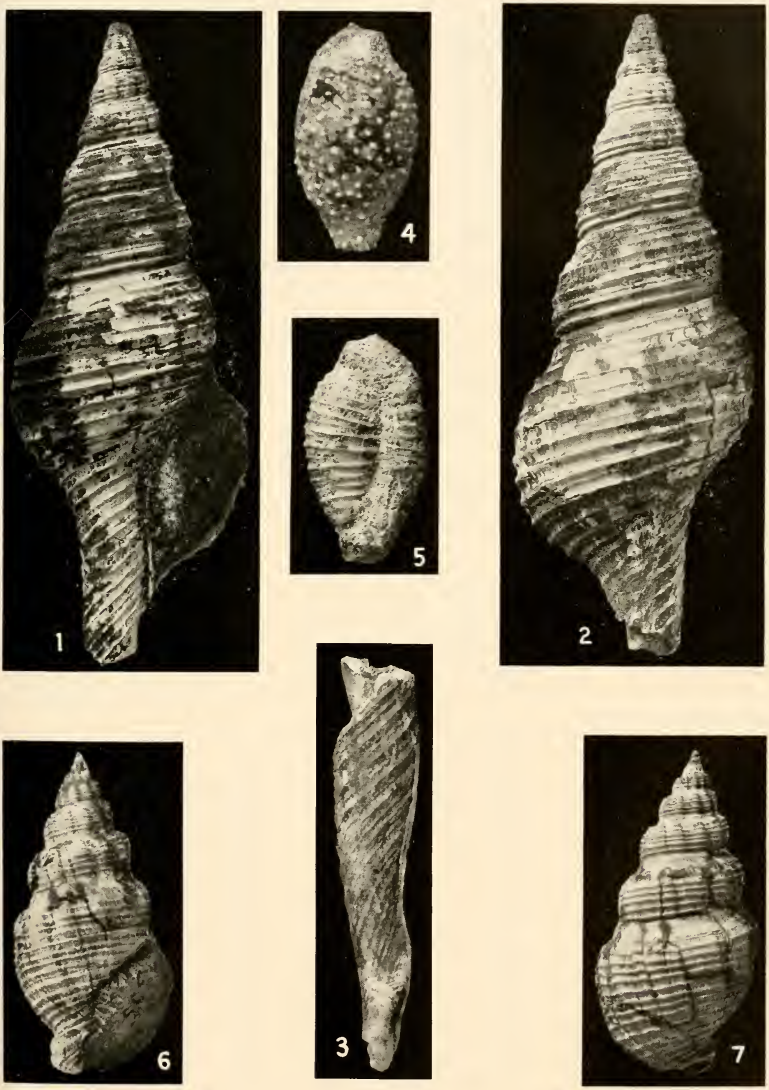
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Plate 16

Figs. 1, 2. *Ampullaria tuberacola* Anderson, new species. Holotype No. 4655 (C. A. S. type coll.), front and basal views of mature shell; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 125.

Fig. 3 *Ampullaria tuberacola* Anderson, new species. Paratype, No. 4656 (C. A. S. type coll.), rear view of young shell; Loc. 267, C. A. S., as above; p. 125.

Fig. 4. *Phos baranoanus* Anderson, new species. Holotype No. 4657 (C. A. S. type coll.), front view; Loc. 299, C. A. S., horizon P, Tuberá group, near Plotts' well, southwest of Baranoa, Colombia; p. 137.

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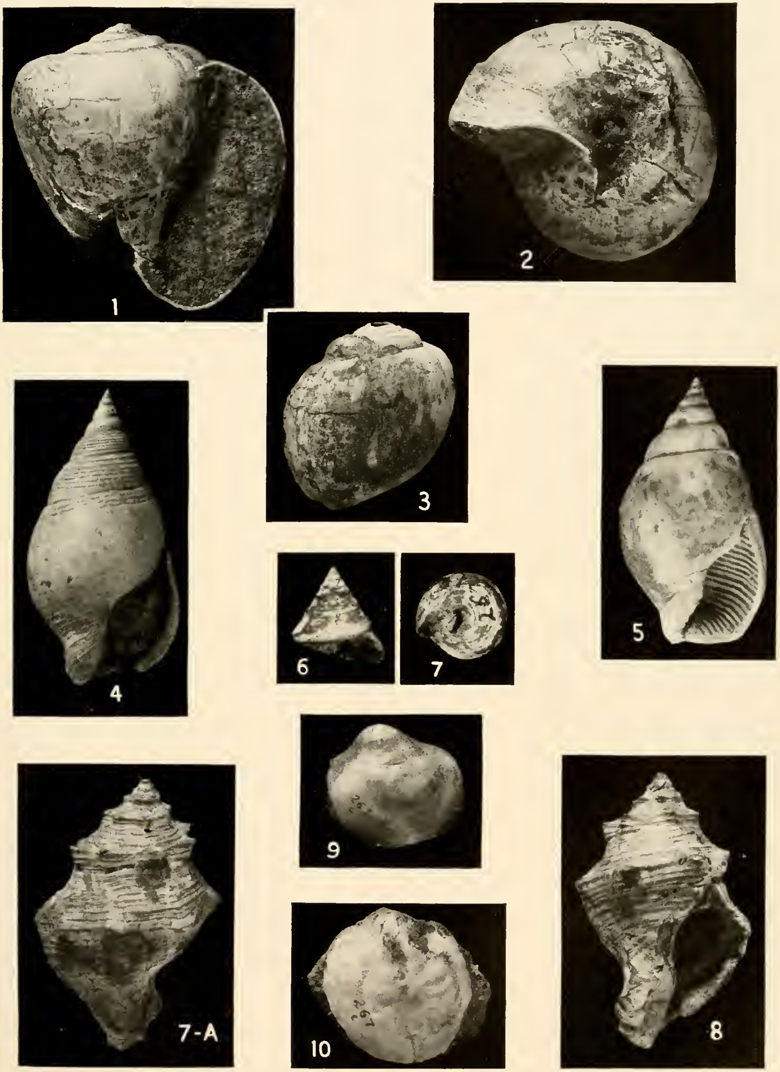
Fig. 9. *Anomia mamillaris* Anderson. Holotype No. 4165 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, Tuberá group, as above; p. 158.

Fig. 10. *Anomia mamillaris* Anderson. Paratype No. 4167 (C. A. S. type coll.), Loc. as above; p. 158.



March 29, 1929

Plate 17

Fig. 1. *Turritella fredeai* Hodson. Plesiotype 4175 (C. A. S. type coll.), example from basal beds of Tuberá group near Punta Pua, 20 miles north of Cartagena; p. 119.

Figs. 2, 3. *Oliva tuberaënsis* Anderson. Holotype No. 4172 (C. A. S. type coll.), front and rear views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 128.

Fig. 4. *Turritella altilira* Conrad. Plesiotype No. 4658 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 118.

Fig. 5. *Turritella altilira* Conrad. Plesiotype No. 4659 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, as above; p. 118.

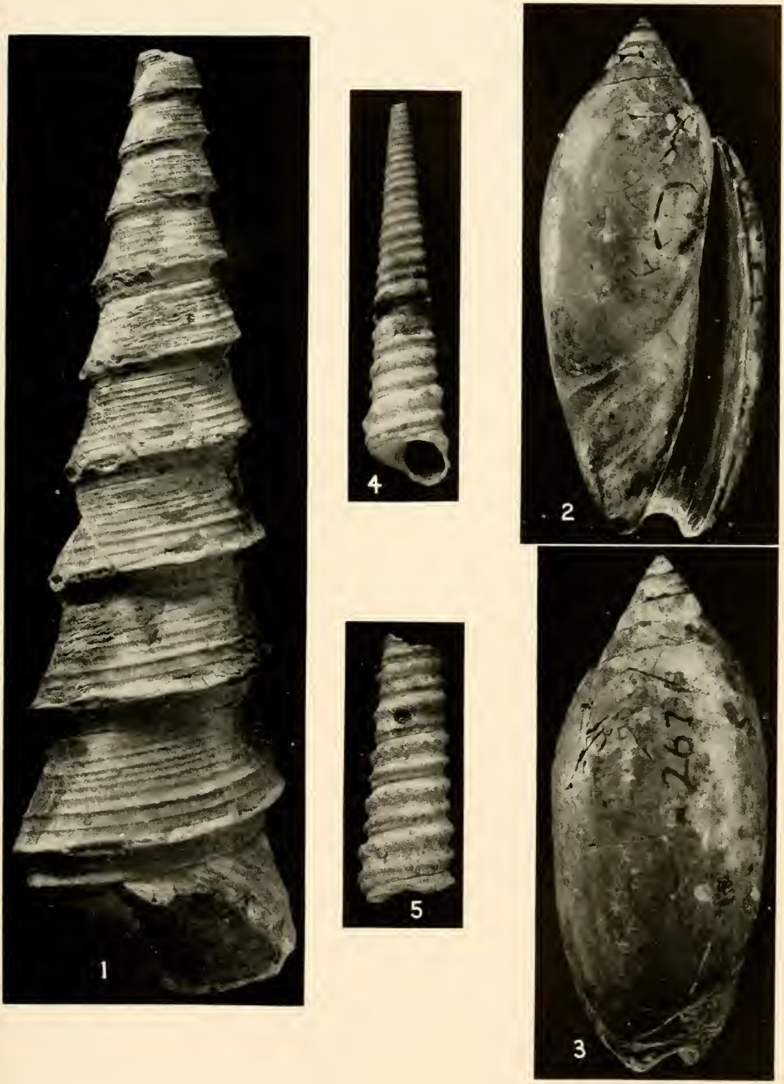

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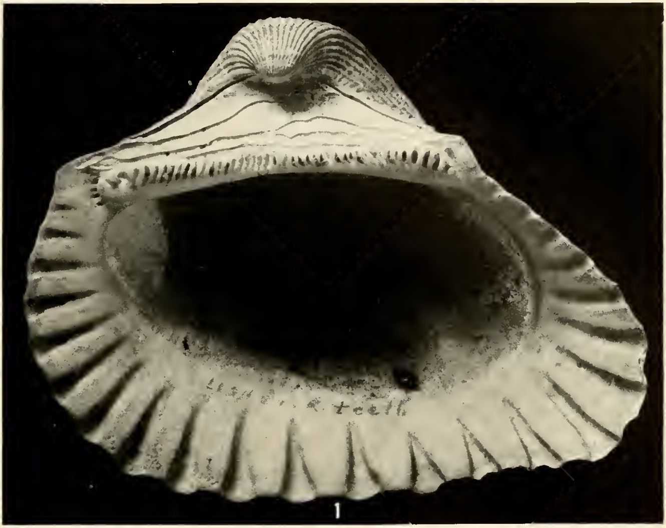
Plate 18

Figs. 1, 2. *Arca (Anadara) grandis* Broderip & Sowerby. Plesiotype No. 4160 (C. A. S. type coll.), interior and exterior views of right valve. Example from Bay of Panama, F. M. Anderson, collector.



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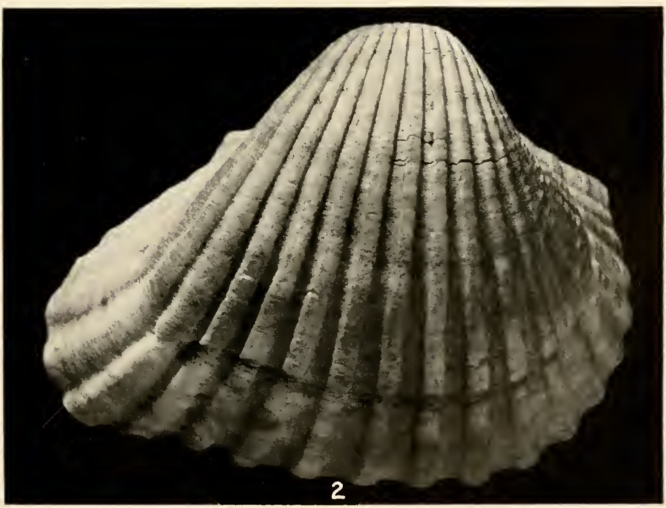

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PLATE 19

Figs. 1, 2. *Cardium* (*Trachycardium*) *pueblœnse* Anderson, new species. Holotype No. 4660 (C. A. S. type coll.), left side and front views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 164.

Fig. 3. *Pecten atlanticola* Anderson, new species. Holotype No. 4661 (C. A. S. type coll.), right valve; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain, Department of Atlantico; p. 156.

Fig. 4. *Pecten macloskeyi* Anderson, new species. Holotype No. 4662 (C. A. S. type coll.), right valve; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 157.

Fig. 5. *Pecten macloskeyi* Anderson, new species. Paratype No. 4663 (C. A. S. type coll.), left valve of small shell; Loc. as above; p. 157.

Fig. 6. *Arca* (*Anadara*) *usiacurii* Anderson. Holotype No. 4158 (C. A. S. type coll.), interior of left valve; Loc. 306, C. A. S., horizon P, Tuberá group, near Usiacuri village; p. 148.

Fig. 7. *Pecten atlanticola* Anderson, new species. Paratype No. 4661a (C. A. S. type coll.), left valve; Loc. 267, C. A. S., horizon P, as above; p. 156.

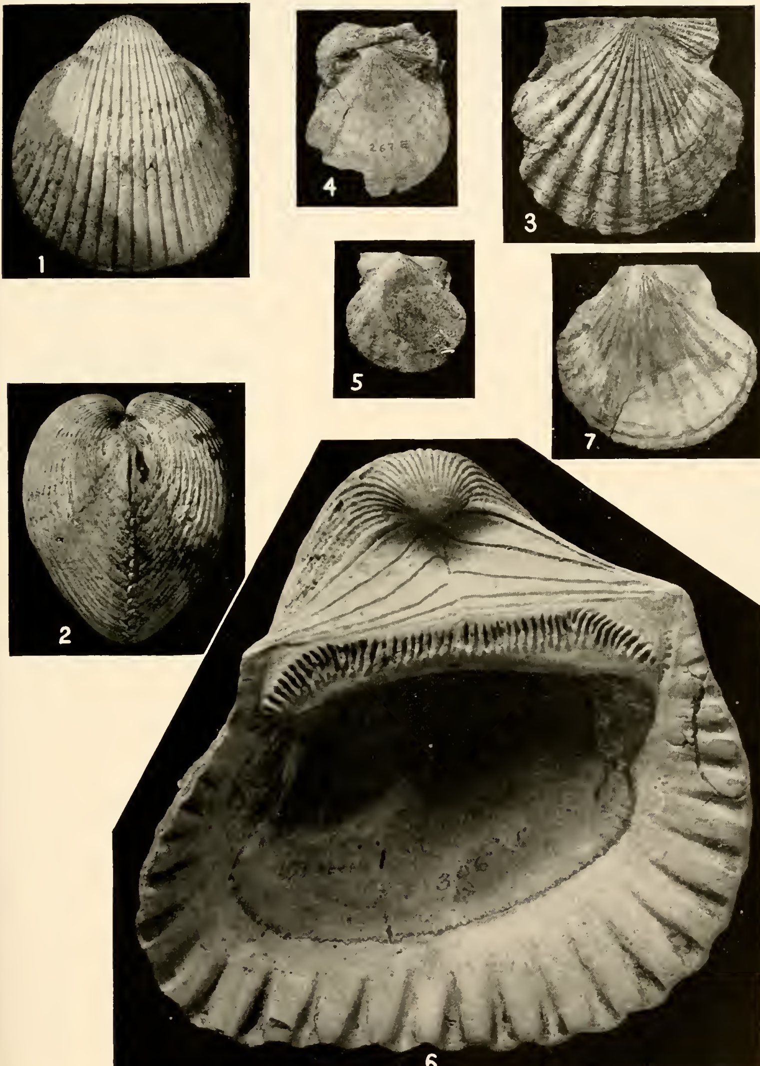
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Plate 20

Figs. 1, 2. *Mactra* (*Mulinia?*) *atlanticola* Anderson, new species. Holotype No. 4161 (C. A. S. type coll.), side and anterior views; Loc. 267, C. A. S., horizon, M - N, Tuberá group, west foot of Tuberá mountain; p. 175.

Fig. 3. *Mactra* (*Mulinia?*) *atlanticola* Anderson. Paratype No. 4162 (C. A. S. type coll.), interior view, showing hinge parts in right valve; Loc. 267, C. A. S., horizon P, as above; p. 175.

Figs. 4, 5. *Cardita* (*Carditamera*) *arata* (Conrad). Plesiotype No. 4164 (C. A. S. type coll.), exterior and interior views of left valve; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 160.

Fig. 6. *Arca* (*Anadara*) *usiacurii* Anderson. Holotype No. 4158 (C. A. S. type coll.), exterior of left valve; Loc. 306, C. A. S., horizon P, Tuberá group, near village of Usiacuri; p. 148.


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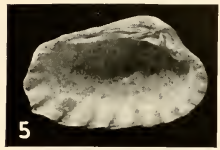
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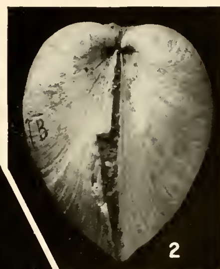
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PLATE 21

Fig. 1. *Thyasira bisecta* (?) (Conrad). Plesiotype No. 4664 (C. A. S. type coll.), cast, left valve; Loc. 350, C. A. S., near Arboletes Bay upper beds of the Tuberá group; p. 162.

Figs. 2, 3. *Tellina protolyra* Anderson, new species. Holotype No. 4163 (C. A. S. type coll.), side and top views; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 174.

Fig. 4. *Arca* (*Anadara*) *usiacurii* Anderson. Paratype No. 4159 (C. A. S. type coll.), interior of left valve, showing crowding of cardinal teeth; Loc. 267, C. A. S:, upper part of horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 148.

Fig. 5. *Mactrella* (*Harvella*) *elegans* (Sowerby). Plesiotype No. 4665 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 176.

Fig. 6. *Mactrella* (*Harvella*) *elegans* (Sowerby). Plesiotype No. 4666 (C. A. S. type coll.), Loc. 267, C. A. S., as above, showing hinge left valve; p. 176.

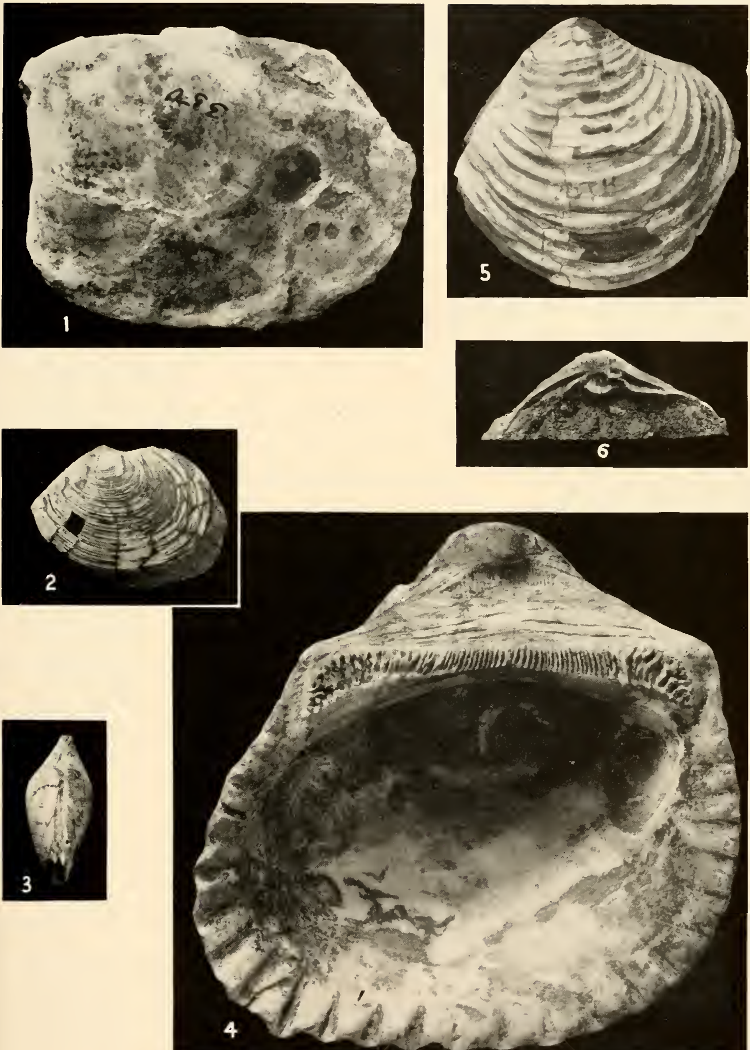
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Plate 22

Figs. 1, 2. *Chama scheibei* Anderson, new species. Holotype, No. 4667 (C. A. S. type coll.), exterior of left and right valves; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 161.

Figs. 3, 4. *Glycymeris usiacurii* Anderson, new species. Holotype No. 4668 (C. A. S. type coll.), external and internal views of left valve; Loc. 325, C. A. S., horizon P, Tuberá group, east of Usiacuri village; p. 153.

Figs. 5, 6. *Diplodonta woodringi* Anderson, new species. Holotype No. 4669 (C. A. S. type coll.), side and top views; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco; p. 162.

Figs. 7, 8. *Glycymeris lamyi* Dall. Plesiotype No. 4670 (C. A. S. type coll.), external and internal views; Loc. 325-A, C. A. S., horizon P. Tuberá group, near Cibarco, Colombia; p. 152.

Fig. 9. *Erycina turbacoensis* Anderson, new species. Holotype No. 4671 (C. A. S. type coll.), Loc. 305, C. A. S., horizon P, Tuberá group, near Turbaco, 13 miles east of Cartagena; p. 163.

Fig. 10. *Erycina turbacoensis* Anderson, new species. Paratype No. 4672 (C. A. S. type coll.), Loc. 305, C. A. S., as above; p. 163.

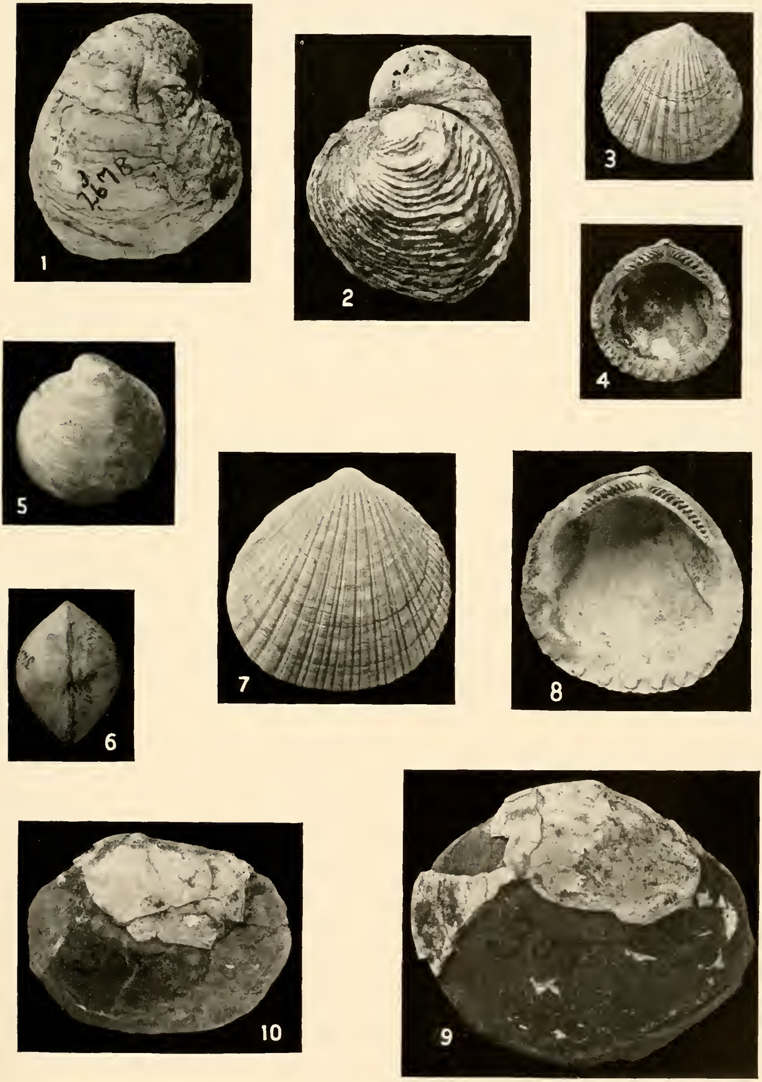


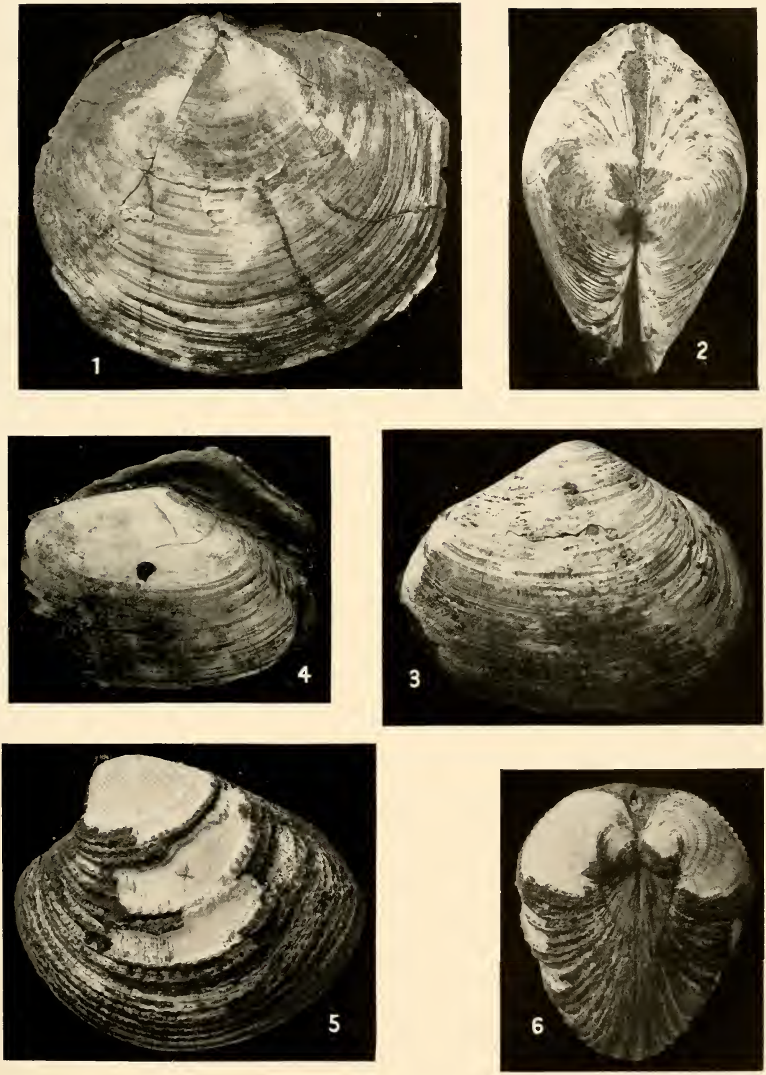
PLATE 23

Fig. 1. *Periploma caribana* Anderson, new species. Holotype No. 4673 (C. A. S. type coll.), exterior view of left valve; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 178.

Figs. 2, 3. *Labiosa* (*Ræta*) *hasletti* Anderson, new species. Holotype No. 4674 (C. A. S. type coll.), top and side views; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 177.

Fig. 4. *Tellina* (*Eurytellina*) *æquiterminata* Brown & Pilsbry. Plesiotype No. 4675 (C. A. S. type coll.), Loc. 304, C. A. S., horizon P, Tuberá group, four miles east of Santa Rosa, 12 miles north of Cartagena; p. 173.

Figs. 5, 6. *Chione atlanticana* Anderson, new species. Holotype No. 4676 (C. A. S. type coll.), side and anterior views; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 172.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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVIII, No. 5, p. 215, plate 24 APRIL 5, 1929

V

A NEW PECTEN FROM THE SAN DIEGO PLIOCENE

BY

LEO GEORGE HERTLEIN

Pecten (Plagioctenium) ericellus Hertlein, new species

Plate 24, figures 10, 11

Shell small, moderately convex; hinge line straight. Right valve ornamented by about 22 subrounded, fairly low radiating ribs which are separated by narrower interspaces; two tiny midribs are present along the base of the sides of the major ribs; ribs and interspaces crossed by concentric lines of growth; anterior and posterior margins ornamented by concentric lines of growth; ventral margin rounded; ears unequal, the anterior with a well-defined byssal notch, and sculpture of about five or six radiating riblets crossed by incremental lines; the posterior ear sculptured by about four or five radiating riblets crossed by lines of growth, no notch present. Altitude 28 mm.; longitude 29.1 mm.; diameter of right valve approximately 7.5 mm.; apical angle in right valve approximately 94°.

Holotype: No. 2998, Mus. Calif. Acad. Sci., from Loc. 1132 (C. A. S.), **Pacific Beach, San Diego, California**, C. H. Sternberg collector; San Diego, Pliocene.

This interesting little species differs from *P. invalidus* Hanna, and *P. circularis* Sowerby, in its numerous low, more rounded, narrower ribs and in the possession of fine secondary ribs along the base of the sides of the major ribs.

This species is named for the late Eric Knight Jordan.

April 5, 1929

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVIII, No. 6, pp. 217, 218, plate 24 April 5, 1929

VI

A NEW SPECIES OF LAND SNAIL FROM KERN COUNTY, CALIFORNIA

BY

G. DALLAS HANNA

Helminthoglypta berryi Hanna, new species

Plate 24, figures 7, 8, 9

Shell of medium size, globose, composed of 5½ well-rounded whorls; suture deep; umbilicus completely closed in the holotype, almost closed in the paratype; white or pale brown, bandless (in all specimens seen); upper portion of whorls sculptured with irregular growth ridges, almost ribs; lower portion of body whorl with a series of malleations, becoming pits in some cases; these pits roughly arranged in spiral order and almost obliterate the growth lines near the margin of the shell; the line of demarcation between the series of growth ridges above and the malleations below is very sharp and is approximately in the position of the color band as usually developed in this genus; aperture large and capacious; outer lip moderately reflected; terminations of peristome connected by a wash of callus over the body whorl. Diameter (holotype) 22.5 mm., height 21 mm.; diameter (paratype 1493) 23 mm., height 21 mm.

Holotype: No. 1492; *paratypes:* Nos. 1493, 1494, Mus. Calif. Acad. Sci., collected by G. D. Hanna **eight miles northeast of Bakersfield, Kern County, California.**

The first known specimens of this remarkable species were found in 1926 in the S. W. ¼ Sec. 32, T. 27 S., R. 29 E., M. D. M., about two miles north of Poso Creek and five miles east of the mouth of Granite Creek. These were somewhat imperfect and seemed so unusual in character and habitat that better material was awaited for description. This was found in 1927, 1½ miles southeast of the top of Round Mountain, Sec. 30, T. 28 S., R. 29 E., M. D. M., about three-fourths mile north of Kern River and four miles east of Oil City; this is the type locality. Specimens were also found further east on Sec. 34, T. 28 S., R. 29 E., M. D. M., and fragments were seen scattered in other places. It is evident that the species is fairly widely distributed in this district.

All of the shells found were dead,[1] but the one made the holotype has the epidermis and the pale brown color preserved. All were found on the slopes of dry, barren, ashy hills, usually, but not always, on northern slopes. No rock outcrops occur near where the shells were found, but invariably they were in torn up earth where cattle had trampled during wet weather. This peculiar habitat, with the pale color and absence of a band, leads to the supposition that the animal is a burrowing form. After having collected snails rather extensively in the forests and among the rocks of California, I was most astonished to find this one on soft, powdery, ashy hills.

The shape is suggestive of the shell found near Monterey called *californiensis,* but in other characters there is little resemblance.

The species is named for Dr. S. Stillman Berry in recognition of his extensive studies of west American land shells.

[1] Since this was written Dr. Berry has collected living specimens of what appears to be the same species in the Kern River oil field and the characters as outlined are confirmed in most respects; the living shell seems thinner than the dead ones upon which the description was based. The habitat is definitely proved not always to be the ashy hills as at first supposed.

PROCEEDINGS

OF THE

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VII

A NEW SPECIES OF LAND SNAIL FROM COAHUILA, MEXICO

BY

G. DALLAS HANNA and LEO GEORGE HERTLEIN

In the autumn of 1926 several species of land shells from central, southern Coahuila, Mexico, were added to the collections of the California Academy of Sciences. One species of *Holospira* appears to be undescribed. The specimens were collected about 16 kilometers north of Ramos Arizpe on the road to Paredon, Coahuila, Mexico.

Holospira aguerreverei Hanna & Hertlein, new species

Plate 24, figures 5, 6

Shell white, composed of 13.5 whorls, the earliest 2.5 smooth, the succeeding three rather indistinctly ribbed; those following and constituting the body of the shell with only faint growth lines, almost glossy; the greatest diameter is at the fourth and fifth whorls from the last, thus producing a spindle-shaped shell; last whorl with about 19 costæ; the number is rather indefinite because close behind the apertural expansion the ribs decrease in size and are close together; some of the later ribs are slightly sinuous below due to the constricted basal cord; imperforate; aperture projecting slightly beyond last whorl, roundly triangular in form, without lamellæ; lip expanded uniformly, brilliant, glossy white; between the lip and the umbibial region, the ribs continuing from the outside are much finer and somewhat indistinct close to the lip; sutures deeply impressed in the embryonic portion constituting the first five whorls, elsewhere the whorls are much flattened; the upper and outer part of the free portion of the last whorl is very sharply angulated between the lip and the shell; the basal portion becomes a cord through the presence on both sides of a depression.

Measurements

Length	Diameter		
21.7 mm.	6.0 mm.	Holotype, No. 2848	(C. A. S.)
23.3 mm.	6.1 mm.	Paratype, No. 2849	(C. A. S.)
22.5 mm.	6.4 mm.	Paratype, No. 2850	(C. A. S.)
20.5 mm.	6.1 mm.	Paratype, No. 2851	(C. A. S.)

Holotype: No. 2848; *paratypes:* Nos. 2849-2853, Mus. Calif. Acad. Sci., from 16 kilometers north of **Ramos Arizpe, Coahuila, Mexico**; Santiago E. Aguerrevere, collector.

The species apparently comes closest to *H. semisculpta* Stearns,[1] from San Carlos, Chihuahua, but the last whorls are not so constricted as in that species. *H. mesolia* Pilsbry,[2] from Terrell County, Texas, appears to belong to the same group of species but is even more constricted toward the base than *semisculpta*. *H. pasonis* Dall[3] is another similar but much more coarsely-ribbed species basally and lacks the basal keel. *H. coahuilensis* (Binney)[4] from "Cienga Grande," Coahuila, which might be expected to be closest to the shell here described, is a much larger species, being 29 mm. long, lacks the basal keel and has only about 10 ribs on the last whorl, according to Pilsbry.[5]

The species is named for Mr. Santiago E. Aguerrevere who made the collection.

[1] Proc. U. S. Nat. Mus., Vol. 13, 1890, p. 208, pl. 15, figs. 1, 4.
[2] Nautilus, Vol. 26, 1912, p. 89.
[3] Nautilus, Vol. 8, 1895, p. 112.
[4] Amer. Journ. Conch., Vol. 1, 1865, p. 50, pl. 7, figs. 4, 5.
[5] Man. Conch., Vol. 15, ser. 2, 1903, p. 92.

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FOURTH SERIES

VOL. XVIII, No. 8, pp. 221-227, plate 24 APRIL 5, 1929

VIII

SOME NOTES ON OREOHELIX

BY

JUNIUS HENDERSON

Oreohelix peripherica castanea (Hemphill) has long been a puzzle to me. A great deal of material from Mr. Hemphill in many public and private collections, labelled *castanea,* or rather *castaneus,* bears no resemblance to the form that he originally designated by that name. For example, there are in the University of Colorado Museum seven such lots from the Hemphill collection. The specimens from White Bird, Idaho, labelled *castaneus,* are just like some that are labelled *bicolor,* while two others from the same place, labelled *castaneus,* show some indications of the variegated colors of *variabilis,* but are more depressed and differ in sculpture and some other characters. White Bird is a locality where some extensive and intensive collecting should be done and the material from each station studied as a whole, before being divided into varieties, in order to comprehend the real significance of Hemphill's "varieties."

I have always considered *castanea* a very slightly differentiated color form, almost an exact synonym of *Oreohelix peripherica albofasciata* (Hemphill)[1] and still do, but that does not dispose of the whole problem. Henry Hemphill, in his

[1] See Henderson and Daniels, Proc. Acad. Nat. Sci., Phila., LXVIII, 330-334, 1916. Henderson, Univ. Colo. Studies, XIII, 116-117, 1924. Pilsbry, Proc. Acad. Nat. Sci., Phila., LXVIII, 343-357, 1916.

notes published by Binney,[2] gives an account of an interesting and variable fauna of snails which Binney called *Patula,* but now called *Oreohelix,* at the locality where the Bear River breaks through the low range of mountains south of Cache Junction, Utah, into the Salt Lake Valley. Among other things, he says that at the foot of a cliff he "found a colony of the ribbed variety *castaneus.* This spot is continually shaded, the sun never shining on it. Most of this colony are faintly marked with the broad white band of *albofasciata,* but a few are plain chestnut-colored." This is plainly the type locality of *castanea* and the vicinity is also the type locality of typical *albofasciata* and several other varieties of *peripherica.* On page 32, Binney gives the localities for *castanea* as follows: "Box Elder County, Utah; also Celilo, 15 miles from The Dalles, Oregon. (Hemphill.)" In a footnote he says of the Celilo colony: "Probably a colony brought down by the Columbia. It was not found on a subsequent visit." Whence was it brought by the Columbia? Surely not from the Box Elder County locality, which is the type locality of *castanea,* for that is not in the Columbia drainage and has not been except when, during the greatest Pleistocene expansion of ancient Lake Bonneville, it established an outlet at the northern end of the basin. Furthermore, the Celilo colony is not the same thing at all as that called *castaneus* by Hemphill in his note.

On Plate 2, figures 11 and 14, Binney shows *castanea* as a rather dark, strongly-ribbed form, one figure being quite high-spired, as in typical *albofasciata,* the other being depressed, but such difference in elevation is often seen in colonies of *Oreohelix.* It seems perfectly clear that the Utah material first mentioned by Hemphill and figured by Binney in his figure 14, if not figure 11, must be considered the typical form—the real *castanea*—and figure 14 the type figure. It seems also perfectly clear that this is merely a variable melanistic form of *albofasciata,* in which the broad, white peripheral band is more or less obscured by a wash of brown, a phenomenon not at all uncommon in *Oreohelix,* especially in *O. depressa.* All of the material assignable to *peripherica* or any of its varieties that

[2] Binney, 2nd Supplement to 5th Vol. Terr. Air-breathing Moll. U. S. and adjacent territories, p. 31, 1886.

I have seen in collections, or found myself, have been from the Salt Lake Valley and its tributaries.

Binney and Hemphill called all snails now placed in the genus *Oreohelix* varieties of *Helix* (or *Patula) strigosa,* even such very diverse things as *haydeni* and *cooperi.* In the University of Colorado Museum three examples (No. 7140) from the Hemphill collection are labelled "*H. strigosa* v. *castaneus,* Utah." Two of them are almost typical *albofasciata,* but the other has the peripheral band somewhat obscured and may be considered *castanea.* In what Hemphill considered his "Main Collection," now in the California Academy of Sciences, of lot No. 7589, bearing a similar label, there are five specimens, all quite dark, the peripheral band showing but dimly, hence typical *castanea.* Lot No. 7590, four specimens, bearing a similar label with the additional words "paler—longer," are light, uniform brown. I have selected the best example of No. 7589 in the Academy collection as a lectotype, which has been assigned the number 2986 in the type collection (C. A. S.). It is fully adult and has five whorls. Its size, form and sculpture are well represented by Binney's figure 14; figure 1 accompanying the present paper is from a photograph of it by the author; diameter 15.5, altitude 13 mm. In the University of Colorado Museum there are two specimens of this form that I found near the tunnel at Wheelon, Utah, very close to the northern boundary of Box Elder County, and certainly but a very short distance from the type locality of *castanea.*

The Oregon material presents greater difficulty. In order fully to understand the Hemphill material scattered through many collections, one must remember that he had a habit of dividing the specimens from a given colony into "varieties," based mostly upon slight differences in color or elevation of spire, often well marked in typical examples but grading completely into one another, and the division of his material was not always made altogether consistently. Furthermore, he was very careless about his locality labels, left many of them very vague, and did not give the locality in the same language in the different "varieties" from the same colony.

Thus his *Oreohelix* material from Oregon probably all came from the single colony at Celilo, as I concluded from an examination of the material itself, though some of it is labelled merely "eastern Oregon," and Celilo is not in eastern Oregon, except in the loose sense in which the term "eastern" is often used to distinguish the more arid portions of Washington and Oregon from the moist belt of the western portions of the states. Celilo is on the northern boundary of Oregon west of the middle north-south line. To reinforce the conclusion drawn from an examination of the material, we have the fact that Hemphill and Binney mention no other Oregon locality for this genus than Celilo, and the further fact that in three of five lots examined the locality is given as "eastern Oregon, near Celilo." California Academy of Sciences' Nos. 7681 and 7684 are labelled *Helix strigosa* var. *cooperi,* while Nos. 7587 and 7588 are labelled *Helix strigosa* var. *castaneus,* yet I am rather confident that these all came from one variable colony, such as are not uncommon with the genus *Oreohelix,* and I am equally confident that they have nothing to do with either *cooperi* or the form that he called *castaneus* from the type locality in Utah. No. 7587 carries the additional words "elevated, smooth," while No. 7588 reads "depressed, smooth, one reversed." University of Colorado Museum No. 7142, from the Hemphill collection, is labelled *"Helix alternata* Say var. *castaneus* Hemphill, eastern Oregon." I believe this lot is also from Celilo. I cannot identify any of this Oregon material with any described species and am therefore naming and describing it as new.

Oreohelix variabilis Henderson, new species

Plate 24, figures 2, 3, 4

Shell rather elevated, solid, whitish, variegated with small, irregular, very light-brown blotches; whorls 5½, fairly convex, bluntly angled at the periphery, the angulation continuing at least to beginning of last whorl, but not to the aperture; transverse sculpture rather coarse, irregular striæ, about as in *cooperi* and *depressa,* crossed by very fine, obscure, irregular, incised, spiral lines. Under a lens of good power the whole surface of the last whorl appears rough and coarse. The last whorl turns more decidedly downward toward the aperture than in most species of *Oreohelix,* the ends of the peristome coming rather close together and being connected by a very thick callus, thus forming an almost continuous peristome. This feature is not entirely accidental, as it is as well developed in several other specimens, though on others the callus is thinner and the downward turn of the whorl not quite so pronounced. The aperture is very oblique, somewhat wider than high, the abrupt downward turn at the base giving the appearance of a strong rib within, parallel with the lip. Diameter 22 mm.; altitude 16 mm. The smallest example in this lot of 12 specimens has a diameter of 15 mm., altitude 11 mm.

Holotype: No. 2987; *paratypes:* Nos. 2988, 2989, Mus. Calif. Acad. Sci., from **Celilo, Oregon.** Henry Hemphill collector.

Some examples of this lot exhibit a few faint, narrow, spiral color bands both above and below the periphery. Four specimens of the five in lot No. 7681 exhibit one strong brown band just below the periphery, a broad band just below the suture, the two separated by a whitish band, with traces of finer bands on the base. The fifth example is coarsely ribbed, with broad, blackish bands, and does not seem to belong with the rest at all. It is not unlikely that it belongs with the Utah material and was mixed with this lot before the material was numbered. I have found much evidence of such mixtures in Hemphill's collections. Lot No. 7587 consists of five slightly more elevated shells, each pretty well covered with a reddish-brown wash, but on the base showing the characteristic coloring of this species and being in other ways unlike *castanea*. The same is true of the five examples in lot No. 7588, but they are rather depressed and one of them is reversed. The five specimens in lot No. 7142, University of Colorado Museum, are similar to No. 7587, but average a little smaller.

In the more elevated examples of *variabilis* the spire is distinctly more straightly conical than in elevated forms of *cooperi* or *peripherica* (+*castanea*, etc.), which tend more toward a dome-like outline. Dr. Henry A. Pilsbry writes me that he has found in the Hemphill material in the Academy of Natural Sciences of Philadelphia two topotypic specimens of *O. variabilis* which long ago had been placed with their large collection of *cooperi* and hence overlooked.

Plate 24

Fig. 1. *Oreohelix peripherica albofasciata*, color form *castanea* (Hemphill)' diameter, 15.5 mm.; lectotype No. 2986 (C. A. S. type coll.), from Box Elder Co., Utah; p. 221.

Fig. 2. *Oreohelix variabilis* Henderson, new species; diameter, 22 mm.; holotype No. 2987 (C. A. S. type coll.), from near Celilo, Oregon' p. 224.

Fig. 3. *Oreohelix variabilis* Henderson, new species; diameter, 20.1 mm.; paratype No. 2988 (C. A. S. type coll.), from near Celilo, Oregon; p. 224.

Fig. 4. *Oreohelix variabilis* Henderson, new species; diameter, 19.4 mm.; paratype No. 2989 (C. A. S. type coll.), from near Celilo, Oregon; p. 224.

Fig. 5. *Holospira aguerreverei* Hanna & Hertlein, new species; true length 21.7 mm., diameter 6.0 mm.; holotype No. 2848 (C. A. S. type coll.), from 16 kilometers north of Ramos Arizpe, Coahuila, Mexico; p. 219.

Fig. 6. *Holospira aguerreverei* Hanna & Hertlein, new species; side view of specimen shown in fig. 5; p. 219.

Figs. 7, 8, 9. *Helminthoglypta berryi* Hanna, new species; diameter, 22.5 mm.; holotype No. 1492 (C. A. S. type coll.), from eight miles northeast of Bakersfield, Kern County, California; p. 217.

Figs. 10, 11. *Pecten* (*Plagioctenium*) *ericellus* Hertlein, new species; altitude, 28 mm.; holotype No. 2998 (C. A. S. type coll.), from locality 1132 (C. A. S.), Pacific Beach, San Diego, California. Pliocene; p. 215.


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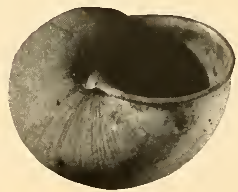
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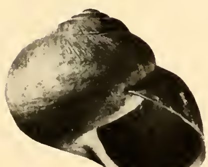
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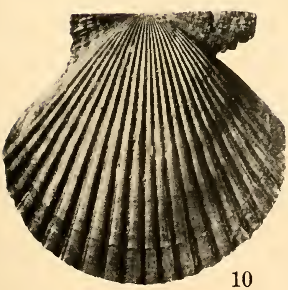
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IX

NOTES ON THE NORTHERN ELEPHANT SEAL

BY

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After passing through various nomenclatural vicissitudes, the elephant seal of southern waters had apparently arrived at a certain permanence in *Macrorhinus leoninus* until the appearance, in 1909, of Lydekker's paper "On the Skull-Characters in the Southern Sea-Elephant."[1] Basing his studies on the skulls of two males from Macquarie Island, a male from Chatham Island, a female from the "Antarctic Seas," a male from the Crozet group, and an old male from the Falklands, Lydekker reached the conclusion that the differences found in the palatal regions of these specimens warranted the recognition of the following species and subspecies: *Macrorhinus leoninus typicus* [=*M. l. leoninus*] (Juan Fernandez); *M. l. falclandicus* (Falkland Islands), perhaps inseparable from the typical race; *M. l. macquariensis* (Macquarie and ?Chatham islands); and *M. crosetensis* (Crozet and ?Kerguelen and Heard islands).

In this paper no attempt was made to discuss the cranial features of the Northern Elephant Seal, but Lydekker noted that the characters exhibited by the palatines of a skull of that form were sufficient for its recognition as a distinct species. In an appended note, resulting from a communication from

[1] P. Z. S. 1909, pp. 600-606.

Rothschild, it was remarked that should the northern species prove to be identical with that from Juan Fernandez and Chile, the specific name *leoninus* should be reserved for the animals of that region, and the elephant seals from the Falklands, and from Macquarie and Chatham islands should be known respectively as *M. falclandicus falclandicus* and *M. f. macquariensis.* The reason for this division is obscure in view of the statement that the Falkland Island race was perhaps inseparable from the typical *leoninus.*

Lydekker's paper proved but the prodrome of one by Lönnberg.[2] While recognizing the probability of a widely distributed species being separable into geographic races, Lönnberg found himself unable to accept Lydekker's conclusions. The characters upon which the latter's species and subspecies were founded (with the exception of the breadth of palate in the Crozet example), all fell within the range of variation exhibited by the series (seven adult and semi-adult males, three young males, and one adult female) from South Georgia examined by Lönnberg.

With a series of five males and four females from Guadalupe Island, one male from the Falklands, two or three from Macquarie, and two or three from Crozet Island at his disposal, Rothschild[3] continued the discussion. Although the promised article, giving the constant characters by which the various subspecies might be recognized, has not yet appeared, Rothschild confessed his faith in the validity of *Mirounga leonina leonina* (coasts of California and adjacent islands, wintering on Chilean coasts), *M. l. patagonica* (Falkland Islands, South Georgia, and ?South Shetlands), *M. l. kerguelensis* = *M. l. crozettensis* [*sic*] (Herd, Kerguelen, Crozet islands, etc.), *M. l. peronii* (islands of Bass Straits), and *M. l. macquariensis* (Macquarie Islands).

Apparently Rothschild was governed largely in his decision as to the unity of the species by a report from Harris "that he must reach the island [Guadalupe] before the middle of May or the Sea Elephants would have migrated to the south." Rothschild states that he "looked up the matter, and . . . found that, although a few stray individuals might formerly

[2] P. Z. S. 1910, pp. 580-588.

[3] Nov. Zool., XVII, pp. 445-446.

have led a pelagic life north of the Equator, the bulk of the Northern Sea Elephants migrated in the hot weather to the Chilean coast and the islands near (Juan Fernandez, Masafuera, etc.)," but the sources of his information are not revealed.

That rookeries are more or less completely deserted subsequent to the breeding season is hardly sufficient for the determination of a migration in any particular direction. Breeding grounds in the southern hemisphere (Kerguelen, South Georgia, and Macquarie, etc.) are similarly vacated after the season of reproduction, and the fact that elephant seals have been found in the Antarctic pack ice (65° 08′ S.)[4] and at Cape Royds (77° 40′ S.)[5] in January is evidence of a movement away from, rather than across, the equator.

Moreover, the information furnished by Harris was inaccurate. Scammon[6] found several cows and their young, the latter apparently but a few days old, on Santa Barbara Island in June, 1852. Townsend[7] reports finding a pup three weeks old on Guadalupe Island, October 9, 1883; and the new-born young he met with on the Lower Californian islands in 1883-84 were dropped at various times between November 1 and February 1. In 1911, he saw a dozen or more females with very young pups on March 5 at Guadalupe Island. In the Academy's collection are skull and skeleton of a pup a few weeks old taken on Guadalupe Island, May 8, 1914.

Reports from recent expeditions visiting Guadalupe Island during the summer months indicate the presence of a considerable herd at that season. The *Tecate* Expedition[8] reported the presence of 264 adult animals, July 12, 1922, and 300 four days later. Mexican officials visiting the island in early September of the same year found 150 females and an equal number of pups about 30 inches in length.[9] In 1923, 366[10] were counted on July 16, and on August 30 of the succeeding year

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[4] Wilkes, C., Nar. U. S. Expl. Exped., II, p. 291.

[5] Wilson, E. A., Geog. Jour., XXV, p. 393; Nat. Antarctic Exped., N. H., Zool., II, p. 53.

[6] Marine Mammals of the North-western Coast of North America, p. 118.

[7] Proc. U. S. Nat. Mus., VIII, p. 93; Bull. Am. Mus. Nat. Hist., XXXV, p. 407.

[8] Hanna, Proc. Calif. Acad. Sci., 4th Ser., XIV, p. 229; Anthony, Jour. Mam., V, p. 146; Proc. Calif. Acad. Sci., 4th Ser., XIV, pp. 310, 313.

[9] Anthony, Proc. Calif. Acad. Sci., 4th Ser., XIV, p. 313.

[10] Huey, Science, n. s., LXI, p. 406; Anthony, Jour. Mam., V, p. 148.

124[11] occupied the beach. A total of 465 animals was found on the island on June 23, 1926.[12]

This evidence of an extended breeding season and the presence of a considerable herd of elephant seals in North American waters during all seasons seem to militate against the view of a migration of these animals to Juan Fernandez, especially as Anson[13] found elephant seals with young on that island during his stay, from June 10 to September 19. It is stated that the young were born during the "winter."

With a view to aiding in the determination of the status of the elephant seals of the north Pacific, the Academy's series of specimens has been examined. These examples apparently but inadequately represent the Guadalupe animals, skulls of greater length, two feet (605 mm.)[14] and 556 mm.,[15] having been known. It has been deemed advisable, however, to place the measurements on record, together with notes on structural characters.

In order to facilitate comparisons with previously published figures, percentages of basal length of skulls, in addition to the actual measurements, have been given in the appended table. The incomplete skulls appear to be those of adult males. The open pulp cavities of the canines and the condition of the sutures in the largest complete skull bear witness to the animal's immaturity, and even the skulls of the somewhat older females show that the possibilities of additional growth had not been exhausted.

Through the courtesy of Dr. Charles Anderson, Director of the Australian Museum, Sydney, and Mr. George P. Engelhardt, Curator of the Department of Natural Sciences, Brooklyn Museum, Brooklyn, an examination of the skulls of two adult males from Macquarie Island and one adult male from South Georgia has been made possible. The measurements of these specimens are given below.

In basal length the complete skulls of the males in the Academy's collection fall considerably short of those from

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[11] Huey, Science, n. s., LXI, p. 406.
[12] Huey, Jour. Mam., VII, p. 160.
[13] *Cf.* Thomas, Jour. Voy. to the South Seas in 1740-44, p. 40.
[14] Townsend, Proc. U. S. Nat. Mus., VIII, p. 93.
[15] Huey, Jour. Mam., V, p. 241.

	Males						Females		
	1133	4658	1136	963	879	1139	962	1137	1138
Basal length	....	....	440.00	405.00	347.00	306.00	353.00	328.00	223.00
Zygomatic width	349.00	321.00	299.00	277.00	240.00	209.00	214.50	218.00	170.00
Zygomatic width in o/o of basal length	....	....	67.95	68.14	69.16	68.00	60.76	66.45	76.23
Length of palate	....	....	228.00	214.00	....	140.00	172.00	148.00	91.00
Length of palate in o/o of basal length	....	....	51.81	52.83	....	45.75	48.44	43.90	40.80
Width of palate	....	....	138.50	127.30	111.75	96.25	101.00	99.75	71.75
Width of palate in o/o of basal length	....	....	31.47	31.43	32.20	31.45	28.61	30.41	32.17
Length of interpalatine suture	....	....	25.50	37.00	26.00	17.00	23.00	19.00	9.00
Length of interpalatine suture in o/o of basal length	....	....	5.79	9.14	7.49	5.55	6.51	5.79	4.48
Length of premaxillaries in palatine surface	....	....	90.50	85.00	66.00	62.50	66.25	58.50	38.00
Length of premaxillaries in palatine surface in o/o of basal length	....	....	20.56	20.98	19.02	20.42	18.76	17.83	17.04
Width of occipital condyles	131.00	117.00	109.00	106.50	98.50	94.00	97.00	94.40	85.50
Width of occipital condyles in o/o of basal length	....	....	24.75	26.29	28.38	30.71	27.47	28.78	33.85
Width of skull at posterior edge of *meatus aud. externus*	298.00	280.00	264.00	253.50	225.00	194.00	190.00	192.00	156.00
Width of skull at posterior edge of *meatus aud. externus* in o/o of basal length	....	....	60.00	62.59	64.84	63.39	53.82	58.53	69.95
Width of skull on a level with the upper posterior premaxillary suture	....	....	141.25	129.75	105.50	85.20	91.60	89.75	60.75
Width of skull on level with the upper posterior premaxillary suture in o/o of basal length	....	....	32.10	32.03	30.40	27.84	25.94	27.36	27.24
Least frontal width of skull	78.00	68.20	57.50	57.00	46.50	40.00	41.50	43.50	26.75
Least frontal width of skull in o/o of basal length	....	....	13.06	14.07	13.40	13.07	11.75	13.26	11.99
Length of nasals	....	....	72.00	65.00	51.25	....	56.50	49.75	41.00
Combined width of nasals	....	....	58.50	47.75	38.50	....	....	....	22.75

	South Georgia	Macquarie Island	
Basal length	505.00	475.00	465.00
Zygomatic width	381.00	355.00	352.00
Zygomatic width in o/o of basal length	75.44	74.73	75.69
Length of palate	280.00	253.00	263.00
Length of palate in o/o of basal length	55.44	53.26	56.02
Width of palate	175.00	173.00	168.00
Width of palate in o/o of basal length	34.65	36.42	36.12
Length of interpalatine suture	55.00	47.00	50.00
Length of interpalatine suture in o/o of basal length	10.89	9.89	10.75
Length of premaxillaries in palatine surface	103.00	115.00	104.50
Length of premaxillaries in palatine surface in o/o of basal length	20.39	24.21	22.47
Width of occipital condyles	136.50	108.50	120.00
Width of occipital condyles in o/o of basal length	27.02	22.84	25.80
Width of skull at posterior edge of *meatus aud. externus*	322.00	276.00	296.00
Width of skull at posterior edge of *meatus aud. externus* in o/o of basal length	63.76	57.57	63.65
Width of skull on a level with the upper posterior premaxillary suture	161.00	167.00	165.00
Width of skull on a level with the upper posterior premaxillary suture in o/o of basal length	31.88	35.15	35.48
Least frontal width of skull	81.00	79.50	68.50
Least frontal width of skull in o/o of basal length	16.03	16.73	14.73
Length of nasals	62.00	95.00	96.50
Combined width of nasals	58.00	58.50	55.00

South Georgia and Macquarie Island, but it must be borne in mind that all save one were from young animals. From the zygomatic breadth of the two incomplete skulls it may be assumed that their length would be nearly equal to the largest South Georgia ones, and the previously mentioned skulls measured by Townsend and Huey exceed in this dimension. It may be noted that the crania of two adult females from Guadalupe surpass by 60 and 35 mm. Lönnberg's South Georgia example.

In the South Georgia specimens as well as in the Guadalupe ones the greatest relative zygomatic width occurred in quite young animals. It is, therefore, of significance that while the zygomatic breadth of only one adult or semi-adult from South Georgia fell below 70 per cent of the basal length, only one (an immature female) from Guadalupe Island had a zygomatic breadth of more than 70 per cent.

Six of Lönnberg's series have the relative width of skull at the posterior edge of the *meatus auditorius externus* more than 64.84 per cent, the highest attained by all but one young from Guadalupe. Specimens from South Georgia and Macquarie Island, measured by the author, and Turner's Heard Island skulls are 63.76, 57.57, 63.65, 64.4, and 61.2, however.

The length of palate in the Guadalupe elephant seals varied in relation to the basal length from 40.80 (young) to 52.83 per cent. Even the smallest of Lönnberg's series did not fall below 45.0 per cent, and three exceeded 52.83 per cent. The Macquarie Island animals measured by the writer proved to have a relative palatal length of 53.26 and 56.02, but the one measured by Lydekker was 52.7 per cent.

The width of palate in Lönnberg's series varies from 37.1 to 32.2 per cent of basal length, and the same measurement in the Guadalupe specimens is from 32.2 to 28.61 per cent. Skulls measured by Lydekker had a palatal breadth varying from 35 to 39.3 per cent, and 36.12 and 36.42 are the percentages of the Macquarie Island skulls given in the table above.

It might have been supposed that the width of skull at the level of the upper posterior premaxillary suture might bear close relationship to the palatal breadth, but this did not manifest itself in the measurements. The variations in that dimension in the Guadalupe examples easily fall within the limits of those of the southern seals.

In the case of the least frontal width of skull, a decided difference between the northern and southern animals is evident. That measurement in South Georgia and Macquarie skulls ranges from 20.5 to 14.73 per cent of the basal length, with the exception of one of 12.2 per cent, and from 15.1 to 13.6 in Heard Island examples. The percentage in Guadalupe ones is from 14.07 to 11.75.

It is unfortunate that the proportionate measurements of the two larger incomplete Guadalupe Island skulls are not available for comparison, as they might have made it possible to attain a fairer estimate of the northern elephant seal. The comparisons would also be of greater value were it known how nearly similar in age were the animals whose skulls were the source of the figures. From a study of the measurements presented in these tables, however, and those recorded by Lydekker and Lönnberg, it would appear that, although many of its cranial dimensions fall within the range of variation exhibited by the elephant seal of the southern oceans, the Guadalupe animal possesses a relatively narrower skull. Whether degeneration, due to the near approach of the northern race to extinction, is a factor involved in the reduction in breadth is a debatable point.

The extent of variability manifested in the form of the skull and its component parts makes any decision based upon a limited series of slight value. One character believed to be sufficiently constant to separate the northern from the southern animals was discovered. In Guadalupe Island examples, it was found that in the dorsal aspect the premaxillæ as they extend backward also expand laterally, the lateral outline being distinctly convex in its basal half. The southern specimens examined all appear to have the lateral margins of the premaxillæ parallel.

It would seem, therefore, that there is sufficient justification for regarding the northern elephant seal as a separate species, *Macrorhinus angustirostris*.

In the examination of the Academy's series of specimens certain other skeletal and anatomical characters have been noted which seem of sufficient value to record. Although it is not so pronounced a feature as in the South Georgia and Macquarie Island skulls, the premaxillary tubercle is present in all the Guadalupe specimens. In this latter series the mesethmoid has never been seen to reach the upper surface of the skull as it does in the southern specimens. The pterygoid processes of the Academy's specimens are inclined to be small and rather slender. The skull of one of the females (No. 1137) has both palatines divided into two parts by a suture. In the skull of the male pup (No. 961), probably only a few weeks old, is seen indications of the cranial element found by Cleland[16] in *Cystophora cristata* and other Pinnipedia, and believed by him to correspond to the paroccipital of Owen in osseous fishes.

There is great individual variation in the dentition of the Academy's Guadalupe series, its extent being evident in the following formulæ:

$$\text{I.}\frac{2-2}{1-1};\quad \text{C.}\frac{1-1}{1-1};\quad \text{P.M.}\frac{4-4}{4-3};\quad \text{M.}\frac{0-0}{1-0};\quad \left\{\begin{array}{l}\text{C. A. S.}\\ \text{No. 962}\\ \text{female}\end{array}\right.$$

$$\text{I.}\frac{2-2}{1-1};\quad \text{C.}\frac{1-1}{1-1};\quad \text{P.M.}\frac{4-4}{4-4};\quad \text{M.}\frac{1-1}{0-0};\quad \left\{\begin{array}{l}\text{C. A. S.}\\ \text{No. 1139}\\ \text{male}\end{array}\right.$$

$$\text{I.}\frac{2-2}{1-1};\quad \text{C.}\frac{1-1}{1-1};\quad \text{P.M.}\frac{4-4}{4-4};\quad \text{M.}\frac{1-1}{1-0};\quad \left\{\begin{array}{l}\text{C. A. S.}\\ \text{Nos. 1136 and 879}\\ \text{males}\end{array}\right.$$

$$\text{I.}\frac{2-2}{1-1};\quad \text{C.}\frac{1-1}{1-1};\quad \text{P.M.}\frac{4-4}{4-4};\quad \text{M.}\frac{1-1}{1-1};\quad \left\{\begin{array}{l}\text{C. A. S.}\\ \text{Nos. 963 and 961 (pup)}\\ \text{males}\end{array}\right.$$

$$\text{I.}\frac{2-2}{1-1};\quad \text{C.}\frac{1-1}{1-1};\quad \text{P.M.}\frac{4-4}{4-4};\quad \text{M.}\frac{1-1}{1-2};\quad \left\{\begin{array}{l}\text{C. A. S.}\\ \text{No. 1137}\\ \text{female}\end{array}\right.$$

$$\text{I.}\frac{2-2}{1-1};\quad \text{C.}\frac{1-1}{1-1};\quad \text{P.M.}\frac{4-4}{4-4};\quad \text{M.}\frac{1-1}{2-2};\quad \left\{\begin{array}{l}\text{C. A. S.}\\ \text{No. 1138}\\ \text{young female}\end{array}\right.$$

[16] Rept. Brit. A. A. S., 1902, pp. 646-647.

The vertebral formula of the Guadalupe specimens appears to be: cervical, 7; dorsal, 15; lumbar, 5; sacral, 3; caudal, 9. The absence of a tenth caudal vertebra may, however, be due to mischance in the preparation of the skeleton. In comparison with corresponding parts figured by Turner[17] the spinous process of the cervical vertebræ is much elevated. This character is evident even in the vertebræ of a pup. The hypapophysial tubercle of the atlas is well developed, and the lateral laminæ are considerably depressed apically, giving the lower margin of that vertebra a very sinuous outline. The breadth of the anterior articular surfaces of the axis appears to be proportionately small. The spinous process of the atlas of Nos. 1139, male, and 1137, female, resembles that figured by Turner, but this process in the other males is decidedly broader. The centrum of the third cervical is more nearly oval or elliptical oval. In the seventh vertebra, the transverse processes are not depressed apically as are they in Turner's example. In no case would a straight line drawn between their lowest apices touch the lower margin of the centrum.

On the ventral surface of only the anterior and posterior dorsal vertebræ is evidence of a keel discovered. The bodies of the lumbar vertebræ are slightly flattened, or, in some instances, double keeled so that a ventral groove is formed.

In No. 1136, male, the epiphyses of the first and second, and the second and third sacrals are anchylosed to one another, but not to the centra. In No. 1137, female, the three sacral vertebræ and anchylosed, and in No. 962, female, four vertebræ in the sacral region are fused.

In the Academy's series the first and second caudal vertebræ are possessed of a neural arch. One specimen has the arch present in three, and another specimen has the laminæ of the third caudal nearly united to form an arch, and the fourth is very deeply grooved.

The scapulæ of the Guadalupe seals exhibit considerable variation in form, which is made evident in the following table:

[17] Voy. Challenger, Zoology, XXVI, Seals, pls. II-IV.

Sex	Greatest depth	Greatest width	Percentage of width in depth
Females	115.00	122.00	106.08
	207.00	192.00	92.75
	205.00	205.00	100.00
Males	180.00	173.00	96.11
	195.00	210.00	107.69
	250.00	265.00	106.00
	235.00	240.00	102.12

The skins in the Academy collection were examined and a count of the vibrissæ made. The arrangement of the brow bristles differs, but there are usually eight to ten in the group. A single bristle is found on each side of the median line of the head about halfway between the nostril and eye. The mystacial bristles are arranged in seven rows, the total number varying from 46 to 49. In this regard there seemed to be such a marked difference between these numbers and those given by Allen[18] that the result was verified by count of the papillæ on the under surface of the hide. It appears that the number of maxillary bristles of the Guadalupe Island animals is considerably greater than that of the South Georgia ones. Murphy[19] found that his specimens exhibited 39 maxillary bristles on each side.

I am pleased to acknowledge indebtedness to Dr. G. Dallas Hanna, Curator, Department of Paleontology, and Mr. Joseph Mailliard, Curator Emeritus, Department of Ornithology and Mammalogy, for the photographs used in illustrating this paper.

[18] U. S. Geol. Surv., Misc. Pub., XII, p. 743.
[19] Bull. Am. Mus. Nat. Hist., XXXIII, p. 76.

Plate 25

Fig. 1. Northern Elephant Seal, male. Guadalupe Island, Mexico, July 12, 1922. Photograph by G. Dallas Hanna.

Fig. 2. Northern Elephant Seal, male. Guadalupe Island, Mexico, July 12, 1922. Photograph by G. Dallas Hanna.

Fig. 1

Fig. 2

Plate 26

Fig. 1. Anterior surface of atlas of *Macrorhinus angustirostris.* Photograph by Joseph Mailliard.

Fig. 2. Anterior surface of axis of *Macrorhinus angustirostris.* Photograph by Joseph Mailliard.

Fig. 3. Anterior surface of third cervical vertebra of *Macrorhinus angustirostris.* Photograph by Joseph Mailliard.

Fig. 4. Anteiior surface of seventh cervical vertebra of *Macrorhinus angustirostris.* Photograph by Joseph Mailliard.

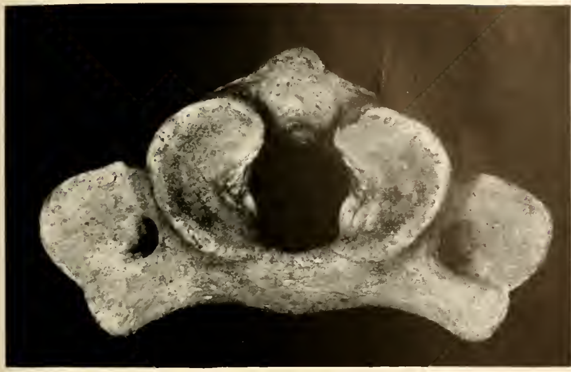

Fig.1

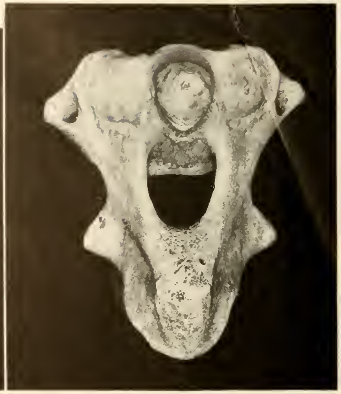

Fig.2

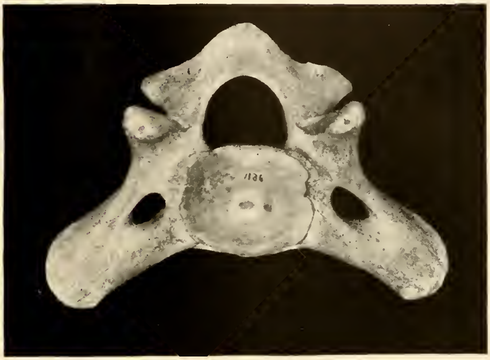

Fig.3

Fig.4

PROCEEDINGS

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X

ON A SMALL COLLECTION OF BIRDS FROM TORRES STRAIT ISLANDS, AND FROM GUADALCANAR ISLAND, SOLOMON GROUP

BY

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In the years 1920 and 1921, Mr. J. August Kusche visited Australia and the Papuan region for the purpose of assembling general natural history collections. Among the specimens he secured was a small number of birds from Prince of Wales and Thursday islands, Australia, and Guadalcanar Island, Solomon Group. These skins, now in the museum of the California Academy of Sciences, form the basis of the present paper.

None of the localities visited was an ornithological *terra incognita.* Torres Strait islands have been worked on several occasions by collectors. The bird life of certain of the islands has been quite thoroughly investigated, others still present opportunities for the study of their native fauna, and all are interesting because their position renders them suitable as observatories in the study of the migratory movements of Australian and Papuan birds. Both Prince of Wales and Thursday islands have already been ornithologically explored, but, despite this fact, the present assemblage of specimens includes species apparently not previously reported from Prince of Wales Island.

April 5, 1929

Prince of Wales Island (10° 40′ S., 142° 10′ E.) is the largest of the islands of the group bearing that name. It is about 14 miles from the mainland, and covers an area of nearly 12 square miles. Thursday Island (10° 40′ S., 142° 20′ E.) lies to the northward, and is only about 900 acres in extent. All the islands of the group are hilly, and on them are peaks which rise to an elevation of nearly 700 feet. In former days, Prince of Wales Island supported a native population of about 500 persons, but at the present time the numbers are greatly reduced. The desultory mining operations carried on there have resulted in no extensive settlement as there is on Thursday Island, where Port Kennedy has become the metropolis of the Torres Strait pearl fisheries.

Lying off the eastern coast of New Guinea is the Solomon Group, of which Guadalcanar Island (9° 30′ S., 165° E.) is one of the largest and best known. This island is about 82 miles long, and averages a breadth of 25 miles. Lofty forest-clad mountains rise in the eastern and southern portions, Mt. Lammas attaining an elevation of 8005 feet. The descent of these mountains to the sea is abrupt on the east and south, but to the north extend rolling prairies covered with high grass. From May to November the island is swept by the southeast trade wind, and during the period from December until April the inequitable northwest monsoon makes itself felt. These moisture-laden winds result in a coastal rainfall of 100 to 150 inches a year, and a precipitation in the mountains that is said to be between 400 and 500 inches annually. Several navigable rivers, flowing northward, aid in carrying off the surplus water.

In spite of the reputed ferocity of the natives, the Solomon Islands have received due attention from naturalists, and the labors of nineteeth century pioneers blazed a trail for more finished work on the part of their successors. In the 20th century, Lord Rothschild's interest in the Papuan islands has resulted in the amassing of excellent collections of birds from the Solomon Islands in Tring Museum, and his studies, and those of Hartert, have aided greatly in giving us a comprehensive knowledge of their avifauna. Nevertheless, there remain to be learned many facts in variation, distribution, and migration. It is, therefore, to be regretted that the collection here under consideration lacks detailed information regarding the localities in which the collecting was done. But facts obtained from the specimens themselves seem worthy of presentation.

In its entirety, Mr. Kusche's collection comprised 138 bird skins, representing 56 species and subspecies. From July 20 to August 18, inclusive, 1920, examples of 27 species were taken on Prince of Wales Island; during five days of September (7 to 11, inclusive), specimens of eight species were secured on Thursday Island; and between November 26, 1920, and January 30, 1921, representatives of 25 species were added to the collection on Guadalcanar Island. Ten *Megapodius* eggs were obtained on Savo Island, off Guadalcanar Island, on February 18, 1921.

List of Species

1. **Megapodius reinwardt brenchleyi** Gray

Nos. 2996-3005: eggs, February 18; Savo Island.

The incubation of one of these eggs had begun, the remainder were fresh. The ground color of these eggs varies from almost pure white to light buff (Ridgway). The overlying color ranges from pinkish buff, through a pale isabella, to avellaneous. Oates[1] gives 2.8 (71.2 mm.) and 3.05 (77.5 mm.) inches in length, and 1.75 (44.5 mm.) and 1.9 (48.2 mm.) inches in breadth as the extreme measurements of his series. The extremes exhibited by the Academy's series are: 73.7 mm. and 81.0 mm. in length, and 45.2 mm. and 49.1 mm. in breadth.

2. **Ptilinopus regina** Swainson

Nos. 24410-11: female, August 16; male, August 17; Prince of Wales Island.

Both birds are in fresh plumage. The coloration of No. 24410, female, is very intense for one of that sex. On the under tail-coverts of this example, a bar of orange-red intervenes between the narrow yellow tip of the feather and a

[1] Cat. Birds' Eggs Brit. Mus., I, 1901, p. 16.

central band of magenta. The presence of this last color is apparently unusual, and it is not mentioned in the descriptions of the species given by Salvadori[2] or Mathews.[3]

3. **Ptilinopus superbus** (Temminck)

No. 23312: male, August 16, 1920; Prince of Wales Island.

Fresh plumage has just been assumed. "Eyes red-brown. Legs and feet blood-red. Call, a low *u u i i i*" (Kusche).

4. **Jotreron viridis lewisi** (Ramsay)

No. 22425: female, January 18; Guadalcanar Island.

"Bill orange-yellow. Legs and feet crimson" (Kusche). The feathers of the forehead and chin are gray tipped with green.[4]

5. **Megaloprepia magnifica assimilis** (Gould)

Nos. 24407-08: male, August 18; female, August 17; Prince of Wales Island. No. 24409: male, September 10; Thursday Island.

The specimens at hand differ from the *Megaloprepia assimilis* (=*M. m. keri* Mathews) figured by Mathews[5] in having the fresh feathers of the upper parts a more golden green with bronze reflections. The breast feathers are apically Indian purple (Ridgway), and a subterminal band of dark madder violet (Ridgway) intervenes between that color and the succeeding green area. The measurements (in millimeters) of the series at hand are as follows: Culmen, 15.5, 14.5, 16.5; wing, 180.0, 181.0, 183.0; tail, 148.0, 156.0, 145.0; tarsus, 23.5, 22.0, 22.5. In size these birds appear to approach *M. m. poliura*, but differ from individuals of that race in having the under tail-coverts washed with gamboge.

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[2] Cat. Birds Brit. Mus., XXI, 1893, p. 95.

[3] B. Austr., I, 1910-11, pp. 105, 107.

[4] *Cf.* Salvadori, Cat. Birds Brit. Mus., XXI, 1893, p. 153; Hartert, Nov. Zool., II, 1895, p. 63, footnote; and Rothschild & Hartert, Nov. Zool., VIII, 1901, p. 109.

[5] B. Austr., I, pl. 26.

According to a note on the label, the oviduct of the female contained two ova.

6. **Globicera rufigula** (Salvadori)

No. 24424: male, December 3; Guadalcanar Island.

A moult, involving contour plumage as well as remiges and rectrices, is nearly complete.

7. **Chrysauchœna humeralis humeralis** (Temminck)

No. 24414: female, July 28; Prince of Wales Island.

8. **Geopelia placida placida** Gould

No. 24413: male, August 3; Prince of Wales Island.

9. **Calœnas nicobarica nicobarica** Linnæus

Nos. 24445-48: females, January 2 and 9; males, January 17 and 27; Guadalcanar Island.

10. **Porphyrio indicus neobritannicus** Meyer

No. 24422: male, December 2; Guadalcanar Island.

In the specimen under examination the foreneck and breast are greenish cobalt, in distinct contrast to the remainder of the under parts. The thighs and abdomen are concolor. For birds exhibiting these characters, Hartert[6] has presented cogent arguments for the use of the specific name *indicus* Horsfield, rather than *calvus* Vieillot. But, unless it proves that representatives of two species of Porphyrio are resident in the Solomon Islands, it will be necessary to regard *neobritannicus* as a race of *indicus*, not of *melanotus*.[7]

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[6] Nov. Zool., XXXI, 1924, pp. 105-106.

[7] *Cf.* Hartert, Nov. Zool., XXXI, 1924, p. 108; Mathews, Syst. Av. Austr., 1927, p. 101.

11. **Pluvialis dominicus fulvus** (Gmelin)

No. 24442: female, January 11; Guadalcanar Island.

The remiges are only slightly worn, but the remainder of the plumage is much abraded.

12. **Actitis hypoleucus** (Linnæus)

No. 24894: female, August 17; Prince of Wales Island.

This is a bird in worn garb.

13. **Orthorhamphus magnirostris neglectus** (Mathews)

No. 24423: male, January 17; Guadalcanar Island.

14. **Demigretta sacra novæguineæ** (Gmelin)

Nos. 24416-17: male, January 12; female, January 30; Guadalcanar Island. No. 24418: specimen without data.

The subspecific name has been but tentatively applied to these specimens. The female is almost pure white. A few dark streaks appear in the contour plumage, and dark tips are in evidence on some of the remiges and rectrices. The plumage of the male is devoid of white, and the dataless example has a white line on the throat. The specimens yield the following measurements (in millimeters): Culmen, 86.0, 85.0, 85.0; wing, 295.0, 265.0 (worn), —; tail, 98.5, 90.0, —; tarsus, 75.7, 70.5, 74.0. In size these specimens approach a female collected at Apia, Samoa, which measures: Culmen, 84.5; wing, 265.0 (worn); tail, 94.0; tarsus, 70.0.

15. **Nycticorax caledonicus hilli** Mathews

No. 24415: male, September 9; Thursday Island.

This bird appears to be much paler than that figured by Mathews.[8] The mantle is fawn, but approaches mars brown (Ridgway) on the interscapulars.

[8] B. Austr., III, pl. 193.

16. **Anas superciliosa pelewensis** Hartlaub & Finsch

No. 24421: male, November 26; Guadalcanar Island.

17. **Leucospiza hiogaster pulchella** (Ramsay)

Nos. 24405-06, 24436-38: immature males, December 26 and 30; adult male, January 18; immature female, January 5; adult female, January 23; Guadalcanar Island.

The adult female is in greatly worn dress.

18. **Haliastur indus ambiguus** Brüggemann

Nos. 24419-20: female, December 22; male, December 23; Guadalcanar Island.

"Iris brown. Bill ochre. Legs yellow. The stomach of the male contained a bird" (Kusche).

19. **Eos grayi** Mathews & Iredale

Nos. 24364-68: males, December 4 and 28, and January 8; female, January 8; Guadalcanar Island.

A moult which involves all the feather tracts is in evidence in these examples.

20. **Trichoglossus hæmatodus aberrans** Reichenow

Nos. 24361-63: female, December 4; males, December 4 and January 8; Guadalcanar Island.

These specimens have the occiput purplish brown and the throat purple. In two individuals the unspotted dark green area of the central abdomen is quite evident. The plumage in every case is much worn, but feather renewal has begun on the forehead, crown, and flight feathers.

21. **Kakatoë galerita fitzroyi** (Mathews)

Nos. 24371-73: female, August 7; males, August 8; Prince of Wales Island.

The auriculars of these examples are strongly tinged with yellow, in this respect differing from the type of *fitzroyi* as described by Mathews.[9] The measurements (in millimeters) of the series are: Culmen, 37.0, 37.2, 42.0; wing, 305.0, 298.0, 316.0; tail, 159.0, 164.0, 175.0; tarsus, 24.0, 24.5, 25.0.

22. **Ducorpsius ducorpsii** Pucheran

Nos. 24369-70: female, January 5; male, January 6; Guadalcanar Island.

The basal reddish orange of the feathers of the lores, sides of head, nape, throat, breast, flanks, and upper tail-coverts is quite conspicuous in the case of the male. The presence of this color is mentioned by Finsch,[10] but it is ordinarily disregarded in descriptions of this species.

23. **Lorius roratus solomonensis** (Rothschild & Hartert)

No. 24360: female, January 22; Guadalcanar Island.

The contour plumage has been recently assumed, but all but one rectrix and the outer primaries have still to be replaced.

24. **Megapodargus papuensis baileyi** (Mathews)

No. 24316: male, July 28; Prince of Wales Island.

25. **Eurystomus orientalis solomonensis** Sharpe

Nos. 24312-15: males, December 20 and 21; female, December 22; Guadalcanar Island.

A white patch is present on the chin of each of the specimens. "Iris ruby red. Bill and legs vermilion" (Kusche).

26. **Dacelo leachii kempi** Mathews

Nos. 24303-08: adult male, August 4; males [adult females], July 27; females [immature males], July 29 and August 4; Prince of Wales Island.

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[9] Nov. Zool., XVIII, 1911, p. 264.
[10] Papag., I, 1867, p. 312.

An immature male (labeled "female") taken on August 4, has the tail basally dark blue, and only slight indications of brown are present on the outer webs of the lateral rectrices. A somewhat younger male, labeled "female," has the proxinal two-thirds of the tail dark blue, and the distal portion brown banded with blue. The rectrices of this specimen are quite narrow, the central ones measuring six and the lateral ones four millimeters less than the corresponding feathers of the adult bird. Two birds taken on July 27 are marked as "males"; but, although they appear to be older than the immature male dated July 29, there is no indication of an advance into the plumage of the adult male, the tails being brown to the base.

In these examples the white of the throat merges into light cream buff (Ridgway) on the breast and abdomen. The amount of dark vermiculation on the under surface is variable. One adult female is very heavily marked, but the lower parts of the adult male are very faintly lined.

27. **Lazulena macleayii macleayii** (Jardine & Selby)

No. 24310: female, July 29; Prince of Wales Island.

28. **Sauropatis sancta confusa** (Mathews)

No. 24309: female, August 4; Prince of Wales Island.
No. 24308: male, September 7; Thursday Island.

The female (apparently immature) has feather renewal in progress on the occiput, cervix, and entire under parts.

29. **Sauropatis chloris alberti** Rothschild & Hartert

No. 24311: female, December 4; Guadalcanar Island.

This individual has the pale occipital spot, said to characterize *alberti,*[11] but there is evidence of the very narrow superciliary line to be found in *"perplexa"* (= *Sauropatis chloris solomonis).*[12]

[11] Rothschild & Hartert, Nov. Zool., XV, 1908, p. 361.
[12] Rothschild & Hartert, Nov. Zool., XV, 1908, p. 361.

April 5, 1929

30. **Rhytoceros plicatus mendanæ** Hartert

Nos. 24431-35: male [not sexed], December 3; male, December 25; males [females], January 3 and 17; female [immature male], December 25; Guadalcanar Island.

Two black-headed individuals collected on January 3 and 17 are clearly females, although they are labeled "males." An immature bird, with an ochraceous-tawny head, is marked "female." This example is just acquiring adult plumage, and new feathers are appearing in the contour plumage of the other birds. "Iris yellowish brown. Base of bill dull crimson. Skin below bill light blue" (Kusche).

31. **Cosmærops ornatus ornatus** (Latham)

Nos. 24339-44: males, July 25 and 30, August 2 and 14; female, August 4; Prince of Wales Island.

A male taken on August 14 is undergoing extensive replacement of the body feathers. The remainder of the specimens appear to be in unworn garb. A few undeveloped feathers are in evidence on chin and throat.

32. **Lamprococcyx russatus** (Gould)

Nos. 24355-56: males, July 25 and 29; Prince of Wales Island.

According to the collector, the iris of the bird taken on July 25 was red, that of the one secured on July 29, dark brown. The assumption of new plumage is just begun on the head and throat.

33. **Polophilus phasianinus melanurus** (Gould)

No. 24322: male, July 27; Prince of Wales Island.

This is an individual in striped plumage. "Iris black. Upper mandible straw yellow, lower mandible white. Legs and feet blue-gray" (Kusche).

34. **Nesocentor milo milo** (Gould)

Nos. 24426-30: males, December 21, January 10 and 11; females, January 2 and 12; Guadalcanar Island.

Fresh flight feathers are being acquired by one of the males and one female. A male in its first contour plumage has a few pin feathers still present on the rump and abdomen.

35. **Kempia flavigaster terræreginæ** (Mathews)

No. 24452: male, August 10; Prince of Wales Island.

36. **Pachycephala astrolabi** Bonaparte

Nos. 24337-38, 24455: males and immature female, November 30; Guadalcanar Island.

The immature female has the upper surface, including the tail, bright yellowish olive, the head and interscapulars being strongly washed and pied with kaiser brown. There are faint indications of a yellow cervical collar. The inner webs of the lateral rectrices are narrowly margined with pale cinnamon buff. Externally the wing is kaiser brown, and the throat, forebreast, and auriculars are washed with the same shade. The under tail-coverts are lemon yellow, which, also, suffuses the lower breast and abdomen. The lower surface is obsoletely streaked by the dusky shaft stripes of the feathers.

37. **Leucocirca leucophrys** (Latham)

No. 24451: male, January 7; Guadalcanar Island.

38. **Mastersornis rubecula yorki** (Mathews)

No. 24391: male, August 10; Prince of Wales Island.

This individual is an immature bird in the garb of a female. The plumage is greatly worn, and no fresh feathers are in evidence.

39. Graucalus novæhollandiæ connectens (Mathews)

Nos. 24329-31: male, July 30; females, August 1 and 2; Prince of Wales Island. No. 24332: female, September 7; Thursday Island.

The black is wanting from the forehead of the male, and the throats of all the examples are freckled. The plumage in every case is greatly abraded, but new rectrices being developed by the female taken on September 7 are the only evidence of feather replacement. In view of Campbell's[13] record of an unusual specimen from the Torres Strait islands, the measurements of this series may be of interest. Culmen, 26.5, 26.0, 26.0, 28.0; wing, 190.0, 192.0, 192.0, 193.0, 189.0; tail, 130.0, 143.5, 135.0, 138.0; tarsus, 28.0, 30.0, 28.5, 28.0.

40. Graucalus hypoleucus stalkeri (Mathews)

Nos. 24333-36: males, July 27 and August 1; females, July 27 and 29; Prince of Wales Island.

The characters of *hypoleucus,* rather than those of *papuensis,*[14] appear to be exhibited by this series. In every case the throat is white, and the secondaries exhibit distinct white margins. A plumage renewal, which has already affected the secondaries, lateral rectrices, and throats of three of the specimens, is in progress.

41. Karua leucomela yorki (Mathews)

Nos. 24357-59, 24392: female [male], July 29; females, August 2, 3, and 14; Prince of Wales Island.

A specimen taken on July 29 wears the dress of the male although it is marked "female" by the collector. The under tail-coverts appear to be rather pale in this series, but the vermiculations on the under surface of the females are quite pronounced. The inner secondaries have been recently acquired in all the examples, and a few pin feathers are present on the throat of the female taken on August 2.

[13] Emu, XX, 1920-21, p. 61.

[14] *Cf.* Hartert, Nov. Zool., XII, 1905, p. 224; Ogilvie-Grant, Ibis, 1915, Jubilee Suppl., No. 2, p. 128; Campbell, Emu, XX, 1920-21, p. 61; and Mathews, B. Austr., IX, 1921-22, p. 126.

42. **Edoliisoma erythropygium erythropygium** Sharpe

No. 24456: male [female], December 31; Guadalcanar Island.

This specimen, in newly acquired contour plumage, although marked "male," seems to possess the characters ascribed to the adult female of this species.

43. **Sphecotheres flaviventris flaviventris** Gould

Nos. 24345-51, 24353: males, August 15, 16, 17, and 18; female [immature male], August 16; Prince of Wales Island. No. 24352: male, September 9; Thursday Island.

The immature (marked "female") is just passing into the plumage of the adult male. A moult involving all the feather tracts is well advanced in two instances; in others, the renewal of the plumage has only barely begun.

44. **Artamus leucorhynchus leucopygialis** Gould

No. 24354: male, July 25; Prince of Wales Island.

45. **Caleya megarhyncha griseata** (Mathews)

Nos. 24453-54: male, September 7; female, September 9; Thursday Island.

46. **Microchelidon hirundinacea yorki** (Mathews)

Nos. 24381-82: males, August 12 and 17; Prince of Wales Island.

Both individuals are possessed of the short tail supposed to characterize this race. This feature measures 26.5 and 26.2 mm. in the specimens in hand. Mathews[15] gives 28.0 mm. as the tail length of the type of this subspecies and 32.0 mm. for *hirundinacea*.

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[15] Nov. Zool., XVIII, 1911, p. 387.

47. **Cyrtostomus frenatus australis** (Gould)

Nos. 24374-79: males, July 25, 26, and 29; female, July 25; Prince of Wales Island.

The adult males of this series have the breast and abdomen light cadmium (Ridgway) rather than lemon yellow as has *macgillivrayi*. The bills measure 20 and 21 mm. An immature male, collected on July 26, has metallic feathers appearing on the throat. The renewal of the body plumage of the remainder of the specimens is well advanced.

48. **Cyrtostomus frenatus flavigastra** (Gould)

No. 24380: male, January 7; Guadalcanar Island.

This example is an immature individual. A renewal of the flight feathers, as well as of the contour plumage, is in progress.

49. **Myzomela erythrocephala kempi** Mathews

Nos. 24320-21: males, September 11; Thursday Island.

50. **Melomyza obscura munna** (Mathews)

Nos. 24317-19: females, July 26 and 27, and August 9; Prince of Wales Island.

The measurements of this series (in millimeters) are: Culmen, 19.0, 18.5, 18.5; wing, 68.0, 70.5, 68.0; tail, 52.0, 55.0, 54.0; tarsus, 18.5, 18.1, 18.0. For a female from Cape York, Mathews[16] gives the following measurements: Culmen, 15.0; wing, 60.0; tail, 45.0; tarsus, 18.0. The type of *apsleyi*, a male, from Melville Island measures: Culmen, 18.0; wing, 72.0; tail, 55; tarsus, 19.0. It would seem, therefore, that the birds from Prince of Wales Island approach more nearly in size those from Melville Island than they do those from the adjacent mainland.

The feather replacement of the specimen taken on August 9 is nearly complete, and it is well under way in the other individuals.

[16] B. Austr., XI, 1923-24, p. 331.

51. **Dorothina lewinii ivi** (Mathews)

Nos. 24439-41: males, August 10 and 18; female, August 12; Prince of Wales Island.

52. **Neophilemon orientalis yorki** (Mathews)

Nos. 24323-28: males, July 24, 26, and 27; females, July 20 and August 1; Prince of Wales Island.

The collector has indicated that in two females the irides were "blood-red," and in one male that they were "gray."

53. **Mimeta sagittata subaffinis** (Mathews)

Nos. 24393-95: male, July 26; females, August 10 and 13; Prince of Wales Island.

The extent of the white on the rectrices of these examples varies considerably. The measurements yielded are: Culmen, 30.0, 30.0, 31.5; wing, 145.0, 142.0, 144.0; tail, 107.0, 104.0. 103.0; tarsus, 25.0, 22.5, 24.5.

54. **Neomimeta flavocincta kingi** (Mathews)

Nos. 24396-97: male and female, September 10; Thursday Island.

The contour plumage of both specimens is fresh, but the replacement of flight feathers has only commenced.

55. **Acridotheres tristis tristis** (Linnæus)

No. 24402: male, December 7; Guadalcanar Island.

56. **Lamprocorax cantoroides cantoroides** (Gray)

No. 24443: male, November 30; Guadalcanar Island. "Iris orange" (Kusche).

57. **Metallopsar metallicus nitidus** (Gray)

No. 24444: immature male, November 30; Guadalcanar Island.

A single individual, in its first contour feathers, appears to belong under this head. The pileum is dark brown slightly glossed with purple. The dark brown feathers of the cervix are margined with a paler shade, producing an ill-defined, striped collar. The throat is narrowly, and the remainder of the under surface broadly, streaked with blackish brown on a white or buffy white ground. The flanks are dark brown.

PROCEEDINGS

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XI

THE GENERIC RELATIONSHIPS AND NOMENCLATURE OF THE CALIFORNIA SARDINE

BY

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Confusion has long obtained and still prevails regarding the generic relationships and nomenclature of the California sardine. The earlier history involved is of no distinct pertinence to the present discussion, and will not now be recounted. We shall pick up the story with Regan's 1916 contribution.[1] In that paper, Regan referred the California sardine, as well as the related or identical species of Chile, Japan, Australia and South Africa, to the European genus *Sardina*.

Shortly thereafter, Jordan,[2] apparently on the advice of Seale, synonymized *Sardina* Antipa, 1906, with *Sardinia* Poey, 1858. He did so because Seale had located, in the collections of the Museum of Comparative Zoology, a specimen thought to be the type of Poey's species, *Sardinia pseudo-hispanica,* and showing the generic characters assigned by Regan to *Sardina*.

More recently, Thompson[3] pointed out a number of trenchant characters, more or less overlooked before, which

[1] Ann. and Mag. Nat. Hist., Ser. 8, 18, 1916, 11.

[2] Copeia, 56, 1918, 46 (*see also,* The Genera of Fishes, Stanford Univ. Publ., Univ. Ser., pt. 3, 1919, 299, and pt. 4, 1920, 512).

[3] Fish and Game Comm. Calif., Fish Bull., No. 11, 1926, 8-17.

April 5, 1929

serve to distinguish the sardines of California and Chile from those of Europe. The differences which he noted are as follows: (1) in the American species there is usually a row of dark blotches behind the head, typically not apparent in the European; (2) the scales, as Regan had already observed, are arranged in a very different and in a regular order, each alternate row not being nearly overlapped by the one in front (the apparent number of rows, therefore, is equal to, instead of being about half as numerous as, the true number); (3) the ventral scutes are weaker and less keeled, and have less expanded bases; (4) the gillrakers on the lower limb, unlike those of the European sardine, become gradually and markedly shortened toward the angle of the arch, and they differ markedly in number at comparable sizes; (5) the interopercle is more expanded and widely exposed behind the preopercle; and (6) the opercular ridges (and preopercular edge) are strongly oblique instead of being nearly vertical. All of these points I have completely verified. Other differences, pointed out by Thompson, involving the proportionate sizes of the parts or the position of the fins, appear less trenchant and need not be now considered.

One point not specified by Thompson, nor by Regan, is that the gillrakers of the upper limb fold down over those of the lower limb near the angle, whereas they do not do so in the European species. This very character Regan[4] elsewhere used in the primary separation of the genera of one division of the family.

Another difference in gillraker structure, equally trenchant, has just been discovered by Dr. Henry B. Bigelow, who has kindly allowed me permission to announce the interesting discovery. In the European sardines *(pilchardus* and *sardina)* we find that the minute processes on the gillrakers are simple, slightly-bent, sharply pointed spines, about one-third as long as the width of the gillrakers and spaced about three in a distance equal to this width. In the Californian species, and I find this equally true of the Chilean, Japanese and Australian forms, these processes are complex, for they are composed of a flask-shaped base or stalk and a distinct, fimbriate, grooved, leaf-like terminal element. The processes are nearly half,

[4]Ann. and Mag. Nat. Hist., Ser. 8, 19, 1917, 297-298.

sometimes more than half, as long as the gillrakers are wide, and are more crowded, as about five occur in a space equal to this width. The appearance of the gillrakers of Californian and European sardines, under a microscope, is strikingly unlike. The complex structure and greater length and crowding of these gillraker processes, as well as the longer and more numerous gillrakers, and their overfolding in the Californian and related sardines, provide a straining apparatus much finer than that possessed by the European species. This may perhaps be correlated with their living in seas in which diatoms are relatively more abundant, and crustaceans scarcer, than in European waters.

Even without recourse to the "splitting" tendencies of the day, it appears necessary to divorce generically the Californian and European sardines. Their differences, particularly in scale arrangement and in gillraker structure, are too fundamental and too trenchant to permit of their continued allocation in a single genus. The question of their immediate common origin is even thrown open to some doubt.

The generic separation of the Californian and European sardines reopens of course the problem of the proper generic name for each. It is necessary first to consider Poey's *Sardinia pseudo-hispanica.* The specimen so labelled in the Museum of Comparative Zoology, and stated to be Poey's type in Jordan's note, I have fortunately been able to reexamine. It certainly is not the type, for it is decidedly smaller than the one specimen described by Poey. Furthermore, it is not even conspecific, for it has 51 vertebræ, including the hypural, whereas Poey gives 46 as the number for *pseudo-hispanica.* In other respects, for instance, the lower number of dorsal rays, this alleged type fails to meet Poey's description. The specimen is probably a mislabelled example of the California sardine; at least it belongs to the same genus, for it agrees with it in every one of the characters listed above as distinguishing the Californian from the European species. A main reason for thinking that the specimen in question did not even come from Cuba is that there appears to be no other indication whatever of the occurrence of a sardine of either the Californian or the European type anywhere in the western Atlantic.

It is clear from Poey's description that his *Sardinia pseudo-hispanica* is not closely related to either the Californian or European sardine. There is very good reason to believe that he had the common West Indian species, *Sardinella anchovia* Cuvier & Valenciennes, 1847, which in turn is thought by Regan[5] to be identical with the European *Sardinella aurita* Cuvier & Valenciennes, the type-species of *Sardinella*. We find, for instance, that the number of vertebræ in *anchovia* is 46, just as in Poey's type of *pseudo-hispanica*. Jordan and Evermann's[6] *Clupanodon pseudohispanicus* is apparently the same species as their *Sardinella anchovia*.

It is therefore impossible to refer either the Californian or the European sardine to the genus *Sardinia* Poey, 1858. That name should, I think, be synonymized with *Sardinella* Cuvier & Valenciennes, 1847.

The generic name *Sardina* Antipa, 1906, therefore becomes available for the European species, which with Regan we may call *Sardina pilchardus* (Walbaum). No generic name, however, appears to be available for the California sardine. I now supply this obvious need:

Sardinops Hubbs, new genus

Type-species, *Maletta cærulea* Girard, 1854.

Diagnosis. Clupeidæ with the upper jaw not notably notched on the mid-line; the gillrakers of the upper limb folded over those of the lower limb, which become markedly and progressively shortened toward the angle; carina of glossohyal not denticulate;[7] no bilobed dermal flap on shoulder-girdle; opercle with strong and markedly oblique ridges; preopercular edge strongly sloping; interopercle widely exposed behind preopercle; scale-rows regularly spaced, the lateral scales all with subequal exposed areas; radii on the scales nearly vertical, and paired on each side of median line; keels on ventral scutes weak; last two rays of dorsal and anal fins somewhat enlarged; a row of dark spots typically developed on upper sides behind head.

[5]Ann. and Mag. Nat. Hist., Ser. 8, 19, 1917, 378.
[6] Bull. U. S. Nat. Mus., 47, pt. 1, 1896, 423 and 429.
[7] See Chabanaud, Bull. Soc. Zool. Fr., 51, 1926, 156-163.

Examples of the pilchards or sardines of Chile, Japan and Australia all agree fully with this generic diagnosis, and are clearly congeneric with *Sardinops cærulea* (Girard), as probably is also the South African species *ocellata,* which is known to share most of the characters listed above in common with *cærulea.* It is, in fact, not clear whether the species of these various regions are different from one another. Pending a much needed critical comparison of good material from all these localities, I merely list the species as usually recognized:

1. *Sardinops cærulea* (Girard), 1854. Californian.
2. *Sardinops sagax* (Jenyns), 1842. Chilean.
3. *Sardinops melanosticta* (Temminck & Schlegel), 1846. Japanese.
4. *Sardinops neopilchardus* (Steindachner), 1879. Australian.
5. *Sardinops ocellata* (Pappé), 1853. South African.

The distinctness of *Sardinops cærulea* is particularly doubtful, especially since Thompson *(l. c.)* was unable to differentiate it specifically from *S. sagax.*

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XII

THE FAUNAL AREAS OF SOUTHERN ARIZONA: A STUDY IN ANIMAL DISTRIBUTION

BY

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INTRODUCTION

During the summer of 1927 the Department of Ornithology and Mammalogy of the California Academy of Sciences conducted three field trips to southeastern Arizona. The region visited comprised the lowlands surrounding the Santa Rita Mountains, from 30 to 60 miles southeast of Tucson and a short distance north of the United States-Mexico boundary line. Personnel and itineraries of the three parties were as follows: H. S. Swarth and Joseph Mailliard, with Raymond Gilmore as assistant, left San Francisco by automobile on May 6, arriving at Patagonia, Santa Cruz County, Arizona, on May 10. There we were joined by David M. Gorsuch, who remained with us throughout our stay, as a volunteer aid. With Patagonia as a center, collecting was carried on along the eastern base of the Santa Rita Mountains and some distance to the eastward, from May 10 to June 2. Camp was then shifted to the western base of the Santa Ritas, near the Florida Ranger Station, at the mouth of Stone Cabin Cañon, where we remained from June 2 to 21. Return to San Francisco was accomplished on June 25.

Joseph Mailliard, with Floyd C. Rankin as assistant, left San Francisco by automobile on August 23 and arrived at Patagonia on August 27. They left Patagonia on October 13, reaching home on October 17. Miss Mary E. McLellan, travelling by train from San Francisco to Tucson, collected in Madera Cañon, on the west side of the Santa Rita Mountains, September 3 to October 13. Mr. Sam Davidson was a volunteer aid in collecting mammals during part of that time. Specimens collected upon all three trips include 1127 birds and 423 mammals.

For necessary permits to carry on the collecting of the above mentioned material we were indebted to the courtesy of the Arizona Fish and Game Department, through Mr. D. E. Pettis, State Game Warden. We are also under great obligations to Mr. Marshall Ashburn for permission to camp upon and to hunt over the extensive Ashburn Ranch (formerly the Pennsylvania Ranch) in the Sonoita Valley.

In pursuing the study of this collection I have found it necessary to call upon various institutions and individuals for the loan of specimens and for information, all of which was most generously granted. I am under obligations for such help to Dr. Alexander Wetmore, Assistant Secretary of the Smithsonian Institution, who authorized the loan to me of numerous specimens from the collection of the United States National Museum, including the type of *Agelaius phœniceus sonoriensis*; to Dr. Charles W. Richmond for advice upon various subjects and for specific information regarding the above mentioned type specimen; and to Mr. Gerrit S. Miller, Jr., for identification of the specimens of *Myotis* we collected. To Mr. Paul G. Redington, Chief of the Bureau of Biological Survey, I am indebted for the loan of specimens and for permission to use unpublished data from the files of the Survey bearing upon the distribution of certain species of *Citellus* and *Ammospermophilus* in Arizona; and to Major E. A. Goldman, of the same Bureau, I am indebted for the identification of specimens of *Perognathus*, *Dipodomys*, and *Sigmodon*, and for information regarding other species. From the Museum of Vertebrate Zoology of the University of California, through Dr. J. Grinnell, Director, I received the loan of specimens whenever they were desired, and facilities for working at the

Museum whenever I chose to do so. From the Museum of Comparative Zoology, through Mr. Outram Bangs, I was permitted to borrow a series of skins of *Sayornis nigricans*. From the Field Museum of Natural History, and from the Museum of Leland Stanford, Jr., University, I also received the loan of specimens. From Dr. L. B. Bishop I received the loan of specimens, including an important series of *Agelaius*, and data upon many Arizona-taken bird skins in his collection. The half-tones illustrating this report are all from photographs taken by Mr. Joseph Mailliard. Mrs. Mary McLellan Davidson, Assistant Curator of the Department of Ornithology in this institution, drew the distribution maps and rendered important help also in other ways.

In the following accounts of the species of birds and mammals collected I have for the most part limited my remarks to statements bearing upon distribution. Facts pertaining to nesting or other activities have been omitted in most cases where the species concerned is more or less well known. They have been included in a few cases where it seemed worth while, and, also, data pertaining to migration and molt in birds have been briefly presented, in the belief that these facts were worth placing upon record.

The Region Visited and the Problem Involved

Our field work in southeastern Arizona was primarily for the purpose of studying the local distribution of animal life in the section visited, which comprised the lowlands surrounding the Santa Rita Mountains. Years ago the writer had collected birds extensively and mammals in lesser numbers in that general region, and he had been struck by certain outstanding features in the delimitation of species there. The opportunity now presented itself of acquiring further data on the subject, and field work was pushed accordingly with the object of gathering specimens and information that would bear upon the distribution of lowland forms. The several mountain ranges of southern Arizona rise much like islands from a surrounding sea of plains. Their bird and mammal faunas are peculiar and are sharply differentiated from those of the surrounding lowlands, but

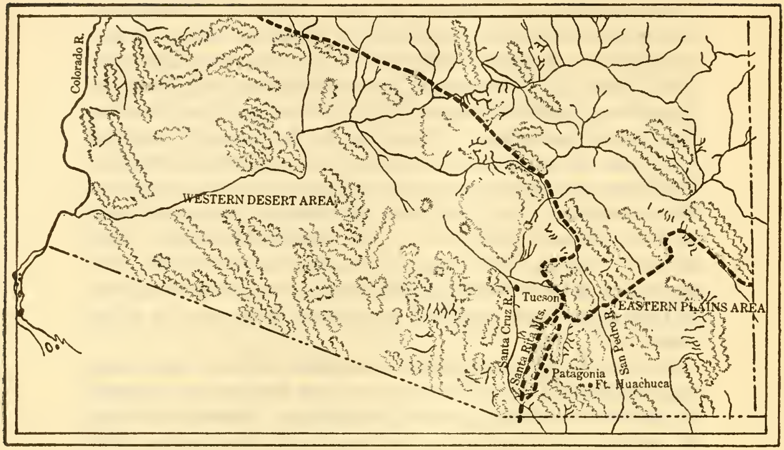

Fig. A. Map of southern Arizona, showing region studied and localities visited by the California Academy of Sciences expeditions of 1927. Broken lines indicate approximate boundaries of Western Desert Area and Eastern Plains Area.

they are quite well known and in any event have no bearing upon the peculiar differentiation of faunas that distinguishes different lowland areas. So, while the Santa Rita Mountains, as a conspicuous boundary line between two lowland differentiation areas, formed a center for our field work, and were even, perforce (through lack of camping facilities elsewhere), the site of our base camps for work on their west side, little attention was paid to the typically high zone species of birds and mammals, and only one or two brief trips were made to high altitudes.

In southern Arizona, from the Colorado River on the west, east to the Santa Rita Mountains, the general appearance of the lowlands is everywhere about the same. Except for limited areas along the river bottoms it is desert of the most arid type, covered with a fairly dense growth of desert plants, a chaparral composed of many different shrubs, bushes and cactuses. This chaparral, as in desert regions elsewhere, is in the shape of isolated clumps of vegetation of

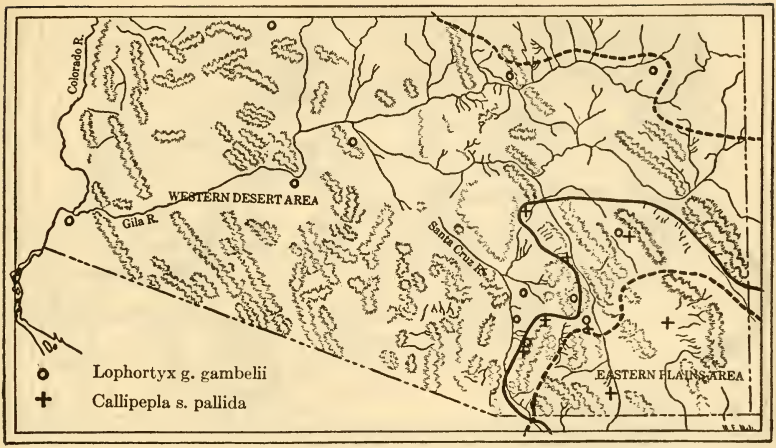

Fig. B. Map showing distribution in southern Arizona of *Lophortyx gambelii gambelii* and *Callipepla squamata pallida*. Symbols indicate published record stations; broken line indicates approximate northern and southeastern boundaries of *L. g. gambelii;* solid line indicates approximate northern and western boundary of *C. s. pallida*.

greater or less extent, separated by areas of bare ground. Cactus of several species are important plants, there being thickets of low-growing cholla almost everywhere, and in places scattered individuals or extensive "forests" of the tall and conspicuous giant cactus. The cactus plants are an important factor in the economics of birds and mammals, so much so that the very existence of several bird species in a region is dependent upon the presence of the giant cactus. The few river beds are marked by rows of tall cottonwoods, with a lesser growth of willows and arrow-weed, the latter sometimes forming dense jungles of considerable extent. Mesquite, catclaw, ocotilla and the creosote bush are all present in abundance, and each occurs in almost pure stands over large areas, and there are many other species of trees and bushes that enter into the composition of the plant covering of this area. It is desert, but well covered with shrubby or tree-like vegetation. There is relatively little grass anywhere.

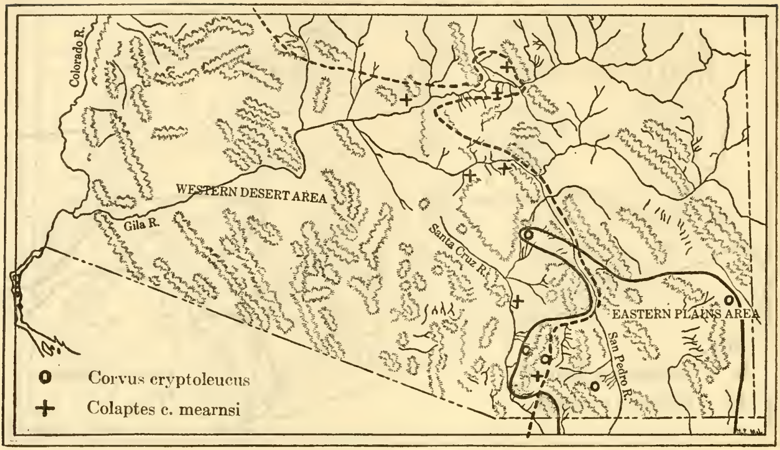

Fig. C. Map showing distribution in southern Arizona of *Colaptes chrysoides mearnsi* and *Corvus cryptoleucus*. Symbols indicate published record stations; broken line indicates approximate northern and eastern boundaries of *Colaptes c. mearnsi;* solid line indicates approximate northern and western limits of *Corvus cryptoleucus.*

East of the Santa Rita Mountains is an entirely different sort of region, and the transition from one to the other is abrupt. Desert chaparral is there replaced by grassy plains. In some rocky foothill sections there may be found small tracts of "brush" or a few scattered cholla cactuses, and in places there are extensive stands of creosote, but for the most part there are illimitable stretches of rolling hills or gently sloping plains covered with grass and with almost nothing else. In some low-lying swales the shorter prairie ("grama") grass is replaced by growths of "sacaton," a coarse bunch grass eight or ten feet high. In parts of the foothill country tree yuccas form the most conspicuous plant growth, and there are places on the grassy plains where small mesquites cover many miles, spaced so regularly and so uniformly of a size as to give the impression of a young peach orchard.

In the western desert area the elevation of the lowlands rises from a little less than 100 feet above sea level on the lower Colorado River to nearly 4,000 feet at the western base of the Santa Rita Mountains. On the eastern grassy plains the average elevation is probably between 4,200 and 5,000 feet. From the south-central portion of Arizona southward and westward and along the western border the summers are long and intensely hot, while the winters are mild. In the southeast the heat of summer is not so intense and the winters are somewhat colder. The annual mean temperature at Tucson is 68° Fahrenheit, at Fort Huachuca, 61°.

Table of Temperatures in the Western Desert Region (at Tucson) and in the Eastern Plains Region (at Fort Huachuca)

	WINTER			SPRING			SUMMER			FALL		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Tucson.........	10	90	52	22	106	66	40	112	85	21	107	70
Fort Huachuca..	0	79	45	16	97	60	37	104	77	15	99	63

There is considerable difference in the rainfall and humidity of the two regions. The valley of the Colorado in southwestern Arizona, with an annual rainfall of less than three inches, represents the extreme conditions as to aridity in the United States. Such conditions prevail along the southern boundary of Arizona eastward over most of Pima County, but in the eastern portion of that county, as the higher mountains are approached, the precipitation increases, the average annual rainfall at Tucson being 9.8 inches. Farther east it becomes still higher, being 16.2 inches at Fort Huachuca.*

It is thus seen that the two sections of southern Arizona that are contrasted in the present study (the boundary line between indicated by the Santa Rita Mountains) present certain slight differences of altitude, of temperature, and of rainfall, that are correlated with different types of vegeta-

*The meteorologic data cited is taken from *Climatology of the United States*, by A. J. Henry (U. S. Dept. Agric., Weather Bureau, Bull. 2, 1906), in which publication see also plate XXVI, showing normal annual precipitation in the United States.

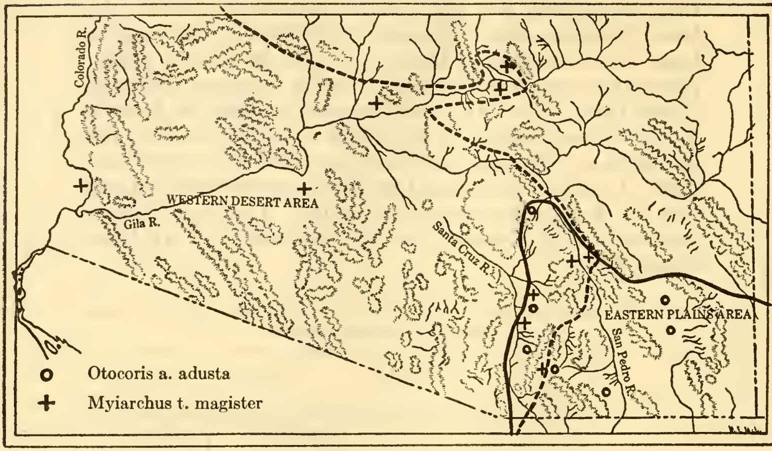

Fig. D. Map showing distribution in southern Arizona of *Myiarchus tyrannulus magister* and *Otocoris alpestris adusta*. Symbols indicate published record stations; broken line indicates approximate northern and eastern boundaries of *Myiarchus t. magister;* solid line indicates approximate boundaries of *Otocoris a. adusta.*

tion and with well marked differences in the faunas of the two regions. To define the two as occupying different life zones, the western Lower Sonoran, the eastern Upper Sonoran, does not seem satisfactory. The western section is, of course, emphatically Lower Sonoran in every respect. The eastern section is slightly higher altitudinally, of slightly greater rainfall, and of slightly lower temperature, and may be conceded to present some Upper Sonoran aspects. At the same time, wherever the eastern grassy plains are invaded by limited growths of shrubs, bushes, or trees, these are in most cases Lower Sonoran desert species, such as mesquite, cholla cactus, ocotilla, etc. In the mountains of this section the foothill regions immediately above the plains possess characteristic Upper Sonoran assemblages of plants and animals which do not descend any lower. In some parts of the plains there are limited numbers of characteristic Lower Sonoran desert birds (Scaled Quail, White-

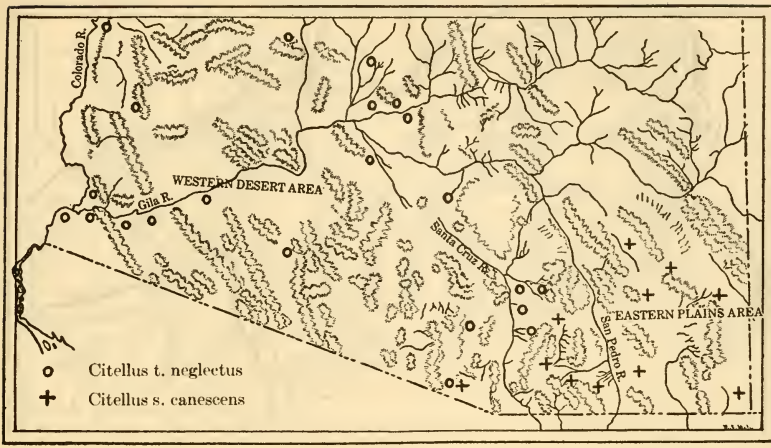

Fig. E. Map showing distribution in southern Arizona of *Citellus tereticaudus neglectus* and *C. spilosoma canescens*. Symbols indicate record stations, mostly from hitherto unpublished data supplied by the United States Bureau of Biological Survey.

winged Dove, Phainopepla, Vermilion Flycatcher, and others) and mammals (species of *Peromyscus*, *Onychomys*, *Lepus*, and others) associated with such species as the Prong-horn, Prairie Dog, Horned Lark, and others, that occur elsewhere in Upper Sonoran and higher.

The two sections, on the whole, do not seem to me to show differences of life zones in their contrasting characteristics, but to be comparable rather to the "faunal areas" described by Grinnell (1915, pp. 9-12) in his treatment of the distribution of birds in California. The extreme southeastern corner of Arizona appears to be definable as a faunal area distinct from the regions to the westward and to the northward. The western boundary of this faunal area is the subject of the present study. Of the boundary line elsewhere I can speak with less assurance, but on the northwest the Santa Catalina Mountains may perhaps mark the dividing line. Of the extent of this faunal area eastward into or through southern New Mexico, and southward into Mexico

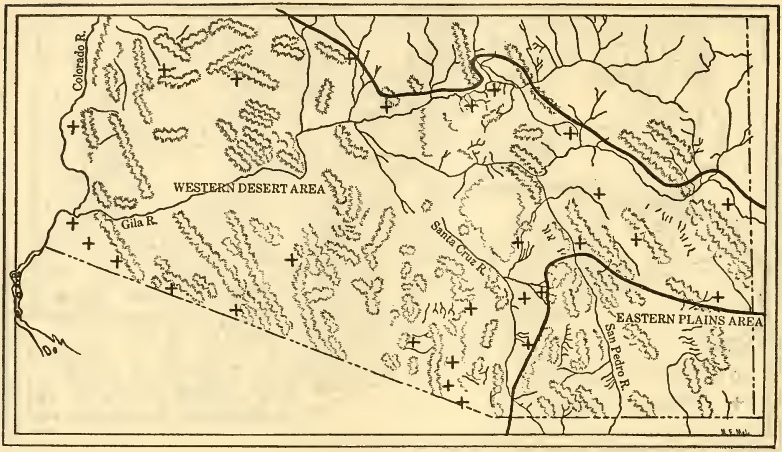

Fig. F. Map showing distribution in southern Arizona of *Ammospermophilus harrisii*. Symbols indicate record stations, mostly from hitherto unpublished data supplied by the United States Bureau of Biological Survey.

I know nothing, but my impression is that the faunal area I am describing in the southeastern corner of Arizona, forms the northwestern portion of a much more extensive area over the regions mentioned.

Aside from Mearns' (1907) divisions along the United States-Mexico boundary line, there has been no previous attempt to indicate in Arizona any faunal divisions other than life zones, but it seems feasible now to outline, though in loose terms and with rather indefinite boundaries, at least five faunal areas into which the state can be divided. The Western Desert Area and the Eastern Plains Area, with which this paper is mainly concerned, are capable of fairly exact definition, and the boundary between these two can be closely indicated. To the northward of these areas is the Central Plateau Area, with the Mogollon Plateau as a center and extending diagonally nearly across the state, from the Grand Cañon at the northwest, to the White Mountains at the southeast. In extreme northeastern Arizona, centering about the Painted Desert and the Little

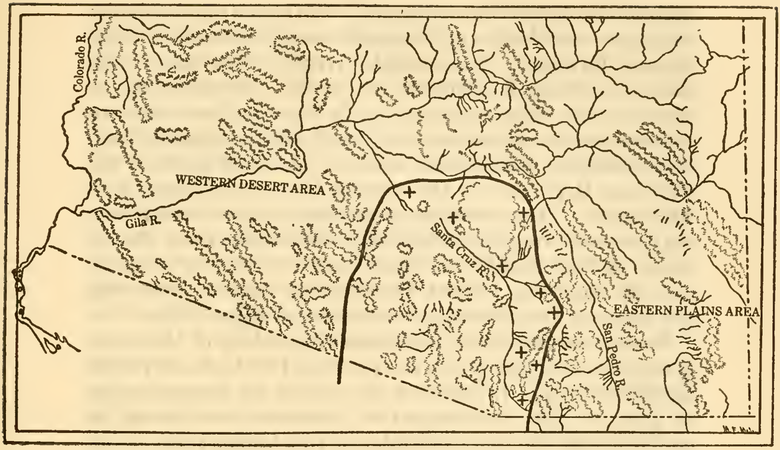

Fig. G. Map showing approximate boundaries of habitat of *Lepus alleni alleni* in Arizona. Symbols indicate known stations of occurrence.

Colorado River, is what may be designated as the Northeastern Desert Area. In the northwest, north of the Colorado River, is a region concerning which I have no first hand knowledge, but which presumably is faunally related to the Great Basin.

The boundary line I have indicated between the Western Desert Area and the Eastern Plains Area does not accord with that described by Mearns (1907, pp. 73-74, pl. II) in his study of the mammals of the Mexican boundary. I can not appreciate any reason for the dividing line he draws across the desert midway between Tucson and Yuma, with the "Western Desert Tract" to the westward, the "Elevated Central Tract" to the eastward. Neither is there any general division of forms in mammals, birds or plants along that line, nor is there any marked change in altitude or climate. The same species and subspecies of mammals and birds, with few exceptions, and the same sorts of vegetation range from the Colorado River eastward to the west base of the Santa Ritas. Grinnell (1914) has shown how potent a barrier the Colorado River is as regards the mammals of the deserts on either side. In the bottom lands the same species of birds and mammals occupy both sides of the stream, forming a characteristic river-bottom fauna; this fauna as a whole is distinctly that of the Arizona valleys to the eastward. My conception of the deserts of southwestern Arizona are as comprising one faunal area, extending from, and including, the bottom lands of the *west* bank of the Colorado River east to the western base of the Santa Rita Mountains. The northern boundary of this desert area may be very roughly indicated as extending from the vicinity of Fort Mohave on the Colorado River, in a southeasterly direction toward Phoenix and Tucson, following the bases of the mountains northeast of those cities.

Faunal conditions at the western boundary of this area, along the Colorado River, are presented by Grinnell (1914) in fullest detail. It has been my aim in the present paper to give as exact a statement as circumstances permit of conditions at the eastern border of this faunal area. Considerably more collecting of small mammals is necessary, however, for the filling out of details.

There are certain conspicuous diurnal mammals whose restriction to one or the other of the two areas here considered is apparent to even rather casual observation. Foremost of these is *Lepus alleni*, as detailed beyond. The restriction of this species east and west within the wider habitat of *Lepus californicus* is one of the most peculiar delimitations among North American animals. In former years the Prairie Dog (*Cynomys ludovicianus arizonensis*) was abundant in southeastern Arizona. Whether or not it has survived persecution by governmental rodent control activities I do not know, but until at least 1907 there were large numbers on the plains between the Huachuca Mountains and Bisbee, and a small and singularly isolated colony some 30 miles farther north, between Fort Huachuca and Fairbank. It is a curious fact that the species did not extend farther north and west over apparently suitable ground. Whether or not it ever reached as far west as the Santa Rita Mountains I do not know; it probably never went beyond.

The Prong-horn (*Antilocapra americana*) was fairly numerous in southeastern Arizona in years past. Upon my first visit to the region, in 1896, there were still herds of

15 or 20 to be found in the San Pedro Valley, and single animals or two or three together were seen by me near the Huachucas and near the east base of the Santa Ritas as late as 1902 and 1903. In 1907 I was told by cattlemen that none remained in that section. The species occurred also in places west of the Santa Ritas, and may still do so here and there, but I do not believe ever in such numbers as on the plains to the eastward.

The small ground squirrels, *Ammospermophilus* and *Citellus*, afford good examples of delimitation of range, and replacement of one species by another in the two regions. Of the smaller nocturnal mammals too little is known to compile any long or exact list of species confined to one section or the other. The pocket gopher (*Thomomys*), prone as this genus is to become differentiated into local forms, apparently is not to be divided in the two regions here considered. Over most of the country no gophers occur, being entirely absent from the hard, dry uplands, distribution taking place along riparian surroundings of the river beds. So division of races of *Thomomys* in this section is apparently entirely altitudinal.

Among birds there are many striking replacements of species or subspecies in the two regions. Some of the most conspicuous are the Gambel Quail and Scaled Quail, and Western Meadowlark and Texas Meadowlark. Some less noticeable replacements are found in subspecies of the Red-winged Blackbird, Cliff Swallow, and Curve-billed Thrasher. It will be noted that although the Western Raven is common in the Lower Sonoran zone of southeastern California and southwestern Arizona, it is rare and mostly an Upper Sonoran species in southeastern Arizona, being replaced on the Lower Sonoran plains of that region by the White-necked Raven.

There is a longer list of bird species from southwestern Arizona than from the southeast, the varied vegetation of the southwest affording congenial surroundings to many that do not occur on the grassy plains. On the other hand, there are certain conspicuous bird species of the southeastern plains that are pretty closely confined to that region, such as the Swainson Hawk, Scorched Horned Lark, and White-necked Raven. There are in the southeast some

Upper Sonoran species characteristic of the region that occasionally descend as far as the upper edge of the plains, and that form one of the several factors tending to give an Upper Sonoran aspect to the lowlands. Some of these are the Western Nighthawk, Western Yellow-wing Sparrow, and the Azure Bluebird. The last mentioned species was not encountered by us, but information recently received by me from Dr. L. B. Bishop, and from Mr. Edward C. Jacot, of Prescott, Arizona, justifies its inclusion in my statement.

The accompanying lists of mammals and birds may serve to convey an idea of the two contrasting faunas. It must be borne in mind, though, that these are not hard and fast divisions and that in many cases species mainly confined to one of the two regions may extend more or less into the other territory. This is especially true of certain birds of the river bottoms, which, occurring in greatest abundance in southwestern Arizona, penetrate in lesser numbers along the more sparsely brush-margined streams of the southeast. This applies to such species as Song Sparrow, Pyrrhuloxia, Least Vireo, and Yellow Warbler. The same is true of certain species of the chaparral of the mesa.

A striking feature of our findings along the dividing line between the two opposed faunal areas is the manner in which many species from either side extend short distances beyond the normal boundary. As a basis for our work the Santa Rita Mountains were a convenient line of demarcation, and forming as they do a colossal wall across the plains, they might easily be supposed to be a barrier in fact as they are in appearance. Again and again, though, we found western species ranging clear around the mountains in a ribbon-like habitat below the eastern foothills, and, conversely, eastern species extending around to the western base of the range. The Allen Jack Rabbit, in small numbers, occurs eastward as far as Sonoita and Patagonia, but at that point finds some insuperable obstacle to its farther extension over the open plains beyond, an obstacle that has no existence for the more widely spread Black-tailed Jack Rabbit. The Scaled Quail ranges westward around the mountainous wall, to be stopped below the western foothills by some impalpable barrier that absolutely forbids farther progress. So, at any point around the base of the mountains one may find in greater or less abundance an infiltration of species that properly belong on the opposite side, with assurance that within a short distance east or west, as the case may be, those species will be found to disappear.

The elucidation of this feature in the distribution of species along this boundary line entails in the case of many of the small nocturnal mammals more extensive trapping than we were able to accomplish. With such an animal as *Dipodomys spectabilis* the conspicuous mounds and burrows are sufficient to advertise its presence, but with many others it is not usually safe to generalize as to their status in either of the faunal areas upon the basis of a limited number of specimens from a few localities. With diurnal mammals and birds the facts are more readily apparent.

Another interesting aspect of distribution in this part of Arizona is found in the manner of occurrence of certain migratory birds. The McCown Longspur, Chestnut-collared Longspur, and Baird Sparrow are all common migrants on the eastern grass-lands, but they do not occur on the western deserts. The Lark Bunting, however, which might be expected to adhere as closely to the open prairie, is far more abundant in western Arizona.

There are certain bird species that have almost or entirely disappeared from Arizona in recent years, exact information regarding which would be of great value and interest in this connection. I refer to the Masked Bob-white (*Colinus ridgwayi*), the Rufous-winged Sparrow (*Aimophila carpalis*), and the Botteri Sparrow (*Peucæa botterii*). In all likelihood these three birds were mainly inhabitants of grasslands, and there seems little reason to doubt that their disappearance was due entirely to the overstocking of the ranges with cattle. When years of drought came every vestige of their natural cover was destroyed. This explanation has been advanced by Brown (1904) to account for the disappearance of the Bob-white, and it probably explains also the nearly complete extinction locally of the two species of sparrows. The Cassin Sparrow, with similar habitat predilections, is migratory, if, in fact, it breeds in this region at all. So it survives in Arizona and is to be found, we may assume, in the same sort of surroundings that were formerly shared with its vanished relatives.

The delimitation of the ranges of species, east or west, as described in this paper, must be understood to apply to a relatively narrow area bordering the Arizona-Mexico boundary line. Thus, certain of the birds here ascribed to a western habitat are known to occur farther east into New Mexico and Texas, but this eastern extension of range occurs either north or south of the region here under discussion.

Birds

Western Desert Area	Eastern Plains Area
	Colinus ridgwayi
Lophortyx g. gambelii	*Callipepla s. pallida*
Melopelia a. trudeaui	
Scardafella inca	
	Buteo swainsoni
Asturina plagiata	
Micropallas w. whitneyi	
Dryobates s. cactophilus	
Colaptes c. mearnsi	
Myiarchus t. magister	
	Otocoris a. adusta
Corvus c. sinuatus	*Corvus cryptoleucus*
Agelaius p. sonoriensis	*Agelaius p. nevadensis*
Sturnella neglecta	*Sturnella m. hoopesi*
	Ammodramus s. bimaculatus
	Peucæa botterii
	Aimophila carpalis
Melospiza m. saltonis	
Cardinalis c. superbus	
Pyrrhuloxia s. sinuata	
Guiraca c. interfusa	
Piranga r. cooperi	
Petrochelidon l. lunifrons	*Petrochelidon l. melanogastra*
Vireo b. arizonæ	
Vermivora luciæ	
Dendroica a. sonorana	
Toxostoma c. palmeri	*Toxostoma c. curvirostre*
Toxostoma bendirei	
Polioptila m. melanura	

Mammals

Western Desert Area	Eastern Plains Area
Myotis c. pallidus	*Myotis c. californicus*
Citellus t. neglectus	*Citellus s. canescens*
Ammospermophilus harrisi	
	Cynomys l. arizonensis
Thomomys f. toltecus	*Thomomys f. toltecus*
Perognathus amplus	
Perognathus b. baileyi	
Perognathus p. pricei	*Perognathus p. pricei*
Dipodomys s. spectabilis	
Dipodomys m. merriami	*Dipodomys m. olivaceus*
	Dipodomys o. ordii
Onychomys t. torridus	*Onychomys t. torridus*
Reithrodontomys m. megalotis	*Reithrodontomys m. megalotis*
Peromyscus e. eremicus	*Peromyscus e. eremicus*
Peromyscus m. sonoriensis	*Peromyscus m. sonoriensis*
	Peromyscus l. arizonæ
Sigmodon h. cienegæ	*Sigmodon h. cienegæ*
Neotoma a. albigula	*Neotoma a. albigula*
Lepus a. alleni	
Lepus c. eremicus	*Lepus c. eremicus*
Sylvilagus a. arizonæ	*Sylvilagus a. arizonæ*

April 26, 1929

Check-List of the Birds

1. *Chlidonias nigra surinamensis* (Gmelin)
2. *Nettion carolinense* (Gmelin)
3. *Querquedula cyanoptera* (Vieillot)
4. *Dafila acuta tzitzihoa* (Vieillot)
5. *Ardea herodias treganzai* Court
6. *Butorides virescens anthonyi* (Mearns)
7. *Rallus virginianus* Linnæus
8. *Porzana carolina* (Linnæus)
9. *Fulica americana* Gmelin
10. *Gallinago delicata* (Ord)
11. *Pisobia minutilla* (Vieillot)
12. *Tringa solitaria* Wilson
13. *Actitis macularia* (Linnæus)
14. *Oxyechus vociferus vociferus* (Linnæus)
15. *Callipepla squamata pallida* Brewster
16. *Lophortyx gambelii gambelii* Gambel
17. *Cyrtonyx montezumæ mearnsi* Nelson
18. *Columba fasciata fasciata* Say
19. *Zenaidura macroura marginella* (Woodhouse)
20. *Melopelia asiatica trudeaui* (Audubon)
21. *Chæmepelia passerina pallescens* Baird
22. *Scardafella inca* (Lesson)
23. *Cathartes aura septentrionalis* Wied
24. *Accipiter velox* (Wilson)
25. *Accipiter cooperii* (Bonaparte)
26. *Parabuteo unicinctus harrisi* (Audubon)
27. *Buteo borealis calurus* Cassin
28. *Buteo swainsoni* Bonaparte
29. *Asturina plagiata* Schlegel
30. *Aquila chrysaëtos* (Linnæus)
31. *Cerchneis sparveria phalæna* (Lesson)
32. *Polyborus cheriway* (Jacquin)
33. *Asio wilsonianus* (Lesson)
34. *Otus asio cineraceus* (Ridgway)
35. *Bubo virginianus pallescens* Stone
36. *Speotyto cunicularia hypogæa* (Bonaparte)
37. *Micropallas whitneyi whitneyi* (J. G. Cooper)
38. *Geococcyx californianus* (Lesson)
39. *Coccyzus americanus occidentalis* Ridgway
40. *Ceryle alcyon caurina* Grinnell
41. *Dryobates scalaris cactophilus* Oberholser
42. *Dryobates arizonæ arizonæ* (Hargitt)
43. *Sphyrapicus varius nuchalis* Baird
44. *Melanerpes formicivorus aculeatus* Mearns
45. *Centurus uropygialis uropygialis* Baird
46. *Colaptes cafer collaris* Vigors
47. *Colaptes chrysoides mearnsi* Ridgway
48. *Phalænoptilus nuttallii nuttallii* (Audubon)
49. *Chordeiles virginianus henryi* Cassin
50. *Chordeiles acutipennis texensis* Lawrence
51. *Aëronautes saxatalis* (Woodhouse)
52. *Eugenes fulgens* (Swainson)
53. *Archilochus alexandri* (Bourcier & Mulsant)
54. *Calypte costæ* (Bourcier)
55. *Cynanthus latirostris* Swainson
56. *Tyrannus verticalis* Say
57. *Tyrannus vociferans* Swainson
58. *Myiarchus tyrannulus magister* Ridgway
59. *Myiarchus cinerascens cinerascens* (Lawrence)
60. *Myiarchus tuberculifer olivascens* Ridgway
61. *Sayornis sayus sayus* (Bonaparte)
62. *Sayornis nigricans nigricans* (Swainson)
63. *Nuttallornis mesoleucus* (Lichtenstein)
64. *Myiochanes richardsonii richardsonii* (Swainson)
65. *Empidonax difficilis difficilis* Baird
66. *Empidonax traillii brewsteri* Oberholser
67. *Empidonax hammondii* (Xantus)
68. *Empidonax griseus* Brewster
69. *Pyrocephalus rubinus mexicanus* Sclater
70. *Camptostoma imberbe* Sclater
71. *Otocoris alpestris adusta* Dwight
72. *Otocoris alpestris occidentalis* McCall
73. *Cyanocitta stelleri diademata* (Bonaparte)
74. *Aphelocoma sieberi arizonæ* (Ridgway)
75. *Corvus corax sinuatus* Wagler
76. *Corvus cryptoleucus* Couch
77. *Molothrus ater obscurus* (Gmelin)
78. *Tangavius æneus æneus* (Wagler)
79. *Agelaius phœniceus nevadensis* Grinnell
80. *Sturnella magna hoopesi* Stone
81. *Sturnella neglecta* Audubon
82. *Icterus parisorum* Bonaparte
83. *Icterus cucullatus nelsoni* Ridgway
84. *Icterus bullockii* (Swainson)
85. *Euphagus cyanocephalus cyanocephalus* (Wagler)
86. *Passer domesticus* (Linnæus)
87. *Carpodacus cassinii* Baird
88. *Carpodacus mexicanus frontalis* (Say)
89. *Astragalinus psaltria hesperophilus* Oberholser
90. *Spinus pinus pinus* (Wilson)
91. *Calcarius ornatus* (J. K. Townsend)
92. *Pooecetes gramineus confinis* Baird
93. *Passerculus sandwichensis nevadensis* Grinnell
94. *Ammodramus bairdii* (Audubon)
95. *Ammodramus savannarum bimaculatus* Swainson
96. *Chondestes grammacus strigatus* Swainson
97. *Zonotrichia leucophrys* (Forster)
98. *Zonotrichia gambelii* (Nuttall)
99. *Spizella passerina arizonæ* Coues
100. *Spizella breweri* Cassin
101. *Junco phæonotus palliatus* Ridgway
102. *Amphispiza bilineata deserticola* Ridgway
103. *Peucæa cassinii* (Woodhouse)

104. *Aimophila ruficeps scottii* (Sennett)
105. *Melospiza melodia saltonis* Grinnell
106. *Melospiza melodia fallax* (Baird)
107. *Melospiza lincolnii lincolnii* (Audubon)
108. *Pipilo fuscus mesoleucus* Baird
109. *Oberholseria chlorura* (Audubon)
110. *Cardinalis cardinalis superbus* Ridgway
111. *Pyrrhuloxia sinuata sinuata* (Bonaparte)
112. *Hedymeles melanocephalus melanocephalus* (Swainson)
113. *Guiraca cærulea interfusa* Dwight & Griscom
114. *Passerina amœna* (Say)
115. *Spiza americana* (Gmelin)
116. *Calamospiza melanocorys* Stejneger
117. *Piranga ludoviciana* (Wilson)
118. *Piranga hepatica oreophasma* Oberholser
119. *Piranga rubra cooperi* Ridgway
120. *Petrochelidon lunifrons melanogastra* (Swainson)
121. *Hirundo erythrogastra* Boddaert
122. *Tachycineta thalassina lepida* Mearns
123. *Stelgidopteryx serripennis* (Audubon)
124. *Bombycilla cedrorum* Vieillot
125. *Phainopepla nitens* (Swainson)
126. *Lanius ludovicianus excubitorides* Swainson
127. *Vireosylva gilva swainsonii* (Baird)
128. *Lanivireo solitarius cassinii* (Xantus)
129. *Lanivireo solitarius plumbeus* (Coues)
130. *Vireo huttoni stephensi* Brewster
131. *Vireo belli arizonæ* Ridgway
132. *Vermivora luciæ* (J. G. Cooper)
133. *Vermivora ruficapilla gutturalis* (Ridgway)
134. *Vermivora celata lutescens* (Ridgway)
135. *Dendroica æstiva sonorana* Brewster
136. *Dendroica æstiva brewsteri* Grinnell
137. *Dendroica auduboni auduboni* (J. K. Townsend)
138. *Dendroica nigrescens* (J. K. Townsend)
139. *Dendroica townsendi* (J. K. Townsend)
140. *Oporornis tolmiei* (J. K. Townsend)
141. *Geothlypis trichas scirpicola* Grinnell
142. *Geothlypis trichas occidentalis* Brewster
143. *Icteria virens longicauda* Lawrence
144. *Wilsonia pusilla pileolata* (Pallas)
145. *Wilsonia pusilla chryseola* Ridgway
146. *Setophaga picta* Swainson
147. *Mimus polyglottos leucopterus* (Vigors)
148. *Toxostoma curvirostre curvirostre* (Swainson)
149. *Toxostoma curvirostre palmeri* (Coues)
150. *Toxostoma bendirei* (Coues)
151. *Toxostoma crissale crissale* Henry
152. *Heleodytes brunneicapillus couesi* (Sharpe)
153. *Salpinctes obsoletus obsoletus* (Say)
154. *Catherpes mexicanus conspersus* Ridgway
155. *Thryomanes bewickii eremophilus* Oberholser
156. *Troglodytes aëdon parkmanii* Audubon
157. *Sitta carolinensis nelsoni* Mearns
158. *Bæolophus wollweberi annexus* (Cassin)
159. *Psaltriparus plumbeus* (Baird)
160. *Auriparus flaviceps flaviceps* (Sundevall)
161. *Regulus calendula calendula* (Linnæus)
162. *Polioptila cærulea amœnissima* Grinnell
163. *Polioptila melanura melanura* Lawrence
164. *Hylocichla ustulata ustulata* (Nuttall)

General Accounts of the Birds

1. **Chlidonias nigra surinamensis** (Gmelin)

Two specimens (Nos. 29822-29823), birds of the year, were collected six miles north of Patagonia, September 8. There are few records of the occurrence of this species in Arizona, but it was collected by Henshaw in August in Cochise County (Henshaw, 1875, p. 487; Saunders, 1896, p. 22) and is probably a fairly regular late summer migrant in the southeastern section of the state.

2. **Nettion carolinense** (Gmelin)

Small flocks were seen on cattle "tanks" near Patagonia, on September 22, when an immature male (No. 29824) was collected, and on the 23rd, when a female (No. 29826) was shot.

3. **Querquedula cyanoptera** (Vieillot)

A few birds, paired or singly, appeared on the several reservoirs and "tanks" on the Ashburn ranch, May 11 to 20. We were told that prior to our arrival ducks of several species had been of fairly common occurrence there. Presumably the few we saw were the last straggling migrants. A female Cinnamon Teal (No. 29825) was collected September 23, and others were seen.

4. **Dafila acuta tzitzihoa** (Vieillot)

A flock of ten or twelve seen near Patagonia, September 1, and one specimen (No. 29827) preserved. Ducks that may have been of the same species were seen later, in September and October.

5. **Ardea herodias treganzai** Court

A single bird, possibly the same individual, was seen near Patagonia several times during the first two weeks of September.

6. **Butorides virescens anthonyi** (Mearns)

An adult female (No. 29407) was taken on one of the small lakes on the Ashburn ranch, May 24, and a young female (No. 29828) at the same place, September 15. The species is known to breed in southern Arizona.

7. **Rallus virginianus** Linnæus

Seen several times (May 11 to 20) on the lakes on the Ashburn ranch. There are very few records of the occurrence of this species in Arizona (see Swarth, 1914, p. 17), and, while it has been found nesting in the White Mountains (Goldman, 1926, p. 163), there are no breeding records from any more southern locality. The birds that we saw may have been migrants.

8. **Porzana carolina** (Linnæus)

One seen near Patagonia on September 13.

9. **Fulica americana** Gmelin

A pair of coots were settled during May on one of the lakes on the Ashburn ranch, presumably nesting or preparing to do so.

10. **Gallinago delicata** (Ord)

One seen near Patagonia on September 9.

11. **Pisobia minutilla** (Vieillot)

One specimen (No. 29833) was collected at a cattle "tank" near Patagonia on September 19.

12. **Tringa solitaria** Wilson

Four specimens collected, taken August 29, August 31, September 10, and September 11, respectively, all within a few miles of Patagonia (Nos. 29829-29832). It is not possible to designate these with certainty as of either of the two subspecies into which this species has been divided, *Tringa solitaria solitaria* and *T. s. cinnamomea.* Two are males, two females. The two females possess the marking on the inner web of the outer primary that is supposed to distinguish *cinnamomea,* the two males do not. None of the four is markedly cinnamomeous in dorsal spotting, all being essentially like eastern birds in this regard. Wing measurements (in millimeters) are as follows: males, 127, 136; females, 134, 138. Comparison with Ridgway's (1919, pp. 358, 363) measurements of the two subspecies will show how inconclusive these figures are. I have elsewhere (Swarth, 1926, p. 70) given my reasons for doubting the existence of two distinguishable subspecies of *Tringa solitaria.*

13. **Actitis macularia** (Linnæus)

Several seen on the Ashburn ranch, usually at the muddy margin of the watering places of the cattle, at intervals until May 22. Two collected near Patagonia in the fall, on August 31 and September 20, respectively (Nos. 29834-29835).

14. **Oxyechus vociferus vociferus** (Linnæus)

Relatively abundant in the Sonoita Valley. This is an arid region, of course, with little to attract even as adaptable a wader as the Killdeer, but wherever there was surface water some were to be found. Newly hatched young appeared during the second week in May. One specimen was collected near Patagonia on August 30 (No. 29836).

15. **Callipepla squamata pallida** Brewster

This, the common quail of the southeastern portion of Arizona, was surprisingly rare in the valley of the Sonoita. In previous years I had found it in fair abundance in the nearby valley of the San Pedro River, but along the Sonoita, so I was told, quail never had been common. However that may be, we saw but one pair of Scaled Quail during our stay in this region, this at a point some five miles north of Patagonia, on May 20. On our several trips between Patagonia and Tucson, we invariably began to see a few as soon as we rounded the north end of the Santa Rita Mountains. On the mesa along the west base of the Santa Ritas they were abundant, slightly outnumbering the Gambel Quail in that section. The harsh, clanging, two-syllabled call-note of the Scaled Quail was a familiar sound, heard mostly in the early morning. During the first three weeks in June the birds were almost invariably in pairs, sometimes two, three, or even four pairs, being seen in company. A female shot June 4 had not yet begun to lay, but contained an egg about half-formed. On June 14 a young bird was seen, scuttling along with its parents, so tiny that it seemed likely that the rest of the brood was not yet hatched.

The territory immediately below the west base of the Santa Rita Mountains is the westernmost limit of the Scaled Quail's range. A pair seen several miles north of Continental (some ten miles west of the mountains) represents our farthest point of observation in that direction. I know of no records west of the Santa Cruz River. Farther north the species is known to range west to Oracle (some 60 miles exactly north of our Santa Rita station), which point it apparently reaches by way of the valley of the San Pedro. The section about Tucson, midway between the Santa Rita Mountains and Oracle, is inhabited (exclusively, I believe) by the Gambel Quail. It is noteworthy that the Scaled Quail skirts the apparent barrier of the Santa Rita Mountains to the western base of the range, where it is halted by some condition that is less obvious to the view, though more effective, than the mountain wall. The only apparent change in the valley beyond lies in its gentle descent to a lower altitude (from about 4000 feet at the Florida Ranger Station to 2400 feet at Tucson). Vegetation and other factors remain essentially the same.

Four specimens of Scaled Quail were collected, three males and one female (Nos. 29408-29411).

16. **Lophortyx gambelii gambellii** Gambel

A pair that were seen on May 28 a few miles east of Patagonia were the only ones noted in that region in the early summer. In the fall several flocks were encountered there. In the western foothills of the Santa Ritas and on the mesa below, this was a common species. Newly hatched young were encountered on June 5, and others, somewhat larger, were often seen thereafter. Young that were unable to fly were frequently found several miles from the nearest water, in contradiction to the theory advanced by Grinnell (1927b, p. 528) regarding *Lophortyx californica*, that the young would perish unless hatched within a short distance of where water could be obtained. (In this connection see Vorhies, 1928.)

This is a more western bird than the Scaled Quail, and finds in the Santa Rita region its eastern limit in southern Arizona, though its general range extends to western Texas. Our work was in a section that forms marginal territory, where the ranges of Scaled and Gambel quails overlap. The Gambel Quail, however, does not extend to the east side of the Santa Ritas in anything like the numbers of the Scaled Quail on the west side. There are a few scattered records of occurrence a little farther to the eastward, near Fort Huachuca and near Tombstone, but the species is rare anywhere east of the Santa Rita Mountains.

Thirteen specimens were collected (Nos. 29413, 29414, 29837-29845, 30247, 30248): two adult males on the Santa Rita Range Reserve in June; two females in Madera Cañon, September 26; three males and six females at points near Patagonia, September 11 and October 6. The fall birds had all completed, or nearly completed, the molt. On one young female shot October 6 a few feathers of the juvenal plumage still persist.

17. **Cyrtonyx montezumæ mearnsi** Nelson

On June 18 two (not a pair) were seen and an adult male (No. 29412) collected in Stone Cabin Cañon at an elevation of about 7000 feet. During the fall collecting, a young male (No. 30246) almost entirely in juvenal plumage, was collected in Madera Cañon on September 17, one of a small flock. A single bird, believed to be of this species, was flushed from a corn field in the San Rafael Valley, September 30, and a flock of about 20 in grass land near the railroad station of Sonoita on October 11.

18. **Columba fasciata fasciata** Say

During the last week in May a few Band-tailed Pigeons were seen in Monkey Spring Cañon, on the Ashburn ranch. About our camp at the Florida Ranger Station they were present in numbers. Acorns were ripening at that time in the clump of oaks that sheltered our camp and the pigeons were constantly in the trees, paying very little attention to our presence. They seemed to come from a distance to feed here, apparently from high up in the mountains, where, presumably, they were nesting. Two specimens were collected, both adult males (Nos. 29415-29416). On September 1 and 2, flocks were seen near Patagonia. In Madera Cañon small flocks were seen during the first week in October, the last on October 7.

19. **Zenaidura macroura marginella** (Woodhouse)

A common species throughout southern Arizona, and found in fair numbers in the territory where we were working. Nests with eggs were found near Patagonia the middle of June, several of them in small mesquite trees, six or eight feet from the ground.

Mourning Doves were abundant about Patagonia at the end of August and early in September, and in lesser numbers at that season on the west side of the Santa Rita Mountains. Three specimens were collected in Madera Cañon, a young male September 12, and adult male and female October 5 (Nos. 30249-30251).

20. **Melopelia asiatica trudeaui** (Audubon)

In the Sonoita Valley, near Patagonia, there were some White-winged Doves when we arrived (May 10), and they increased in numbers daily. We were told that they first had been seen but a few days before we came. At the west base of the Santa Ritas they were numerous, and by the time we had moved to that side they were nesting. A nest with two eggs, incubation advanced, was found June 7. It was in a hackberry overhanging the edge of a wash, the nest placed on a flat crotch some ten or twelve feet above the floor of the gully.

The White-winged Dove is not at all common nor of general distribution farther east in Arizona; west to the Colorado River it is everywhere in the lowlands. In previous collecting in Cochise County (immediately east of the Patagonia region) I had found it nesting along the San Pedro River, though not nearly so abundantly as along the Sonoita; in the Huachuca Mountains (some 25 miles east of the Sonoita) I never found it nesting at all.

At the end of August there were a few of these doves about Patagonia, and they were seen occasionally nearly throughout September. The last was noted on September 23. Eleven specimens were collected (Nos. 29417-29425, 29846, 29847), all from the vicinity of Patagonia, nine adults in May, a molting adult September 22, and a young bird August 30.

21. **Chæmepelia passerina pallescens** Baird

First seen on the Ashburn Ranch May 17, and at intervals during the next two weeks. At the west base of the Santa Ritas the species was present in small numbers.

Four specimens were collected, adult male and female, on the Ashburn Ranch, May 29 (Nos. 29426-29427), another pair (Nos. 29848-29849) two miles south of Patagonia on September 13.

22. **Scardafella inca** (Lesson)

One seen in a garden in Patagonia on May 28, and others noted in the vicinity of the town in August and September, the last on September 23. Two collected, on August 30 and September 11, respectively (Nos. 29850-29851). The later taken individual was still in the midst of the annual molt.

23. **Cathartes aura septentrionalis** Wied

Abundant throughout the region. It was striking to see the way in which the Turkey Buzzard has adapted itself to a new source of food. Many small mammals are killed by autos on the highways over the desert, among which jack rabbits are the most conspicuous. The Buzzards haunt the roads and descend upon the crushed rabbits a very short time after they are killed. It was noteworthy with what agility these ungainly birds would avoid an approaching machine, waiting until it had come within few yards before swinging out to one side, out of the way, then back to the carcass without delay. As many as eight or nine Turkey Buzzards were seen around one dead rabbit, and the carcasses were, of course, usually disposed of within a few hours.

24. **Accipiter velox** (Wilson)

An immature male was collected near Patagonia on September 28 (No. 29854). It is a common migrant in the region.

25. **Accipiter cooperii** (Bonaparte)

Frequently observed, on both sides of the Santa Ritas. A pair remained about our camp at the Florida Ranger Station so persistently that it seemed likely that they had a nest nearby. Two specimens were collected (Nos. 29428-29429), a male near Patagonia, June 1, in immature plumage, very worn and faded, and an adult female, near the Florida Ranger Station, June 6.

26. **Parabuteo unicinctus harrisi** (Audubon)

Several seen in a flight of Swainson Hawks near Sonoita, on September 16.

27. **Buteo borealis calurus** Cassin

Of fairly common occurrence throughout the lowlands of Arizona, and seen by us at frequent intervals throughout our stay. Two specimens were collected (Nos. 29430-29431), both in immature plumage and apparently non-breeding birds, taken on May 17 and June 14, respectively.

28. **Buteo swainsoni** Bonaparte

A summer visitant to Arizona, where it is most numerous on the open plains. We first met with the species on May 23, when a single bird was taken in San Rafael Valley; May 25 a number were observed at the same place. On the west side of the Santa Ritas the species was not abundant, but several pairs were scattered over the mesa. A nest found on the Santa Rita Range Reserve contained on June 11 a single egg, on June 16 a newly hatched young bird. It was in a palo verde, the tallest tree in the vicinity, about 20 feet from the ground. The nest was a bulky structure, about four feet across, built entirely of rather large sticks and twigs. With the young bird we found the remains of a very small cottontail rabbit and a kangaroo rat. Both parent birds remained in the vicinity when the nest was visited, circling about and screaming, but not venturing near.

A large flight of migrating Swainson Hawks was seen on the plains near Sonoita on September 16, two birds at about the same place on September 23. Three specimens were collected (Nos. 29432, 29433, 29855): a male in immature plumage, badly worn, on May 23, an adult female, not yet laying, on June 2, and an immature female, September 16. The first contained in its stomach the remains of a lizard, the second, mammal fur.

29. **Asturina plagiata** Schlegel

Seen in the vicinity of Patagonia several times during September. Two specimens collected on September 24, an adult male and an immature male (Nos. 29852-29853). The adult is just finishing the molt from the immature plumage.

30. **Aquila chrysaëtos** (Linnæus)

Seen occasionally, most often on the west side of the Santa Ritas. One was observed eating a dead rabbit by the roadside, an animal that had not been killed by the eagle itself.

31. **Cerchneis sparveria phalæna** (Lesson)

A fairly common species in this region during the summer. About Patagonia pairs were spaced along the Sonoita and in the bottoms of the cañons descending from the Santa Ritas and the Patagonia Mountains, where rows of sycamores and other large trees afforded nest sites and look-out posts. West of the Santa Ritas Sparrow Hawks occur mostly where giant cactus supplies the needed nest cavities.

A nest with four eggs was found in Temporal Cañon at about 4500 feet elevation, May 28, in a natural cavity in a sycamore, about 11 feet from the ground. This cañon is broad and open, with barren slopes on either side, affording the open country that the Sparrow Hawk seems to require.

Two adult males were collected near Patagonia, on May 18 and 20, respectively, and a female below the mouth of Madera Cañon, October 5 (Nos. 29434-29435, 30252).

32. **Polyborus cheriway** (Jacquin)

Seen on several occasions in the Santa Cruz Valley between Tucson and the Santa Rita Mountains. One was observed standing by a pool of water at the roadside some 20 miles south of Tucson, on June 2. On June 10, on the Santa Rita Range Reserve, I shot at one that was feeding with some Turkey Buzzards on a dead jack rabbit, but it flew away, though mortally wounded. Two days later I found the dead bird and saved the complete skeleton. This individual was in excessively worn and faded plumage, and beginning the annual molt. Other Caracaras were seen in the same general region.

33. **Asio wilsonianus** (Lesson)

A young bird (No. 29436), recently out of the nest, was collected at about 5000 feet altitude in Stone Cabin Cañon, Santa Rita Mountains. It was accompanied by one of the parent birds. This young bird was, of course, hatched in the immediate vicinity of the place where it was found, and it constitutes, I believe, the first breeding record for the species in Arizona. I do not know that it has ever been reported as nesting anywhere so far south.

34. **Otus asio cineraceus** (Ridgway)

At our camp near the mouth of Stone Cabin Cañon, Screech Owls were heard calling occasionally at dusk. In the late evening of June 13 an entire family was discovered in trees near the camp, and an adult male and a male and female in juvenal plumage were collected (Nos. 29439-29441).

35. **Bubo virginianus pallescens** Stone

Seen on several occasions in the vicinity of Patagonia, and less often on the Santa Rita Range Reserve. So far from being helpless in day time, the several Horned Owls that were observed at the latter place were as wary as any hawk, taking flight in the blazing sunshine when the observer was still out of gun-shot range, and flying to such a distance as successfully to avoid pursuit.

Two adult females (Nos. 29437-29438) were collected near Patagonia in May, on the 14th and 27th, respectively. The stomach of the first contained remains of a wood rat

(*Neotoma*) and a large snake. These two birds are darker colored than the average example of *pallescens*, being closely similar to certain specimens of *pacificus* from the San Joaquin Valley, California. In one the feet are immaculate and nearly white, in the other they are heavily spotted on a tawny ground. A third specimen (No. 29856), collected near Patagonia on September 30, is paler colored than the others, and much nearer the mode of *pallescens*.

36. **Speotyto cunicularia hypogæa** (Bonaparte)

Seen but once, a single bird in the San Rafael Valley, May 23. It is hard to understand the absence of this species from the region. In previous visits to southern Arizona I had found Burrowing Owls in prairie dog towns, but rarely elsewhere, and had assumed that their absence was due to the lack of burrowing animals that could supply them with homes, though it would seem that the large kangaroo rat of the region and the several species of small ground squirrels might meet the need. To emphasize the problem, I had brought to my notice conditions in Imperial Valley, California, through which we passed on our way home. Here, in the cultivated sections, redeemed from the desert in recent years, Burrowing Owls are as abundant as I have seen them anywhere, as they certainly were not under original desert conditions. In Imperial Valley there are no mammals better suited to dig holes for the owls than the species found in Arizona, where the birds are so nearly absent, so it would seem that there must be other reasons explaining their presence or absence in any section.

37. **Micropallas whitneyi whitneyi** (J. G. Cooper)

There are no giant cactuses in the Patagonia region, and but very few near our camp-site on the west side of the Santa Ritas, and the Elf Owl is so closely associated with this plant during the breeding season that it is useless searching for it elsewhere. A scanty assemblage of cactuses, not over ten or twelve plants all told, is scattered over the mesa east of Continental, and these were examined on June 15. One family of Elf Owls was collected, an adult female with two newly hatched young (Nos. 29442-29444), and a second adult was seen in another cactus, too high up in the plant for the ladder to reach. The species is almost unknown east of the Santa Ritas.

38. **Geococcyx californianus** (Lesson)

Seen a number of times in the vicinity of Patagonia, but not nearly so numerous as in the chaparral about Tucson. Abundant on the Santa Rita Range Reserve, as elsewhere in this valley, and usually in pairs at the time of our visit in June. An adult male was collected near Patagonia on May 25, an immature male in Madera Cañon, September 10, and an adult female below Madera Cañon, October 8 (Nos. 29445, 30253, 30254).

39. **Coccyzus americanus occidentalis** Ridgway

First observed near Patagonia, May 25. Others were seen and heard several times during the next few days, and it seemed evident that they were just arriving from the south. Several were seen near the Florida Ranger Station during June, and two were collected there, an adult male and female, taken June 14 and 16, respectively (Nos. 29446-29447). The female contained in its stomach two green caterpillars and a lizard 100 millimeters long, the latter swallowed entire and rolled into a coil. This seems a startling diet for a tree-dwelling cuckoo, but there is at least one other instance reported, also from the vicinity of Tucson, of a lizard being taken by one of these birds (Visher, 1910, p. 282). During the last week in August cuckoos were seen in fair abundance about Patagonia, and in lesser numbers somewhat later, the last on September 11. Four specimens were taken at that time (Nos. 29857-29860).

The validity of the subspecies *occidentalis* has been questioned by W. E. Clyde Todd (1922, p. 213), and, it seems to me, on good grounds. Between the eastern and western races of the Yellow-billed Cuckoo there is a slight average difference in size, the western bird being the larger and with a somewhat heavier bill. There is a rather wide range of variation in specimens from any one locality, as shown in the accompanying table, and the largest eastern birds do not fall far short of the maximum measurements of western specimens (see Ridgway, 1916, pp. 12-19). Birds from the Pacific coast are the largest, those from central Arizona near the type locality of *occidentalis* (the Santa Rita Mountains) are intermediate in size. The subspecies would have a better claim to recognition if restricted to the Pacific coast, but I am unwilling to suggest the changes in nomenclature that such a course would necessitate. I retain the name *occidentalis* here in deference to the opinions of others, but the subspecies is certainly as slightly differentiated as any in our *Check-list*, and I feel that no violence to the facts would result from suppression of the name.

40. **Ceryle alcyon caurina** Grinnell

Seen occasionally during September, along the Sonoita below Patagonia and about the small lakes on the Ashburn ranch, where two specimens were collected on September 20 (Nos. 29861-29862). One was taken in Madera Cañon, far from any fish-inhabited water, on September 14 (No. 30255).

41. **Dryobates scalaris cactophilus** Oberholser

In southeastern Arizona, east of the Santa Rita Mountains, the vast areas of prairie land are for the most part unsuitable to this species. Wherever even a scanty growth of chaparral has found a foothold, though, the Cactus Woodpecker is pretty sure to occur, for it does not require large trees. Along the streams and washes in this same area, as elsewhere, it does frequent the sycamores and other larger growths, but these do not form the preferred habitat. In the lowlands west of the Santa Rita Mountains this woodpecker is in the surroundings that suit it best. It does not frequent the giant cactus (I do not believe that there is a known instance of its nesting in one), but stays nearer the ground, in cholla cactus, creosote bush, catclaw or other low-growing vegetation.

Seventeen specimens were taken: from Patagonia, five in May and four in September; from the Santa Rita Range

Measurements in millimeters of *Coccyzus americanus occidentalis*

Collection	No.	Sex Age	Locality	Date	Wing	Tail	Culmen	Tarsus
H. S. Swarth	3115	♂ ad.	Huachuca Mts., Arizona	Aug. 2, 1902	146.0	146.5	24.5	27.0
H. S. Swarth	4028	♂ ad.	Tucson, Arizona	June 5, 1903	150.0	149.0	26.0	26.5
G. F. Morcom		♂ ad.	Tucson, Arizona	June 6, 1903	143.0	148.0	27.0	27.0
C. A. S.	29446	♂ ad.	Santa Rita Mts., Arizona	June 14, 1927	143.5	144.5	26.0	25.0
C. A. S.	29857	♂ ad.	Patagonia, Arizona	Sept. 5, 1927	141.0	148.0	25.0	25.0
H. S. Swarth	2011	♀ ad.	Huachuca Mts., Arizona	June 21, 1896	156.0	154.0	28.0	27.0
H. S. Swarth	4044	♀ ad.	Tucson, Arizona	June 10, 1903	150.0	159.0	28.5	27.5
G. F. Morcom		♀ ad.	Huachuca Mts., Arizona	July 1, 1896	151.0	148.0	26.5	27.0
G. F. Morcom		♀ ad.	San Pedro R., Arizona	June 10, 1902	149.0	145.0	27.0	27.5
G. F. Morcom		♀ ad.	Tucson, Arizona	June 3, 1903	152.0	153.0	27.0	27.0
C. A. S.	29447	♀ ad.	Santa Rita Mts., Arizona	June 16, 1927	152.5	157.0	26.0	27.0
C. A. S.	29860	♀ ad.	Patagonia, Arizona	Sept. 9, 1927	154.0	155.0	26.0	26.5

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Reserve, three adults and two juveniles (June 6 and 7); from lower Madera Cañon, three collected in September and October (Nos. 29448-29457, 29863-29866, 30256-30258).

42. **Dryobates arizonæ arizonæ** (Hargitt)

An Upper Sonoran zone species that barely descends into the region where we did most of our work in the spring. In the Patagonia section, a few individuals follow the scattered oaks down to the edge of the valley, where an adult male was collected May 19. A few were seen, also in oak trees, near the western base of the Santa Ritas, where an adult male was taken on June 7, and a full-grown juvenal on June 18.

Specimens were collected at Fort Crittenden, September 19, at a point five miles west of Patagonia, October 7, and three in lower Madera Cañon, September 6 and 23, and October 3. Eight specimens in all were taken (Nos. 29458-29460, 29867, 29868, 30259-30261). Male birds shot September 6 and 19 still retain traces of the juvenal head marking.

43. **Sphyrapicus varius nuchalis** Baird

A winter visitant to the region. Specimens were taken at Patagonia, October 6, and at Sonoita, October 11 (Nos. 29869-29870).

44. **Melanerpes formicivorus aculeatus** Mearns

Breeding in small numbers in the Patagonia region, mostly in the sycamores and other trees along the Sonoita. We collected five specimens there on dates ranging from May 14 to June 1, all adults. More abundant in the fall, when eight were collected near Patagonia and Fort Crittenden on dates ranging from September 9 to October 12. Five were taken in Madera Cañon between September 3 and 24. Eighteen specimens in all were preserved (Nos. 29461-29465, 29871-29878, 30262-30266).

45. **Centurus uropygialis uropygialis** Baird

Very few seen in the spring, either about Patagonia or on the west side of the mountains, neither place seeming to afford needed conditions. They are most abundant in groves of giant cactus and in mesquite-grown river bottoms. We collected one specimen, an adult male, near Patagonia on May 15 (No. 29466). More abundant about Patagonia in the fall, when eight specimens were taken, between August 29 and October 8 (Nos. 29879-29886). Birds collected during the first week in September were still in the molt.

46. **Colaptes cafer collaris** Vigors

There were a few Red-shafted Flickers in the valley near Patagonia, and more in the wooded foothills of the nearby Santa Rita Mountains. A full grown juvenile (No. 29468) was collected three miles southwest of Patagonia, June 1. On the west side of the Santa Ritas an adult male (No. 29469) was taken near the head of Stone Cabin Cañon (7000 feet altitude) on June 18. The latter is the most heavily marked bird, as regards size of black spots on the under parts, and the black crescent on the breast, that I have seen from any region. Common in Madera Cañon (5200 feet altitude) in the fall.

47. **Colaptes chrysoides mearnsi** Ridgway

The Gilded Flicker is so closely confined to the giant cactus, at least during the nesting season, that it is little more than a chance to find one elsewhere. At Patagonia, which is beyond the eastern limit of the giant cactus in this section, perhaps six or seven of the Flickers were seen during the month we spent there. During several previous years, when I collected assiduously and for long periods of time in the region immediately to the eastward, in Cochise County, Arizona, not a single Gilded Flicker was observed there. The eastern foothills of the Santa Rita Mountains may thus be taken as the eastern limit of the range of the Gilded Flicker in southern Arizona. We saw the species occasionally on the Santa Rita Range Reserve, west of the mountains, but not often, for there were but few giant cactuses in the region where we worked.

Two specimens, adult male and female, were collected on the Ashburn Ranch, north of Patagonia. The female (No. 29470, May 30) is a normal example of the species. The male (No. 29467, May 17) has the usual yellow color of the wings and tail of *chrysoides* replaced by red, as in *cafer*. In fact, the only feature by which the specimen can be recognized as an example of *chrysoides* is its small size. The bird is similar to specimens described and discussed by Grinnell (1914, p. 136), and its appearance doubtless is to be explained in the same way, namely, as the result of a "proneness to replacement of yellow by red, without there having been any interbreeding with another species" (Grinnell, *loc. cit.*). It should be pointed out, though, that, in the specimen in hand, the red is decidedly deeper than in Grinnell's Colorado River specimens, being of exactly the shade seen in *cafer*; and that the dark markings generally (such as the dusky bars on the upper surface) are decidedly darker and more extensive than is usual in *chrysoides*, being again just as in *cafer*. Were it a hybrid between *cafer* and *chrysoides*, though, it seems likely that the size of the bird would have been greater than it is. Its measurements are those of the smaller *Colaptes chrysoides mearnsi*.

48. **Phalænoptilus nuttallii nuttallii** (Audubon)

Poor-wills were heard every evening at our camp on the Ashburn Ranch, near Patagonia. One specimen, an adult male (No. 29491), that was collected there on May 27, responded to a whistled imitation of its call note by approaching instantly and alighting on a fence post within a few yards of the imitator. They were seen and heard with fair frequency about our camp near the Florida Ranger Station during June.

49. **Chordeiles virginianus henryi** Cassin

A Nighthawk was flushed by Gilmore from the limb of an oak tree, near old Fort Crittenden, May 30. No Texas Nighthawks were seen by us in this region, nor (in my experience) does *texensis* ordinarily roost in trees. The Western Nighthawk does so habitually, and I have no doubt that the bird seen was of this species.

50. **Chordeiles acutipennis texensis** Lawrence

Extremely abundant in the lowlands west of the Santa Rita Mountains but not seen by us east of that point. Frequently abroad during the day in the hottest sunshine. A set of two eggs (much incubated) was taken on June 4. The sitting bird was exposed to the full glare of the sun, the eggs being placed on a gravelly ridge, at the base of a little mesquite, some six feet high, which gave no sheltering shade. Three skins of this species were preserved, an adult female (parent of the above described set of eggs), an adult female taken on June 11, and a downy nestling taken June 13 (Nos. 29492-29494).

51. **Aëronautes saxatalis** (Woodhouse)

Seen in both the eastern and western foothills of the Santa Ritas, and on many occasions. One specimen was collected, an adult male, June 2 (No. 29471). For the use of the name *saxatalis* see the discussion of this case by Oberholser (1920, p. 294), with whose conclusions I am in accord. No one who has seen the White-throated Swift in life can doubt the application of Woodhouse's description.

52. **Eugenes fulgens** (Swainson)

A Transition zone species within whose confines we barely entered. An adult male (No. 29472) was collected in Stone Cabin Cañon at about 7000 feet altitude, June 18, and one or two female hummingbirds that may have been of this species were seen near our camp at the mouth of the cañon.

53. **Archilochus alexandri** (Bourcier & Mulsant)

This was the only species of hummingbird definitely identified by us in the vicinity of Patagonia. Adult males were seen not uncommonly, and a great many more females, usually along streams or washes, about sycamores and willows. An adult female was collected on the Ashburn Ranch, May 12 (No. 29473), and a young bird, full grown, in Madera Cañon, September 13 (No. 30268).

54. **Calypte costæ** (Bourcier)

Definitely identified only in the vicinity of our camp near the Florida Ranger Station. A young bird and the accompanying female parent were collected on June 16 (Nos. 29474-29475). No adult males were seen.

55. **Cynanthus latirostris** Swainson

An adult female was collected in Madera Cañon, September 13 (No. 30267). This, I believe, is the latest fall date upon which the species has been taken in Arizona.

56. **Tyrannus verticalis** Say

A common species in the lowlands of Arizona. Seen in some numbers on both sides of the Santa Rita Mountains, from the lowest foothills out into the valleys. Kingbirds of both species were numerous about Patagonia early in September and remained in diminishing numbers until October 11. The difficulty of distinguishing between *verticalis* and *vociferans* in life, especially in their molting condition at that time, prevented the securing of definite dates of departure of each species. An adult *verticalis* (No. 29889) was taken on September 7, then in the midst of the annual molt.

57. **Tyrannus vociferans** Swainson

Very abundant in the Sonoita Valley, and in scarcely lesser numbers in the western foothills of the Santa Ritas. An extremely noisy species at the beginning of the nesting period, but restricting its worst clamor to the early morning hours. At our camp on the Ashburn Ranch I was awakened every morning by an outrageous chorus of these birds, beginning shortly before the first gray appearance of dawn and continuing until nearly sunrise, when the noise ceased rather abruptly. Occasionally some restless individual would awaken an hour or two before dawn and begin his shrill outpourings, but meeting with no response, would subside for the time being. By the second week in June the kingbirds had quieted down and called but little.

Adults collected near Patagonia during the first two weeks in September are molting, with the old remiges and rectrices partly replaced by half-grown new feathers. Two young birds (September 5 and 6) are mostly in juvenal plumage. In one the juvenal rectrices are being replaced by new feathers. In the young bird the tail feathers are shorter than in the later plumages, and are narrowly tipped with rusty brown. In the succeeding feathers the ends are broadly margined with yellowish gray. The specimens at hand do not show conclusively that the juvenal remiges also are renewed at this time but it seems likely that they are. The latest taken fall specimens were collected on October 2 at Patagonia, on October 6 in Madera Cañon.

Fifteen specimens in all were collected (Nos. 29476-29482, 29887, 29888, 29890-29892, 30269-30271), ten adults and two juveniles near Patagonia, three adults in Madera Cañon.

58. **Myiarchus tyrannulus magister** Ridgway

Seen in small numbers in the eastern foothills of the Santa Rita Mountains. The first arrival appeared on the evening of May 15, and others were observed during the next few days. A mated pair was collected in Temporal Cañon at 4800 feet altitude. From the region east of the Sonoita Valley there are no records of the occurrence of this bird, though a great deal of careful ornithological work has been done there. In the Santa Cruz Valley, west of the Santa Ritas, the species is known to be fairly common, but it nests almost entirely in giant cactus, and there being none of these plants near our camp on the west side of the mountains, we saw no Arizona Crested Flycatchers there. Three specimens in all were collected, an adult male and two adult females (Nos. 29483-29485). For the use of the name *Myiarchus tyrannulus magister* see Hellmayr, 1927, p. 162.

59. **Myiarchus cinerascens cinerascens** (Lawrence)

A common species, mostly in the Lower Sonoran life zone, and seen by us in every section visited. Four specimens, two adult males and two adult females, were collected in the spring, three from the vicinity of Patagonia and one from the mouth of Stone Cabin Cañon, on dates ranging from May 11 to June 11 (Nos. 29486-29489). An adult male (No. 29893) taken near Patagonia on September 13, has nearly completed the annual molt.

60. **Myiarchus tuberculifer olivascens** Ridgway

This is a species primarily of the Upper Sonoran zone, scarcely venturing down into the areas where most of our work was carried on. There were a few still migrating when we arrived at the Ashburn Ranch, May 10, and several were seen or heard there during the next week. A few were observed near the mouth of Stone Cabin Cañon during the third week in June. One specimen was collected, an adult male taken on the Ashburn Ranch, May 14 (No. 29490). I am following Hellmayr (1927, p. 186) in using the name *Myiarchus tuberculifer olivascens.*

61. **Sayornis sayus sayus** (Bonaparte)

Fairly abundant and of general distribution in the valleys of southern Arizona. At our camp on the Ashburn Ranch a pair of Say Phoebes had a nest in the well, built in a crevice in the dirt wall about 15 feet down. This is a favorite nesting site with the species in this region and I have seen a number of nests similarly placed, in wells or in mine shafts The young of the birds under observation hatched out during the last week in May, judging from the actions of the parents. Two specimens of Say Phoebe were collected, adult female and male taken May 14 and 23, respectively (Nos. 29495-29496).

62. **Sayornis nigricans nigricans** (Swainson)

Not common. There was a nest in a barn on the Ashburn Ranch, and a few of the birds were seen elsewhere, always around human habitations.

Three were collected near Patagonia, one September 4, two September 15, and two in lower Madera Cañon, September 10 and 21, respectively (Nos. 29894-29896, 30272, 30273). These birds have just finished the molt, and the color of their fresh, unfaded plumage was so different from any California skins at hand as to warrant comparison with as much other material as could be assembled. Through the courtesy of the officials in charge, I was able to examine a series of 15 skins from central Mexican localities from the collection of the United States Biological Survey, a series of 25 from central Mexican localities from the collection of the Museum of Comparative Zoology, and specimens from northern Lower California from the collection of the Museum of Vertebrate Zoology.

The Arizona birds are slaty black, in notable contrast to the more brownish color of comparable California birds. It will be noted that this same slaty black coloration is the distinguishing feature of *Sayornis nigricans salictaria*, described by Grinnell (1927a, p. 68) from northern Lower California, based upon fresh-plumaged birds, and, in fact, the two series, from southeastern Arizona and from northern Lower California, are practically indistinguishable in appearance. Comparison with specimens from northern and central Mexico failed to disclose any from those regions of the same shade, though some were taken at the same season of the year. Mexican birds were essentially like those from California. It accordingly seems possible (in fact it seems to be the only explanation for the situation) that the slaty-black hue of freshly molted birds is an evanescent feature, fading quickly in life, and that in prepared skins this color alters appreciably in the course of years, even in tightly closed museum cases. My Arizona birds and Grinnell's "*salictaria*," collected recently, at the same season, are alike in slaty-black color. Central Mexican birds and Californian birds at hand that were taken at the same season of the year were all collected ten years ago or more and are again alike in their more brownish hue. Grinnell's (1927, p. 69) *brunnescens*, from the Cape San Lucas district, Lower California, based upon old skins, is characterized (in part) by relatively brownish coloration.

I at first inclined to the belief that the Arizona form represented the northern limits of *Sayornis nigricans nigricans*, of central Mexico, with the Pacific coast of California occupied by another subspecies, *S. n. semiatra* (see Nelson, 1900, p. 125), but in the light of the specimens here assembled, as described above, I can adopt no other course than to call them all by the one name, *nigricans*. The presence or absence of black streaking on the lower tail coverts, defined by Nelson as a differentiating character between *nigricans* and *semiatra*, I do not find to be of any subspecific value as between Arizona and California birds (see Brewster, 1902, p. 119; Ridgway, 1907, p. 598, footnote).

63. **Nuttallornis mesoleucus** (Lichtenstein)

A single bird, a late migrant, was collected on the Ashburn Ranch, May 12 (No. 29497). During the fall migration one was taken at Patagonia on September 22, one in Madera Cañon on September 24. For the use of the name *Nuttallornis mesoleucus* see Hellmayr, 1927, p. 189.

64. **Myiochanes richardsonii richardsonii** (Swainson)

A common summer bird of the Upper Sonoran zone in southern Arizona, and found by us in some numbers in the foothill region on both sides of the Santa Rita Mountains. The sycamores and other trees along the stream beds form the preferred habitat. Six specimens were collected: from the Patagonia region, May 23, August 31, September 5, October 8; from Madera Cañon, September 3 and 10 (Nos. 29498, 29898-29900, 30275, 30276).

65. **Empidonax difficilis difficilis** Baird

A summer visitant to the Transition zone of the mountains of southern Arizona. During May the species was migrating in the valleys, and a belated migrant was collected far from the mountains on the Santa Rita Range Reserve as late as June 7. One taken near the mouth of Stone Cabin Cañon on June 10 may have been nesting near by. During the fall migration the species was abundant on both sides of the Santa Ritas. Nineteen specimens were collected, five on dates ranging from May 21 to June 10, 14 on dates ranging from September 4 to 28 (Nos. 29499-29503, 29901-29904, 30277-30286). An adult female shot September 7 has not yet begun the annual molt.

66. **Empidonax traillii brewsteri** Oberholser

Seen several times in the vicinity of Patagonia during the latter part of May. One was shot in Temporal Cañon (4500 feet altitude) on May 28, two near Patagonia on September 28, and one in Madera Cañon, September 17 (Nos. 29905-29906, 30287).

67. **Empidonax hammondii** (Xantus)

An adult male was collected seven miles north of Patagonia on May 12; two others were shot near Patagonia in the fall, on September 24 and October 3, respectively (Nos. 29504, 29907, 29908). The last taken specimen, an adult female, is apparently just beginning the annual molt.

68. **Empidonax griseus** Brewster

One bird, mostly in juvenal plumage (No. 29909), was collected at Fort Crittenden on September 19, the only time the species was encountered. The Gray Flycatcher is not known to breed anywhere in Arizona.

69. **Pyrocephalus rubinus mexicanus** Sclater

Abundant in the lowlands wherever there is water available. Pairs were spaced at frequent intervals along the water courses and they were about all the ranch houses, but the birds were seldom seen on the open cactus-covered mesa. A nest was found on the Sonoita on May 13, with three eggs nearly ready to hatch, in a cottonwood, 20 feet from the ground. It was a flimsy affair, and nearly hidden in the relatively large fork in which it was placed. Others found later were similarly placed and of similar construction.

The species was abundant about Patagonia at the end of August but had nearly disappeared before the end of

September. Last seen October 2. Seen only once in Madera Cañon, on September 21. Specimens taken early in September had almost or entirely finished the molt. Twenty specimens were collected, nine males and eleven females (Nos. 29505-29513, 29910-29919, 30288).

70. **Camptostoma imberbe** Sclater

Two birds, adult male and female (Nos. 29514, 29515), were collected by Mailliard and Gorsuch in Temporal Cañon (4800 feet altitude), May 20, and others were seen the same day. These may have been migrating, for subsequent visits to the cañon were fruitless, so far as this species was concerned. On September 13 Mailliard shot an adult female (No. 29920) two miles south of Patagonia. This bird has nearly finished the annual molt and is in fresh fall plumage, but it is very little different from the May specimens. It is slightly more yellowish below and more olivaceous above.

This little flycatcher is apparently one of the rarest of birds north of the Mexican boundary. In all probability it is a regular summer visitant to parts of southern Arizona, but, due to its unobtrusive nature and the small numbers in which it occurs, it has been overlooked by most collectors in that region.

Previous occurrences in Arizona known to me are as follows: Five specimens, adult and young, taken by F. Stephens near Tucson, during April and May, 1881 (Brewster, 1882, p. 208). These birds were collected, so Mr. Stephens told me, in the Santa Cruz River bottom, above San Xavier Mission, some ten to fifteen miles from Tucson. One specimen collected by F. Stephens "near Tucson" in April, 1884 (Bendire, 1895, p. 325). Two specimens, adult and young, collected by F. Stephens and H. S. Swarth at the same place on the Santa Cruz River as where Stephens' first birds were taken, June 11, 1903 (Swarth, 1905, p. 47). One specimen collected by R. D. Lusk, on the San Pedro River ten miles above its junction with the Gila, March 1, 1911 (Bailey, 1923, p. 32). One specimen, a young female, in the collection of J. Eugene Law (No. 8028, coll. J. E. L.), collected by Mr. Law at

Harrington's, on the old road between Vail and Benson, on the southeastern slope of the Rincon Mountains, September 5, 1919. One specimen in the Field Museum of Natural History, collected at Tucson, May 29, 1887. Three specimens in the collection of Dr. L. B. Bishop (Nos. 34848-34850, coll. L. B. B.), two males and a female, taken near Tucson on June 28, August 23, and July 10, 1922, respectively.

71. Otocoris alpestris adusta Dwight

East and northeast of the Santa Rita Mountains there are vast areas of grass land furnishing ideal surroundings for horned larks, which breed there in abundance. We found them in numbers in San Rafael Valley (about 5000 feet altitude), from which section open plains extend uninterruptedly toward the Huachuca Mountains and farther, into Mexico. A few horned larks were seen at old Fort Crittenden, and they were fairly numerous beyond this point, to the northward, along the road rounding that end of the Santa Rita Mountains.

On the west side of the mountains, this species is decidedly rare. I saw a few there in June, 1903 (Swarth, 1905, p. 79), but none on this visit. Even a scanty growth of widely scattered bushes suffices to keep them away. There are records of occasional birds seen about Tucson, but only in winter; the only ones that I, myself, have seen from there were of the more western subspecies, *leucansiptila*. West of Tucson there is little suitable country for horned larks until the Colorado River is crossed.

Nineteen adult specimens of the Scorched Horned Lark were collected during May (Nos. 29516-29534), one from a point seven miles north of Patagonia, May 22, the others from San Rafael Valley, May 23 and 25. Young birds were seen flying on the two latter dates.

In the fall there proved to be but a small proportion of *adusta* among the enormous flocks of horned larks that frequented the plains. The series collected at that time includes only six individuals that are referable to *adusta*, collected at various dates from September 1 to October 9 (Nos. 29988-29993). I found similar conditions existing years ago near the Huachuca Mountains in the fall, that is, relatively few *adusta* among a preponderant number of *occidentalis*, indicating a deserting of the breeding grounds by *adusta* during the winter months.

72. **Otocoris alpestris occidentalis** McCall

Horned larks were found in large numbers in the fall in San Rafael Valley and on the grassy plains near Sonoita. Sixty-seven specimens (Nos. 29921-29987) that were collected upon various dates between September 1 and October 9 I have referred to the subspecies *occidentalis*. Some of the first taken birds are still in process of molt.

73. **Cyanocitta stelleri diademata** (Bonaparte)

Abundant in the Transition zone of the Santa Rita Mountains, but not seen in summer at the low level at which we were camped. Three adults were collected in Stone Cabin Cañon, at about 7000 feet altitude, on June 18 (Nos. 29535-29537).

74. **Aphelocoma sieberi arizonæ** (Ridgway)

A common bird in the Upper Sonoran oak-covered foothills of the Santa Rita Mountains. During May a few individuals wandered down into the bottom lands along the Sonoita, but none was nesting at so low an altitude. Present in fair abundance about our camp at the west base of the mountains, near the Florida Ranger Station. Thirty-three specimens were collected (Nos. 29538-29553, 29994-30005, 30289-30292), 24 from the east and nine from the west side of the mountains. In this species the bill is entirely black only at full maturity. In the young it is blackish above and mostly flesh-colored below, the black gradually spreading as the bird matures. More than a full year is required for the bill to become entirely black, and many birds taken in the spring and summer, otherwise adult in appearance, still have the parti-colored bill, a reliable indication of their age. Two such females collected on May 26, from the appearance of their ovaries evidently were not breeding, and from the full-feathered condition of the lower parts just as evidently had not been sitting on eggs. So in some cases, at least, this species does not breed until two years old.

The type locality of *Cyanocitta ultramarina* var. *arizonæ* Ridgway, is Fort Buchanan, and there are certain interesting details regarding the discovery of the species at that place, as recounted by Florence Merriam Bailey (1923, p. 33, footnote). Most of our specimens from the east side of the Santa Ritas were collected within five miles of the site of Fort Buchanan, and some were shot from oak trees about the ruined buildings of Fort Crittenden, which had been established at a later date on practically the same spot as the older Fort Buchanan.

The series includes two nearly full-grown young, taken on May 26 and 30, respectively, birds still in juvenal plumage throughout as late as September 5, and others in the post-juvenal molt during the first week in October. The annual molt of the adult is also finished early in October.

75. Corvus corax sinuatus Wagler

Ravens were fairly common in the Sonoita Valley, but owing to the difficulty of distinguishing between *sinuatus* and *cryptoleucus* in life, it is impossible to state their relative abundance. My impression is, though, that *sinuatus* was the common form in this rather more wooded region, and that *cryptoleucus* replaced it entirely in the plains region immediately to the eastward. Neither species appeared to be nesting in May, or at any rate those seen were not so occupied. They were generally encountered in small flocks, six to ten in number. West of the Santa Rita Mountains ravens were less common, and there *sinuatus* was the only form definitely identified, recognized by its call note.

One specimen (No. 29554) was collected near Patagonia, June 2, and there is one other example from southern Arizona at hand, from the collection of G. Frean Morcom, taken by Frank Stephens near Tucson, June 4, 1903. Ravens of this species from southeastern Arizona may be assumed to belong to the subspecies *sinuatus*. These two birds are somewhat larger than ravens from southern California, as are several other Arizona specimens that I have handled.

The measurements given below, as far as they go, give some weight to Oberholser's (1918, p. 224) assignment of the subspecies *clarionensis* to the mainland of southern California, as compared with the larger *sinuatus* from points farther east, but the variation that may be encountered in one locality (see table below, and also Grinnell, 1914, p. 156) renders it unwise to generalize on a few specimens. The latest monographer of the group (Meinertzhagen, 1926) lumps *clarionensis* and *sinuatus.*

The ravens that I have examined from southeastern Arizona show the same feature that Grinnell (*loc.cit.*) notes on birds from the Colorado River, of greater whiteness at the base of the feathers of neck and upper breast, as compared with specimens from the Pacific slope of California. It might be desirable to recognize a coastal form, *clarionensis,* and a desert-inhabiting form, *sinuatus,* on the basis of the slight differences in color and average measurements just described. But in that case I could not follow Oberholser (*loc. cit.*) in his assertion of extensive overlapping of these subspecies in southern Arizona. I do not believe that more than one form of *Corvus corax* can be recognized there. This subspecies is continuously distributed and fairly abundant over the deserts of southeastern California and southwestern Arizona; it abruptly becomes rare when the grass land (the habitat of *Corvus cryptoleucus*) is reached in the southeastern corner of the latter state.

76. **Corvus cryptoleucus** Couch

A few White-necked Ravens were seen in San Rafael Valley on May 23 and 25, and a flock of fifty or more on September 1. The species was probably included among the many ravens seen near Patagonia. It has been previously reported from points immediately west of the Santa Rita Mountains, and we may have seen it there, too, but we did not positively recognize the species among the few ravens there observed. One specimen was collected, an adult female taken in San Rafael Valley, 15 miles east of Patagonia, May 25 (No. 29555).

Tucson and Oracle represent the westernmost points of record for this species in Arizona. It is not common west

Measurements in millimeters of *Corvus corax sinuatus* from southern Arizona, southern California, and Clarion Island

Collection	No.	Sex	Locality	Date	Wing	Tail	Cul-men	Depth of bill	Tar-sus
G. F. Morcom		♂	Tucson, Arizona	June 4, 1903	435.0	228.0	71.0	26.0	71.0
C. A. S.	29554	♂	Patagonia, Arizona	June 2, 1927	430.0	234.0	71.5	28.0	69.5
C. A. S.	18918	♂	Buttonwillow, Kern Co., Calif.	Nov. 6, 1914	380.0	201.0	63.5	25.5	63.0
C. A. S.	18919	♂	Buttonwillow, Kern Co., Calif.	Nov. 6, 1914	402.0	219.0	65.0	24.2	63.0
C. A. S.	18917	♀	Buttonwillow, Kern Co., Calif.	Nov. 23, 1914	389.0	219.0	61.0	25.0	63.5
C. A. S.	18920	♀	Buttonwillow, Kern Co., Calif.	Nov. 6, 1914	399.0	215.0	65.0	25.2	63.5
C. A. S.	28157	♂	Clarion Id., Revillagigedo Ids., Mex.	April 28, 1925	376.0	212.0	61.0	25.5	62.5
C. A. S.	28158	♂	Clarion Id., Revillagigedo Ids., Mex.	April 28, 1925	373.0	208.0	61.5	26.0	60.0
C. A. S.	28159	♀	Clarion Id., Revillagigedo Ids., Mex.	April 28, 1925	393.0	223.5	68.0	27.0	64.0

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of the grass-covered plains of the extreme southeastern corner of the state.

77. **Molothrus ater obscurus** (Gmelin)

A common species in the lowlands of southern Arizona, and seen by us in some numbers in all sections visited. Early in May the Dwarf Cowbirds were not yet laying, judging from those we dissected. A non-breeding male shot on May 27 was in parti-colored plumage, with patches of glossy feathers interspersed among the duller colored first year feathers. This bird was not molting. Twenty-three specimens were collected, all from points near Patagonia (Nos. 29556-29574, 30006-30009). The series includes one bird in juvenal plumage, taken on September 6, and three adults nearly through the annual molt, taken on October 2.

78. **Tangavius æneus æneus** (Wagler)

It seems reasonable to believe that this species has entered Arizona during recent years. It was first reported by Visher (1909, p. 307) from the vicinity of Tucson, and has since been observed by others, there and elsewhere in southeastern Arizona, where, in fact, it is now an abundant summer visitant. That all of the earlier collectors in the state could have overlooked the bird seems unlikely in the extreme, and it is especially improbable that it could have escaped so keen an observer as Herbert Brown, who lived for years in a locality where this Cowbird is now abundant.

About Patagonia the Bronzed Cowbird was observed a day or two after our arrival on May 10, and in greatly increased numbers toward the end of the month. It was last seen September 6. Bands of six or eight attended individual horses or steers, often in company with Dwarf Cowbirds, trotting closely alongside the selected animal in order to take advantage of the small patch of shade it afforded, and showing a marked preference for feeding by the animal's head. On our several drives up and down the Santa Cruz Valley south of Tucson, Red-eyed Cowbirds were always seen, especially about irrigated sections. About our camp at the mouth of Stone Cabin Cañon, the species was not abundant, but a few of the birds were seen at intervals throughout our stay. Females collected near Patagonia on May 19 contained partly formed eggs.

I was puzzled at first at a difference in the color of the eyes of different adult males. Later observation showed that although in a freshly killed adult male the eye was bright red, in an hour or two it had greatly faded, and by the time the specimen reached the skinning table the eye was an inconspicuous reddish brown. The females collected present a parti-colored effect, due to the head, neck and upper back, in varying degrees, being clothed in more recently acquired plumage than that covering the rest of the bird. They are not in process of molt, no pin feathers being present, but on the parts indicated the feathers are unworn and of soft gray or blackish coloration, in sharp contrast to the brownish and rather frayed plumage elsewhere. Nineteen specimens were preserved, nine adult males, nine adult females, and one juvenile (Nos. 29575-29590, 29592, 30010, 30011).

79. **Agelaius phœniceus nevadensis** Grinnell

Red-winged Blackbirds were found breeding in small numbers in the Sonoita Valley, and a series of 13 specimens collected, eight males, four females, and a juvenile female (Nos. 29591, 29593-29604). The young bird, just out of the nest, was taken on May 29.

In southeastern Arizona there are not many places suitable for *Agelaius*, but wherever a little marsh land or reed-grown ponds or reservoirs are found, small colonies become established. The birds are thus scattered at wide intervals over the southeastern portion of the state, and very possibly northward along its entire eastern boundary. This, the Red-winged Blackbird of eastern Arizona, is not the same as the subspecies occupying the Colorado Valley. Notable features of the Colorado Valley race are the long, slender bill, and (in the female) pale coloration. Conspicuous points of difference distinguishing the more eastern bird are the heavier, shorter bill, and the darker coloration of the female. This bird has been recorded several times as *neutralis* (see Swarth, 1914, p. 47), but it is not of that subspecies, and comparison shows such close resemblance to a series of *Agelaius* from northern Nevada that I am placing the Arizona race under the same name, *nevadensis*. This form I am convinced occupies most, or all, of Arizona east of the Santa Catalina and the Santa Rita mountains.

The type specimen of *Agelaius phœniceus sonoriensis* unfortunately was collected within what I consider to be the breeding range of *nevadensis* in Arizona. This bird (coll. U. S. National Museum No. 49771, female [though marked "male" in two places on the label], collected at Camp Grant, 60 miles east of Tucson, Arizona, February 10, 1867) has been available to me for examination. It has also recently been the subject of careful study by A. J. van Rossem (1926, p. 227), who has pointed out certain peculiarities of the specimen. His suggestion that its true identity may lie in the direction of the later-described *fortis* may be correct, and at any rate serves to indicate the indeterminate nature of this unfortunately chosen type specimen. It differs from the mode of the *Agelaius* of the lower Colorado Valley, to which the name *sonoriensis* has been generally applied, in having a distinctly heavier, stubbier bill, in which particular it can not be matched in a large series of Colorado River birds. In coloration, however, it is closely similar to some females from the Colorado River, and correspondingly different from the mode of *nevadensis* and *fortis*. Altogether, I am disposed to let the name *sonoriensis* continue to stand for the Colorado River form, and to regard the type specimen as a stray or migrant, a winter-taken bird from beyond the normal breeding range of the subspecies. There has been already such a confusion of the names applied to this race, as well as to the proper type locality, that I am unwilling to suggest a change that might cause further trouble.

The point I wish to emphasize here is the fact that there are two subspecies of *Agelaius phœniceus* breeding in southern Arizona, one occupying the valley of the lower Colorado River and its tributaries as far east as Tucson, the other, the region east from the Santa Catalina and Santa Rita mountains. Breeding birds from Phoenix and Tempe are mostly indistinguishable from Colorado Valley specimens. Breeding birds from near Tucson are intermediate, some of

Measurements in millimeters of *Agelaius phœniceus nevadensis*

Collection	No.	Sex	Locality	Date	Wing	Tail	Cul-men	Depth of bill	Tar-sus
C. A. S.	29597	♂	Patagonia, Arizona	May 11, 1927	125.0	91.5	21.0	11.0	29.5
C. A. S.	29598	♂	Patagonia, Arizona	May 15, 1927	127.0	92.2	22.0	11.5	32.0
C. A. S.	29595	♂	Patagonia, Arizona	May 16, 1927	115.0	91.2	20.5	10.0	28.0
C. A. S.	29596	♂	Patagonia, Arizona	May 16, 1927	122.0	92.5	21.0	11.0	29.5
C. A. S.	29593	♂	Patagonia, Arizona	May 19, 1927	118.5	83.5	21.0	11.5	30.0
C. A. S.	29594	♂	Patagonia, Arizona	May 20, 1927	118.0	83.0	21.0	10.0	29.5
C. A. S.	29599	♂	Patagonia, Arizona	May 31, 1927	123.0	86.0	20.0	10.5	31.0
C. A. S.	29591	♂	Patagonia, Arizona	May 15, 1927	121.0	87.5	23.0	12.0	30.0
				Average	121.2	88.4	21.2	10.9	29.9
				Minimum	115.0	83.0	20.0	10.0	28.0
				Maximum	127.0	92.5	23.0	12.0	32.0

them having distinctly heavy and stubby bills, as compared with the slender-billed western race, but on the whole they are best associated with the Colorado Valley subspecies.

80. **Sturnella magna hoopesi** Stone

Meadowlarks were seen by us in San Rafael Valley on May 23 and 25, in pairs, widely spaced over the grassy plains. Later a number were seen at the northeastern base of the Santa Ritas, some miles north of Camp Crittenden. They were more abundant in both places at the end of the summer, in September and October. Specimens collected were all of the subspecies *hoopesi*, and I am satisfied that all the meadowlarks seen east of the mountains were of that form. The characteristic song of *neglecta* was never heard. There is a specimen of *neglecta* at hand, collected by D. M. Gorsuch near Patagonia, March 5, 1927, and I, myself, have taken the species in the fall somewhat farther east, near the Huachuca Mountains, but the facts suggest *neglecta* to be a winter visitant only in that part of Arizona.

Hoopesi has apparently an unusually protracted breeding season and a correspondingly lengthened period of plumage change. A female shot in San Rafael Valley on May 25 had laid part of its set, but on the same day a young bird was collected, nearly full-grown and able to fly. Other young birds, almost entirely or altogether in juvenal plumage were taken as late as October 4. An adult shot September 1 is still in worn breeding dress, having not yet begun the molt, and another collected October 4 is in the midst of the change, tail-less and scarcely able to fly. On the other hand, an adult taken September 14 is practically through the molt.

It seems impossible to indicate characters that will differentiate *hoopesi* and *neglecta* in all stages of plumage. Call notes and songs of the two are unfailing indicators in the field. In the adult bird the presence or absence of yellow on the malar region is the best single character, and it is one that is usually to be depended upon. *Neglecta* is not a grayer colored bird than *hoopesi*, though it has been so described. In fact, California examples of *neglecta* are generally of a decidedly richer brown. In *neglecta* the yellow of the underparts is not paler than the average of *hoopesi*. Some fall specimens of *hoopesi* have the yellow decidedly of an orange hue, but this is not always the case, and such spring specimens of *hoopesi* as I have handled have the yellow about as in *neglecta*, paler than in most California examples of that species. Usually in fresh fall plumage *hoopesi* is more buffy on flanks and lower tail coverts than is *neglecta*. Juvenal-plumaged *hoopesi* and *neglecta* are not to be distinguished, so far as I can see. Length of tarsus, shorter in *neglecta*, longer in *hoopesi*, is the most reliable structural character that I have found.

We collected 35 specimens of *Sturnella magna hoopesi*, mostly from San Rafael Valley, a few from the vicinity of Sonoita (Nos. 29606-29611, 29615, 30021-30048).

81. **Sturnella neglecta** Audubon

As mentioned above, a specimen of *neglecta* (No. 30749) was shot by D. M. Gorsuch near Patagonia, March 5, 1927, the only record we have for the species on the east side of the Santa Ritas. In the Santa Cruz Valley a few meadowlarks were seen as we passed along the road some ten or twelve miles south of Tucson, and, though these were not specifically identified, it seems likely that they were *neglecta*, which has been found in that section before. *Hoopesi* has never been taken there.

We saw no meadowlarks on the Santa Rita Range Reserve while we were there in June. On the nearby mesa below the mouth of Madera Cañon, Miss McLellan saw none in the fall until October 7, on which day a number suddenly appeared. Two collected proved to be *neglecta* (Nos. 30293-30294).

82. **Icterus parisorum** Bonaparte

Our camp near Patagonia (elevation 4700 feet) was just below the level at which this species breeds in this region. The song was heard occasionally on the hillsides above, and now and then one of the birds was seen. At our camp at the west base of the mountains (elevation 4000 feet) conditions were about the same. Three specimens were collected, all breeding males (Nos. 29612-29614). These are all in plumage stages intermediate between the juvenal and the full-plumaged male. It is a curious fact that in southern Arizona, while high-plumaged birds preponderate when the species first arrives from the south, in March and April, breeding birds are, in my experience, almost all in the imperfect, presumably immature, stage. A corresponding stage exists in the males of the other two orioles in this region, *nelsoni* and *bullocki*, but not nearly so commonly. High-plumaged birds are in the majority in those two species.

83. **Icterus cucullatus nelsoni** Ridgway

Present in small numbers in the vicinity of Patagonia; abundant in the lowlands at the west base of the Santa Ritas. Thirteen specimens were collected (Nos. 29616-29628), consisting of five fully mature males, two males breeding but in imperfect plumage, and six adult females.

84. **Icterus bullockii** (Swainson)

A common species in the Patagonia region, frequenting mostly the rows of cottonwoods and sycamores along the stream beds. On the west side of the mountains the Bullock Oriole was much less abundant, thus reversing conditions as observed in the Arizona Hooded Oriole. Five specimens were collected (Nos. 29629-29633), three high-plumaged males, one breeding male in immature plumage, and one adult female, all taken near Patagonia.

85. **Euphagus cyanocephalus cyanocephalus** (Wagler)

An adult female (No. 29605) was taken on the Ashburn Ranch, May 13. Exact manner of occurrence of the species there can not be stated, as it was some days before I realized that the small companies of black birds we were seeing were Bronzed Cowbirds, not the Brewer Blackbird. The species is doubtless a winter visitant to the region, and the one bird collected was probably a straggler that had lingered after most of its kind had gone on. In the fall a few were seen near Fairbank on September 26. About Patagonia flocks were passing through, apparently migrating, during the first week in October.

86. **Passer domesticus** (Linnæus)

Present in fair abundance in the Patagonia region. To be seen everywhere about human habitations, and some birds were even noted carrying building material into cottonwood trees far removed from any houses. Much less common at the west base of the Santa Ritas, where, in fact, only a few were seen. In southern Arizona generally the species has arrived everywhere where conditions are satisfactory. This general dispersal has been accomplished within the last 25 years (see Swarth, 1914, p. 50).

87. **Carpodacus cassinii** Baird

A common winter visitant to southern Arizona, mostly in the mountains. One specimen (No. 29634), an adult female, taken near Patagonia, May 20, was the only one seen. This bird had undoubtedly lingered beyond the usual time of departure.

88. **Carpodacus mexicanus frontalis** (Say)

Present in fair abundance both in the Patagonia region and at the west base of the mountains. Full-grown young were flying about by June 1. Four specimens collected (Nos. 29635-29637, 30295), an adult male, adult female, juvenile female, and an (apparently) immature male. The last mentioned specimen, collected October 11, is in an unusual plumage for this species. It is a male bird that has passed beyond the juvenile stage but has not acquired the usual red plumage. It is in the streaked female plumage but with small patches of red, little more than traces, on breast, top of head, and rump.

89. **Astragalinus psaltria hesperophilus** Oberholser

Present in fair abundance, and breeding, in the Sonoita Valley near Patagonia, in lesser numbers at the west base of the Santa Ritas. Ten specimens were preserved (Nos. 29638-29640, 30049-30055): In the early summer two adult males and one full-grown juvenile, the latter collected on June 5; in the fall seven specimens, on dates ranging from August 29 to October 8. Arizona examples of this species are to my eye indistinguishable from Californian specimens. In both regions partly black-backed individuals occur, such as served as a basis for the name *arizonæ.* I do not believe that increasing age brings on an increased amount of the black, but rather that it is individual variation and that it becomes rather more common toward the east.

90. **Spinus pinus pinus** (Wilson)

A few Pine Siskins still lingered in the vicinity of Patagonia during the month of May, two specimens (Nos. 29641, 29642), collected May 19 and 21, respectively, being the last that were seen. Siskins from southern Arizona average rather paler colored and are less heavily streaked below, as compared with specimens from the Pacific coast. These differences may indicate an approach toward the Mexican subspecies, *macropterus,* but I can not detect any corresponding variation in size. In southern Arizona, moreover, the Pine Siskin occurs only as a winter visitant, and such birds may, of course, have come from some region far to the northward. Definite breeding records in Arizona are all from the Mogollon Divide and northward. There is apparently an hiatus here between the southern breeding limit of *S. pinus pinus* and the habitat of *S. pinus macropterus,* of Mexico.

91. **Calcarius ornatus** (J. K. Townsend)

A migrant and winter visitant in southeastern Arizona. First appeared in San Rafael Valley October 9, seen there again in some numbers on October 10, and near Sonoita on October 11. Twelve specimens were collected (Nos. 30056-30067).

92. **Poœcetes gramineus confinis** Baird

Seen during the fall migration, when it appeared in abundance on the mesa below Madera Cañon, and in the vicinity of Patagonia. Fourteen specimens were collected at each of these localities, 28 in all (Nos. 30068, 30069, 30071-30082, 30296-30309), on dates ranging from September 13 to October 11.

93. **Passerculus sandwichensis nevadensis** Grinnell

Among the swarms of sparrows that appeared in the fall in the grassland east of the Santa Ritas there were some Savannah Sparrows. Five specimens were collected, two in San Rafael Valley, three near Sonoita, between September 14 and October 11 (Nos. 30070, 30083-30086). All are of the subspecies *nevadensis*.

94. **Ammodramus bairdii** (Audubon)

Two specimens collected in San Rafael Valley, a molting and very ragged adult on October 1, another nearly through the molt, October 10 (Nos. 30087, 30088). The species has been reported as occurring in large numbers in this part of Arizona in the fall (Henshaw, 1875, p. 253) and in the spring (Swarth, 1904, p. 38). It has not been found anywhere west of the Santa Rita Mountains.

95. **Ammodramus savannarum bimaculatus** Swainson

We found a few Western Grasshopper Sparrows in San Rafael Valley, 15 miles east of Patagonia, May 23 and 25. There were swales in which there was a fairly dense growth of tall "bunch-grass," and the birds could not be forced to leave this shelter. In the fall they were found in the same place, and also near Sonoita. There are previous records by Henshaw (1875, p. 25) and by Nelson (see Bailey, 1923, p. 38) of midsummer occurrences in the Sonoita Valley. We collected eight specimens (Nos. 29643-29646, 30089-30092): four adults, not yet breeding, May 23 and 25; two in juvenal plumage, September 7, October 4; a molting adult, October 10; one in fully acquired winter plumage, October 6.

96. **Chondestes grammacus strigatus** Swainson

Common in the vicinity of Patagonia and elsewhere in the Sonoita Valley. Three specimens collected there in May (Nos. 29647-29649). Not seen at the western base of the Santa Ritas during June, but one specimen collected below Madera Cañon on September 27 (No. 30310).

97. **Zonotrichia leucophrys** (Forster)

Fairly common in the Sonoita Valley early in May, being one of the last of the migrants to depart. Last seen May 24. Three specimens collected (Nos. 29650-29652). An immature female was collected below Madera Cañon, October 6 (No. 30312).

98. **Zonotrichia gambelii** (Nuttall)

First seen at the western base of the Santa Ritas, below Madera Cañon, on September 27, and found in increasing numbers soon after. Immatures were greatly in excess of white-crowned adults. Five specimens collected, between September 27 and October 5 (Nos. 30311, 30313-30316). For my reasons for using the binomials, *Zonotrichia leucophrys* and *Z. gambelii*, see Swarth, 1926, p. 123.

99. **Spizella passerina arizonæ** Coues

Does not breed in southern Arizona but appears in numbers toward the end of the summer. One of the most abundant of birds during September and October about Patagonia and in Madera Cañon. There were many streaked juveniles in the first arriving flocks. A few individuals had finished the post-juvenal molt by the middle of September, but these were exceptions. An adult collected on September 17 had hardly begun to molt and molting birds were collected throughout September and in early October. Eighteen specimens were taken in the Patagonia region, and 35 in and below Madera Cañon, on dates ranging from September 2 to October 10 (Nos. 30093-30110, 30328-30362).

100. **Spizella breweri** Cassin

A very few, the last departing migrants, were seen near Patagonia in May, the last on May 15. In the fall they returned in large numbers, both at Patagonia, east of the Santa Ritas, and below Madera Cañon, on the west side. Eighteen specimens were collected, one on May 12, the others between August 30 and October 12 (Nos. 29653, 30111-30117, 30317-30327).

101. **Junco phæonotus palliatus** Ridgway

A common species in the Santa Rita Mountains at a higher altitude than that where most of our collecting was carried on. Seven specimens were collected in Madera Cañon during September (Nos. 30363-30369).

102. **Amphispiza bilineata deserticola** Ridgway

Fairly common on the rocky hills bordering the Sonoita Valley near Patagonia. Abundant at the west base of the Santa Ritas, on the Santa Rita Range Reserve and throughout the valley below. Young out of the nest were collected on June 5 and a bird still in juvenal plumage was taken September 23. The fall molt lasts well into October. Twenty-two specimens were collected (Nos. 29654-29659, 29692, 30118-30120, 30370-30381).

103. **Peucæa cassinii** (Woodhouse)

Not seen during May and June. In the late summer, eight specimens (Nos. 30121-30128) were taken within ten or twelve miles of Patagonia between August 27 and September 23. Six (Nos. 30382-30387) were collected below the mouth of Madera Cañon on September 27 and 28; they seemed to be present there only during two or three days. The species has not been proven to breed in southern Arizona, and this series does not definitely settle the question.

If it were not for the fact that we failed to find this bird in May and June (and I was searching for it over the exact ground where it was found in the fall) I would have assumed that the series taken in August and September were certainly representative of a breeding species. One bird collected on August 27, just beginning the annual molt, is marked as having "testes still fully enlarged," and adults and young collected during September are variously advanced in the molt. It seems likely, though, that the species is a migrant here from some more northern point.

It is noteworthy that neither *Peucæa botterii* nor *Aimophila carpalis* were seen by us though we were in the exact region where both had been found in abundance in years past. So far as I know neither species has been observed in Arizona for many years. These species of *Peucæa* and *Aimophila* occupied the grass-grown lowlands, and it is possible that the over-grazing of this region which had for one result the disappearance of *Colinus ridgwayi* also brought about the local extinction, or near-extinction, of the less conspicuous sparrows. *Peucæa cassini*, apparently not a breeding species, returns on migration, but the others, deprived of shelter on their nesting grounds, seem to be gone, or, at any rate, to have become extremely scarce.

104. **Aimophila ruficeps scottii** (Sennett)

The Sonoita Valley is just below the breeding limit of this species, which is primarily a bird of the Upper Sonoran zone. A few were seen in Temporal Cañon and elsewhere in the surrounding hills, and some were found also near the western base of the Santa Ritas, in Sawmill, Stone Cabin and Madera cañons, above 4000 feet. Birds in juvenal plumage were taken as late as September 14, and an adult not yet beginning the annual molt on September 13. Ten specimens were collected, including three juveniles (Nos. 29660-29662, 30129-30132, 30388-30390).

105. **Melospiza melodia saltonis** Grinnell

We found song sparrows only in the river bottom a few miles below Patagonia, where an abundance of tangled vegetation, long grass and running water made a favorable combination that was not encountered elsewhere. Four specimens were collected there on June 1, two adults and two juveniles, and five more between September 2 and October 8 (Nos. 29663-29666, 30133-30137). Young in juvenal plumage throughout were taken as late as September 15.

These birds are darker colored and more heavily streaked on the breast than comparable specimens from the Colorado River. I have collected similarly dark-colored song sparrows near Fairbank, on the San Pedro River, some 30 miles northeast of Patagonia, and these two localities may be regarded as close to the eastern limit of the range of the subspecies *saltonis*.

106. **Melospiza melodia fallax** (Baird)

One specimen collected near Patagonia, October 8 (No. 30138). This subspecies occurs as a winter visitant in southern Arizona. For use of the name *fallax* for the Rocky Mountain Song Sparrow see Grinnell, 1914, p. 174.

107. **Melospiza lincolnii lincolnii** (Audubon)

A common migrant and winter visitant. Four specimens collected near Patagonia, between September 21 and October 7 (Nos. 30139-30142).

108. **Pipilo fuscus mesoleucus** Baird

A common species in the foothills and at the base of the mountains on both sides of the Santa Ritas. The nesting season is evidently a long one; a male taken September 8 had testes still in breeding condition. On May 11 a nest was found containing three fresh eggs, and at the same time nearly full-grown young were flying about. A nest in course of construction was found on May 20. Such nests as I saw were in willow or mesquite, from five to seven feet above the ground. On the Santa Rita Range Reserve, several miles from the mountains, during the third week in June, Cañon Towhees were abundant and in loosely assembled flocks of as many as eight or ten birds. A young bird still in juvenal plumage was collected on September 18; the annual molt of the adults is not finished until nearly the middle of October. Twenty-nine specimens were collected (Nos. 29667-29679, 30143-30152, 30392-30397).

109. **Oberholseria chlorura** (Audubon)

A late migrant through southern Arizona in the spring. A few stragglers were seen at intervals near Patagonia during the first three weeks in May, the last on May 20. They re-appeared in numbers early in September on both sides of the mountains. Eight specimens were collected, two in May, six between September 7 and October 3 (Nos. 29680, 29681, 30153-30156, 30398-30400).

110. **Cardinalis cardinalis superbus** Ridgway

Abundant in the western foothills of the Santa Rita Mountains. Not seen by us in May in the Sonoita Valley; so far as I know the species has not been found breeding east of this point in southern Arizona. At the western base of the Santa Ritas a nest was found on June 7 at the mouth of Stone Cabin Cañon, placed on a branch of a mesquite, about six feet from the ground. It contained two young birds, probably about a week old. Four specimens were collected near Patagonia in the fall, three on September 9, one on October 5. A young male shot September 9 is in the midst of the post-juvenal molt, with large tracts of red plumage. The bill is still black. An adult female taken the same day is also ragged with molt, and an adult male taken October 5 has nearly completed the molt. Sixteen specimens in all were collected (Nos. 29682-29691, 30157-30160, 30547, 30548).

111. **Pyrrhuloxia sinuata sinuata** (Bonaparte)

Seen at various points at the north end and along the western base of the Santa Rita Mountains, but nowhere as abundantly as the Arizona Cardinal, which it resembles so closely in general appearance and in habits. On June

8, five adult males were seen chasing each other through a mesquite thicket. Two specimens were collected, adult males, taken near the mouth of Sawmill Cañon (Nos. 29693, 29694).

112. **Hedymeles melanocephalus melanocephalus** (Swainson)

The Sonoita Valley is probably just below the lower limit of the breeding range of this species, but migrating individuals passed through there in numbers during the first three weeks in May. At the same time others were nesting in the surrounding cañons at only a slightly higher level. A nest found in Temporal Cañon on May 20, contained three eggs. It was the usual flimsy structure, placed near the end of a drooping sycamore limb, about 12 feet from the ground. Fairly common in September, both at Patagonia and in Madera Cañon. Twelve specimens collected, seven adults in early summer, five immatures in the fall, between August 28 and September 21 (Nos. 29695-29701, 30161-30163, 30401, 30402).

113. **Guiraca cærulea interfusa** Dwight & Griscom

A common summer visitant in southern Arizona to such lowland localities as have some running water. The first arrival was seen near Patagonia on May 14, and increasing numbers appeared during the next two weeks. The species was present, but not common, at the western base of the Santa Rita Mountains, where specimens were taken near the Florida Ranger Station. A few were seen along the road side in irrigated sections of the Santa Cruz Valley during June; the species is known to be fairly abundant there. The latest fall specimen was taken near Patagonia on September 28. An adult male shot on August 28 has not begun the post-nuptial molt. Young males taken September 5 and 28 are in first winter plumage throughout. Twelve specimens collected, eight adult males, one adult female, three immature males (Nos. 29702-29709, 30164-30167). I am following Dwight and Griscom (1927, p. 4) in applying the name *interfusa* to the Arizona race of the Blue Grosbeak.

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114. **Passerina amœna** (Say)

Migrating commonly in the Sonoita Valley. First seen on May 12, and abundant a few days later. An adult male observed at the Florida Ranger Station on June 16 may have been an indication that the species was nesting there, farther south in Arizona than it has yet been found breeding. An adult male and two adult females were collected in the vicinity of Patagonia, May 19 and 27 (Nos. 29710-29712), seven more between August 30 and October 3 (Nos. 30168-30174). Young birds mostly in juvenal plumage were shot early in September. An adult male taken September 28 and a female on October 3 have nearly finished the molt. In the male bird the blue body color is almost entirely hidden by brown feather tips. Wearing away of these tips would reveal the usual summer plumage.

115. **Spiza americana** (Gmelin)

An immature female (No. 30175) was collected by Mailliard four miles south of Patagonia on September 24. The species has previously been recorded from Arizona by Henshaw (1875, p. 295), who took specimens on the San Pedro River, at Fort Crittenden and at Fort Lowell, in August and September, 1873 and 1874; and by Scott (1887, p. 205), from a specimen taken by Herbert Brown at Tucson, September 11, 1884.

116. **Calamospiza melanocorys** Stejneger

A flock of 300 or more seen near Continental on September 25, and two birds at a point five miles north of Patagonia on October 13. A common winter visitant to the region.

117. **Piranga ludoviciana** (Wilson)

Migrating commonly along the Sonoita Valley during the middle of May. Common until May 20, and one bird collected as late as May 28. Three specimens were preserved, two males and one female. Seen again in the fall, when specimens (all birds of the year) were collected at Patagonia, August 28 to September 11, and in Madera Cañon, September 4 to 15. Ten specimens in all were collected (Nos. 29713-29715, 30176-30179, 30403-30405).

118. **Piranga hepatica oreophasma** Oberholser

This is a species mostly of the Transition zone, and its occurrence in the foothills near Patagonia was merely as a migrant, and a rather uncommon one. It was not seen on the floor of the valley, but usually in the oaks of the surrounding hills. A female collected in Temporal Cañon (altitude about 4500 feet) on May 28 was evidently incubating eggs at the time. The species was seen occasionally in the cañons at the western base of the Santa Rita Mountains in June, and fairly commonly in Madera Cañon in the fall. Five specimens were collected in May and June, three red-plumaged males, one male, adult but in female plumage, and one adult female (Nos. 29716-29720). Six collected in Madera Cañon between September 8 and 25 (Nos. 30406-30411) are all nearly through the molt.

119. **Piranga rubra cooperi** Ridgway

An abundant species in the Sonoita Valley and but little less so at the western base of the Santa Ritas. Near Patagonia mating was going on during the second week in May, the birds frequenting mostly the rows of large cottonwoods and sycamores along the stream beds. Although the species is so common there, that section marks practically the eastern limit of the breeding range in southern Arizona. At the base of the Huachuca Mountains, some 30 miles east of Patagonia, the Cooper Tanager occurs as an uncommon migrant; there are no breeding records from that range.

Sixteen specimens were collected in the early summer, twelve males and four females (Nos. 29721-29736). These are all breeding adults, but one of the males is almost indistinguishable from females, having just a few pale red feathers scattered over head and body, a second has somewhat more of such reddish areas, while a third has the throat, pileum, intercapulars, and tail as brilliantly red as in the fully mature male, the red areas being sharply defined against the generally yellowish body coloration. The remaining nine male birds are in uniformly bright red plumage. None of the parti-colored birds is in process of molt. It has been assumed that this imperfect plumage is a sign of immaturity and that several years are required for its perfection. This may be true, but I do not think that it has been proved. The parti-colored birds are relatively rare, not nearly so common as the red males, and if each individual passed through the same sequence of plumages the mottled birds should be the more numerous.

Ten were collected near Patagonia in the fall, between August 28 and October 7 (Nos. 30180-30189). Two males, shot August 28 and 31, respectively, are changing from yellow to red plumage, and on these birds there are remnants of yellow over all parts. Fully mature males, red throughout, and nearly or quite through the annual molt, were taken September 6 and 28, and October 7. Immature birds, entirely through the post juvenal molt, were collected August 28 and 29.

120. **Petrochelidon lunifrons melanogastra** (Swainson)

A few cliff swallows were nesting on buildings in the town of Patagonia and elsewhere in the valley, and they were abundant there during the first half of September. Four specimens (Nos. 30190-30193) were collected near Patagonia on August 31, one adult male in worn breeding plumage and three young birds. These skins are not such as to show subspecific characters very well, but there is a series of breeding birds in the collection of Dr. L. B. Bishop from this same region, unmistakably of the subspecies *melanogastra*.

121. **Hirundo erythrogastra** Boddaert

A fairly common summer visitant to southern Arizona, mostly about human habitations. Seen in and about Patagonia until the middle of September. Two specimens collected on September 16 (Nos. 30194-30195).

122. **Tachycineta thalassina lepida** Mearns

Abundant about Patagonia during the first two weeks in September. Two young birds (Nos. 30196, 30197) were collected on September 7 and 10, respectively.

123. **Stelgidopteryx serripennis** (Audubon)

Found nesting, or preparing to do so, along various dry stream beds in the Sonoita Valley. A female collected on May 22 had laid part of its set. Two specimens collected (Nos. 29737, 29738).

124. **Bombycilla cedrorum** Vieillot

Two birds, presumably a pair, seen, and one (No. 29739) collected, on the Ashburn Ranch, May 29. These were probably late migrants or winter visitants; the species is not known to breed in this region.

125. **Phainopepla nitens** (Swainson)

Present in small numbers about Patagonia when we arrived early in May, and increasing greatly toward the end of the month. On the west side of the mountains, in June, flocks of Phainopeplas (loose assemblages of 20 or 30 individuals) appeared every afternoon, flying up Stone Cabin Cañon. Six specimens collected (Nos. 29740, 29741, 30412-30415), including four males in fresh fall plumage that were taken below Madera Cañon, October 10 to 13.

126. **Lanius ludovicianus excubitorides** Swainson

A rare bird in the vicinity of Patagonia, where it was seen on but a few occasions. West of the mountains, on the Santa Rita Range Reserve, shrikes were present in fair abundance. During the second week in June several broods of young were encountered, evidently just out of the nest. Seven specimens were collected there, three adults and four juveniles (Nos. 29742-29748). The old birds (June 10, 13, 13) are in badly worn plumage but not yet beginning to molt. The young (June 8, 14, 16) are in juvenal plumage throughout. In the fall a molting adult was taken near Patagonia, September 8, and two immatures below Madera Cañon, September 26, and October 1, respectively (Nos. 30198, 30416, 30417).

127. **Vireosylva gilva swainsonii** (Baird)

A few seen, presumably migrating, near Patagonia, the last on May 21. Abundant in the fall, when two specimens were taken near Patagonia and six in Madera Cañon on various dates between September 5 and 21 (Nos. 30199, 30200, 30418-30423). An adult shot September 5 had not yet begun the annual molt.

128. **Lanivireo solitarius cassinii** (Xantus)

A common migrant. One specimen collected at Fort Crittenden, September 19, and nine in Madera Cañon, between September 13 and 26 (Nos. 30201, 30424-30432).

129. **Lanivireo solitarius plumbeus** (Coues)

One specimen (No. 30433) taken in Madera Cañon on September 20. This probably is about as late a date as the species remains.

130. **Vireo huttoni stephensi** Brewster

One bird collected at the lower edge of the oak belt on the Ashburn Ranch, May 21, and one in Madera Cañon, September 19 (Nos. 29749, 30434).

131. **Vireo belli arizonæ** Ridgway

Rather uncommon in the Sonoita Valley. At the western base of the Santa Ritas this is a common bird, and individuals were heard singing on all sides in the mesquite thickets. The preference the Arizona Least Vireo shows for mesquite-bordered dry washes is a life history trait that contrasts strongly with the California Least Vireo's choice of willow-grown bottom lands. In the Sonoita Valley near Patagonia there are willow bordered streams, such as the California bird frequents, but Least Vireos were decidedly rare there, in contrast to their abundance in mesquite thickets elsewhere. Three adults were collected in June below Sawmill Cañon, and one in Madera Cañon, September 16 (Nos. 29750-29752, 30435). These and other Arizona specimens at hand bear out the validity of the subspecies *arizonæ*, as yet not recognized in the A. O. U. *Check-list*.

132. **Vermivora luciæ** (J. G. Cooper)

Abundant in the Sonoita Valley near Patagonia, and somewhat less numerous at the west base of the Santa Rita Mountains. A nest with four eggs was taken on the Ashburn Ranch, May 19. It was in a hole (apparently an old knot hole) in the trunk of a mesquite, three and one-half feet from the ground. The hole was about 1¾ inches across, and about 3 inches high. The nest, about 1½ inches in diameter, was only an inch or so within the opening, and the eggs could be seen from outside. The nest was composed of shreds of dry mesquite bark, some feathers, and mammal fur. Six skins of the Lucy Warbler were preserved, two males and six females, all adult (Nos. 29753-29758).

133. **Vermivora ruficapilla gutturalis** (Ridgway)

A common migrant. Five specimens from Patagonia and six from Madera Cañon, on various dates from August 31 to September 27 (Nos. 30202-30206, 30436-30441).

134. **Vermivora celata lutescens** (Ridgway)

Two collected near Patagonia on the fall migration, on September 16 and October 3, respectively (Nos. 20307, 20308).

135. **Dendroica æstiva sonorana** Brewster

136. **Dendroica æstiva brewsteri** Grinnell

Yellow warblers were seen daily during May in the Sonoita Valley, but not in any numbers. *Brewsteri* was migrating through the region at the time, and of the five yellow warblers collected, four (Nos. 29759-29762) proved to be of this subspecies. These were taken May 12, 13, and 15. One specimen of *sonorana*, a breeding bird, was shot on May 18 (No. 29763); an adult male in fresh fall plumage was taken on August 31 (No. 30209). Migrating examples of *brewsteri* were collected in Madera Cañon on September 6 and 15 (Nos. 30442, 30443).

137. **Dendroica auduboni auduboni** (J. K. Townsend)

A few migrants were still passing through the Patagonia region during the second week in May. Two specimens were collected on May 14 (Nos. 29764, 29765). Last seen on May 15.

138. **Dendroica nigrescens** (J. K. Townsend)

Breeds commonly in the live-oak belt. Three specimens (Nos. 30444-30446) collected in Madera Cañon in the fall, the last on October 10. This is, perhaps, as late a date as the species has been reported in southern Arizona.

139. **Dendroica townsendi** (J. K. Townsend)

A few migrating individuals seen early in May. Last observed May 17.

140. **Oporornis tolmiei** (J. K. Townsend)

Migrating in small numbers early in May. One specimen collected on May 13, the last observed (No. 29766). Abundant in the fall. Six taken near Patagonia and two in Madera Cañon, from August 28 to September 29 (Nos. 30210-30215, 30447, 30448).

141. **Geothlypis trichas scirpicola** Grinnell

142. **Geothlypis trichas occidentalis** Brewster

The breeding yellowthroat of southern Arizona is distinguishably different from the migrant that passes through the region. To the breeding bird I have in previous publications applied the name *scirpicola* (Swarth, 1912, p. 71), as I do here, in order to indicate this difference, but this is an unsatisfactory arrangement. Specimens are hard to obtain and there are few available. I feel that an adequate series might show the yellowthroat of southeastern Arizona to belong to the form *melanops,* of the Mexican plateau. An adult male collected by myself on the San Pedro River, July 6, 1902, and sent at that time to Mr. Ridgway for his inspection was pronounced by him as "approaching *Geothlypis trichas melanops.*" (In this connection see also Ridgway, 1902, p. 674, footnote.) It is a large, bright colored bird, with the lower parts almost entirely yellow.

A few pairs of yellowthroats occupied the limited areas where suitable surroundings exist in the vicinity of Patagonia. An adult female was taken in tules bordering one of the small lakes on the Ashburn Ranch on May 24, another along the Sonoita three miles south of Patagonia, on June 1 (Nos. 30739, 30740). Two adult males that were collected near Patagonia on September 15 are in the midst of the annual molt (Nos. 30216, 30217). The migrating form (*occidentalis*) was sparingly present in the Sonoita Valley early in May. Two specimens (Nos. 29767, 29768) were collected, the last on May 19.

143. **Icteria virens longicauda** Lawrence

A common bird in the Sonoita Valley. Not often seen, but in full song and heard daily at many different points. Five specimens collected: three adults taken in May; a young bird in the post-juvenal molt, September 2; an adult nearly through the annual molt, September 9 (Nos. 29769-29771, 30218, 30219).

144. **Wilsonia pusilla pileolata** (Pallas)

145. **Wilsonia pusilla chryseola** Ridgway

This species (represented most abundantly by the subspecies *pileolata*) is a common migrant in southern Arizona. It passes through later in the spring than most transients, and was seen in some numbers near Patagonia during May, when three specimens of *pileolata* (Nos. 29772-29774) were collected. In the fall, at the same place, six specimens of *pileolata* (Nos. 30222-30227) and two of *chryseola* (Nos. 30220-30221) were taken from August 28 to September 15. In Madera Cañon, September 7 to 26, five specimens of *chryseola* (Nos. 30449-30453) and two of *pileolata* (Nos. 30454, 30455) were secured.

146. **Setophaga picta** Swainson

A common species in the Transition zone of the Santa Rita Mountains. Seen by our party whenever individuals ascended the cañon above the Florida Ranger Station to a level a few hundred feet above our camp. Full-grown young were flying about during the first week in June. Abundant in Madera Cañon during September. By September 1 young birds had all passed through the post-juvenal molt and were indistinguishable from adults. One specimen taken near Patagonia, September 15. Thirteen specimens in all were preserved (Nos. 29775-29777, 30228, 30456-30464).

147. **Mimus polyglottos leucopterus** (Vigors)

Abundant everywhere in the lowlands. About Patagonia and at the west base of the Santa Ritas the Mockingbird was one of the most common birds. Numerous below Madera Cañon in the fall, when two were taken, on October 10 and 12, respectively. Five specimens in all were collected (Nos. 29778-29780, 30465, 30466).

148. **Toxostoma curvirostre curvirostre** (Swainson)

149. **Toxostoma curvirostre palmeri** (Coues)

Thrashers of this species occur in small numbers in the Sonoita Valley and elsewhere eastward from the Santa Ritas, in great abundance from the western base of the mountains westward. J. Eugene Law (1928, p. 151) has called attention to the fact that the form occurring in the southeastern corner of Arizona is *curvirostre*, and not *palmeri*, which assertion is borne out by the material we collected. Ten specimens were taken in the Patagonia region, two males and two females, adult, in May, three males and one female, adult, in September and October, and two in juvenal plumage, one shot May 14, the other September 6; and four were collected at the west base of the Santa Ritas, two adults in October and two juveniles in June (Nos. 29781-29787, 30229-30233, 30467, 30468). For the purpose of this study this series has been supplemented by additional specimens from Tucson and from points in Cochise County, in extreme southeastern Arizona.

Differences between the two lots, east and west of the Santa Ritas, are, in most cases, fairly apparent, especially so in the freshly assumed fall plumage. The eastern birds (*curvirostre*) are rather more slaty above, have fairly well marked white wing bars, have sharply defined white tips to the outer rectrices, and the breast spots are large and fairly well defined. The western birds (*palmeri*) are browner above, lack the wing bars, have the tail spots obscurely indicated or else entirely wanting, and have the breast spots less distinct. There are some anomalous specimens at hand from points east of the mountains that may be explained as illustrating intergradation between two closely related subspecies, or, perhaps, as being wanderers (they were taken out of the breeding season) from their normal habitat. As a rule, though, birds from the two regions are sufficiently unlike to justify Law's (*loc. cit.*) disposition of them. It will be noted that the eastern boundary of *Toxostoma c. palmeri*, as here restricted, is the same as that of *Toxostoma bendirei*.

On May 13 a nest of *curvirostre* was found near Patagonia containing three eggs, nearly ready to hatch; at the same time full grown young were seen. On May 28 a set of four eggs was taken. As a bird in juvenal plumage was collected on September 6, the nesting season is obviously of long duration. On June 5 a nest of *palmeri* was found containing newly hatched young. In nestlings the iris is whitish, changing to yellow during the post-juvenal molt.

150. **Toxostoma bendirei** (Coues)

Not seen on the east side of the Santa Rita Mountains. On the mesa at the western base of the range the species was probably fairly numerous, but owing to its close resemblance to the more abundant *palmeri* it was not possible to make sure of the identity of all the thrashers that were seen. One specimen of *bendirei* was preserved (No. 29788), a male shot on June 9, mostly in juvenal plumage.

151. **Toxostoma crissale crissale** Henry

The Crissal Thrasher is not nearly so generally distributed as are the Palmer and Bendire thrashers, and it is also much more secretive in its habits. Not seen by us in Sonoita Valley. Neither did we find it upon the cholla-covered mesa below the western base of the Santa Ritas, but it was discovered in some mesquite-grown washes at the mouth of Sawmill Cañon. Three birds were collected there, two adult males on June 12 and 17, respectively, and a juvenile male on June 13 (Nos. 20789-20791). An adult male (No. 30469) was taken in a similar wash below Madera Cañon on October 12, and others were seen.

152. **Heleodytes brunneicapillus couesi** (Sharpe)

Not seen by us in Sonoita Valley, where there is but little cactus suitable for the nesting sites that this bird prefers. On the Santa Rita Range Reserve it is an abundant species. Nests with small young were found there during the first week in June, and full-grown young were flying about at the same time. Late in June birds were seen at work upon newly constructed nests, but these may have been built merely as resting places, and not necessarily for the reception of eggs. Cactus Wrens sometimes use nests thus throughout the year. Six specimens of Cactus Wren were preserved, four adults and two juveniles (Nos. 29702-29706, 30470).

153. **Salpinctes obsoletus obsoletus** (Say)

Seen occasionally in the spring in the vicinity of Patagonia and also at the west base of the Santa Ritas, but not common in either place. Abundant in lower Madera Cañon in September. Eight specimens collected (Nos. 30471-30477, 30234).

154. **Catherpes mexicanus conspersus** Ridgway

One specimen, an adult male (No. 29797), was collected near our camp on the Ashburn Ranch, May 16, and others were heard singing in Temporal Cañon, near by. A pair of Cañon Wrens had a nest in a shed at the Florida Ranger Station. One was collected in Madera Cañon on October 4 (No. 30484). The species is of general distribution in suitable places in southern Arizona.

155. **Thryomanes bewickii eremophilus** Oberholser

Found near Patagonia in the live oaks and underbrush of the rocky hills bordering the valley, where full-grown young were seen during the last week in May. Not abundant, and even less numerous in June at the western base of the mountains. Common in Madera Cañon, however, in September. Fourteen specimens collected (Nos. 29798-29803, 30235, 30236, 30478-30483).

156. **Troglodytes aëdon parkmanii** Audubon

Breeds in the mountains at a higher altitude than that at which most of our work was done, moving down after the breeding season to the foothills and valleys. Fairly common in lower Madera Cañon throughout September. Six specimens collected (Nos. 29804, 30237, 30485-30488).

157. **Sitta carolinensis nelsoni** Mearns

A few of these nuthatches, the breeding season apparently over, appeared at the lower level of the oaks on the hills bordering the Sonoita Valley, during the third week in May. Others were seen there in September and in Madera Cañon in October. Eight specimens in all were collected, including two juveniles taken on May 26 (Nos. 29805-29807, 30238-30240, 30489).

158. **Bæolophus wollweberi annexus** (Cassin)

A common resident of the live-oak belt in the Santa Ritas, as in the other mountain ranges of southern Arizona. In the vicinity of Patagonia a few individuals appeared from time to time in the oaks on the surrounding hills. Abundant in Madera Cañon in the fall. The post-juvenal molt of young birds, and annual molt of adults, are not completely over until nearly the end of September. Sixteen specimens were collected (Nos. 29808-29810, 30241-30245, 30490-30498).

159. **Psaltriparus plumbeus** (Baird)

Another Upper Sonoran species that barely extends down to the floor of the Sonoita Valley, where but few were seen. As early as May 12, Lead-colored Bush-tits were seen in flocks, as though the nesting period was quite over. Ten specimens were collected, two adults and five young near Patagonia in May, and three molting birds in Madera Cañon, September 12 and 15 (Nos. 29811-29817, 30499-30501). The juveniles all had dark-colored eyes; in the adults the eye was white.

160. **Auriparus flaviceps flaviceps** (Sundevall)

A common desert species of general distribution in the lowlands of southern Arizona. A nest with two eggs was found in Temporal Cañon, May 20. Abundant in and below Madera Cañon in September and October, ascending up to 4800 feet. Fourteen specimens were preserved (Nos. 29818, 29819, 30502-30512, 30514).

161. **Regulus calendula calendula** (Linnæus)

Seen near Patagonia during the first week in October. One collected in Madera Cañon on October 11 (No. 30513).

162. **Polioptila cærulea amœnissima** Grinnell

An Upper Sonoran zone species that we saw in small numbers in the foothill country bordering the Sonoita Valley and at the western base of the Santa Ritas. One specimen collected at Patagonia, September 22, and five in Madera Cañon, September 7 to 21 (Nos. 30244, 30515-30519). For use of the name *amœnissima* see Grinnell, 1926, p. 494.

163. **Polioptila melanura melanura** Lawrence

In small numbers at the western base of the Santa Rita Mountains, in the chaparral of the Santa Rita Range Reserve. For the use of the name *melanura* see Penard, 1923, p. 335, and Grinnell, 1926, p. 496.

164. **Hylocichla ustulata ustulata** (Nuttall)

A few migrating Russet-backed Thrushes were seen near Patagonia, the last on May 30. Of three birds collected (Nos. 29820, 29821) two are so nearly intermediate in appearance between *ustulata* and *swainsoni* as to make them difficult to place. I have collected other specimens of the same nature in Arizona. The occurrence of such indeterminate specimens is, perhaps, an answer to the query raised by Van Rossem (1925, p. 37), who suggests that there is possibly specific difference between *ustulata* and *swainsoni*.

Check-List of the Mammals

1. *Myotis velifer velifer* (Allen)
2. *Myotis californicus californicus* (Audubon & Bachman)
3. *Myotis thysanodes thysanodes* Miller
4. *Corynorhinus rafinesquii pallescens* Miller
5. *Antrozous pallidus pallidus* (Le Conte)
6. *Spilogale ambigua* Mearns
7. *Mephitis estor* Merriam
8. *Urocyon cinereoargenteus scottii* Mearns
9. *Otospermophilus grammurus grammurus* (Say)
10. *Citellus spilosoma canescens* (Merriam)
11. *Citellus tereticaudus neglectus* (Merriam)
12. *Ammospermophilus harrisii* (Audubon & Bachman)
13. *Thomomys fulvus toltecus* Allen
14. *Thomomys fulvus intermedius* Mearns
15. *Perognathus flavus flavus* Baird
16. *Perognathus amplus* Osgood
17. *Perognathus baileyi baileyi* Merriam
18. *Perognathus penicillatus pricei* Allen
19. *Dipodomys spectabilis spectabilis* Merriam
20. *Dipodomys merriami merriami* Mearns
21. *Dipodomys merriami olivaceus* Swarth
22. *Dipodomys ordii ordii* Woodhouse
23. *Onychomys torridus torridus* (Coues)
24. *Reithrodontomys megalotis megalotis* (Baird)
25. *Peromyscus eremicus eremicus* (Baird)
26. *Peromyscus maniculatus sonoriensis* (Le Conte)
27. *Peromyscus leucopus arizonæ* (Allen)
28. *Peromyscus boylii rowleyi* (Allen)
29. *Sigmodon hispidus cienegæ* A. B. Howell
30. *Neotoma albigula albigula* Hartley
31. *Mus musculus musculus* Linnæus
32. *Lepus alleni alleni* Mearns
33. *Lepus californicus eremicus* Allen
34. *Sylvilagus auduboni arizonæ* (Allen)

General Accounts of the Mammals

1. **Myotis velifer velifer** (J. A. Allen)

Four specimens collected (Nos. 5963-5966), all females and all from the same tunnel (McCleary's mine, altitude about 5000 feet), from which specimens of *Myotis t. thysanodes* and *Corynorhinus r. pallescens* were also taken. One was collected on September 27, and three on October 1.

2. **Myotis californicus californicus** (Audubon & Bachman)

One specimen (No. 5967) collected in Madera Cañon, altitude 4800 feet, on October 6. In the treatment accorded the subspecies of *Myotis californicus* by Miller & Allen (1928, p. 148, map 11), it will be noted that the dividing line drawn between the forms *californicus* and *pallidus* in southern Arizona accords with that separating the Western Desert Area and the Eastern Plains Area.

3. **Myotis thysanodes thysanodes** Miller

Seven specimens collected (Nos. 5956-5962). These are all males and were all taken at the same place, in a mining tunnel (McCleary's mine), at about 5000 feet altitude in

Madera Cañon, one on September 27, three on October 1, and three on October 9.

4. **Corynorhinus rafinesquii pallescens** Miller

Three specimens collected. No. 5687, female, was taken in a cave in a limestone ledge bordering the Sonoita, seven miles north of Patagonia, on May 23. It contained one fetus. Nos. 5954, 5955, males, were found in a tunnel (the McCleary mine), in Madera Cañon at about 5000 feet elevation, on September 27. In the rocky ledge along the Sonoita there are series of caves, large and small, which, apparently, are occupied at some time of the year by a large number of bats. Our investigations in May disclosed very few, not more than six or eight individuals all told. These few bats were active and alert, departing at the first indication of danger.

5. **Antrozous pallidus pallidus** (Le Conte)

The adobe cabin that we occupied on the Ashburn Ranch evidently sheltered a number of bats, between the walls and under the roof. Several Pallid Bats were caught on May 23 and 24, as they issued from crevices in the walls at dusk, and two, both females, were preserved (Nos. 5688-5689). Two more, male and female, respectively, were collected at the same place on August 29 (Nos. 5941-5942).

6. **Spilogale ambigua** Mearns

An adult male (No. 5948) was trapped in Madera Cañon, altitude 5200 feet, on September 30.

7. **Mephitis estor** Merriam

An adult female (No. 5910) was trapped near the mouth of Stone Cabin Cañon, June 9.

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8. **Urocyon cinereoargenteus scottii** Mearns

Gray Foxes are fairly common in the Arizona mountains, extending down into the lowest foothills. One specimen, an adult female (No. 5911), was obtained by our party, trapped near our camp on the Ashburn ranch, seven miles north of Patagonia, on May 21.

9. **Otospermophilus grammurus grammurus** (Say)

An Upper Sonoran species that descends into Sonoita Valley at a few points. We saw ground squirrels occasionally along a rocky ledge bordering the bed of the Sonoita near the Ashburn ranch house, and four specimens (Nos. 5893-5896), adults in rather worn pelage, were collected there in May. Seen at about 5200 feet elevation in Madera Cañon.

10. **Citellus spilosoma canescens** (Merriam)

A small colony was found on the grounds about the old buildings of Fort Crittenden, where the animals were using, in part at least, burrows of *Dipodomys spectabilis*. Two specimens, adult females, were trapped there on June 1 and September 16, respectively (Nos. 5892, 5940), and a young male (No. 5939) was shot at a nearby locality, near Sonoita, on September 7. I was told that the species occurred in small numbers on the west side of the Santa Ritas, toward the north end of the range, but we saw none there ourselves. From the Santa Ritas eastward this species entirely replaces *Citellus tereticaudus neglectus* (see Mearns, 1907, p. 337), which in some respects it closely resembles. I have found it at various scattered points in southeastern Arizona, but never in any such numbers as *neglectus* attains to the westward. *Canescens*, moreover (and the same holds true of *obsidianus*, the only other subspecies of this species with which I am acquainted), is far more wary and retiring than the races of *tereticaudus*, so that even when present in fair abundance it may be overlooked.

11. **Citellus tereticaudus neglectus** (Merriam)

A common species on the desert plains from the Santa Rita Mountains westward, though by no means of general distribution. We found colonies along the road leading from Madera Cañon to Helvetia, covering circumscribed areas a few miles below the base of the mountains. Seven specimens (Nos. 5885-5891) were collected there on June 10 and 14, all scantily haired and nearly all in process of pelage renewal.

On June 10, Gorsuch, walking through a *Citellus* colony, caught sight of the tail of a Gila Monster (*Heloderma suspectum*) in one of the burrows, and, as he watched, the reptile slowly backed out. About its mouth *Citellus* hair adhered and when the lizard was killed and opened a spermophile was found in its stomach, swallowed entire, head first. Snakes, from their greater abundance, are probably a more serious menace, but from either of these enemies the spermophiles must be well-nigh helpless in a system of burrows that does not provide several outlets. In the colonies observed here the holes were in gravelly, hard-packed ground, and (though I made no excavations) I received the impression that the burrows were of rather simple construction. Some of the animals, however, were seen going in and out of kangaroo rat holes, in mounds that were honeycombed with runways, where doubtless they were in greater safety.

Round-tailed Spermophiles were occasionally seen in mesquite trees, ten or fifteen feet from the ground. I saw one, surprised in such a situation by one of our party who walked below without seeing the animal, that remained quietly aloft until the danger had passed, when it descended to the ground and to its nearby burrow.

12. **Ammospermophilus harrisii** (Audubon & Bachman)

Abundant on the Santa Rita Range Reserve, as it is over much of the lowlands of Arizona west of that point. As far as I know, the species does not occur along the Arizona-Mexico boundary line east of the Santa Rita Mountains. We did not see it in the Sonoita Valley, I never saw it in previous years collecting in southern Cochise County, and Mearns (1907, p. 304-305) comments upon its absence from that section. Its range, then, in southern Arizona extends from the Colorado River east to the west base of the Santa Ritas. Farther north in the state, probably from the base of the Mogollon escarpment south about to the latitude of Fort Bowie, it extends eastward into New Mexico.

The local distribution of this and the other small ground squirrels (*Ammospermophilus* and *Citellus*) of Arizona presents various peculiar features. Although it is not unusual to find two species in the same locality, still, as a rule, they are segregated, and some one species, is, invariably, I believe, greatly in preponderance at any one place. Thus, in the section where we were working *Ammospermophilus harrisii* was abundant over the greater part of the slope extending from Madera and Sawmill cañons down to the Santa Cruz River. Some miles north of the mouth of Sawmill Cañon there are large colonies of *Citellus tereticaudus neglectus*, where very few of *A. harrisii* were seen. Between Tucson and the Santa Catalina Mountains, some years ago, I found the *Citellus* abundant, to the absolute exclusion of the *Ammospermophilus*. I have not been able in the places indicated to correlate the presence or absence of these species with soil conditions, as described by Grinnell (1914, pp. 219, 224) from the valley of the Colorado River. Nowhere in this general region are there areas of wind-drifted sand, such as Grinnell describes as the preferred habitat of *tereticaudus*. The ground is almost uniformly hard and gravelly except in the river bottoms, and there no spermophiles were seen.

Ammospermophilus harrisii is a diurnal animal, active throughout the day, and, when present, conspicuously in view. In trapping in the region where this ground squirrel occurs I lost a large proportion of small mammals, destroyed in the traps, and came to the conclusion that *harrisii* must be responsible. The specimens were mutilated through being nibbled at, the leg bones of a rat or mouse being left attached to the everted skin, so the damage must have been done by a small-sized animal. As specimens of *Ammospermophilus* were found thus eaten in the traps when I knew that they had been trapped during the day, it was evident that a diurnal species was at least partly responsible. The damage was most frequently inflicted where *Ammospermophilus* was abundant, so altogether I am inclined to lay the blame on that species. Mearns (1907, p. 305) comments upon the carnivorous habits of this ground squirrel.

Ammospermophilus harrisii saxicola was described by Mearns (1896, p. 444; 1907, p. 306) from southwestern Arizona, as distinct from *A. h. harrisii* of the region where we collected. I have compared the fourteen adults we collected on the Santa Rita Range Reserve (see table, p. 352) with a series of twenty-four comparable adults from the lower Colorado River, in the Museum of Vertebrate Zoology and am unable to appreciate the color differences described by Mearns. Neither do I find such differences in measurements as Mearns ascribes to the two forms (see table, p. 352, and compare with tables given by Mearns [1907, pp. 307-309], and by Grinnell [1914, p. 220]). Consequently I agree with Grinnell (*loc. cit.*) in the conclusion that *Ammospermophilus harrisii salicicola* Mearns is not deserving of recognition.

13. **Thomomys fulvus toltecus** Allen

14. **Thomomys fulvus intermedius** Mearns

Pocket Gophers were abundant in the lowlands bordering the Sonoita. Throughout this portion of Arizona I think it is true that these animals in the lowlands are restricted to the vicinity of streams and to irrigated land adjoining, being entirely absent from the rocky foot-hills, the desert mesa, and the grassy plains. In the Patagonia section we found them only in the bottom lands. At the western base of the Santa Ritas no gopher sign was found anywhere on the Santa Rita Range Reserve or in the part of Stone Cabin Cañon where we were camped. In September, Miss McLellan found gophers in Madera Cañon, where five were trapped near the 5000-foot contour and workings seen up to about 7000 feet.

Measurements in millimeters of adult *Ammospermophilus harrisii* from the Santa Rita Range Reserve, Pima County, Arizona.

Collection	No.	Sex	Date	Total length	Tail vertebræ	Hind foot
C. A. S.	5873	♂	June 7, 1927	225	81	42
C. A. S.	5875	♂	June 8, 1927	255	91	41
C. A. S.	5884	♂	June 13, 1927	223	79	36
C. A. S.	5871	♀	June 5, 1927	233	80	40
C. A. S.	5872	♀	June 5, 1927	238	78	39
C. A. S.	5874	♀	June 7, 1927	226	80	39
C. A. S.	5870	♀	June 8, 1927	235	78	40
C. A. S.	5876	♀	June 8, 1927	246	83	43
C. A. S.	5877	♀	June 8, 1927	228	80	39
C. A. S.	5878	♀	June 8, 1927	232	80	40
C. A. S.	5880	♀	June 11, 1927	225	83	40
C. A. S.	5881	♀	June 15, 1927	223	83	41
C. A. S.	5882	♀	June 15, 1927	230	88	40
C. A. S.	5883	♀	June 13, 1927	225	80	36
			Average....	231.7	81.7	39.3

Bailey (1915) ascribes the gopher of the lowlands of this part of Arizona to *Thomomys fulvus toltecus*, that of the mountains to *T. f. intermedius*. Applying to our Patagonia series the characters ascribed to *toltecus*, and to the Madera Cañon specimens those of *intermedius*, I can follow him in this division. The Patagonia specimens, 28 in all (Nos. 5724-5751), are larger and duller brown. The five from Madera Cañon (Nos. 5949-5953) are smaller, richer brown, and black-backed.

Our specimens of *toltecus* were all taken in one pasture, seven miles north of the town of Patagonia, at about 4500 feet altitude, and on the border line between the Upper and Lower Sonoran zones. We saw no gopher sign in such purely Lower Sonoran localities as we visited, where conditions were evidently unfavorable to the species. Bailey (*loc. cit.*, p. 86) ascribes to *toltecus* a Lower Sonoran habitat, but it occurs also in some Upper Sonoran localities, as in the foothills of the Huachuca Mountains. There must be many such places where disconnected areas inhabited by *toltecus* are far more widely separated than are the habitats of *toltecus* and *intermedius*. In the Huachucas, for instance, there is practically continuous distribution of pocket gophers from the mountain tops down the cañons eastward to where they open upon the plains. Then there is a wide plains area devoid of these animals until the bottom lands of the San Pedro and Babocomari rivers are reached. As Bailey points out, the differences in subspecific characters occur as between specimens from the mountain tops and those from the mountains' base (between which there is essentially continuous distribution), while close resemblances exist between widely separated lowland distribution areas. It is a peculiarity in subspecific differentiation that is worthy of future study.

15. **Perognathus flavus flavus** Baird

Two specimens (Nos. 5787, 5788) were obtained, trapped near our camp at the mouth of Stone Cabin Cañon, on June 9 and 10, respectively. The trap line was laid along a north-facing slope, grass covered and with scattering

Measurements in millimeters of *Thomomys fulvus toltecus* and *T. f. intermedius*

Collection	No.	Sex	Locality	Date	Total length	Tail vertebræ	Hind foot
			Thomomys fulvus toltecus				
C. A. S.	5728	♂	Patagonia	May 15, 1927	229	69	30
C. A. S.	5733	♂	Patagonia	May 16, 1927	214	62	29
C. A. S.	5735	♂	Patagonia	May 17, 1927	225	72	31
C. A. S.	5736	♂	Patagonia	May 17, 1927	242	83	31
C. A. S.	5751	♂	Patagonia	May 20, 1927	229	64	28
			Thomomys fulvus intermedius				
C. A. S.	5951	♂	Madera Cañon, Sta. Rita Mts.	Sept. 29, 1927	190	62	24
C. A. S.	5952	♂	Madera Cañon, Sta. Rita Mts.	Sept. 30, 1927	200	65	27
C. A. S.	5953	♂	Madera Cañon, Sta. Rita Mts.	Sept. 30, 1927	205	67	27
			Thomomys fulvus toltecus				
C. A. S.	5724	♀	Patagonia	May 14, 1927	212	71	30
C. A. S.	5725	♀	Patagonia	May 14, 1927	202	60	28
C. A. S.	5727	♀	Patagonia	May 15, 1927	219	63	28
C. A. S.	5729	♀	Patagonia	May 15, 1927	205	57	29
C. A. S.	5731	♀	Patagonia	May 16, 1927	207	57	27
C. A. S.	5732	♀	Patagonia	May 16, 1927	206	60	28
C. A. S.	5737	♀	Patagonia	May 17, 1927	226	73	28
C. A. S.	5738	♀	Patagonia	May 18, 1927	212	69	29
C. A. S.	5739	♀	Patagonia	May 18, 1927	211	60	28
C. A. S.	5743	♀	Patagonia	May 19, 1927	204	60	29
			Thomomys fulvus intermedius				
C. A. S.	5949	♀	Madera Cañon, Sta. Rita Mts.	Sept. 27, 1927	182	57	25
C. A. S.	5950	♀	Madera Cañon, Sta. Rita Mts.	Sept. 28, 1927	163	52	25

oak trees. No other pocket mice were taken in this line, and this species of *Perognathus* was not otherwise found by us.

16. **Perognathus amplus** Osgood

Found only on the Santa Rita Range Reserve, where four were trapped, three on June 13, one on June 16 (Nos. 5783-5786). Two are adults, two in juvenal pelage. The first three secured were taken within a few hundred yards of each other, the fourth about a mile distant, in trap lines that were about five miles northwest of the Florida Ranger Station, and a mile or more from the base of the mountains.

17. **Perognathus baileyi baileyi** Merriam

A rather uncommon species in the section of the Santa Rita Range Reserve where we were trapping. Eight specimens (Nos. 5752-5759) were preserved and a few more discarded (damaged in the traps) from our trap lines there during June. Somewhat more abundant during October immediately below Madera Cañon, where 17 skins were obtained (Nos. 5970-5985, 6037). On the plains bordering the western base of the Santa Rita Mountains was the only place where we found the species. None was taken in the foothills and none east of the mountains. One was found in the stomach of a rattlesnake (*Crotalus atrox*).

18. **Perognathus penicillatus pricei** Allen

Eleven from the vicinity of Patagonia, twelve from the Santa Rita Range Reserve, and two from lower Madera Cañon (Nos. 5760-5782, 5968-5969). The species was decidedly rare in the Patagonia region, where the specimens preserved represent the entire catch for a month. At the western base of the mountains it was more numerous, and many more were caught than were preserved. No juveniles were taken at Patagonia, during May, but on the Santa Rita Range Reserve, during June, the young were as numerous as adults.

19. **Dipodomys spectabilis spectabilis** Merriam

A common species in the higher portion of the Santa Rita Range Reserve. Twenty-three specimens (Nos. 5848-5870) were trapped there during June, all adults. No young ones were seen or trapped, and none of the females collected contained embryos or was nursing. Three specimens (Nos. 5933-5935) were trapped at Fort Crittenden in September. The conspicuous mounds and other workings of the animal were not seen elsewhere on the east side of the Santa Ritas, and it may be doubted that the species extends farther east in the near vicinity of the boundary line.

For life history and other information regarding this species, as observed in the exact section where we were working, see Vorhies and Taylor, 1922.

20. **Dipodomys merriami merriami** Mearns

Extremely abundant west of the Santa Rita Mountains, where it is of general distribution over the desert plains and up to the base of the mountains. Forty-six specimens (Nos. 5802-5847) were prepared during June, all from the Santa Rita Range Reserve, and many more trapped animals were discarded for various reasons.

21. **Dipodomys merriami olivaceus**, new subspecies

Type.—Male adult, skin and skull, No. 6235, Mus. Calif. Acad. Sci., collected by Sam Davidson (orig. No. 39), October 28, 1928, **Fairbank, Cochise County, Arizona.** Measurements of type: Total length 243.0 mm.; tail vertebræ, 141.0; hind foot 37.0; ear, 12.0. Skull: greatest length, 36.5 mm.; breadth of skull across bullæ, 23.0; spread of maxillary arches, 17.2; greatest length of nasals, 13.5; greatest width of rostrum near end, 3.2; width of maxillary arch at middle, 5.0.

Diagnosis.—A slightly differentiated race of *Dipodomys merriami*, varying from typical *D. m. merriami* in darker coloration and in slightly larger skull with appreciably higher brain case.

Material examined.—Three specimens from Fairbank, Arizona, in the collection of the California Academy of Sciences; ten specimens from Fairbank, Arizona, in the Stanford University collection; nine specimens from Fairbank, Arizona, and three from the east base of the Huachuca Mountains, Arizona, in the collection of the Field Museum of Natural History.

Remarks.—We collected no specimens of four-toed kangaroo rats east of the Santa Rita Mountains. I knew, however, that the species occurred in that general region, having collected some, years before, at the east base of the Huachuca Mountains, and the manner of occurrence there, in comparison with conditions west of the Santa Ritas, made it seem desirable to make close comparison of specimens from the two regions. We had abundant material from the western area, but none from the eastern. To aid us in supplying this need, Mr. Sam Davidson, of Palo Alto, California, who was in Tucson temporarily, made a trip to Fairbank, where he trapped three specimens on October 27 and 28, 1928. I was also able to borrow specimens from the Stanford University collection and from the Field Museum of Natural History, as above indicated.

From the western base of the Santa Rita Mountains westward throughout the lowlands of southwestern Arizona (the Western Desert Area), *D. m. merriami* is one of the most common, perhaps the commonest, small mammal. In the Eastern Plains Area kangaroo rats are rare, occurring in small colonies at widely scattered intervals. Apparently open grass land is not suited to their needs, for they usually occur in sandy washes, where soft ground and low scattered bushes afford more congenial surroundings.

Examination of specimens shows the presence of certain slight differentiating characters that can be associated with animals from the two regions. Of these features color is the most outstanding.

Olivaceus is relatively dark colored, more olivaceous, as compared with the bright reddish hue of typical *merriami*, a difference that shows strongly in comparing series from the nearby localities of Fairbank and the Santa Rita Range Reserve. *Merriami* is markedly variable in coloration, as pointed out by Grinnell (1922, p. 74), but the Fairbank specimens stand outside the limits of variation in any series of *merriami* examined from western Arizona or southeastern California. Coloration of *olivaceus* is practically indistinguishable from that of *Dipodomys ordii ordii*, which occurs together with *olivaceus* in southern Arizona. In fact, a specimen of *ordii*, labelled *merriami*, was found among the borrowed skins. In the skull, the slightly greater general size and higher brain case of *olivaceus* are average characters that hold fairly well, though there is overlapping between the two forms in these regards.

Once the peculiar features of the Fairbank specimens were appreciated, the possibility suggested itself of their being the same as the form *Dipodomys ambiguus* Merriam (1890, p. 42), described from El Paso, Texas, and later regarded as a subspecies of *D. merriami*. A series of "*ambiguus*" was loaned me by the United States Biological Survey, with the added information that that form was now considered by mammalogists of the Survey as indistinguishable from typical *merriami*. With this opinion I can concur, as the El Paso specimens in the series are indistinguishable from my series from the Tucson region. The series of "*ambiguus*," however, includes two skins from Jarilla, New Mexico, and one of these is exactly like *olivaceus* in color. Whether or not this indicates intergradation between the two forms in that region I can not say; no such close resemblance appears in any series from points west of the Santa Rita Mountains.

I wish to emphasize the fact that *olivaceus* is not a strongly marked form. It is admittedly a faintly indicated subspecies, of average heavier build and darker coloration than *merriami* in about the same degree, as at the western edge of the *merriami* habitat, the variant *simiolus* is slightly smaller and paler colored. As these differences do exist, however, and, moreover, as they can be correlated with markedly different physical surroundings and living conditions, it seems to me desirable to have names for each of the forms concerned.

That the El Paso specimens should prove to be the same as those from Tucson is probably an indication of continuous distribution of *merriami* between the two points through a belt to the northward of the habitat of *olivaceus*.

After the above account was written there was published the description by Goldman (1928, p. 141) of *Dipodomys merriami mayensis*, from southern Sonora, Mexico, which is also described as a dark colored form. The possibility suggested itself, of course, of *mayensis* and *olivaceus* being synonymous, but, although I have not made direct comparison of specimens, the skull characters of *mayensis* that are emphasized by Goldman and demonstrated in his measurements are not features of *olivaceus*. *Mayensis* appears to be a different, and probably a more strongly marked, subspecies.

22. **Dipodomys ordii ordii** Woodhouse

Present in small numbers in the Sonoita Valley. Thirteen specimens (Nos. 5789-5801) were trapped between May 16 and 30, all in rather sandy bottom lands bordering the Sonoita River, a few miles north of Patagonia. The series includes three half-grown young, collected on May 27 and 29.

23. **Onychomys torridus torridus** Coues

Not common in the Sonoita Valley. Trap lines in a section of the bottom lands where the soil was rather light and sandy produced six specimens in about two weeks. Other trap lines where conditions were different did not catch any. West of the mountains, on the Santa Rita Range Reserve, the species was far more abundant, and some were caught almost every night. Thirty-seven specimens in all were preserved, six from the vicinity of Patagonia (Nos. 5652-5657), twenty-two from the Santa Rita Range Reserve (Nos. 5658-5679), and nine from below the mouth of Madera Cañon (Nos. 5986-5992, 6032).

Another species, *Onychomys leucogaster ruidosæ*, occurs east of the Santa Ritas, as at Fairbank (Hollister, 1914, p. 448), but we failed to find it and have no data showing whether or not the two species occur over precisely the same ground.

Measurements in millimeters (average, minimum and maximum) of *Dipodomys merriami merriami* and *D. m. olivaceus*

No. of speci-mens	Locality	Greatest length of skull	Breadth of skull across bullæ	Spread of maxillary arches	Greatest length of nasals	Greatest width of rostrum near end	Width of maxillary arch at middle
10[1]	Fairbank, Arizona............	36.9 (36.0-37.5)	23.2 (23.0-23.5)	17.0 (16.5-18.0)	13.4 (13.0-14.0)	3.1 (3.0-3.2)	5.1 (5.0-5.5)
10[2]	Santa Rita Range Reserve, Ariz.	35.9 (35.0-36.0)	22.6 (22.0-23.0)	16.1 (16.0-16.5)	13.0 (12.0-14.5)	3.1 (3.0-3.2)	4.9 (4.5-5.2)
10[3]	El Paso, Texas (8), and Jarillo, New Mexico (2)...........	35.3 (34.5-36.0)	22.7 (22.0-23.2)	16.7 (16.0-17.2)	12.4 (12.0-13.0)	3.0	4.8 (4.2-5.0)

[1]Coll. Stanford University, 5; coll. Field Museum of Natural History, 5. Nine males, one female.

[2]Ten males.

[3]Coll. U. S. Biological Survey. Six males, four females.

Measurements in millimeters (average, minimum and maximum) of *Dipodomys merriami merriami* and *D. m. olivaceus*

No. of specimens	Locality	Total length	Tail vertebræ	Hind foot	Ear	Ratio percent length of tail to total length
10[1]	Fairbank, Arizona........	246.3 (232.0-256.0)	145.8 (135.0-157.0)	37.2 (35.0-40.0)	10.7 (9.0-14.0)	59.1 (57.0-62.0)
10[2]	Santa Rita Range Reserve, Ariz..........	243.6 (231.0-268.0)	142.7 (133.0-160.0)	37.2 (36.0-38.0)	9.9 (7.0-11.0)	58.4 (57.0-61.0)
10[3]	El Paso, Texas (8), and Jarillo, New Mexico (2)..	245.7 (236.0-252.0)[4]	145.7 (140.0-152.0)[4]	38.6 (36.0-40.0)	....	59.7 (57.0-62.0)[4]

[1]Coll. Stanford University, 8; coll. Field Museum of Natural History, 2. Nine males, one female.

[2]Ten males.

[3]Coll. U. S. Biological Survey. Six males, four females.

[4]Nine specimens.

24. **Reithrodontomys megalotis megalotis** (Baird)

Evidently rather rare throughout the region. Four were trapped near Patagonia, on May 15, 18, 19, and 28, respectively, and three of them preserved (Nos. 5639, 5684, 5685). One was caught at the mouth of Stone Cabin Cañon, June 11 (No. 5683).

25. **Peromyscus eremicus eremicus** (Baird)

Eleven specimens collected: One from near Patagonia, and ten from the foothills at the western base of the Santa Rita Mountains (Nos. 5628-5635, 5641, 6017, 6018). The Patagonia specimen (from a trap line that produced *P. l. arizonæ* and *P. m. sonoriensis*) was the only example of this mouse that we caught in that region. At the western base of the mountains *eremicus* was found mostly in rocky places in the lowest foothills. Only one or two were caught on the Santa Rita Range Reserve, and those on the bottoms of gulleys leading from the hills. No *Peromyscus* of any kind was caught on the level floor of the Range Reserve, where other species of rodents were decidedly abundant.

26. **Peromyscus maniculatus sonoriensis** (Le Conte)

Four specimens (Nos. 5647-5649, 5651) were trapped in bottom lands adjoining the Sonoita River, some six miles north of Patagonia, in the same trap lines that were producing *Dipodomys*, *Perognathus*, and *Onychomys*. Not one was collected in all the trapping that was carried on at the western base of the Santa Ritas. I have not found the species to be common anywhere in southeastern Arizona.

27. **Peromyscus leucopus arizonæ** (Allen)

Seven specimens (Nos. 5638, 5640, 5642-5646) were collected near Patagonia, in the same trap lines that produced our few examples of *sonoriensis*. This was in sandy or gravelly bottom lands. None of this species was taken in the rocky localities that harbored *rowleyi*, nor was any collected on the west side of the Santa Ritas.

28. **Peromyscus boylii rowleyi** (Allen)

Abundant in the mountain ranges of southeastern Arizona, down to the lower limit of the Upper Sonoran zone; absent from the plains. Twenty-seven specimens preserved from the Patagonia region, 47 from the vicinity of the Florida Ranger Station, and from lower Madera Cañon (Nos. 5591-5627, 5636, 5637, 5650, 5994-6016, 6019-6026, 6029-6031). All taken at our Patagonia station were in rocky outcroppings bordering the Sonoita River, at the lower edge of the oak woods. None was found on the valley floor where other species of *Peromyscus* were trapped.

29. **Sigmodon hispidus cienegæ** A. B. Howell

Three cotton rats (Nos. 5680-5682) were taken near our camp seven miles north of Patagonia, on May 20, 21, and 23, respectively. One was found drowned in a ditch, the other two were caught in the same trap on a sandy stretch adjoining the Sonoita River bottom, far from water at that season, and where I had been trapping *Dipodomys* and *Perognathus*. Several piles of brush, like small, flattened, wood rat "houses" had attracted my attention there, but no wood rats were caught, and the traps were undisturbed after the cotton rats were captured. Two more were trapped on marshy ground bordering the Sonoita a short distance below Patagonia on September 21 and 23, respectively. These two were females, containing the one 12, the other 14, embryos!

I am applying to these specimens the name *Sigmodon hispidus cienegæ* A. B. Howell (1919, p. 161), at the suggestion of Major E. A. Goldman, and without myself making any study of the systematic status of the group. No less than five names are in use for cotton rats from different localities in southern and central Arizona, with few specimens available from any one place. The differences involved are mostly of size, and size has been shown by Grinnell (1914, p. 230) to vary so much in one of the races that some doubt may be felt as to the validity of at least some of the subspecies described.

April 26, 1929

30. **Neotoma albigula albigula** Hartley

Of common occurrence nearly everywhere in Upper and Lower Sonoran zones, but less numerous about Patagonia than on the west side of the mountains. On the Santa Rita Range Reserve wood rats were especially abundant, and their nests, often of great size, were conspicuous nearly everywhere in the chaparral. Many more specimens were trapped than could be skinned, but 39 were preserved, as follows: from Patagonia, 20 (Nos. 5690-5709), collected in May; from Stone Cabin Cañon and the adjacent Santa Rita Range Reserve, 14 (Nos. 5710-5723), collected in June; from lower Madera Cañon, 5 (Nos. 5943-5947), collected between September 23 and October 8.

A large proportion of the wood rats trapped were infested with larvæ of a species of bot-fly, huge grubs often nearly an inch long, lying just under the skin. These were most often found on the throat, where the rat seems powerless to dislodge them. Twelve of the 39 specimens preserved had grubs so located. They are mostly on animals taken during June. It was noticeable that the other rodents of the region were free of this sort of pest, which, however, was also common on rabbits.

31. **Mus musculus musculus** Linnæus

One was trapped in brush land, some distance from any houses, near Patagonia on May 27 (No. 5683).

32. **Lepus alleni alleni** Mearns

Extremely abundant in the vicinity of Tucson. The distribution of this species in Arizona is of more than ordinary interest, occurring as it does over a relatively restricted area, and having its range delimited by factors that are difficult to comprehend. As we travelled east in Arizona we found this hare rather abruptly plentiful at a point about one-third of the way from Florence to Tucson, which point in fact marks approximately the known western boundary of its range. On the Santa Rita Range Reserve it was so numerous that it was no uncommon occurrence in the early morning for 12 or 15 of these hares to be in sight at once, fleeing at the approach of our auto along the road. The species occurs in small numbers in the Sonoita Valley, where we saw several within a few miles of Patagonia, but it is decidedly rare there and elsewhere along the east base of the Santa Rita Mountains, and does not occur at all in the open country still farther east.

In the original account of *Lepus alleni* (Mearns, 1890, p. 294), the habitat is said to lie "between Phoenix and Benson," a statement that has been repeated in other publications. I doubt if it extends quite as far northwestward as Phoenix, and it certainly does not reach as far east as Benson. The vicinity of Pantano, about 20 miles west of Benson, marks the eastern boundary of the species. Minor corrections of range of this sort may appear unimportant, but in this and some other desert species of the same region there is significance in their distribution that will be understood eventually only by close attention to just such details.

A subspecies of *Lepus californicus* (*L. c. eremicus*) occurs about the Tucson region in company with *alleni* and in about equal numbers. We saw them together repeatedly on the Santa Rita Range Reserve, sometimes sitting under the same bush or running away side by side. The species *Lepus californicus*, however, occurs uninterruptedly across the desert plains of southern Arizona, from the Colorado River to New Mexico. The dividing line between two subspecies of this species, *eremicus* and *deserticola*, lies somewhere near the western limit of *L. alleni*, but this is the only coincidence between any boundaries of the two species and it is doubtful if there is any real correlation there. It is difficult to imagine the factors that delimit the range of one species of jack rabbit and permit the other to pass unhindered, but that there are such factors must be realized by anyone noting the sharp delimitation of the one species, *alleni*, within the wider habitat of the other, *californicus*.

Lepus alleni is placed by Nelson (1909, p. 115) in the *Lepus callotis* group, or white-sided jack rabbits, the members of which have a peculiar habit of flashing the white markings on their haunches from one side to the other as they flee from pursuit. This habit is described and figured by Nelson (*loc. cit.*, p. 115, pl. 1), as observed in *Lepus callotis*, in terms that do not entirely accord with my own observations upon *L. alleni.* In the text and on the plate cited the changing white area is described and figured as on the sides and flanks of the animal. My own observations (made with the above account fresh in my mind) were of an animal on which the white area covered the entire rump and extended forward barely to include the flanks.

On rabbits seen at close range, quiet and not alarmed, the white hardly shows at all. The white hairs are dark-tipped and in the smooth-lying pelage the white is hidden. Evidently it is flashed into view by a twitching of the skin, as described by Nelson, that raises the white hairs conspicuously. As the startled jack rabbit departs it is usually quartering, rarely going straight away from the observer, and always the haunch in view shows a flash of white. As it bounds along it turns constantly, exposing sometimes one flank, sometimes the other, the white area shifting with every turn, but not extending forward beyond the haunches. The black dorsal line of the tail is always conspicuous against the white rump, pointing straight down when the animal is at rest. When the left haunch is presented, conspicuously white, the tail is pulled over, pointing sharply to the left; with the right haunch flaring white the tail points to that side. Apparently the skin on one side or the other is drawn taut by the same action that pulls the tail to left or right, as the case may be. It all goes so quickly as to be obviously automatic.

Another peculiar habit of *Lepus alleni* is, as it starts to run, to make four or five long hops on the hind legs alone, kangaroo fashion, without touching the fore-feet to the ground, and then to settle down to the ordinary mode of locomotion. Occasionally, with ears keenly erect, the kangaroo hops are again resorted to in flight, to get sight or sound of possible pursuers. This is something that I have never observed in any other species of rabbit, but it is the usual thing with *alleni*.

We collected five specimens of *Lepus alleni:* A half-grown female, May 14, and an adult male, May 19, near Patagonia; an adult male and two adult females on the Santa

Rita Range Reserve, collected on June 6, 8, and 16, respectively (Nos. 5902, 5903, 5906-5908).

33. **Lepus californicus eremicus** Allen

In great numbers on the Santa Rita Range Reserve and elsewhere on the desert plains west of the Santa Ritas. Decidedly rare in the Sonoita Valley, east of the mountains, but occurring throughout this region and over the plains to the eastward. Throughout the lowlands of extreme southeastern Arizona there is lack of cover, and jack rabbits are scarce accordingly, but patches of sacaton grass shelter a few, and others may occasionally be jumped from most bare and unpromising situations. There is no break in the east and west distribution of this jack rabbit, though it exists in much smaller numbers on the southeastern grassy plains than on the southwestern deserts. Three specimens were preserved, all adult males collected during May within seven miles of Patagonia (Nos. 5904, 5905, 5909).

34. **Sylvilagus auduboni arizonæ** (Allen)

In abundance over the lowlands west of the Santa Rita Mountains. East of the mountains it was relatively scarce, being influenced by lack of shelter on the grassy plains just as the jack rabbit is, though as a smaller animal it can take advantage of more hiding places. I have found cottontails on the open plains sheltered under dessicated carcasses of cattle, the dried skin over the bones being all that was left, and this forming a very acceptable haven. Five specimens were preserved, four from the vicinity of Patagonia in May, one from the Santa Rita Range Reserve in June (Nos. 5897-5901).

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PLATE 27

Fig. 1. Western foothills of the Santa Rita Mountains; in the distance is Elephant Head, a rocky pinnacle near the southern end of the range. Scattered live-oaks clothe the foothills, especially on north-facing slopes, down to the edge of the plains. Photo taken in June, 1927.

Fig. 2. Santa Rita Range Reserve below Sawmill Cañon. There are places immediately below the western foothills where limited areas on the plains are relatively free of brush, grass covered, and with a sparse growth of small mesquites. Photo taken in June, 1927.

Fig. 1

Fig. 2

April 26, 1929

PLATE 28

Fig. 1. Santa Rita Range Reserve. The vegetation here shown is of the type that is prevalent over the lowlands of this region, with cactus of several species conspicuous everywhere. This is the habitat of such birds as Palmer Thrasher, Cactus Wren, Gambel Quail, and Black-throated Sparrow; of such mammals as jack rabbits and cotton-tails, Harris Ground Squirrel, kangaroo rats, pocket mice, and grasshopper mice. Photograph taken in June, 1927.

Fig. 2. The giant cactus is conspicuous over some parts of the plains but it is not of general distribution. There is a long list of bird species that nest by preference in woodpecker holes in the cactus, and there are some of these birds that in Arizona rarely occur far from this plant. Some species of widely diverse character that are closely associated with the giant cactus are the Elf Owl, Gilded Flicker and Arizona Crested Flycatcher. Photo taken thirty miles west of Tucson, June 21, 1927.

Fig. 1

Fig. 2

Plate 29

Fig. 1. Sonoita Valley between Patagonia and Fort Crittenden; the Santa Rita Mountains in the distance to the westward. The low foothills here shown support a sparse growth of scrubby live-oaks (mostly on north facing slopes), with little or no underbrush. The ground is green with grass after the rains, but at the time when this photograph was taken it was bare and parched, well-nigh denuded of grass by grazing cattle. Photo taken in May, 1927.

Fig. 2. In some parts of the eastern foothills yuccas cover large areas in almost pure stands. They form the favorite haunt of the Scott Oriole. Photo taken May 28, 1927.

Fig. 1

Fig. 2

Plate 30

Fig. 1. The western edge of the San Rafael Plains, twenty miles east of Patagonia; the Santa Rita Mountains in the distance, to the westward. It is about at this point that the last rolling foothills merge into the open plains. Photo taken in September, 1927.

Fig. 2. The San Rafael Plains. From this point eastward the lowlands are mostly open prairie, destitute of any vegetation but grass. There are occasional small tracts of brush land, and along the washes there are a few cottonwoods, willows and other trees. These plains are the habitat of the Swainson Hawk, White-necked Raven, Texas Meadowlark, and Scorched Horned Lark. In migration they are occupied by Chestnut-collared and McCown longspurs, and by Baird, Savannah, and Western Vesper sparrows. Photo taken in September, 1927.

Fig. 1

Fig. 2

PLATE 31

Fig. 1. Mound and burrows of *Dipodomys spectabilis*. Other small mammals were constantly caught in traps set about these mounds, such as *Dipodomys merriami*, *Ammospermophilus harrisii*, and species of *Perognathus*. There seemed to be very few individuals of *Dipodomys spectabilis* in any one mound, and the elaborate systems of runways were entered freely by other species. Photo taken on the Santa Rita Range Reserve, June, 1927.

Fig. 2. Travertine rock bordering the Sonoita River near Patagonia, showing the entrances of caves, some of which extended to great depths. They were inhabited by several species of bats, by the Rock Squirrel (*Otospermophilus grammurus*), by Wood Rats (*Neotoma albigula*), and by an occasional Horned Owl (*Bubo virginianus pallescens*). Photo taken in May, 1927.

Fig. 1

Fig. 2

PLATE 32

Fig. 1. The Sonoita River, flowing along the eastern foothills of the Santa Rita Mountains, is bordered by rows of tall cottonwoods, sycamores, and willows, with, in many places, dense thickets of lower growing shrubbery below. In such surroundings are found Arkansas and Cassin kingbirds, Vermilion Flycatcher, Cooper Tanager, Bullock and Arizona Hooded orioles, Sonora Yellow Warbler, and Lucy Warbler. Photo taken seven miles north of Patagonia, May, 1927.

Fig. 2. The crumbling walls of some of the adobe buildings comprising old Camp Crittenden; Santa Rita Mountains in the distance. It was here that H. W. Henshaw made an important collection of birds in 1874. On open ground between the buildings we found small colonies of *Citellus spilosoma canescens* and *Dipodomys spectabilis*. Photo taken May 30, 1927.

Fig. 1

Fig. 2

PROCEEDINGS

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XIII

THE ESCALLONIAS IN GOLDEN GATE PARK, SAN FRANCISCO, CALIFORNIA, WITH DESCRIPTIONS OF NEW SPECIES

BY

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The conditions in Golden Gate Park are very favorable to these beautiful South American shrubs. They grow vigorously, bloom profusely, and almost continuously. Mr. John McLaren, the eminent superintendent of the parks of San Francisco, has always been interested in introducing new plants from other countries and the escallonias seem to have been especially successful. Fifteen different kinds are now in Golden Gate Park. Great confusion prevails concerning the names of many of these escallonias. Some are undescribed, probably hybrids; while others are almost universally incorrectly named by nurserymen and gardeners. One authentic hybrid has been produced in the Park by Mr. Peter Rock, the superintendent of the nursery. He pollinated *Escallonia montevidensis* with pollen from *Escallonia macrantha* and the best seedling proved to be an exceptional plant which is named in his honor. The different escallonias will be described in this article.

1. **Escallonia rockii** Eastwood, new hybrid
(E. macrantha × E. montevidensis.)

Tall, widely branching shrubs with striate and slightly angled branches; leaves obovate, obtuse, tapering to a short petiole, irregularly glandular-denticulate, upper surface glabrous and glossy, lower paler and with a few scattered glands, blades about 5 cm. long, 2 cm. wide; inflorescence a loosely branching thyrsoid panicle, often more than a foot long, the peduncles and pedicels minutely puberulent; bracts and bractlets with marginal glands; calyx broadly turbinate with some glands on the margin of the widely separated, subulate teeth; corolla pale pink or white with the buds and tips of the petals a darker pink, the claws somewhat spreading but forming a tube about 8 mm. long; filaments and style of equal length, the yellow anthers and green capitate stigmas inserted in a low yellow rounded disk.

This is one of the most vigorous species in the Park and in flower almost continuously. There are bushes in the Park 10 to 15 feet high.

Type: Herbarium Calif. Acad. Sci. No. 78638, collected in Golden Gate Park, December, 1917.

2. **Escallonia franciscana** Eastwood, new hybrid

Tall shrub with erect, stout branches, glandular and viscid throughout; leaves thick, oblong to elliptic, tapering to a short, thick, margined petiole, apex acute or obtuse, margin finely but unevenly crenulate, the lower part entire, both surfaces with large dark glands, more numerous and conspicuous on the lower surface; inflorescence a narrow panicle, very viscid throughout, as if varnished; calyx as long as the ovary, about 4 mm., open-campanulate with slender subulate divisions; corolla pink, the claws of the petals almost 1 cm. long and conniving to form a distinct tube, the spreading roundish limb much shorter; filaments shorter than the style and both stamens and pistil included in the corolla tube, the style in a cup-like disk surmounting the ovary. This is the common tall, pink-flowered escallonia with the odor of slippery elm, generally known as *Escallonia rosea,* a name belonging to a quite different species. It is one of the oldest in cultivation in the

Park and has spread by cuttings to other parks and gardens. It seems to be related to *Escallonia illinita* Presl., or to *E. viscosa* Forbes, both of which have white flowers and different leaves. The color of the flowers and the heavy texture of the leaves suggest a connection with *E. macrantha,* which may be one of its parents. The strong odor emanating from the bushes suggests a relationship with *E. illinita,* but to most people the odor is not disagreeable as that is said to be.

Type: Herbarium Calif. Acad. Sci. No. 78584, collected in Golden Gate Park, July 31, 1918.

3. **Escallonia macrantha** Hook. & Arn.

(Hook. Bot. Miscell. 3: 341. 1833. Bot. Mag., t. 4473.)

This is the most generally cultivated species in California and is in bloom several times a year according to the frequency of pruning and watering. As it grows in the Park, it agrees exactly with the plate in the Botanical Magazine where it was first figured. It is generally advertised in catalogues as *Escallonia rubra,* a name belonging to another species. *Escallonia macrantha* is a compact spreading shrub, densely clothed with broad, thick leaves, shining on the upper surface and with many large glands on the lower. The flowers are a lovely crimson in short, close panicles, the claws conniving to form a tube as long as the limb is wide. It is the largest flowered escallonia, the size of the flower differing slightly according to the fertility of the soil, the amount of water, or the vigor of the shoot.

4. **Escallonia rubra** R. & P.

(Pers. Syn. 2: 235.)

An erect shrub with many erect branches terminated by narrow panicles or sometimes by simple racemes. The leaves are rather thin, oblanceolate to oblong-obovate, tapering to a short margined petiole and narrowing to an acute apex, almost glabrous with the glands on the lower surface very few. The flowers are bright crimson, the claws of the petals conniving into a narrow tube twice as long as the limb; calyx with triangular spreading divisions; pistil and anthers slightly exserted, the style inserted in a conical receptacle surmounting the ovary.

Near the Pershing monument there is a cluster of these shrubs and some can be found almost always in bloom.

5. **Escallonia punctata** DC.
(Prod. IV: 3. 1830.)

This is a related species with leaves pointed at both ends. It is glandular throughout except the corolla and upper leaf surface. The flowers are sometimes solitary or in few-flowered corymbs, the corolla a beautiful crimson, the claws of the petals forming a tube and the open-campanulate calyx becoming red, the divisions slender subulate. The insertion of the stigma is similar to that of *E. rubra*, but the flowers resemble those of *E. macrantha*.

6. **Escallonia pterocladon** Hook.
(Bot. Mag. t. 4827. 1855.)

7. **Escallonia exoniensis** Hort. ex Handl.
(Trees Kew, pt. 1: 227.)

These two species are very similar, as is to be expected, since the latter is a hybrid between *E. pterocladon* and *E. rubra*, raised in Veitch's nursery, Exeter, England. Both have distinctly ridged stems and erect branches terminated with panicles of many flowers. *Escallonia pterocladon* has white flowers, while those of *E. exoniensis* are beautifully tinged with pink and the inflorescence is more spreading. The plant figured in the Botanical Magazine has simpler inflorescence than any in the Park. Both have flowers with the claws of the petals conniving to form a tube, but the calyx of *E. pterocladon* is smooth while that of *E. exoniensis* is glandular. Both are dainty and beautiful in bloom and grow luxuriantly in the Park.

Near the Pershing monument they are planted with *E. rubra*.

8. **Escallonia rubricalyx** Eastwood, new hybrid

The origin of this form is obscure. It may be the same as *Escallonia rubra* var. *flor alba* Lodd., Bot. Cab., t. 1291, and is perhaps a hybrid between *E. rubra* and *E. grahamiana.* It is a spreading shrub, never becoming tall, with slender branches. The flowers are in small, few-flowered panicles with white petals forming a short tube, and with red calyx. The bushes have a rounded outline and are profusely flowered. The leaves resemble those of *E. grahamiana.*

Type: Herbarium Calif. Acad. Sci. No. 78611, collected in Golden Gate Park, August, 1918.

[The two following escallonias with large panicles of white flowers are often confused, as they are somewhat superficially alike, but they really belong to different sections because of essential differences in the flowers.]

9. **Escallonia montevidensis** DC.
(Prod. 4; 4. 1830.)

The leaves of this species have a little notch at the top, the petals of the flowers do not form a tube, and the stamens and pistil are conspicuously exserted. On account of the butterflies and other insects that swarm over the bushes when in flower, this is called the butterfly-bush in the park. It has only one season of bloom in late summer, with large, rounded panicles of white flowers. The finest bushes are along the border of Stow Lake, where there is always an abundant supply of water.

10. **Escallonia grahamiana** Gill ex Hook. & Arn.
(Bot. Miscell. 3: 343. 1833.)

This was figured as *Escallonia glandulosa* in Sweet's British Flower Garden, 4; t. 81. A specimen was sent to Mr. W. J. Bean of the Royal Botanic Gardens at Kew for verification and for comparison with the type. In cooperation with Mr. T. A. Sprague of the Royal Herbarium, the identification was verified. The leaves of this species are never notched at the apex, but in shape otherwise similar to those of *E. montevidensis.* The panicle is not rounded at the top but pyramidal, the petals have claws that connive to form a tube, the stamens and style are not conspicuously exserted, the insects do not hover over this in swarms, and its period of bloom is longer and more irregular. The sessile glands interspersed through the inflorescence doubtless suggested Sweet's name, but there are other species much more glandular. It becomes so badly infested with the Citrophilus mealy bug, *Pseudococcus gahani* Green, that it is being removed in many places. It has gone under more names than any other species.

11. **Escallonia philippiana** Engler
(Linnæa, 36: 571. 1869-70.)

This is considered by some botanists to be a variety of *E. virgata* Pers., Syn. 1: 234. Until recently there was but one plant in the Park. It is a low, much-branched shrub with the branches curving downwards and densely clothed when in flower with short, leafy branches; leaves small, glabrous and deciduous; flowers in the leaf axils; petals white, spreading, without claws; filaments and style very short. This escallonia resembles a leptospermum in general appearance when in flower.

12. **Escallonia langleyensis** Vilm. & Bois.
(Frut. Vil. Cat. 1: 131.)

This is a hybrid between *E. philippiana* and *E. punctata* and was produced in Mr. Veitch's nursery, Exeter, England. It has the habit and foliage of *E. philippiana,* but is not so stiff. It has the beautiful crimson flowers with short, broad claws and the glandular pubescence of *E. punctata.*

13. **Escallonia organensis** Gardner
(In Hooker's Icones: t. 514. 1843.)

This has recently been introduced into the nursery and is not yet planted out. The leaves are narrowly obovate with red margins; stems also red. It is figured in the Botanical Magazine: t. 4274 with a densely flowered, compact, rounded panicle. The petals are a lovely rose-color with a dark red spot at the throat above a short tube.

14. **Escallonia pulverulenta** (R. & P.) Pers.
(Syn., I: 235. 1805-7.)

This cannot be mistaken for any other species. The flowers are white, densely crowded in a long spike resembling a tail, and the stigma is 2-cleft. The whole plant is downy and viscid. *Escallonia berteriana* DC., Prod., IV: 665 is a smoother form of this, which has been named *E. pulverulenta glaber* Engler, Fl. Bras., XXV: 149.

It is not in the Park, but the name has been incorrectly applied to other species.

15. **Escallonia revoluta** R. & P.
(Pers., Syn. I: 235. 1805-7.)

This species is also unmistakable. It is a tall, coarse, erect shrub said to attain the height of 30 feet. The whole plant is covered with a thick white down. The tubular white flowers are very densely clustered in large terminal pyramidal panicles. The leaves are thick and revolute.

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XIV

STUDIES IN THE FLORA OF LOWER CALIFORNIA AND ADJACENT ISLANDS

BY

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Introduction

In the spring of 1925, the California Academy of Sciences sent an expedition to the Revillagigedo Islands off the Pacific coast of Mexico. The U. S. Navy Department detailed the U. S. mine-sweeper Ortolan for the use of the Academy. Mr. H. L. Mason accompanied the expedition as botanist. On the way to the islands a short stop was made at Guadalupe Island and a small collection of plants was secured. Clarion Island was reached April 26, and from then until May 11, Clarion, Socorro and San Benedicto islands were explored. On the return trip, the vessel stopped at the Tres Marias Islands, May 14-24, and collections were made on Maria Madre, Maria Magdalena and Isabella islands. From there the vessel sailed north along the west coast of Lower California and made landings at Cape San Lucas, Magdalena Bay, Turtle Bay, Cedros Island, San Quintin Bay, and San Martin Island. Mr. Mason is preparing the report on the Botany of the Revillagigedo Islands, but it is not yet ready. The present writer has worked up all the other collections except that from the Tres Marias Islands. The collection on these islands was made at the end of the dry season and the specimens were very poor. Duplicates were sent to Paul C. Standley, an authority on Mexican plants at the National Herbarium, and were named by him.

The reports on Guadalupe Island, Cedros Island and Tres Marias Islands include all the species that have been reported from those islands, with the names of the collectors and references to the publications. This assembling of all the known species that have been published from those islands will be a great help to future explorers.

Many species were originally described from certain of the localities where landings were made by the Ortolan Expedition and topotypes were collected whenever possible. Lists of the topotypes have been added, supplementing those represented in the collections.

List of the Plants Recorded from Guadalupe Island, Mexico

Guadalupe Island lies 135 miles from the coast of Lower California and 250 miles south of the border of the United States. It is about 20 miles long from north to south and 3 to 7 miles wide. From a narrow beach the island rises abruptly to a sort of plateau indented by precipitous cañons and at the top traversed by ridges, the highest rising on Mount Augusta to an elevation of about 4000 feet. The northern part of the island is less arid than the southern, due to the heavy fogs which are so dense that the moisture condensing on the trees forms small streams from which some of the springs are supposed to be fed. Groves of pines and cypresses are on the uplands and on the sides of some of the cañons at the northern end evergreen oaks are found. Palms grow in warm cañons that are sheltered from the winds.

This island has been known to navigators since early times and was noted by Vancouver, though he did not stop there. Goats were introduced long ago to furnish fresh meat to passing vessels. Later the island was purchased by a Californian company and was stocked with angora goats. These have multiplied excessively and have almost completely destroyed the vegetation so that today but little remains of one of the most remarkable floras on the Pacific coast.

The first knowledge of this flora came from the collection of Dr. Edward Palmer, who spent from February to May, 1874, exploring and collecting. The results were published by Sereno Watson, who wrote the first account of the island, including a list of the collection with Dr. Palmer's notes, in the eleventh volume of the Proceedings of the American Academy, pages 105-121. One hundred and nineteen species were listed, representing 99 phanerogams, 6 ferns, 11 mosses and 4 hepatics, of which 42 phanerogams and 1 hepatic have been described as new.

Dr. Edward Palmer brought back seeds of the cypress and palm. Today fine trees of the cypress are to be found in various parts of California, notably a row along the State Capitol building at Sacramento and others in Golden Gate Park. The palms are found in various parts of the state.

Dr. Edward L. Greene spent a week on the island, late in April, 1885, and collected 120 species, adding 15, of which 10 were described as new, the other 5 being introduced species of wide distribution. The results of his trip were published in the Bulletin of the California Academy of Sciences, volume 1:214-228. Besides an interesting account of the island, he published the new species and the list in the same volume.

Dr. Palmer made a second trip, from March 27 to April 3, 1889, and collected 72 species, adding 14, of which 4 were new. This list was published by Dr. George Vasey and Dr. J. N. Rose in their first volume of the Contributions of the U. S. National Herbarium, pages 21-27, 1890.

Dr. F. Franceschi[1] spent the latter part of December, 1892, and the early part of January, 1893, on the island. Besides an account of the island, which was published together with the list of species in the fourth volume of Zoe, pages 130-139, 1893, he wrote articles for several garden magazines. The phanerogams were named by Mrs. Katherine Brandegee and the lichens by Dr. E. L. Greene. Among his collections were 11 endemic species and one which Dr. Greene described as a new genus founded on a specimen in the Herbarium of the California Academy of Sciences, which he named *Petromecon frutescens* Pitt., 5:294, 1905. The other species, *Petromecon palmeri,* l.c., 296, was originally described as *Eschscholtzia palmeri* Rose, Contr. U. S. Nat. Herb., 1:23. 1890.

[1]This was the name under which he published. His true name is Dr. Emanuele Orazio Fenzi.

In the fifth volume of Zoe is an account of the Voyage of the Wahlberg, a vessel owned and used by A. W. Anthony in exploring the islands and coast of Lower California. Mr. T. S. Brandegee accompanied the expedition as far south as San Jose del Cabo, and among the places visited in the early spring of 1897 was Guadalupe Island. No full list of species was published, but 10 species were added, all from the mainland of California. In June of the same year an expedition consisting of Messrs. Rufus L. Green, Charles B. Wing and Wilbur W. Thoburn visited the island to make certain fur-seal investigations. They collected some plants, a list of which was published by Dr. William Russel Dudley in "The Fur-Seals and Fur-Seal Islands of the North Pacific Ocean," part III: 280-283, 1899. Thirty-seven species were collected, one a new species of *Calandrinia*, and 2 species were added.

Dr. G. Dallas Hanna and J. R. Slevin, in July, 1923, visited the island in the interest of the California Academy of Sciences, and made a small collection and photographed the pines and cypresses.

The last collection was that of H. L. Mason while botanical collector for the expedition of the California Academy of Sciences to the Revillegigedo Islands in 1925. Mr. Mason was on the island only two days (April 19-20), and in stormy weather, so that a small collection of only 43 species was made. Two weeds not before reported and nine topotypes were collected.

In the present list of species the collector's name is given after each species with the exception of that made by Green, Wing and Thoburn. This is indicated as Dudley's list. Three lists have been made to show the relationship of the flora. The list of species first described from Guadalupe Island numbers 51, the list from the mainland or islands off the coast of California numbers 74, while that of widely distributed species numbers 35. It will be seen from these lists, as well as from the general list, that the flora is related more to that of the mainland of California than to that of the peninsula of Lower California or the islands adjacent. It suggests a former connection with the mainland and is perhaps the remnant of another peninsula extending south and paralleling that of Lower California.

List of Species
Originally described from Guadalupe Island, Mexico

(Stars indicate types and daggers indicate topotypes in the Herbarium of the California Academy of Sciences.)

†*Cupressus guadalupensis* Watson
†*Pinus radiata binata* Lemmon
Erythea edulis Watson
Brodiæa insularis Greene
†*Quercus tomentella* Engelm.
Phoradendron guadalupensis Trelease
†*Atriplex palmeri* Watson
Hesperonia heimerlii Standley
Talinum guadalupense Dudley
†*Eschscholtzia elegans* Greene
†*Eschscholtzia ramosa* Greene
†*Petromecon palmeri* Greene
**Petromecon frutescens* Greene
Thysanocarpus erectus Watson
Trifolium palmeri Watson
**Hosackia ornithopus* Greene
Lupinus niveus Watson
**Lupinus guadalupensis* Greene
†*Sphæralcea sulphurea* Watson
Sphæralcea palmeri Rose
†*Lavatera occidentalis* Watson
Mentzelia dispersa Watson
Œnothera guadalupensis Watson
Hesperalæa occidentalis Watson
Convolvulus macrostegius Greene
Gilia guadalupensis Brand
Gilia pygmæa Brand
Phacelia phyllomanica Gray
Phacelia floribunda Greene
†*Cryptanthe maritima* Greene
Cryptanthe foliosa Greene
Harpagonella palmeri Gray
Pogogyne tenuiflora Gray
Calamintha palmeri Gray
Nicotiana petunæfolia Greene
Solanum calvum Bitter
Solanum profundeincisum Bitter
Castilleja guadalupensis Brandegee
Mimulus latifolius Gray
Marah guadalupensis Greene
Galium angulosum Gray
Stephanomeria guadalupensis Brandegee
†*Corethrogyne cana* Greene
†*Franseria camphorata* Greene
Hemizonia frutescens Gray
Hemizonia palmeri Gray
†*Hemizonia greeniana* Rose
†*Perityle incana* Gray
†*Perityle grayi* Rose
Baeria palmeri Gray
Senecio palmeri Gray

List of Species chiefly Californian

Notholæna newberryi D. C. Eaton
Polypodium californicum Kaulf.
Polypodium scouleri H. & G.
Pityrogramma triangularis Maxon
Pellæa mucronata D. C. Eaton
Polystichum munitum Presl.
Juniperus californica Carr.
Phyllospadix torreyi Watson
Dissanthelium californicum Benth.
Brodiæa lugens Greene
Hesperocnide tenella Torr.
Pterostegia drymarioides F. & M.
Suæda californica Watson
Aphanisma blitoides Nutt.
Montia perfoliata Howell
Calandrinia menziesii T. & G.
Calandrinia maritima Nutt.
Stellaria nitens Nutt.
Tissa macrotheca Britt.
Tissa pallida Greene
Ranunculus hebecarpus H. & A.
Lepidium lasiocarpum Nutt.
Thelypodium lasiophyllum Greene
Tillæa erecta H. & A.

Ribes sanguineum Pursh.
Heuchera?
Alchemilla cuneifolia Nutt.
Rhus laurina Nutt.
Ceanothus cuneatus Nutt.
Ceanothus crassifolius Torr.
Rhamnus crocea Nutt.
Trifolium amplectens T. & G.
Trifolium microcephalum Pursh.
Hosackia grandiflora Benth.
Vicia exigua Nutt.
Crossosoma californicum Nutt.
Frankenia grandifolia Ch. & Schl.
Sanicula menziesii H. & A.
Mentzelia micrantha T. & G.
Opuntia prolifera Engelm.
Epilobium minutum Lindl.
Arctostaphylos, sp.
Dodecatheon clevelandi Gray
Gilia nevinii Gray
Collomia gilioides glutinosa Gray
Nemophila racemosa Nutt.
Ellisia chrysanthemifolia Benth.
Emmenanthe penduliflora Benth.
Pectocarya penicillata DC.
Amsinckia vernicosa H. & A.
Amsinckia intermedia F. & M.
Lycium californicum Nutt.
Solanum wallacei Parish.
Castilleja foliolosa H. & A.
Antirrhinum speciosum Gray
Antirrhinum nuttallianum Benth.
Orthocarpus purpurascens Benth.
Specularia biflora Gray
Githopsis specularioides Nutt.
Microseris linearifolia Gray
Microseris lindleyi Gray
Malacothrix clevelandi Gray
Agoseris heterophylla Greene
Micropus californicus F. & M.
Filago arizonica Gray
Filago californica Nutt.
Gnaphalium sprengelii H. & A.
Leptosyne gigantea Kell.
Baeria coronaria Gray
Baeria gracilis Gray
Eriophyllum cæspitosum Dougl.
Amblyopappus pusillus H. & A.
Matricaria discoidea DC.
Artemisia californica Less.

List of Species widely distributed, probably introduced

Aristida adscensionis L.
Muhlenbergia microsperma Kunth.
Polypogon monspeliensis Desv.
Phalaris intermedia Bosc.
Avena fatua L.
Bromus sterilis L.
Bromus trinii Desv.
Hordeum murinum L.
Juncus bufonius L.
Parietaria floridana Nutt.
Chenopodium album L.
Chenopodium murale L.
Mesembryanthemum crystallinum L.
Silene antirrhina L.
Silene gallica L.
Myosurus minimus L.
Lepidium bipinnatifidum Desv.
Sisymbrium canescens Nutt.
Brassica nigra Koch
Brassica campestris L.
Oligomeris glaucescens Camb.
Erodium moschatum L'Her.
Erodium cicutarium L'Her.
Melilotus indica All.
Malva borealis Wallm.
Daucus pusillus Mx.
Anagallis arvensis L.
Solanum nigrum L.
Linaria canadensis L.
Plantago patagonica Jacq.
Galium aparine L.
Sonchus oleraceus L.
Sonchus tenerrimus L.
Hypochæris glabra L.
Centaurea melitensis L.

POLYPODIACEÆ; Fern Family

1. *Notholæna newberryi* D. C. Eaton, Bull. Torr. Bot. Club iv: 12. 1885. *Type locality,* San Diego. "Throughout the island," Palmer. Greene. Franceschi. Hanna & Slevin. Mason 1532.

2. *Polypodium californicum* Kaulf., Enum. Fil. 102. 1824. *Type locality,* California. "Abundant at north end," Palmer. Greene. Franceschi. Mason 1533.

3. *Polypodium scouleri* Hook. & Greville, Icon. Fil. 1: pl. 56. 1828. *Type locality,* Columbia River region. "Encircling the trunk of a single tree," Palmer. Hanna & Slevin, "On oak trees."

4. *Pityrogramma triangularis* Kaulf., Maxon, Contr. U. S. Nat. Herb. 17: 173. 1913. This was reported as *Gymnogramme trangularis* Kaulf. *Type locality,* San Francisco. "In crevices of the highest cliffs in the middle and south end of the island," Palmer. Franceschi. Mason 1514.

5. *Pellæa mucronata* D. C. Eaton, U. S. & Torr. Mex. Bound. Surv. Bot. 233. 1859. This was reported as *P. ornithopus* Hook. *Type locality,* hills near San Francisco Bay. "Rare in crevices of highest cliffs," Palmer. Franceschi.

6. *Polystichum munitum* Kaulf., Presl., Tent. Pter. 83. 1836. This was reported as *Aspidium munitum* Kaulf. *Type locality,* California. "Only two clumps seen at the northern end in a rocky place inaccessible to goats," Palmer.

CONIFERÆ; Pine Family

7. *Juniperus californica* Carr., Rev. Hortic. Ser. IV, iii: 352. 1854. *Type locality,* California. "Over the middle of the island and occasionally at the south end in low valleys and ravines, forming groves about fifteen feet high," Palmer. "Now upon the verge of extinction," Greene. Not since collected.

8. *Cupressus guadalupensis* S. Watson, Proc. Am. Acad. 14: 300. 1879. *Type locality,* Guadalupe Island. "In irregular clusters in the middle of the island," Palmer. "A fine grove near the springs," Greene. "On plateau at the top of the island opposite northeast anchorage," Hanna & Slevin.

Dudley's list. Hanna & Slevin collected cones from two different trees, one having the large cone characteristic of the type and the other with cones as small and globular as those of *Cupressus goveniana* Gord.

9. *Pinus radiata binata* (Engelm.), Lemmon, West Am. Cone-Bearers 42. 1895. *Type locality,* Guadalupe Island. This pine differs from typical *Pinus radiata* in having two needles in a sheath instead of three, and much shorter leaves. The cones are much smaller, but are without prickles and are of the same shape as those of the type; otherwise it might be referred to *Pinus muricata* D. Don. Perhaps it should be regarded as a distinct species. "High elevations at the north end, the largest seven and a half feet in circumference and averaging seventy feet high; at the extreme northern end and facing the bay the trees assume a hedge-like form," Palmer. Greene. Franceschi. Hanna & Slevin. Dudley's list.

ZOSTERACEÆ; Eel-grass Family

10. *Phyllospadix torreyi* S. Watson, Proc. Am. Acad. 14: 303. 1879. *Type locality,* Santa Barbara. Dudley's list.

POACEÆ; Grass Family

11. *Aristida adscensionis* L., Sp. Pl. 82. *Type locality,* Ascension Island. This was reported in Dr. Palmer's second collection as *Aristida bromoides* H. B. K. "In deep cañons," Palmer. Rose (see Contr. U. S. Nat. Herb. 22: 544). Mason 1540.

12. *Muhlenbergia microsperma* (DC.), Kunth., Rev. Gram., i: 64. 1829. *Type locality,* Mexico. This was reported as *M. debilis* Trin. "Growing in abundance on warm slopes in the middle of the island," Palmer. Greene. Franceschi. Mason 1541.

13. *Polypogon monspeliensis* (L.), Desf., Fl. Atlant., i: 66. *Type locality,* Europe. "Common about springs," Green. Franceschi. Dudley's list.

14. *Phalaris caroliniana* Walt., Fl. Carol. 74. *Type locality,* Carolina. Voyage of the Wahlberg, T. S. Brandegee, (Zoe 5: 22).

15. *Avena fatua* L., Sp. Pl. 80. *Type locality,* Europe. "Several small patches in open places on the best soil," Palmer. "Very little seen," Greene. "Very common," Mason 1542.

16. *Bromus sterilis* L., Sp. Pl. 77. *Type locality,* Europe. "On warm hillsides sometimes in large patches as if sown, at the south and middle of the island," Palmer. Mason 1843.

17 *Bromus trinii* Desv., in C. Gay, Fl. Chil. 6:441. 1853. Reported as *Trisetum barbatum* Steud. *Type locality,* Chile. "Abundant at southern end due to wet season," Palmer.

18. *Hordeum murinum* L., Sp. Pl. 85. *Type locality,* Europe. "Only a few tufts seen near the cabins on the plateau," Greene. "Very common," Mason 1544. Dudley's list.

19. *Dissanthelium californicum* Benth., in Hook., Icon. Pl. t. 1375. 1881. *Type locality,* Catalina Island. (Reported as *Stenochloe californica* Nutt).

PHOENICACEÆ; Palm Family

20. *Erythea adulis* (Wendl.), S. Watson, Bot. Cal. 2:212. 1880. *Type locality,* Guadalupe Island. "Frequent in deep, warm ravines from the northern end to Jacks Bay; the only thing on the island having a tropical look. It attains a height of about forty feet, averaging about fifteen inches in diameter. Each tree bears one to four clusters of fruit four feet in length and each weighing 40 to 50 pounds. The fruit is eaten by man, goats, birds and mice. In flower near the end of March," Palmer. Greene. "Northwestern part of the island, the principal grove not less than one mile and a half long by half to a mile in breadth. There and in a few other parts where palms are still growing in small numbers their range in altitude appears to be between 300 to 1000 feet. A few expanded flowers were to be found already at the beginning of December, but the general blossoming takes place in January and the fruits are said to ripen in April," Franceschi Dudley's list.

JUNCACEÆ; Rush Family

21. *Juncus bufonius* L., Sp. Pl. 328. *Type locality,* Europe. "From the middle to the north end of the island growing abundantly in very springy places," Palmer. Greene.

LILIACEÆ; Lily Family

22. *Brodiæa insularis* Greene, Bull. Cal. Acad. Sci. 2:134. 1886. *Type locality,* Guadalupe Island. Greene listed this as *B. capitata* Benth. Palmer collected it on his second trip. Greene describes it with leaves an inch broad and scape often more than four feet high. It was exceedingly common on the plateau all about the spring.

23. *Brodiæa lugens* Greene, Bull. Cal. Acad. Sci. 2:142. 1886. This was identified by T. S. Brandegee, one of the additions collected on the Voyage of the Wahlberg as common on the slopes of Sparrmann's Cañon. The *type locality* of this species, which Greene later transferred to *Calliprora,* is mountain summits back of Vacaville, California. It seems improbable that this rare species of which Greene claims to have been the only collector can be the same as the Guadalupe Island species.

CUPULIFERÆ; Oak Family

24. *Quercus tomentella* Engelm., Trans. Acad. Sci. St. Louis 3: 393. 1877. *Type locality,* Guadalupe Island. This was first considered identical with *Q. chrysolepis* Liebm. "Frequent at the north end and occasionally found in the cañons on both sides of the island, often large specimens 40 feet high and widespreading; timber good and durable though knotty," Palmer. Greene. Franceschi. Hanna & Slevin. Mason 1537.

URTICACEÆ; Nettle Family

25. *Hesperocnide tenella* Torr., in Pacif. Rail. Rep. 4:139. 1857. *Type locality,* Napa Valley. "In damp, shady places among high rocks in the middle of the island," Palmer. Greene. Franceschi.

26. *Parietaria floridana* Nutt., Gen. Am. 2:208. 1818. *Type locality,* "Near St. Mary's, West Florida." "Abundant in situations similar to the preceding," Palmer. Greene. Hanna & Slevin. Mason 1509, 1510.

LORANTHACEÆ; Mistletoe Family

27. *Phoradendron guadalupense* Trelease, Univ. Ill. Bull. 13:29. 1916. *Type locality,* Guadalupe Island. This was reported in Watson's list as *P. bolleanum* Eichler. "Near the north end on *Juniperus* and *Cupressus,* more frequently the former," Palmer. This has not since been collected.

POLYGONACEÆ; Buckwheat Family

28. *Pterostegia drymarioides* Fisch. & Meyer, Ind. Sem. Hort. Petrop, 2:48. 1835. *Type locality,* Bodega Point, California. "In the shade of rocks in the middle, and more rarely at the south end," Palmer. Greene. Mason 1526.

CHENOPODIACEÆ; Salt Bush Family

29. *Chenopodium album* L., Sp. Pl. 219. *Type locality,* Europe. "Only one plant near the sea on the east side," Palmer. Greene. Hanna & Slevin.

30. *Chenopodium murale* L., Sp. Pl. 219. *Type locality,* Europe. "A few plants near the landing, evidently a new-comer," Greene. Franceschi. Dudley's list. Mason 1520.

31. *Atriplex palmeri* S. Watson, Proc. Am. Acad. 11:146. 1876. *Type locality,* Guadalupe Island. "Only at the south end in rounded bushes about 1½ feet high," Palmer. Greene. Hanna & Slevin. Dudley's list. Mason 1538.

32. *Atriplex rosei* Standl., N. Am. Fl. 21:60. 1916. *Type locality,* Guadalupe Island. Rose 15022 in part.

These two species of *Atriplex* are considered subspecies of *A. barclayana* (Benth.), Dietr. The first, *A. barclayana palmeri,* and the second, *A. barclayana dilatata* (Greene), Hall & Clements, Phylogenetic Method in Taxonomy, 315.

33. *Suæda californica* S. Watson, Proc. Am. Acad. 9:89. 1874. *Type locality,* Salt marshes of San Francisco Bay. Mason 1539.

34. *Aphanisma blitoides* (Nutt.), ex Moq. in DC. Prod. 13:54. 1849. *Type locality,* San Diego, California. Brandegee, Voyage of the Wahlberg, Zoe, 5:22.

ALLIONACEÆ; Four O'Clock Family

35. *Hesperonia heimerlii* Standl., Contr. U. S. Nat. Herb. 13. 412. 1911. *Type locality,* Guadalupe Island. This was reported as *Mirabilis californica* Gray. "Of compact branching habit in crevices in the walls of cañons on the east side," Palmer. This was also collected at the south end on Palmer's second trip. Greene. Rose. Franceschi. Dudley's list.

FICOIDACEÆ; Fig Marigold Family

36. *Mesembryanthemum crystallinum* L., Sp. Pl. 480. *Type locality,* Cape of Good Hope. "On beach at landing," Greene. Dudley's list.

PORTULACACEÆ; Portulaca Family

37. *Montia perfoliata* Howell, in Eryth. I:38. 1893. Reported as *Claytonia perfoliata* Don. North America. "All over the island," Palmer. "Corolla small and more purple," Greene. Franceschi.

38. *Calandrinia menziesii* (Hook.), T. & G. Fl. N. Am. I:197. *Type locality,* south of the mouth of the Columbia. "All over the island in masses," Palmer. "Smaller than in California, white flowers very frequent," Greene. Mason 1507.

39. *Calandrinia maritima* Nutt., in T. & G. Fl. N. Am. I:197. *Type locality,* San Diego. Collected by Brandegee on the Voyage of the Wahlberg, Zoe, 5:22.

40. *Talinum guadalupense* Dudley, Report Fur-Seal Investigations, part 3 (1896-97), p. 282. Leaves thick and fleshy oblanceolate, 2-5 cm. long, all radical. Root fusiform fleshy, broadening at top into a short rhizoma extending laterally. Flowering panicles 3-5 dm. in height, ascending, naked except for the deltoid acuminate scarious bracts at the bases of the divaricate, scattered branches which occupy the

upper half. Flowers in terminal close clusters. Sepals 2, roundish, persistent. Petals rose-colored, broadly obovate, nearly 1 cm. long. Stamens numerous. Slender exserted style with 2-3-lobed stigmas. Capsule broadly ovoid acute. Walls 3-valved, splitting from above. Placenta basal. Seeds disk-shaped, numerous.

CARYOPHYLLACEÆ; Pink Family

41. *Stellaria nitens* Nutt., in T. & G., Fl. N. Am. I: 185. *Type locality*, "Plains of the Columbia." "At middle and north end under rocks," Palmer.

42. *Silene antirrhina* L., Sp. Pl. 419. Europe. "Only in cañons on east side near beach," Palmer.

43. *Silene gallica* L., Sp. Pl. 417. Europe. "Sparingly in middle of island," Palmer. "Very common in lower cypress groves," Greene. Dudley's list.

44. *Tissa macrotheca* (Hornem), Britt. in Bull. Torr. Bot. Club 16: 129. 1889. California. "Common on exposed sides of hills, in arroyos and sides of cañons," (Palmer on second trip). Franceschi. Dudley's list.

45. *Tissa pallida* Greene, ex Britton, l. c. *Type locality*, San Francisco. "Collected with the preceding but not so common," (Palmer on second trip).

RANUNCULACEÆ; Buttercup Family

46. *Ranunculus hebecarpus* Hook & Arn., Bot. Beech. Voy. 316. 1844. California. "Abundant on warm slopes in the middle of the island," Palmer. "Only in the shade of *Quercus tomentella*," Greene.

47. *Myosurus minimus* L., Sp. Pl. 284. Europe. "In the middle of the island and at the north, near springs," Greene.

PAPAVERACEÆ; Poppy Family

48. *Eschscholtzia elegans* Greene, Bull. Cal. Acad. Sci., 1: 182. 1885. *Type locality*, Guadalupe Island. Small annual with delicate dissected foliage and rotate flowers not

an inch wide. On summit of Guadalupe. Palmer. Greene. Mason.

49. *Eschscholtzia ramosa* Greene, Bull. Torrey Bot. Club, 13:217. 1886. *Type locality,* Guadalupe Island. Annual, dendroid, in habit. Pods 3½ in long. Palmer. Greene. Dudley's list. Mason 1500.

50. *Petromecon palmeri* Pitt., 5:293. 1905. *Type locality,* Guadalupe Island. This is the same as *E. palmeri* Rose. Palmer.

51. *Petromecon frutescens* Greene, l. c., 294. *Type locality,* Guadalupe Island. Larger than the preceding and less succulent, stigmas 4. Type in Herb. Cal. Acad. Sci. Franceschi.

CRUCIFERÆ; Mustard Family

52. *Thysanocarpus erectus* S. Watson, Proc. Am. Acad. II:124. 1876. *Type locality,* Guadalupe Island. "In clear, level spots only between Jacks Bay on west side and Mt. Augusta," Palmer. It has never been found again.

53. *Lepidium lasiocarpum* Nutt., in T. & G. Fl. N. Am. I:115. *Type locality,* Santa Barbara. "In ravines in the middle of the island, rarely at south end," Palmer. Greene. Mason 1516.

54. *Lepidium bipinnatifidum* Desv., Journ. Bot. 3:165. 1814. Reported by Watson as *L. menziesii* DC. "Generally abundant," Palmer. Mason 1524.

55. *Thelypodium lasiophyllum* (H. & A.), Greene in Bull. Torr. Bot. Club 13:142. 1886. California. This was reported in Watson's list as *Sisymbrium reflexum* Nutt. "Abundant in the middle and at the south end," Palmer. Greene.

56. *Sisymbrium canescens* Nutt., Gen. Am. 2:68. Virginia to Georgia. "In great abundance," Palmer. Greene.

57. *Brassica nigra* Koch., in Roehl., Deutschl. Fl., ed. 3, 4:713. Europe. "In considerable quantity in the middle of the island," Palmer.

58. *Brassica campestris* L., Sp. Pl. 666. Europe. "A few plants near the cabins," Greene.

RESEDACEÆ; Mignonette Family

59. *Oligomeris glaucescens* Camb., in Jacquem. Voy. Bot., 4:24. t. 25. Europe. Reported as *O. subulata* Boiss. "In deep, warm cañons, middle of island, occasionally south," Palmer. Greene. Franceschi. Dudley's list. Mason 1522.

CRASSULACEÆ; Stonecrop Family

60. *Tillæa erecta* Hook. & Arn., Bot. Beech. Voy. 24. 1884. California. "In large patches among rocks and sagebrush," Palmer. Besides the typical form, a variety was also collected which was doubtfully referred to *T. leptopetala* Benth. Greene also collected it.

SAXIFRAGACEÆ; Saxifrage Family

61. *Ribes sanguineum* Pursh., Fl. Am. Sept. 1:164. "Only two plants in shade of cliffs at north end," Palmer. This is probably some other species, as the *type locality* of the true *R. sanguineum* Pursh., is Vancouver Island, and it has been found in California only at the extreme north.

62. *Heuchera ?*......."A single plant in a rock crevice, not in bloom," Palmer. Franceschi.

ROSACEÆ; Rose Family

63. *Alchemilla cuneifolia* Nutt., in T. & G. Fl. N. Am. 1:432. *Type locality,* Santa Barbara. "Among rocks and sagebrush at north end, also around a spring where it was much larger," Palmer. Greene. This was identified as *A. occidentalis* Nutt., but that is a northern species, while *A. cuneifolia* was described from specimens collected at Santa Barbara. Both may be too near *A. arvensis* Scop.

GERANIACEÆ; Geranium Family

64. *Erodium moschatum* L'Her., Ait. Hort., Kew ed. 1, 2:404. Europe. "Middle of the island," Palmer. Greene saw very little of this. Franceschi. Dudley's list. Mason 1517.

65. *Erodium cicutarium* L'Her, l. c. 414. Europe. "Abundant all over the island," Palmer. Greene. Franceschi. Dudley's list.

ANACARDIACEÆ; Sumach Family

66. *Rhus laurina* Nutt., in T. & G. Fl. N. Am. 1:219. *Type locality,* Santa Barbara. "Four found in crevices of high rocks," Palmer. Greene. Franceschi. Dudley's list.

RHAMNACEÆ; Buckthorn Family

67. *Ceanothus cuneatus* Nutt., in T. & G. Fl. N. Am. 1:267. *Type locality,* "gravelly islands and bars of the Wahlamet above the dry falls." "Middle of island, three small shrubs seen, not in flower," Palmer.

68. *Ceanothus crassifolius* Torr., Pac. Rail. Rep. 4:75. 1857. *Type locality,* Cajon Pass. "Only three alive at base of Mt. Augusta," Palmer. "A small seedling plant near cabins," Greene. Franceschi.

69. *Rhamnus crocea* Nutt., in T. & G. Fl. N. Am. I:261. *Type locality,* Monterey. "Six found in crevices of high cliffs in the middle of the island," Palmer. This is exceedingly variable in the size and shape of the leaves. The specimen collected by Mason is a mere scrap. However, Dr. Hanna and Mr. Slevin collected fine specimens from an arborescent shrub with leaves from elliptical to almost orbicular, 4.5 cm. long to 3.5 cm. wide, obtuse at apex and base with margin finely serrulate. It comes nearest to *R. pirifolia* Greene, Pitt., 3:15, described from specimens collected on Santa Cruz Island. The leaves of specimens in Herb. Cal. Acad. Sci. of *R. pirifolia* from the type island have leaves relatively much longer than wide, while those of *R. insularis* Kellogg from Cedros have much smaller leaves more like those of typical *R. crocea* Nutt. Hanna & Slevin. Mason 1528.

LEGUMINOSÆ; Pea Family

70. *Trifolium amplectens*........, T. & G., Fl. N. Am. 1:319. California. "Rare, only on beach at east side of island," Palmer. Franceschi. Mason 1511.

71. *Trifolium microcephalum* Pursh., Fl. Am. Sept. 2:478. *Type locality,* "On the banks of Clarck's River." "Very abundant at middle and north end of island," Palmer. Greene. Dudley's list. Mason 1512.

72. *Trifolium palmeri* S. Watson, Proc. Am. Acad. 11:132. 1876. *Type locality,* Guadalupe Island. "Rather abundant in the middle of the island and around a spring," Palmer. Franceschi. Mason 1513.

73. *Lupinus niveus* S. Watson, l. c. 126. *Type locality,* Guadalupe Island. "Only in the middle of the island on high cliffs," Palmer. Greene saw one flowering specimen and what appeared to be numerous seedlings. Franceschi.

74. *Lupinus guadalupensis* Greene, Bull. Cal. Acad. Sci., 1:184. 1885. *Type locality,* Guadalupe Island. "On high plateau," Greene. Type in Herb. Cal. Acad. Sci.

75. *Hosackia ornithopus* Greene, Bull. Cal. Acad. Sci. 1:185. 1885. Type from Guadalupe Island in Herb. Cal. Acad. Sci. "Frequent in the middle of Guadalupe Island," Franceschi. Dudley's list. Palmer collected the same, reported as *H. argophylla* Gray.

76. *Hosackia grandiflora* Benth., Trans. Linn. Soc. 17:365. 1837. California. "Among trees in the middle of the island," Palmer. Greene.

77. *Melilotus indica* All., Fl. Pedem. 1:308. India. "Common along the beach, ascending into shady cañons," Palmer. This was collected by Dr. Palmer on his second visit and was probably introduced by the goats.

78. *Vicia exigua* Nutt., in T. & G. Fl. N. Am. 1:272. *Type locality,* plains of Oregon and upper California. "Among rocks, center of island, only one seen," Palmer. Greene reported it as not uncommon and Palmer reported it on his second visit as common in shady sides of ravines at the north end.

MALVACEÆ; Mallow Family

79. *Sphæralcea sulphurea* S. Watson, Proc. Am. Acad. 11:125. 1876. *Type locality,* Guadalupe Island. "In large bunches three feet high in crevices of highest rocks from middle to the southern end where most abundant," Palmer. Franceschi. Greene. One plant seen by Mason 1506.

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80. *Sphæralcea palmeri* Rose, Contr. U. S. Nat. Herb. 1:23. 1890. *Type locality,* Guadalupe Island. This was collected by Dr. Palmer on his second trip. "On all exposed places on the south end of the island." According to Dr. Rose, the carpels are narrower and longer than in the preceding, but it must be closely related.

81. *Lavatera occidentalis* S. Watson, l. c. 125. *Type locality,* Guadalupe Island. "Conspicuous plant on cliffs in the middle of the island," Palmer. Greene describes the largest shrubs as 10 feet high. Franceschi. Hanna & Slevin.

82. *Malva borealis* Wallm., in Liljebl., Svensk. Fl., ed. 3:374 Europe. "Very common on eastward slope," Palmer. Greene. Franceschi. Dudley's list. Mason 1530.

DILLENIACEÆ

83. *Crossosoma californicum* Nutt., Journ. Acad. Phila., N. S. 1:150. t. 22. 1847. *Type locality,* Catalina Island. "In crevices of cliffs overhanging a cañon in the middle of the island," Palmer. "Only nine bushes found, accessible only by the aid of a rope," Greene. Franceschi. Hanna & Slevin (specimens shot down).

FRANKENIACEÆ; Salt-weed Family

84. *Frankenia grandifolia* Ch. & Schl., Linnæa 1:35. 1826. *Type locality,* near San Francisco. On the side of the bank near the northeast anchorage. Dudley's list.

UMBELLIFERÆ; Parsley Family

85. *Daucus pusillus* Mx., Fl. Bor. Am. 1:164. Carolina. "Abundant through the middle of the island," Palmer. Greene.

86. *Sanicula menziesii* Hook. & Arn., Bot. Beech. Voy., 142. 1844. California. "Two plants only, without flowers or fruit, in rock crevices, middle of the island," Palmer.

LOASACEÆ; Blazing Star Family

87. *Mentzelia dispersa* S. Watson, Proc. Am. Acad. 11:115 & 137. 1876. *Type locality,* Guadalupe Island. "In ravines at the middle and south end," Palmer.

88. *Mentzelia micrantha* (H. & A.), in T. & G. Fl. N. Am. 1:535. California. "Only on beach near landing," Greene.

CACTACEÆ; Cactus Family

89. *Opuntia prolifera* Engelm., in Am. Journ. Sci. II. 14:338. 1852. *Type locality,* San Diego, California. Greene. Franceschi. Dudley's list. Mason 1547, not collected. Common throughout the island.

90. *Neomammillaria goodridgii* (Scheer), Britt. & Rose, Cactaceæ, 4:158. *Type locality,* Cedros Island. Greene. Dudley's list.

ONAGRACEÆ; Evening Primrose Family

91. *Epilobium minutum* Lindl., in Hook. Fl. Bor. Am. 1:207. Northwest coast of America. "Only at north end among rocks and sagebrush," Palmer. "Two or three plants only seen," Greene.

92. *Œnothera (Sphærostigma) guadalupensis* S. Watson, Proc. Am. Acad., 11:115 & 137. 1876. *Type locality,* Guadalupe Island. "Only two plants in a ravine on east side near beach," Palmer.

ERICACEÆ; Heather Family

93. *Arctostaphylos* sp. Greene found a single seedling plant not more than two or three years old under a cypress.

PRIMULACEÆ; Primrose Family

94. *Dodecatheon clevelandi* Greene, Pitt. 1:213. 1888. *Type locality,* San Diego. This is the species reported by Palmer, Greene, and Franceschi, and collected in flower by Anthony. A specimen of Anthony's collection in the Herbarium of the California Academy of Sciences indicates this species.

95. *Anagallis arvensis* L., Sp. Pl. 148. Europe. "Only one plant found near beach," Palmer. "Only one plant on top of island," Greene.

OLEACEÆ; Olive Family

96. *Hesperalœa palmeri* Gray, Proc. Am. Acad. 11:83. 1876. *Type locality,* Guadalupe Island. This was described as a new genus from Guadalupe Island. Dr. Palmer reported it as a tree with sulphur-colored flowers in a terminal panicle. Three live trees only were seen in a cañon on the east side; no young trees seen, but many dead ones. As this has never been found again, the species is probably extinct.

CONVOLVULACEÆ; Morning Glory Family

97. *Convolvulus macrostegius* Greene, Bull. Cal. Acad. Sci. 1:208. 1885. *Type locality,* Guadalupe Island. This was reported by Watson as *C. occidentalis* Gray. "In crevices of high rocks hanging down six feet or more," Palmer. "A thousand flowers on one plant," Greene. Franceschi.

POLEMONIACEÆ; Phlox Family

98. *Gilia guadalupensis* Brand., Das Pflanzenreich, 4:134. 1907. *Type locality,* Guadalupe Island. This was described together with the next from specimens collected by Dr. Palmer on his first visit, and both listed in Watson's report under *Gilia pusilla californica* Gray. "Abundant under brush and in protected places in the middle of the island," Palmer.

99. *Gilia pygmæa* Brand., l. c.

100. *Gilia nevinii* Gray, Syn. Fl., 1. Suppl. 411. *Type locality,* San Clemente Island. This was reported by Watson as *Gilia multicaulis millefoliata.* "Localities similar to the preceding, flowers blue and showy or cream-colored with a violet base," Palmer. Franceschi. Dudley's list. Mason 1905.

101. *Collomia gilioides glutinosa* (Benth.), Gray, Proc. Am. Acad. 8:260. 1870. *Type locality,* California. "Abundant in similar localities to the preceding," Palmer. Greene lists this as *Gilia divaricata* Nutt. The species described in this aggregate are very closely related.

HYDROPHYLLACEÆ; Waterleaf Family

102. *Nemophila racemosa* (Nutt.), Gray in Proc. Am. Acad. 10: 315. (1875.) *Type locality,* San Diego, California. This was reported in Watson's list as *N. aurita* Lindl. "On warm slopes middle of the island; rarely at south end," Palmer. Since Greene and Dr. Franceschi found only *N. racemosa* at the same place, probably Watson was mistaken, owing to poor specimens.

103. *Ellisia chrysanthemifolia* Benth., Trans. Linn. Soc. 17: 274 (1837.) California. "Abundant under sagebrush, throughout the island," Palmer. Greene reported it as *Eucrypta.* Franceschi. Mason 1525.

104. *Emmenanthe penduliflora* Benth., Trans. Linn. Soc. 17: 281. 1837. California. "Rocky ravines in the middle of the island," Palmer. Greene. Franceschi. Mason 1515.

105. *Phacelia phyllomanica* Gray, Proc. Am. Acad. 11: 87. (1876.) *Type locality,* Guadalupe Island. "Rare in crevices of high rocks in the middle of the island," Palmer. Greene reports it as often more than six feet high. Franceschi.

106. *Phacelia floribunda* Greene, Bull. Cal. Acad. Sci. 1: 200. (1885.) *Type locality,* Guadalupe Island. It was reported by Watson as *P. phyllomanica interrupta* Gray. "Frequent in rocky ravines at middle and south end," Palmer. Greene reports it as an annual from lower parts of the island. Dudley's list.

BORAGINACEÆ; Borage Family

107. *Harpagonella palmeri* Gray, Proc. Am. Acad. 11: 88. (1876.) *Type locality,* Guadalupe Island. "Only at the south end," Palmer. Greene.

108. *Pectocarya penicillata* A. DC., Prodr. 10: 120. *Type locality,* California. "With the above," Palmer.

109. *Amsinckia vernicosa* H. & A., Bot. Beech. Voy. 370. *Type locality,* California. "Very abundant at south end," Palmer.

110. *Amsinckia intermedia* F. & M., Ind. Sem. Petrop. 1: 26. *Type locality,* Bodega Head. This was reported among the additions collected on the voyage of the Wahlberg. Zoe 5 :22.

111. *Cryptanthe maritima* Greene, Pitt. 1:117. (1887.) *Type locality,* Guadalupe Island. This was described as *Krynitzkia maritima* by Greene, and listed in Watson's report on Palmer's collection as *Eritrichium angustifolium* Torr. "At south end and near beach," Palmer. Greene. Franceschi. Dudley's list. Mason 1501.

112. *Cryptanthe foliosa* Greene, Pitt. 1:113. (1887.) *Type locality,* Guadalupe Island. This was described as *Krynitzkia foliosa* Greene. It was reported by Watson as *Eritrichium utriculatum* Torr. "Cañons in the middle of the island," Palmer. Greene reports this as the same as *E. ramosissima* Gray. Franceschi.

LABIATÆ; Mint Family

113. *Pogogyne tenuiflora* Gray, Proc. Am. Acad. 11:100. (1876.) *Type locality,* Guadalupe Island. "Very rare among sagebrush on the eastern side," Palmer. This has never been collected again and is probably extinct.

114. *Calamintha palmeri* Gray, Proc. Am. Acad. 11:100. (1876.) *Type locality,* Guadalupe Island. "Abundant among trees and sagebrush in the middle of the island, strong-scented and not eaten by goats," Palmer. Greene.

SOLANACEÆ; Nightshade Family

115. *Nicotiana petunæflora* Greene, Bull. Cal. Acad. Sci. I:209. (1885.) *Type locality,* Guadalupe Island. This was reported by Watson as *N. bigelovii* Watson. "Only in a few places in the center of the island, in open spots and good soil; flowers greenish yellow, bronzy below. The leaves stick to the goats' hair," Palmer. Greene.

116. *Lycium californicum* Nutt., ex Gray in Bot. Cal. 1:542. *Type locality,* San Diego, California. "Extreme south end on rocky bluffs, not abundant," Palmer. Mason 1540.

117. *Solanum wallacei* (Gray), Parish in Proc. Cal. Acad. Sci., Ser. 3:2:166. 1901. This was reported as *S. xanti* Gray, and has been named *S. xanti wallacei* by the same author. *Type locality,* Catalina Island. "Only in the middle

of the island in large bunches about two feet high, in the crevices of the rocks, blooming all the year," Palmer. Greene. Franceschi.

118. *Solanum (Morella) profundeincisum* Bitter, in Fedde, Repert. 12:80 (1913.) *Type locality,* Guadalupe Island. This is Palmer's No. 61, and 60 in part, reported as *Solanum nigrum douglasii* Gray. "Only two plants on the beach on the east side; flowers white, small," Palmer.

119. *Solanum (Morella) calvum* Bitter, l. c. 81. *Type locality,* Guadalupe Island. This was reported as *S. nigrum* var. under Palmer's No. 60 in part. "Rare in the middle of the island and in a cañon near the beach on the east side, in rich level spots; flowers purple or white; fruit black," Palmer. Greene also reported a *Solanum* related to *S. nigrum.* Bitter's type is white-flowered.

SCROPHULARIACEÆ; Figwort Family

120. *Castilleja foliolosa* H. & A., Bot. Beech. Voy. 154. California. "Rare, only middle of the island," Palmer.

121. *Castilleja guadalupensis* Brandegee, Zoe 5:166. (1903.) *Type locality,* Guadalupe Island. Brandegee collected this in an almost inaccessible spot on the western cliff.

122. *Mimulus latifolius* Gray, Proc. Am. Acad. 11:95 1876. *Type locality,* Guadalupe Island. "Only in the middle of the island, scattered in warm, moist spots," Palmer. Greene.

123. *Antirrhinum speciosum* (Nutt.), Gray, Proc. Am. Acad. 7:376. 1868. *Type locality,* Catalina Island. *Galvesia speciosa* Nutt. Pl. Gamb. 149. t. 22. "Frequent in crevices of high rocks in the middle of the island," Palmer. Greene.

124. *Antirrhinum nuttallianum* Benth., in DC. Prod. 11:592. *Type locality,* San Diego, California. "Rather rare in deep, warm cañons in the middle of the island," Palmer. Greene. Mason 1523.

125. *Linaria canadensis* (L.), Dumont, Bot. Cult. 2:96. North and South America. "Rare on sides of cañons in the middle of the island," Palmer.

126. *Orthocarpus purpurascens* Benth., Scroph. Index, 13. California. Brandegee in Voy. Wahl., Zoe 5:22.

PLANTAGINACEÆ; Plantain Family

127. *Plantago patagonica* Jacq., Ic. Rar. t. 306. South America. "South end of island," Palmer. Collected on both trips. Greene.

CUCURBITACEÆ; Gourd Family

128. *Marah guadalupensis* (S. Watson), Greene, Leafl. 2:36. (1910.) This was reported as *Megarrhiza guadalupensis* Watson. *Type locality,* Guadalupe Island. "In crevices of high rocks in the middle of the island; flowers white; fruit green," Palmer. "Fruit conspicuously flattened laterally," Greene. Franceschi.

RUBIACEÆ; Madder Family

129. *Galium angulosum* Gray, Proc. Am. Acad. 11:74. (1876.) *Type locality,* Guadalupe Island. "A single small shrubby plant in a crevice of a high cliff in the middle of the island; flowers greenish white," Palmer.

130. *Galium aparine* L., Sp. Pl. 108. Europe. "Common on warm, shady hillsides in the middle and more rarely at the south end," Palmer. Greene. Dr. Franceschi saw two specimens but collected none.

CAMPANULACEÆ; Harebell Family

131. *Specularia biflora* (R. & P.), Gray, Proc. Am. Acad. 11:82. (1876.) *Type locality,* Chile. "Rare in the shade of rocks and sagebrush on hillsides in the middle of the island," Palmer.

132. *Githopsis specularioides* Nutt., Trans. Am. Phil. Soc., N. S. 8:258. (1843.) *Type locality,* plains of the Oregon near the outlet of the Wahlamet [Willamette]. "Abundant at the middle and north end under sagebrush and dead branches; flowers white, turning to blue after gathering," Palmer.

CICHORIACEÆ; Chicory Family

133. *Sonchus oleraceus* L., Sp. Pl. 794. Europe. "Very rare on warm slopes in the middle of the island," Palmer. "Very common on the eastward slope of the island," Greene. Franceschi. Hanna & Slevin. Dudley's list. Mason 1531.

134. *Sonchus tenerrimus* L., l. c. Europe. This was found only by Palmer on his second trip, who reported it as a very slender form 2-8 inches high in shady cañons at the south end.

135. *Microseris linearifolia* (DC.), Gray, Proc. Am. Acad. 9:209. (1874.) California. "Only in the middle of the island on stony ridges, eaten closely by goats," Palmer. "Abundant and very rank about the springs and the cypress groves where the goats do not now range," Greene. Franceschi.

136. *Microseris lindleyi* (DC.), Gray, l. c. 210. Western shores of North America. This has been collected by Brandegee, Voyage of the Wahlberg, Zoe 5:22.

137. *Malacothrix clevelandi* Gray, Bot. Cal. 1:433. *Type locality*, San Diego. "Abundant among rocks and trees in the middle of the island," Palmer. Greene.

138. *Stephanomeria guadalupensis* Brandegee, Zoe 5:104. *Type locality,* Guadalupe Island. Collected by Brandegee in Sparrman's Cañon. The clumps of white leaves growing on the nearly perpendicular, dark-colored cliffs are very conspicuous.

139. *Agoseris heterophylla* (Nutt.), Greene, Pitt. 2:178. (1891.) California. "About the springs in grassy ground, fine large specimens," Greene.

140. *Hypochæris glabra* L., Sp. Pl. 810. Europe. A single plant, not before reported. Mason 1529.

COMPOSITÆ; Sunflower Family

141. *Corethrogyne cana* (Gray), Greene, Bull. Cal. Acad. Sci. 1:223. (1885.) *Type locality,* Guadalupe Island. This was reported by Watson as *Diplostephium canum* Gray. "Large shrub, about four feet high, of loose habit, found only in the crevices of high, rocky cliffs; flowers yellow," Palmer.

Greene saw but one plant. It was six feet high, but not in flower. Franceschi.

142. *Micropus californicus* Fisch. & Meyer, Ind. Sem. Hort. Petrop. 2: 42. *Type locality,* Bodega Head, California. "On dry, gravelly slopes in the middle of the island," Palmer. No other collector has found this species, which is so common on the mainland.

143. *Filago arizonica* Gray, Proc. Am. Acad. 8: 652. 1873. *Type locality,* Verde Mesa, Arizona. "On level ground at south end," Palmer. Greene. Mason 1527.

144. *Filago californica* Nutt., in Trans. Am. Phil. Soc. N. S. 7: 405. 1841. *Type locality,* Santa Barbara. "A fine growth about the springs north of the middle portion of the island," Greene. Franceschi. Dudley's list. Mason 1527a.

145. *Gnaphalium sprengelii* Hook. & Arn., Bot. Beech. Voy. 150. California. "Only in the middle of the island on stony ridges," Palmer. Greene saw only one plant and the species has not since been collected on the island.

146. *Franseria camphorata* Greene, in Bull. Cal. Acad. Sci. 1: 192. 1885. *Type locality,* Guadalupe Island. This was reported by Watson as *Franseria bipinnatifida* Nutt. "One of the most conspicuous plants at the south end, growing in thick, roundish clumps, giving the country a greenish-white appearance, flower buds red, bloom straw-color," Palmer. Greene in his description alludes to the strong camphor odor for which it is named. "Not common," Dudley's list. Mason 1518.

147. *Leptosyne gigantea* Kellogg, in Proc. Cal. Acad. Sci. 4: 198. (1870.) *Type locality,* San Miguel Island. "Only two plants found in the crevices of high rocks, five feet high and branching near the top," Palmer. This has not since been collected.

148. *Hemizonia frutescens* Gray, Proc. Am. Acad. 11: 79. (1876.) *Type locality,* Guadalupe Island. "In compact bunches in the crevices of high rocks, a few small plants among bushes," Palmer. Greene. Dudley's list.

149. *Hemizonia palmeri* Rose, Contr. U. S. Nat. Herb. 1: 24. (1890.) *Type locality,* Guadalupe Island. This was collected by Dr. Palmer on his second visit, and was reported

as common on the south end of the island in all exposed places.

150. *Hemizonia greeneana* Rose, l. c. *Type locality,* Guadalupe Island. Dr. Palmer reports this as common at the south end in all the arroyos and cañons along the beach. It is a very homely plant, growing in great clumps in barren places. Hanna & Slevin.

151. *Perityle incana* Gray, Proc. Am. Acad. 11:78. (1876.) *Type locality,* Guadalupe Island. "Very common in the middle of the island in the crevices of high rocks hanging in massive bunches of yellow bloom," Palmer. Greene. Franceschi. Dudley's list. Mason 1519.

152. *Perityle grayi* Rose, in Coult. Bot. Gaz. 15:118. (1890.) *Type locality,* Guadalupe Island. This was reported by Watson as *P. emoryi* Torr., and is probably the plant that Greene reported as *P. californica* Benth. "Scattered through some of the cañons on the east side, flowers white, showy," Palmer. Franceschi. "Abundant," Dudley's list. Mason 1502.

153. *Baeria palmeri* Gray, Bot. Cal. 1:376. *Type locality,* Guadalupe Island. "Abundant in warm, low spots in the middle and at the south end, flowers showy," Palmer. Greene.

154. *Baeria coronaria* (Nutt), Gray, Proc. Am. Acad. 19:23. (1883.) *Type locality,* San Diego, California. Collected only on the Voyage of the Wahlberg, Zoe 4:130.

155. *Baeria gracilis* (DC.), Gray, Proc. Am. Acad. 9:196. (1874.) California. Collected only on the Voyage of the Wahlberg, Zoe 5:22.

156. *Bahia lanata* DC., Prod. 5:657. "A single plant on a rocky, open spot in the middle of the island," Palmer. It has not been found since. Franceschi reported an *Eriophyllum* which may be the same.

157. *Amblyopappus pusillus* Hook. & Arn., in Hook. Journ. Bot. 3:321. (1841.) Chile. "In low ground at the southern end," Palmer. Greene. "Common on south facing slope," Mason 1508.

158. *Matricaria discoidea* DC., Prod. 6:50. California. "Around springs in the middle of the island," Palmer. Greene. Franceschi.

159. *Artemisia californica* Less., in Linnæa 6: 523. (1831.) California. "Common," Palmer. Greene. Franceschi.

160. *Senecio palmeri* Gray, Proc. Am. Acad. 11: 89. (1876.) *Type locality,* Guadalupe Island. " 'White sage,' very abundant on warm slopes, about three feet high, a free and showy bloomer," Palmer. Greene. Franceschi.

161. *Centaurea melitensis* L., Sp. Pl. 917. *Type locality,* Malta. Dudley's list. Mason 1521.

List of Plants recorded from Cedros Island, Mexico

Cedros Island, the largest of the islands along the coast of Lower California, lies about 40 miles distant from the shore and midway of the peninsula. From the northern extremity it widens to about 9 miles at the south and is about 20 miles long. It is of volcanic origin and mountainous, with many peaks, the highest of which is less than 4000 feet elevation.

Several collections of plants have been made on the island. In the present list the names of the collectors will be given in chronological order with each species. There have been three published lists and the species not on those lists have been taken from the scattered descriptions of Dr. Kellogg in the publications of the California Academy of Sciences and in revisions and monographs. There may be some that have been overlooked, as it is scarcely possible to be certain that every reference has been found.

The first collection was made by Dr. Veatch, who visited the island in 1859 to investigate the reports of its mineral wealth. He brought back a small collection which he gave to the recently-founded California Academy of Natural Sciences, and the specimens were named by Dr. Albert Kellogg. Some of them were beautifully figured in colors in the Hesperian, later described in the publications of the California Academy of Natural Sciences, and all were new to science. Dr. Streets visited the island in 1876, collecting a few specimens, but no list was published. Mr. Lyman Belding made a small collection in April, 1882, there being a few references to his specimens. The first important collection following that of Dr. Veatch was made by Dr. E. L. Greene in 1885. He spent three days in April and published a delightful description of the island and the trip in Pittonia 1: 194-208. Eighty-two species were collected, 19 being new. In 1889, Lieut. Charles F. Pond of the U. S. Ship Ranger, while surveying the Lower Californian shores and islands, made a small collection on Cedros Island, which was listed by Dr. Greene in Pitt. 1: 266-268. Of nine species listed five were described as new. The next important collection was made by Dr. Edward Palmer, who spent five days on the island in March, 1889. The list of his collection was published by Dr. George Vasey and Dr. J. N. Rose in Contr. U. S. Nat. Herb. 1: 13-20. He collected 97 species, six of which were new, and 44 were added to the known flora of the island. In 1897, T. S. Brandegee visited this island on the voyage of the Wahlberg and the list of his additions was published in Zoe 5: 23. There were 31 species added, one new, namely *Gilia uncialis* Brandegee, a scrap of which is in the herbarium of the California Academy of Sciences. On the 1905-1906 expedition of the California Academy of Sciences to the Galapagos Islands a short stop was made on the island and a few plants collected by Alban W. Stewart. Dr. G. Dallas Hanna made a small collection when he visited the island in 1922. Dr. J. N. Rose and others have made some collections, but no lists of their plants have been published, their collections being occasionally noted in revisions and monographs. The last collection is that of H. L. Mason, the botanical collector on the expedition of the California Academy of Sciences to the Revillagigedo Islands in the spring of 1925. He collected 53 species from June 3-6, adding *Asclepias subulata* Dcne., *Dudleya candida* Britton, *Dudleya* sp., *Polypogon monspeliensis* Desv., *Carex spissa* Bailey, *Eleocharis caribæa* Blake, *Acalypha californica* Benth.

In the present paper four lists have been made, the first being the 55 species which were first described from Cedros Island. Those in this list marked with a star are the types in the herbarium of the California Academy of Sciences, those marked with a dagger are topotypes in our herbarium. The second list consists of 33 species first described from Lower California or the mainland of Mexico. The third is a list of 64 species which were originally described from the mainland of California or Arizona. The fourth is a list of widely-distributed species consisting of 23, generally known as weeds.

List of Species first described from Cedros Island

(Stars indicate types and daggers indicate topotypes in the Herbarium of the California Academy of Sciences.)

†*Juniperus cerrosianus* Kell.
***Agave sebastiana* Greene
†*Eriogonum molle* Greene
†*Eriogonum pondii* Greene
Eriogonum taxifolium Greene
†*Harfordia fruticosa* Greene
Hesperonia cedrosensis Standl.
Thysanocarpus palmeri Vasey & Rose
†*Hosackia nudata* Greene
**Hosackia flexuosa* Greene
Lotus cedrosensis Greene
**Astragalus fastidiosus* Kell.
**Astragalus insularis* Kell.
Astragalus cedrosensis Vasey & Rose
Viscainoa geniculata Greene
†*Veatchia cedrosensis* Gray
**Rhus lentii* Kell.
†*Rhamnus insularis* Kell.
†*Sphæralcea fulva* Greene
Abutilon lemmoni Watson
†*Eucnide cordata* Curran
**Petalonyx linearis* Greene
Cochemica pondii Walton
Neomamillaria goodridgei Britt. & Rose
Ferocactus chrysacanthus Britt. & Rose
**Xylonagra arborea* Donn. Sm. & Rose
**Œnothera cedrosensis* Greene
**Garrya veatchii* Kell.
**Arctostaphylos veatchii* Kell.
Gilia veatchi Parry
Gilia uncialis Brandegee
**Phacelia ixodes* Kell.
Phacelia cedrosensis Rose
†*Cryptanthe cedrosensis* Greene
†*Verbena lilacina* Greene
**Salvia cedrosensis* Greene
Teucrium glandulosum Kell.
**Monardella thymifolia* Greene
†*Lycium cedrosense* Greene
†*Physalis greenei* Vasey & Rose
Nicotiana greeneana Rose
Diplacus stellatus Kell.
**Pentstemon cedrosensis* Kell.
**Galium stellatum* Kell.
**Trixis californica* Kell.
†*Brickellia cedrosensis* Greene
†*Aplopappus tridentatus* Blake
Franseria lancifolia Rydb.
**Viguiera lanata* Kell.
**Encelia stenophylla* Greene
†*Encelia californica asperifolia* Blake
Verbesina hastata Kell.
Porophyllum cedrense Rose & Standl.
**Senecio cedrosensis* Greene
Eriophyllum crucigerum Rydb.

List of Species First described from Mexico or Lower California

Notholæna candida Hook.
Cheilanthes brandegei D. C. Eaton
Ephedra peninsularis Johnston
Muhlenbergia microsperma Kunth.
Eriogonum intricatum Benth.
Atriplex barclayana Benth.
Draba sonoræ Greene
Arabis pectinata Greene
Tillæa connata R. & P.
Dudleya candida Britton
Ribes viburnifolium Gray
Ribes tortuosum Benth.
Lupinus pondii Greene
Phaseolus filiformis Benth.
Parosela benthami Standl.
Parosela megacarpa Standl.

Acalypha californica Benth.
Euphorbia polycarpa Benth.
Zizyphus parryi Torr.
Frankenia palmeri Wats.
Mentzelia adhærens Benth.
Echinocereus maritimus Schum.
Machærocereus gummosus Britt. & Rose
Asclepias subulata Dcne.
Cryptanthe maritima Greene
Datura discolor Bernh.
Antirrhinum junceum Gray
Antirrhinum watsoni Vasey & Rose
Echinopepon minima Watson
Bebbia juncea Greene
Franseria chenopodifolia Benth.
Franseria camphorata leptophylla Gray
Perityle grayi Rose

List of Species found also on the mainland

Pellæa andromedæfolia Fée
Pityrogramma triangularis Maxon
Pinus muricata Don
Melica imperfecta Trin.
Stipa lepida Hitchc.
Carex spissa Bailey
Carex angustata Boot
Brodiæa capitata Benth.
Celtis douglasii Planch.
Eriogonum fasciculatum Benth.
Pterostegia drymarioides Fisch. & Meyer
Aphanisma blitoides Moq.
Atriplex microcarpa Dietr.
Atriplex californica Moq.
Calandrinia maritima Nutt.
Polycarpum depressum Nutt.
Clematis pauciflora Nutt.
Delphinium cardinale Hook.
Lepidium menziesii DC.
Thysanocarpus laciniatus Nutt.
Athysanus pusillus Greene
Isomeris arborea Nutt.
Heteromeles arbutifolia Roem.
Hosackia maritima Nutt.
Euphorbia misera Benth.
Euphorbia albomarginata T. & G.
Ditaxis californica Heller
Simmondsia californica Nutt.
Mentzelia involucrata Watson
Rhus laurina Nutt.
Rhus integrifolia Nutt.
Bergerocactus emoryi Britt. & Rose
Echinocereus engelmanni Parry
Opuntia sp.
Apiastrum angustifolium Nutt.
Bowlesia septentrionalis C. & R.
Gilia gracilis Hook.
Ellisia chrysanthemifolia Benth.
Nemophila aurita Lindl.
Plagiobothrys cooperi Gray
Pectocarya linearis DC.
Amsinckia intermedia Fisch & Meyer
Salvia columbariæ Benth.
Mimulus cardinalis Dougl.
Antirrhinum subsessile Gray
Galium angustifolium Nutt.
Lonicera subspicata H. & A.
Marah macrocarpa Greene
Rafinesquia californica Nutt.
Microseris linearifolia Gray
Malacothrix clevelandi Gray
Aplopappus venetus Blake
Baccharis sarothroides Gray
Filago arizonica Gray
Gnaphalium sprengelii H. & A.
Iva hayesiana Gray
Hemizonia fasciculata T. & G.
Perityle greenei Rose
Baeria gracilis Gray
Amblyopappus pusillus H. & A.
Porophyllum gracile Benth.
Artemisia californica Less.
Gutierrezia sarothræ Britt. & Rose

List of Species widely distributed

Adiantum capillus-veneris L.	*Mesembryanthemum crystallinum* L.
Typha, sp.	*Silene gallica* L.
Polypogon monspeliensis Desv.	*Sisymbrium canescens* Nutt.
Agrostis verticillata Vill.	*Capsella bursa-pastoris* Medic.
Bromus trinii Desv.	*Oligomeris glaucescens* Camb.
Festuca octoflora Walt.	*Erodium cicutarium* L'Her.
Eleocharis caribæa Blake	*Malva borealis* Wallm.
Scirpus riparius Spreng.	*Heliotropium curassavicum* L.
Juncus acutus L.	*Galium aparine* L.
Parietaria floridana Nutt.	*Sonchus tenerrimus* L.
Chenopodium album L.	*Sonchus oleraceus* L.
Chenopodium murale L.	*Senecio sylvaticus* L.

POLYPODIACEÆ; Fern Family

1. *Adiantum capillus-veneris* L., Sp. Pl. 1096. Europe. This is the widely distributed maiden-hair fern. Greene. Mason 2002.

2. *Pellæa andromedæfolia* (Klf.), Fée, Gen. 129. 1850-52. California. Greene collected this under pines at the summit of the island. Palmer.

3. *Notholæna sulphurea* (Cav.), J. Sm., Bot. Voy. Herald 1:233. 1854. *Pteris sulphurea* Cav., Descr. 269. 1802. California & Chile. Mexico. A small fern with white, powdery coating. Greene collected this on dry hillsides and reported it as *Notholæna candida* Hook. Palmer. Mason 2001.

4. *Cheilanthes brandegei* D. C. Eaton, Bull. Torr. Club 17:215, t. 104. 1890. *Type locality,* Magdalena Island. Palmer.

5. *Pityrogramma triangularis* (Kaulf.), Maxon, Contr. U. S. Nat. Herb. 17:173. (1913). *Gymnogramma triangularis* Kaulf. Enum. Fil. 73. 1824. *Type locality,* San Francisco, California. Brandegee.

PINACEÆ; Pine Family

6. *Juniperus cerrosianus* Kell., Proc. Cal. Acad. Sci. 2:97. 1861. *Type locality,* Cedros Island. A low shrub up to 5 feet, fruit large and very blue. Veatch. Greene. Palmer. Hanna. Mason 1991.

7. *Pinus muricata* D. Don, Trans. Linn. Soc. 17:441. 1837. *Type locality,* near San Luis Obispo, California. This pine grows on the summit of the ridges. The trees have slender trunks and some attain a height of 70 feet. Greene. Palmer. Hanna. Mason 2021.

GNETACEÆ; Joint-Fir Family

8. *Ephedra peninsularis* Johnston, Univ. Cal. Pub. Bot. 7:431. 1922. *Type locality,* Magdalena Island. This grew at the north end of the island. Palmer. Mason 2021.

TYPHACEÆ; Bulrush Family

9. *Typha angustifolia* L., Sp. Pl. 971. Europe. This is the common cat-tail or bulrush. The specimen consists of leaves only, but they are narrow as in this species and 6 feet long. Mason 2010. It may be the same as the *Typha* reported in Anthony's collection as *T. latifolia* L.

POACEÆ; Grass Family

10. *Polypogon monspeliensis* (L.), Desv., Fl. Atlant. 8:67. 1797. *Alopecurus monspeliensis* L., Sp. Pl. 61. Europe. A common weed. Mason 2016.

11. *Agrostis verticillata* Vill., Prosp. Pl. Dauph. 16. 1779. Europe. Palmer found a small plot near the spring. Mason 1995.

12. *Melica imperfecta* Trin., Mem. Acad. St. Petersb. VI. Sci. Nat. 2:59. 1836. California. Palmer.

13. *Muhlenbergia microsperma* (DC.), Kunth., Rev. Gram. 1:64. 1829. Mexico. This was reported in Palmer's collection as *M. debilis* Willd.

14. *Bromus trinii* Desv., in Gay Fl. Chile 6:441. 1853. Chile. This was reported in Palmer's list as *Trisetum barbatum* Steud.

15. *Festuca octoflora* Walt., Fl. Carol. 81. 1788. South Carolina. This was reported in Palmer's list as *F. tenella* Willd.

16. *Stipa lepida* Hitch., Am. Journ. Bot. 2:303. 1915. *Type locality,* Santa Inez Forest Reserve, California. Palmer.

September 6, 1929

CYPERACEÆ; Sedge Family

17. *Carex spissa* L. H. Bailey, in Hemsl. Biol. Centr. Amer. 4:94. 1886. *Type locality,* San Diego. A stout sedge with glaucous leaves, brownish at base. Mason 1997.

18. *Carex angustata* Boot., in Hook. Fl. Am. Bor. 2:218. Columbia River. This was collected by Greene in the deepest cañon, in wet ground. This may have been the preceding, as he was uncertain about the species.

19. *Eleocharis caribæa* (Rottb.), Blake in Rhodora 20:24. 1918. *Scirpus caribæus* Rottb., Descr. Pl. Rar. Progr. 24. 1772. *Type locality,* St. Croix, Caribæa Island. Mason 2011.

20. *Scirpus riparius* J. & C. Presl., Rel. Haenk. 1:193. South America. Greene reported this as frequent in moist saline soil.

JUNCACEÆ; Rush Family

21. *Juncus acutus* L., Sp. Pl. 325. Europe. This was reported by Greene as *J. robustus* S. Watson, now regarded as a synonym. It grew at the spring near the seashore and is a stout rush with a rank growth. Palmer. Mason 1936.

AMARYLLIDACEÆ; Century Plant Family

22. *Agave sebastiana* Greene, Bull. Cal. Acad. Sci. 1:214. 1885. *Type locality,* Cedros Island. Greene. Mason collected this in flower and fruit. It grew to a height of 8 feet. Mason 1936.

LILIACEÆ; Lily Family

23. *Brodiæa capitata* Benth., Pl. Hartw. 339. *Type locality,* Monterey. Brandegee.

URTICACEÆ; Nettle Family

24. *Parietaria floridana* Nutt., Am. Gen. 2:208. *Type locality,* near St. Mary's, West Florida. Palmer collected this amid rocks and bushes in cañons.

25. *Celtis douglasii* Planchon, in Ann. Sci. Nat. Ser. III, 10:29. *Type locality,* arid region along the Columbia River. The authority for this is C. S. Sargent's Manual of the Trees of North America, page 322. Collector not stated.

POLYGONACEÆ; Buckwheat Family

26. *Eriogonum fasciculatum* Benth., in Trans. Linn. Soc. 17:411. 1837. Nevada and Arizona. Greene. Palmer. Mason. 1987. 2028.

27. *Eriogonum molle* Greene, Pitt. 1:207. 1888. *Type locality,* Cedros Island. Greene. Hanna.

28. *Eriogonum pondii* Greene, Pitt. 1:267. 1889. *Type locality,* Cedros Island. Greene. Pond. Palmer. Stewart. Mason 2026. 2018.

29. *Eriogonum taxifolium* Greene, Pitt. 1:267. 1889. *Type locality,* Cedros Island. Greene.

30. *Eriogonum intricatum* Benth., Bot. Voy. Sulph. 46, t. 22. 1844. *Type locality,* San Bartolome Bay. This grew on the summit of the ridge. Brandegee. Mason 2037.

31. *Harfordia fruticosa* Greene, in Parry Davenp. Acad. Sci. 5:28. 1886. *Type locality,* Cedros Island. Greene reports this as the commonest shrub at all lower and middle elevations. It grows to a height of 3 feet. Veatch. Greene. Pond. Palmer. Stewart.

32. *Pterostegia drymarioides* Fisch. & Meyer, Ind. Sem. Hort. Petrop. 2: 48. *Type locality,* Bodega Bay. Palmer collected this in the shade of bushes and rocks.

CHENOPODIACEÆ; Salt-bush Family

33. *Chenopodium album* L., Sp. Pl. 219. Europe. Brandegee.

34. *Chenopodium murale* L., Sp. Pl. 219. Europe. Greene. Palmer.

35. *Aphanisma blitoides* Nutt., Moq. in DC. Prodr. 13²:54. 1849. *Type locality,* San Diego, California. Palmer.

36. *Atriplex microcarpa* (Benth.), Dietr. Syn. Pl. 5: 536. *Obione microcarpa* Benth., Bot. Voy. Sulph. 48. 1844. *Type locality,* San Diego. Palmer.

37. *Atriplex californica* Moq., in DC. Prodr. 132: 98. 1849. California. Greene reported this as frequent near the seashore.

38. *Atriplex barclayana* (Benth.), Dietr. Syn. Pl. 537. *Obione barclayana* Benth., Bot. Voy. Sulph. 48. 1844. *Type locality,* Magdalena Bay. This grew in abundance near the beach. Palmer.

ALLIONACEÆ; Four O'clock Family

39. *Hesperonia cedrosensis* Standley, in Contr. U. S. Natl. Herb. 12: 362. 1909. *Type locality,* Cedros Island. Streets. Greene. Palmer. Brandegee. This was reported as *Mirabilis californica* Gray.

FICOIDACEÆ; Fig Marigold Family

40. *Mesembryanthemum crystallinum* L., Sp. Pl. 480. Cape of Good Hope. Brandegee.

PORTULACACEÆ; Portulaca Family

41. *Calandrinia maritima* Nutt., in Torr. & Gray Fl. N. Am. 1: 19. *Type locality,* San Diego. Brandegee.

CARYOPHYLLACEÆ; Pink Family

42. *Polycarpum depressum* Nutt., in Torr. & Gray Fl. N. Am. 1: 17. *Type locality,* San Diego. Palmer found this at the highest point of the north end under pines.

43. *Silene gallica* L., Sp. Pl. 417. Europe. Brandegee.

RANUNCULACEÆ; Buttercup Family

44. *Clematis pauciflora* Nutt., in Torr. & Gray Fl. N. Am. 1: 65. *Type locality,* San Diego. Greene found two or three plants in one of the principal cañons.

45. *Delphinium cardinale* Hook., Bot. Mag. t. 4887. 1855. This was described from the collections of Wm. Lobb introduced into cultivation. Brandegee.

CRUCIFERÆ; Mustard Family

46. *Draba sonoræ* Greene, in Bull. Cal. Acad. Sci. 2: 59. 1886. *Type locality*, northwestern Sonora. Palmer found only one plant on the side of a cañon.

47. *Sisymbrium canescens* Nutt., Am. Gen. 2: 68. Virginia to Georgia. Greene. Palmer.

48. *Lepidium menziesii* DC., Syst. 2: 539. Northwest coast, collected by Menzies. Palmer collected this in exposed places.

49. *Arabis pectinata* Greene, Pitt. 1: 287. 1889. *Type locality,* San Bartolome Bay. Palmer reported this as rather common but scattering.

50. *Thysanocarpus palmeri* Vasey & Rose, Contr. U. S. Natl. Herb. 1: 14. 1890. *Type locality,* Cedros Island. This is described as having purple flowers and pods. According to S. Watson it is closely related to *T. erectus* S. Wats., and according to Greene to *T. emarginatus* Greene. Palmer found only a few plants in a level place.

51. *Thysanocarpus laciniatus* Nutt., in Torr. & Gray Fl. N. Am. 1: 118. *Type locality,* Santa Barbara. Brandegee.

52. *Athysanus pusillus* (Hook.), Greene, Bull. Cal. Acad. Sci. 1: 72. 1885. *Type locality,* Monterey. Brandegee.

53. *Capsella bursa-pastoris* (L.), Medic. Pfl. Gatt. 1: 85. *Thlaspi bursa-pastoris* L., Sp. Pl. 647.

CAPPARIDACEÆ; Caper Family

54. *Isomeris arborea* Nutt., in Torr. & Gray Fl. N. Am. 1: 124. *Type locality,* San Diego. Greene. Palmer. Mason 1999.

RESEDACEÆ; Mignonette Family

55. *Oligomeris glaucescens* Camb., in Jacq. Voy. Bot. 24, t. 25. Mediterranean region. Greene. Palmer.

CRASSULACEÆ; Stonecrop Family

56. *Tillæa connata* R. & P., Fl. Peru 1:70. Ecuador to Peru. This was reported in the list of Palmer's collection as *T. leptopetala* Benth.

57. *Dudleya candida* Britton, in Bull. N. Y. Bot. Gard. 2:18. 1903. *Type locality,* Coronado Islands, Lower California. This is much shorter than the type as described but otherwise seems to agree. The sepals and petals are farinose, the latter pale yellow tinged with pink. Mason 2003a.

58. *Dudleya* sp. This is without basal leaves. The cauline leaves are reflexed and the pink flowers densely clustered at the summit of the red stems; in fruit, the branches elongate and the arrangement of the pods is strongly secund. Mason 2038.

SAXIFRAGACEÆ; Saxifrage Family

59. *Ribes viburnifolium* Gray, in Proc. Am. Acad. 17:202. 1881-82. *Type locality,* near All Saints Bay, Lower California. Brandegee.

60. *Ribes tortuosum* Benth., in Bot. Voy. Sulph. 17. 1844. *Type locality,* San Quintin, Lower California. Brandegee.

ROSACEÆ; Rose Family

61. *Heteromeles arbutifolia* (Ait. f.), M. Roem. Syn. Rosifl. 105. 1847. California. Greene collected this in bud, on the summit of the ridge. Mason 2029.

LEGUMINOSÆ; Pea Family

62. *Hosackia nudata* Vasey & Rose, in Contr. U. S. Nat. Herb. 1:14. 1890. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 1990. This is a sparsely leaved, divaricately branching plant with subsessile flowers changing from yellow to orange.

63. *Hosackia flexuosa* Greene, Bull. Cal. Acad. Sci. 1:82. 1885. *Type locality,* Cedros Island.

64. *Hosackia maritima* Nutt., in Torr. & Gray Fl. N. Am. 1:327. *Type locality,* Santa Barbara. Palmer.

65. *Lupinus pondii* Greene, Pitt. 1 : 288. 1889. *Type locality,* San Bartolome Bay, Lower California. Palmer. Mason 2040. This is annual and related to *L. arizonicus* S. Watson.

66. *Astragalus fastidiosus* (Kell.), Greene in Bull. Cal. Acad. Sci. 1 : 186. 1885. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 2033. Flowers white, pods inflated.

67. *Astragalus insularis* Kell., in Bull. Cal. Acad. Sci. 1 : 6. 1884. *Type locality,* Cedros Island. Veatch. Palmer. Mason 1994. Prostrate, with smaller inflated pods than the preceding.

68. *Astragalus cedrocensis* Vasey & Rose, in Contr. U. S. Nat. Herb. 1 : 15. 1890. This is annual and related to *A. nuttallianus* DC. Palmer.

69. *Phaseolus filiformis* Benth., in Bot. Voy. Sulph. 13. 1844. *Type locality,* Magdalena Bay. Streets. Pond. Palmer. Mason 1988. A slender vine with pink flowers and 3-lobed leaves.

70. *Parosela benthami* (Brandegee), Standl., Contr. U. S. Nat. Herb. 23 : 460. 1922. *Dalea benthami* Brandegee, Proc. Cal. Acad. Sci. II. 2 : 148. 1889. *Type locality,* Santa Margarita Island, Lower California. Pond. Palmer.

71. *Parosela megacarpa* (S. Wats.), Standl., Contr. U. S. Nat. Herb. 23 : 460. *Dalea megacarpa* S. Watson, Proc. Am. Acad. 20 : 359. 1885. *Type locality,* Sonora, Mexico. Greene.

GERANIACEÆ; Geranium Family

72. *Erodium cicutarium* L'Her., in Hort. Kew, ed. 2 : 404. Europe. Brandegee.

ZYGOPHYLLACEÆ; Lignum Vitæ Family

73. *Viscainoa geniculata* (Kell.), Greene, Pitt. 1 : 163. 1888. *Staphylea geniculata* Kellogg, Proc. Cal. Acad. Sci. 2 : 22. 1859. *Type locality,* San Sabastian Bay. This shrub has large, yellowish white flowers and a strongly 4-lobed inflated pod which reminded Kellogg of the pod of *Staphylea.* Veatch. Greene.

EUPHORBIACEÆ; Spurge Family

74. *Acalypha californica* Benth., Bot. Voy. Sulph. 51. *Type locality,* Magdalena Bay. Mason 2021.

75. *Euphorbia misera* Benth., Bot. Voy. Sulph. 51. *Type locality,* San Diego. Mason (without number). Mason's specimen is very poor and the determination uncertain.

76. *Euphorbia albomarginata* Torr. & Gray, in Pac. Rail. R. Report 2: 174. *Type locality,* headwaters of the Colorado. Greene.

77. *Euphorbia polycarpa* Benth., Bot. Voy. Sulph. 50. *Type locality,* Magdalena Bay. Brandegee.

78. *Ditaxis californica* (Brandegee), Heller, Muhl. 8: 60. 1912. *Argythamnia californica* Brandegee, Zoe 5: 230. 1906. *Type locality,* Marshall Cañon, 7 miles west of Coachella, Riverside County, California. Brandegee.

BUXACEÆ; Box Family

79. *Simmondsia californica* Nutt., in Hook. Lond. Journ. Bot. 3: 400. 1844. t. 16. *Type locality,* San Diego. Veatch. Palmer. Veatch's specimen was described by Kellogg as *Galphimia pabulosa* and figured in the Hesperian.

ANACARDIACEÆ; Sumac Family

80. *Veatchia cedrosensis* (Kell.), Gray in Bull. Cal. Acad. Sci. 1: 4. *Rhus veatchiana* Kellogg, Proc. Cal. Acad. Sci. 2: 24. 1859. 1884. *Type locality,* Cedros Island. This is the peculiar elephant tree. Veatch. Greene. Palmer. Stewart. Hanna. Mason 1905.

81. *Rhus lentii* Kell., in Proc. Cal. Acad. Sci. 2: 16. 1859. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Stewart. Hanna. Mason 1985. The fruit is a berry as large as a small cherry.

82. *Rhus integrifolia* (Nutt.), Benth. & Hook., ex S. Watson in Wheeler's Report Bot. 84. *Styphonia integrifolia,* Nutt., in Torr. & Gray Fl. N. Am. 1: 220. *Type localities,* San Diego and Santa Barbara. Greene. Palmer. Mason

2039, leaves entire. 2034, most of the leaves entire but some are 2-3 divided.

83. *Rhus laurina* Nutt., in Torr. & Gray Fl. N. Am. 1:219. *Type locality,* Santa Barbara. Greene. Mason 1981.

RHAMNACEÆ; Buckthorn Family

84. *Rhamnus insularis* (Kell.), Greene, Bull. Cal. Acad. Sci. 2:302. 1887. *Type locality,* Cedros Island. It was published as *R. insulus* Kell., Proc. Cal. Acad. Sci. 2:20. 1859. Veatch. Greene. Palmer. Hanna.

85. *Zizyphus parryi* Torr., in Bot. Mex. Bound Surv. 46. 1859. *Type locality,* San Felipe, California. Palmer's specimens were so named by Dr. William Trelease. It was collected in cañons and on mountain sides.

MALVACEÆ; Mallow Family

86. *Sphæralcea fulva* Greene, Pitt. 1:201. 1888. *Type locality,* Cedros Island. Streets. Greene. Palmer. Mason 2031. The entire plant is yellowish tomentose and the flowers red.

87. *Abutilon lemmoni* S. Watson, in Proc. Am. Acad. 20:357. 1885. *Type locality,* near Santa Cruz, Sonora. Streets.

88. *Malva borealis* Wallm., in Liljebl. Svensk. Fl. ed. 3:574. Europe. Brandegee.

FRANKENIACEÆ; Salt-weed Family

89. *Frankenia palmeri* S. Watson, in Proc. Am. Acad. 11:124. 1876. Lower California on the gulf side. Greene. Palmer.

LOASACEÆ; Blazing Star Family

90. *Eucnide cordata* (Kell.), in Curran, Bull. Cal. Acad. Sci. 1:137. 1885. *Mentzelia cordata* Kellogg, Proc. Cal. Acad. Sci. 2:33. 1859. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 1902. Flowers white with numerous stamens, leaves cordate irregularly crenate.

91. *Petalonyx linearis* Greene, in Bull. Cal. Acad. Sci. 1:188. 1885. *Type locality,* Cedros Island. Greene. Palmer. Mason 2019.

92. *Mentzelia adhærens* Benth., Bot. Voy. Sulph. 15. *Type locality,* Magdalena Bay. Streets. Palmer.

93. *Mentzelia involucrata* S. Watson, in Proc. Am. Acad. 20:367. 1885. San Bernardino County. Brandegee.

CACTACEÆ; Cactus Family

94. *Opuntia* sp. This was listed by Greene as *Opuntia engelmanni,* which at that time was an aggregate. The species may be *O. occidentalis* Engelm. & Bigelow, which is distributed from southwestern California to northern Lower California and adjacent islands. Britt. & Rose Cactaceæ 1:146.

95. *Echinocereus engelmanni* (Parry), Rümpler in Förster Hadb. Cact. ed. 2:805. 1885. *Cereus engelmanni* Parry in Engelm. Am. Journ. Sci. II. 14:338. 1852. *Type locality,* mountains about San Felipe, San Diego County, California. Greene.

96. *Echinocereus maritimus* (Jones), Schuman, Gesambt. Kakteen 27. 1898. *Cereus maritimus* Jones, Am. Nat. 17:973. 1883. *Type locality,* Ensenada, Lower California. Brandegee.

97. *Machærocereus gummosus* (Engelm.), Britt. & Rose, Cactaceæ 2:116. 1920. *Cereus gummosus* Engelm, in Brandegee, Proc. Cal. Acad. Sci. 2:162. 1889. Lower California and adjacent islands. Brandegee.

98. *Bergerocactus emoryi* (Engelm.), Britt. & Rose, Contr. U. S. Nat. Herb. 12:474. 1909. *Cereus emory* Engelm., Am. Journ. Sci. II. 14:338. 1852. Boundary between Lower California and California. Greene.

99. *Ferocactus chrysacanthus* (Orcutt.), Britt. & Rose, Cactaceæ 3:127. *Echinocactus chrysacanthus* Orcutt., Rev. Cact. 1:56. 1890. *Type locality,* Cedros Island. This is probably *Echinocactus emoryi* reported by Greene.

100. *Neomammillaria goodridgei* (Scheer), Britt. & Rose, Cactaceæ 4:158. 1925. *Mammillaria goodridgei* Scheer,

Salm- Dyck. Cact. Hort. Dyck. 1849. 91. 1850. *Type locality,* Cedros Island. Greene.

101. *Cochemiea pondii* (Greene), Walton, Cact. Journ. 2:51. 1894. *Mammillaria pondii* Greene, Pitt. 1:268. 1889. *Type locality,* Cedros Island.

ONAGRACEÆ; Evening Primrose Family

102. *Xylonagra arborea* Donn. Sm. & Rose, Contr. U. S. Nat. Herb. 16:294. 1913. *Œnothera arborea* Kellogg, Proc. Cal. Acad. Sci. 2:32. 1859. *Type locality,* Cedros Island. Veatch. Greene. Mason 2023. A shrub with bright red fuchsia like flowers in racemes, growing in thickets.

103. *Œnothera cedrosensis* Greene, Bull. Cal. Acad. Sci. 1:187. 1885. *Type locality,* Cedros Island. Veatch. Greene. Mason 2085.

UMBELLIFERÆ; Parsley Family

104. *Apiastrum angustifolium* Nutt., in Torr. & Gray Fl. N. Am. 1:644. *Type locality,* San Diego, California. Palmer.

105. *Bowlesia septentrionalis* C. & R., Contr. U. S. Natl. Herb. 7:31. 1900. *Type locality,* near Tucson, Arizona. Brandegee.

GARRYACEÆ; Fringe-bush Family

106. *Garrya veatchii.* Kell., Proc. Cal. Acad. Sci. 1:40. 1873. *Type locality,* Cedros Island. Veatch. Greene.

ERICACEÆ; Manzanita Family

107. *Arctostaphylos veatchii* Kell., Proc. Cal. Acad. Sci. 2:19. 1863. *Type locality,* Cedros Island. Veatch. Greene. This was collected by Greene in the region of the pines near the summit. He reported it as *A. bicolor* Gray.

ASCLEPIADACEÆ; Silkweed Family

108. *Asclepias subulata* Dcne., in DC. Prodr. 8:571. "Nova Hispania." One of the leafless species. Stewart. Mason 2020.

POLOMONIACEÆ; Phlox Family

109. *Gilia veatchii* Parry ex Greene, in Bull. Cal. Acad. Sci. 1:198. 1885. *Type locality,* Cedros Island. Veatch. Greene. Palmer. A shrub with evergreen leaves resembling a juniper, viscid and fragrant; flowers ochroleucus tinged on the outside with bronze-purple.

110. *Gilia uncialis* Brandegee, in Zoe 5:107. 1901. *Type locality,* Cedros Island. This was collected by Brandegee near the summit of the highest mountains on the sides of gulches and under the shade of bushes. It is related to *G. dianthoides* Nutt.

111. *Gilia gracilis* Hook., Bot. Mag. t. 2924. California. Brandegee.

HYDROPHYLLACEÆ; Waterleaf Family

112. *Phacelia ixodes* Kell., Bull. Cal. Acad. Sci. 1:6. 1884. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Stewart. Hanna. Mason 2000. Flowers bluish white in scorpioid spikes, elongating in fruit; entire plant glandular hairy.

113. *Phacelia cedrosensis* Rose, Contr. U. S. Nat. Herb. 1:18. 1890. *Type locality,* Cedros Island. This species is very hispid with slender bristles. Palmer collected it in the shade of bushes in cañons.

114. *Ellisia chrysanthemifolia* Benth., in Trans. Linn. Soc. 17:274. 1837. California. Palmer.

115. *Nemophila aurita* Lindl., Bot. Reg. t. 1601. California. Pond.

BORAGINACEÆ; Borage Family

116. *Cryptanthe cedrosensis* Greene, Pitt. 1:117. 1887. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 2035.

117. *Cryptanthe maritima* Greene, Pitt. 1:117. 1887. *Type locality,* Guadalupe Island. Palmer.

118. *Pectocarya linearis* DC., Prodr. 10:120. Chile. Palmer.

119. *Heliotropium curassavicum* L., Sp. Pl. 130. Cosmopolitan. Pond.

120. *Plagiobothrys cooperi* Gray, Proc. Am. Acad. 20:285. 1885. *Type locality,* San Diego. Palmer.

121. *Amsinckia intermedia* F. & M., Ind. Sem. Hort. Petrop. 2:26. 1836. *Type locality,* Bodega Head, Sonoma County, Calif. Brandegee.

VERBENACEÆ; Verbena Family

122. *Verbena lilacina* Greene, in Bull. Cal. Acad. Sci 1:210. 1885. *Type locality,* Cedros Island. Greene. Palmer. Mason without a number. A tall shrubby species with fragrant lilac flowers in terminal heads.

LABIATÆ; Mint Family

123. *Salvia cedrosensis* Greene, Bull. Cal. Acad. Sci. 1:212. 1885. *Type locality,* Cedros Island. Greene. Palmer. Mason 2027. A shrub with blue flowers, growing along talus slopes.

124. *Salvia columbariæ* Benth., Lab. Gen. et Sp. 302. California. Brandegee.

125. *Teucrium glandulosum* Kell., Proc. Cal. Acad. Sci. 2:23. 1863. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Flowers white with pink shading.

126. *Monardella thymifolia* Greene, Bull. Cal. Acad. Sci. 1:211. 1886. *Type locality,* Cedros Island. Greene. Mason 2022. Low shrub, the flowers pink to purple.

SOLANACEÆ; Nightshade Family

127. *Lycium cedrosense* Greene, Pitt. 1:268. 1889. *Type locality,* Cedros Island. A glandular pubescent spinescent shrub with small, red berries. Pond. Palmer. Mason 2014.

128. *Physalis greenei* Vasey & Rose, Contr. U. S. Nat. Herb. 1:18. 1890. *Type locality,* Cedros Island. Streets. Ponds. Palmer. Stewart.

129. *Nicotiana greeneana* Rose, Contr. U. S. Nat. Herb. 1:18. 1890. *Type locality,* Cedros Island. Palmer.

130. *Datura discolor* Bernh., in Linnæa in Litt. 8:138. 1833. West Indies. Brandegee.

SCROPHULARIACEÆ; Figwort Family

131. *Mimulus cardinalis* Dougl. ex. Benth., Scroph. Ind. 28. California. Greene. Palmer. Mason 1993, flowers red; 2017, flower yellow.

132. *Diplacus stellatus* Kell., Proc. Cal. Acad. Sci. 2:19. 1863. *Type locality,* Cedros Island. Veatch. Greene. Palmer.

133. *Pentstemon cerrosensis* Kell., Proc. Cal. Acad. Sci. 2:19. 1863. *Type locality,* Cedros Island. Veatch. Greene. Belding. Palmer. Mason 2024. A showy species with red flowers.

134. *Antirrhinum junceum* (Benth.), Gray, Proc. Am. Acad. 7:377. 1868. *Maurandia juncea* Benth., Bot. Voy. Sulph. 41. 1844. From San Diego to the Bay of Magdalena. Veatch. Streets. Greene. Pond. Palmer. Mason 1984. This was described and figured by Kellogg as *Saccularia veatchii,* Proc. Cal. Acad. Sci. 2:174. 1863.

135. *Antirrhinum subsessile* Gray, in Coult. Bot. Gaz. 9:55. 1884. *Type locality,* San Diego. Palmer.

136. *Antirrhinum watsoni* Vasey & Rose, Proc. U. S. Nat. Mus. 11:533. 1888. *Type locality,* San Quentin. Palmer.

RUBIACEÆ; Madder Family

137. *Galium angustifolium* Nutt., in Torr. & Gray Fl. N. Am. 2:22. *Type locality,* San Diego. Greene.

138. *Galium aparine* L., Sp. Pl. 108. Europe. Brandegee.

139. *Galium stellatum* Kell., Proc. Cal. Acad. Sci. 2:97. 1863. *Type locality,* Cedros Island. Veatch.

CAPRIFOLIACEÆ; Honeysuckle Family

140. *Lonicera subspicata* Hook. & Arn., Bot. Beech Voy. 349. California. Brandegee.

CUCURBITACEÆ; Gourd Family

141. *Echinopepon minima* (Kell.), S. Watson, Proc. Am. Acad. 24: 52. 1889. *Marah minima* Kellogg, Proc. Cal. Acad. Sci. 2: 18. *Type locality,* Cedros Island. Veatch. Street. Palmer.

142. *Marah macrocarpa* Greene, Leafl. Bot. Obs. 2: 36. 1910. From Santa Barbara to Cedros Island. Greene.

CICHORIACEÆ; Chicory Family

143. *Rafinesquia californica* Nutt., in Trans. Am. Phil. Soc. N. S. 7: 429. 1841. *Type locality,* San Diego. Palmer.

144. *Microseris linearifolia* (DC.), Gray, Proc. Am. Acad. 9: 207. 1874. *Calais linearifolia* DC., Prodr., 7: 85. 1838. California. Palmer.

145. *Malacothrix clevelandi* Gray, Bot. Cal. 1: 433. *Type locality,* San Diego. Greene. Palmer.

146. *Sonchus tenerrimus* L., Sp. Pl. 794. Mediterranean region. Palmer, more common than the next.

147. *Sonchus oleraceus* L., Sp. Pl. 794. Cosmopolitan. Palmer.

MUTISIACEÆ; Mutisia Family

148. *Trixis californica* Kell., Proc. Cal. Acad. Sci. 2: 182, 53. 1862. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 2004.

COMPOSITÆ; Sunflower Family

149. *Brickellia cedrosensis* Greene, Bull. Torr. Bot. Club 10: 86. 1883. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 2004.

150. *Gutierrezia sarothræ* (Pursh), Britt. & Rusby in Trans. N. Y. Acad. Sci. 7: 10. 1887. *Solidago sarothræ* Pursh, Fl. Am. Sept. 540. 1814. On the plains of the Missouri. Greene. Mason 1992.

151. *Aplopappus tridentatus* (Greene), Blake, Contr. U. S. Nat. Herb. 23. 1493. 1926. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 1998.

152. *Aplopappus venetus* (H. B. K.), Blake, Contr. U. S. Natl. Herb. 23. 1492. 1926. *Baccharis veneta* H. B. K., Nov. Gen. & Sp. 4: 68. 1820. *Type locality,* Cuernavaca, Mexico. Greene. Palmer.

153. *Bebbia juncea* (Benth.), Greene, Bull. Cal. Acad. Sci. 1: 179. 1885. *Carphephorus junceus* Benth., Bot. Voy. Sulph. 21. 1844. *Type locality,* Magdalena Bay. Greene. Palmer.

154. *Baccharis sarothroides* Gray, Proc. Am. Acad. 17: 211. 1881. San Diego County, California. Greene. Mason 2009.

155. *Filago arizonica* Gray, Proc. Am. Acad. 8: 652. 1873. *Type locality,* Verde Mesa, Arizona. Palmer.

156. *Gnaphalium sprengelii* H. A., Bot. Beech. Voy. 150. California. Palmer.

157. *Franseria chenopodifolia* Benth., Bot. Sulph. 20. *Type locality,* Magdalena Bay. Greene. Palmer. Mason 2012.

158. *Franseria lancifolia* Rydb., N. Am. Fl. 33: 36. 1922. *Type locality,* Cedros Island. Brandegee. According to Dr. Standley, this is a form of the preceding with less pubescent fruit.

159. *Franseria camphorata* Greene, Bull. Cal. Acad. Sci. 1: 192. 1885. *Type locality,* Guadalupe Island. Greene. Palmer.

160. *Franseria camphorata leptophylla* Gray, Proc. Am. Acad. 22: 309. 1887. *Type locality,* San Fernando, Lower California. Greene.

161. *Iva hayesiana* Gray, Proc. Am. Acad. 11: 78. 1876. San Diego County, California. Greene.

162. *Viguiera lanata* (Kell.), Gray, Proc. Am. Acad. 17: 218. 1881-82. *Bahiopsis lanata* Kellogg, Proc. Cal. Acad. 2: 35. 1859. *Type locality,* Cedros Island. Veatch. Greene. Streets. Belding. Pond. Palmer. Mason 2036.

163. *Encelia stenophylla* Greene, Bull. Torr. Club. 10: 41. 1883. *Type locality,* Cedros Island. Veatch. Greene. Palmer. Mason 1989.

164. *Encelia californica asperifolia* Blake, Proc. Am. Acad. 49: 368. 1914. *Type locality,* Cedros Island. Streets. Pond. Palmer. Mason 2015.

165. *Verbesina hastata* Kell. ex Curran, in Bull. Cal. Acad. Sci. 1: 140. 1885. *Type locality,* Cedros Island. Veatch. Greene. Palmer. This was reported as *Encelia cedrosensis* Rose, in Palmer's list.

166. *Hemizonia fasciculata* (DC.), Torr. & Gray, Fl. N. Am. 2: 397. California. Greene. *Hartmannia fasciculata* DC., *Prodr.* 5: 693. 1836.

167. *Perityle greenei* Rose, in Coult. Bot. Gaz. 15: 117. 1890. *Type locality,* Santa Cruz Island, California. Veatch. Streets. Greene. Palmer.

168. *Perityle grayi* Rose, l. c. *Type locality,* Guadalupe Island. Palmer.

169. *Eriophyllum crucigerum* Rydb., N. Am. Fl. 34: 96. 1915. *Type locality,* Cedros Island. Greene. Palmer. This was reported as *E. confertiflorum* (DC). Gray.

170. *Baeria gracilis* (DC.), Gray, Proc. Am. Acad. 9: 196. 1874. California. *Burrielia gracilis* DC., Prodr. 5: 664. 1836.

171. *Amblyopappus pusillus* Hook. & Arn., in Journ. Bot. 3: 321. 1841. Chile. Palmer.

172. *Porophyllum gracile* Benth., in Bot. Voy. Sulph. 29. 1844. *Type locality,* Magdalena Bay. Greene. Pond. Palmer.

173. *Porophyllum cedrense* Rose & Standl. ex Rydb., Fl. N. Am. 34: 189. 1916. *Type locality,* Cedros Island. Rose.

174. *Artemisia californica* Less., in Linnæa 6: 525. 1831. California. Greene.

175. *Senecio cedrosensis* Greene, Bull. Cal. Acad. Sci. 1: 194. 1885. *Type locality,* Cedros Island. Greene. Palmer.

176. *Senecio sylvaticus* L., Sp. Pl. 868. Europe. Palmer.

September 6, 1929

A List of Plants
Recorded from the Tres Marias Islands, Mexico

The first list of plants from the Tres Marias Islands was published by Dr. J. N. Rose in N. Am. Fauna, U. S. Dept. Agr., No. 11, pages 77-91. It was based on a collection made the last of May at the close of the dry season in 1897 by E. W. Nelson and E. A. Goldman. One hundred and twelve species were recorded from Maria Madre, Maria Magdalena and Maria Cleofa islands, of which 11 were described as new. The next collection was that of H. L. Mason when on the expedition of the California Academy of Sciences to the Revillagigedo Islands in 1925. Collections were made on Maria Madre, Maria Magdalena and Isabella islands from May 16-24 at the end of the dry season and about 120 species were collected. Owing to the incomplete condition of most of the specimens, a duplicate set was sent to the United States National Herbarium for the authoritative determinations of Mr. Paul C. Standley, an authority on Mexican plants. In October, 1925, Mrs. Roxana S. Ferris made a much better collection, owing to the more favorable time of the year. She collected only on Maria Madre from October 21-27 and found 64 species, 10 being new, published with 4 plates in Contr. Dudley Herb. 1:65-81, the title of her paper being: Preliminary Report on the Flora of the Tres Marias Islands.

The greater number of the species listed are of wide distribution in the tropics, a few are peculiar to the adjacent mainland, and 21 have been described as new species, two of which are now considered synonyms. More extended and thorough exploration of these islands will undoubtedly discover many more species. It is with the desire to help future explorers that these lists have been brought together.

List of Species
First described from the Tres Marias Islands

(Stars indicate types and daggers indicate topotypes in the Herbarium of the California Academy of Sciences.)

†*Aristolochia tresmariæ* Ferris
†*Forchammeria sessilifolia* Standl.
Acaciella ferrisæ Britt. & Rose
Mimosa ferrisæ Britt. & Rose
†*Cracca arcuata* Rydb.
†*Atelia insularis* Standl.
Zanthoxylon insularis Rose
Zanthoxylon nelsoni Rose

Zanthoxylon ferrisæ Standl.
Pilocarpus insularis Rose
Esenbeckia nesiotica Standl.
Gymnanthes insoluta Ferris
Acalypha verbenacea Standl.
Astrocasia peltata Standl.
Euphorbia tresmariæ Standl.
†*Buxus pubescens* Greenm.
Matayba spondioides Standl.
Ternstroemia maltbya Rose
Begonia californica brevibracteata Ferris
**Salvia aliena* Greene
Beloperone nelsoni Greene

POLYPODIACEÆ

1. *Adiantum trapezoides* Fée, Gen. 117. 1850-52. Brazil, Jamaica, Mexico. Mason 1822, Maria Magdalena. Ferris 5704.

2. *Adiantum concinnum* H. B. Willd., Sp. 5:451. 1810. Tropical America. Nelson 4273, Maria Madre.

3. *Adiantum tenerum* Swartz, Prod. 135. 1788. Mexico. Nelson 4281, Maria Madre.

4. *Adiantum poiretii* Wikstr., Vet. Acad., Hdl. 1825, 443. 1826. Tropical Africa, East Indies, Mexico. Ferris 5632.

5. *Ceropteris calomenalos* (L.), Under., Bull. Torr. Club 29:632. 1902. *Gymnogramma calomenalos* Kaulf. Tropical America, Natal, Africa. Nelson 4333, Maria Madre.

6. *Dryopteris patens* (SW.), O. Kuntze, Rev. Gen. Pl. 2:813. 1891. *Aspidium patens* Swartz. Cosmopolitan. Nelson 4316, Maria Madre.

7. *Dryopteris karwinskyana* (Mett.), O. Kuntze, Rev. Gen. Pl. 2:813. 1891. Mexico, Guatemala. Ferris 5711.

8. *Aspidium trifoliatum* (L.), Swartz, Schrad. Journ. 1800^2, 30. Tropical America. Nelson 4280, Maria Madre.

9. *Pteris longifolia* L., Sp. Pl. 2:1074. Cosmopolitan. Nelson 4201, Maria Madre.

10. *Coniogramme americana* Maxon, Contr. U. S. Nat. Herb. 17:607. 1916. Mexico. Ferris 5712.

11. *Pellæa seemanni* Hook., Sp. Fl. 2:141, t. 107b. 1858. Mexico. Ferris 5706.

CYCADACEÆ

12. *Zamia loddigesii Miq.* Hoev. & De Vriese, Tijdschr. 10:72. Mexico. Nelson 4329, Maria Cleofa.

POACEÆ

13. *Syntherisma sanguinalis* (L.), Dulsc, Fl. Hautes-Pyr. 77. *Digitaria sanguinalis* (L.), Scop. Cosmopolitan. Mason 1844, Maria Madre. Ferris 5642.

14. *Panicum fasciculatum* Swartz, Prodr. Veg. Ind. 22. Jamaica. Ferris 5675a.

15. *Panicum ramosum* L., Mant. 8:29. Asia. Ferris 5675.

16. *Panicum trichoides* Swartz, Prodr. Veg. Occ. 24. Jamaica. Ferris 5701, 5605.

17. *Lasiacis ruscifolia* (H. B. K.), Hitch., Contr. U. S. Nat. Herb. 15:16. Mexico. Mason 1818, Maria Magdalena.

18. *Lasiacis divaricata* (L.), Hitch., Contr. U. S. Nat. Herb. 15:16. Jamaica. Ferris 5656.

19. *Oplismenus burmanni* (Retz.), Beauv., Ess. Agrost. 54. Tropics. Ferris 5674.

20. *Chætochloa grisebachii* (Fourn.), Scribn., U. S. Dept. Agr. Div. Agrost. Bull. 4:39. Mexico. Ferris 5574.

21. *Chætochloa macrostachya* (H. B. K.), Scrib. & Merr., U. S. Dept. Agr. Div. Agrost. Bull. 21:29, Fig. 16. Mexico. Ferris 5755.

22. *Cenchrus echinatus* L., Sp. Pl. 1050. Jamaica. Mason 1848, Santa Isabella Island. Ferris 5725.

23. *Aristida ternipes* Cav., Icon. 5:46. Panama. Ferris 5724.

24. *Sporobolus argutus* (Nees), Kunth., Enum. Pl. 1:215. Brazil. Ferris 6615.

25. *Pappophorum alopecuroides* Vahl., Symp. Bot. 3:10. t. 51. Tropical America. Ferris 5616.

26. *Bouteloua aristidoides* (H. B. K.), Griseb., Fl. Brit. W. Ind. 537, in obs. Mexico. Ferris 5753.

27. *Eragrostis ciliaris* (L.), Link., Hort. Berol. 1:192. Jamaica. Ferris 5641.

28. *Jouvea pilosa* (Presl.), Scrib., Bull. Torr. Bot. Club 25:143. 1896. Acapulco, Mexico. Ferris 5587.

29. *Gouinia* N. Sp., fide Hitchcock. Mason 1845, Santa Isabella.

30. *Panicum trichoides* Swartz, Prodr. Veg. Ind. Occ. 24. 1788. Jamaica. Nelson 4257 as *P. brevifolium* L., Maria Madre.

31. *Eleusine indica* Gaertn., Fruct. 1:8. India, Jamaica. Nelson 4305, Maria Madre.

32. *Dactyloctenium ægyptiacum* Willd., Enum. Hort. Berol. 1029. 1809. Africa, Asia, America. Nelson 4317, Maria Magdalena.

33. *Arundo donax* L., Sp. Pl. 81. Europe. Nelson 4332. Maria Cleofa.

CYPERACEÆ

34. *Cyperus incompletus* Link., Hort. Berol. 1:319. West Indies. Nelson 4259, Maria Madre.

35. *Cyperus ligularia* L., Amœn. Acad. 5:81. West Indies. Nelson 4330. Maria Cleofa.

36. *Cyperus compressus* L., Sp. Pl. 46. Cosmopolitan. Ferris 5650.

37. *Cyperus tenerrimus* J. & C. Presl., Rel. Haenk. i:166. Mexico. Ferris 5718.

38. *Cyperus cayennensis* (Lam.). Britt., Bull. Dept. Agr. Jamaica 5: Suppl. 1:8. West Indies. Ferris 5567 and 5564.

39. *Cyperus brunneus* Swartz, Fl. Ind. Occ. i:116. West Indies. Ferris 5678.

40. *Cyperus Ottonis* Boeck., in Linnæa 36:350. 1861-62. West Indies. Ferris 5737.

ARACEÆ

41. ? *Philodendron polytomum* Schott., in Bonplandia 7:164. 1859. Central America, Mexico. Ferris 6249.

42. ? *Philodendron anistomum* Schott., in Œstr. Bot. Zeitschr. 8:179. 1858. Central America, Mexico. Ferris 6258.

BROMELIACEÆ

43. *Tillandsia circinnata* Schl., in Linnæa 18:430. 1844. Central America, Mexico. Mason 1742, 1719, 1765, Maria Madre.

44. *Tillandsia juncea* Le Conte, Ann. Lyc. N. York 2:130. 1828. Southern United States, Mexico, South America. Mason 1723, Maria Madre.

45. *Tillandsia balbisiana* Schult. f. Syst. 7:11. 1212. Florida, Mexico, West Indies. Mason 1722, Maria Madre.

46. *Tillandsia fasciculata* Swartz, Prod. Veg. Ind. Occ. 56. Florida, Mexico, West Indies. Mason 1764, Maria Madre. Ferris 3635.

47. *Hechtia* sp. A specimen with leaves only. Mason 1755.

COMMELINACEÆ

48. *Commelina virginica* L., Sp. Pl. ed. II:61. Eastern United States, Tropical America, South America to Patagonia. Ferris 5685.

49. *Tinantia modesta* Brandegee, Proc. Cal. Acad. Sci., 11. 3:175. 1889. *Type locality,* Miraflores, Mexico. Ferris 5703.

AMARYLLIDACEÆ

50. *Agave pacifica* Trelease, Contr. U. S. Nat. Herb. 23:118. 1920. *Type locality,* Creston Island, Mażatlan. Mason 1756, Maria Madre.

DIOSCORIACEÆ

51. *Dioscorea* sp. Ferris 6264.

MARANTACEÆ

52. ? *Calathea cyclophora* Baker, Kew Bull. 1895:17. British Guiana. Ferris 6263.

ORCHIDACEÆ

53. *Oncidium* sp. Mason 1823, Maria Magdalena.

PIPERACEÆ

54. *Peperomia pellucida* (L.), H. B. & K., Nov. Gen. & Sp. 1:64. American & African tropics. Ferris 5707.

55. *Piper aduncum* L., Sp. Pl. 29. Tropical America. Nelson 4283, Maria Madre.

MORACEÆ

56. *Ficus cotinifolia* H. B. & K., Nov. Gen. et Sp. 2:49. Mexico, Central America. Mason 1739 and 1763, Maria Madre. Ferris 5677.

57. *Ficus mexicana* Miquel., Ann. Mus. Bot. Lugd. Bat. 3:300. Mexico, Central America. Ferris 5681.

58. *Ficus petiolaris* H. B. & K., Nov. Gen. et Sp. 2:49. Type from near Mazatlan, Mexico. Ferris 5653.

59. *Ficus involuta* (Liebm.), Miq., Ann. Mus. Bot. Lugd. Bat. 3:298. Central America and Mexico. Nelson 4182, Maria Madre.

60. *Ficus padifolia* H. B. & K., Nov. Gen. et Sp. 2:47. Central America, Mexico. This was reported as *Ficus radulina* Watson. *Type locality,* near Batopilas, Chihuahua. Nelson 4261, Maria Madre.

URTICACEÆ

61. *Myriocarpa longipes* Liebm., in Vidensk. Selsk. Skr. 5:ii:307. 1851. Central America and Mexico. Nelson 4275, Maria Madre.

62. *Celtis monoica* Hemsley, Biol. Centr. Am. Bot. 3:139. *Type locality,* Vera Cruz. Nelson 4236, Maria Madre.

LORANTHACEÆ

63. *Phoradendron townsendi* Trelease, Gen. Phorad. 112. t. 163. 1916. *Type locality,* Socorro Island. Mason 1733, Maria Madre.

OLACACEÆ

64. *Ximenia americana* L., Sp. Pl. 1193. Cosmopolitan tropics. Mason 1705 and 1830, Maria Madre.

65. *Agonandra racemosa* (DC), Standl., Journ. Wash. Acad. Sci., 10: 506. 1920. Mexico. Mason 1786 and 1777, Maria Madre.

ARISTOLOCHIACEÆ

66. *Aristolochia taliscana* H. & A., Bot. Beech. Voy. 309. *Type locality,* Jálisco, Mexico. Mason 1697 and 1778, Maria Madre. Ferris 5685.

67. *Aristolochia tresmariæ* Ferris, Contr. Dudley Herb. 1: 68. 1927. *Type locality,* Maria Madre. Mason 1788, Maria Madre. Ferris 5689.

68. *Aristolochia pardina* Duch., Ann. Sc. Nat. IV. 2: 47. 1854. *Type locality,* Colima, Mexico. Nelson 4304, Maria Madre.

POLYGONACEÆ

69. *Antigonon leptopus* H. & A., Bot. Beech. Voy. 308. t. 69. Common in Mexico, type from West coast. Mason 1698, Maria Madre.

70. *Coccoloba schiedeana* Lindau., in Engler., Bot. Jahrb. 13: 187. 1890. Central America and Mexico. Mason 1806, Maria Magdalena.

71. *Coccoloba leptostachya* Benth., Bot. Voy. Sulph. 159. It came from Columbia and is not given as Mexican by Standley. Nelson 4315, Maria Magdalena. It is probably the preceding species.

AMARANTHACEÆ

72. *Iresine interrupta* Benth., Bot. Voy. Sulph. 156. *Type locality,* Tepic, Mexico, Central America. Nelson 4234, Maria Madre. Mason 1812, Maria Magdalena.

73. *Achyranthes aspera* L., Sp. Pl. 204. Cosmopolitan tropics. Mason 1814, Maria Magdalena.

74. *Celosia nitida* Vahl., Symb. Bot. iii: 44. Tropical America. Ferris 5648.

75. *Gomphrena sonoræ* Torr., in Bot. Mex. Bound. 181. *Type locality,* mountains near Santa Cruz, Sonora. Ferris 5606.

76. *Amaranthus brandegei* Standl., N. Am. Fl. 21: 109 1917. *Type locality,* Cofradia near Culiacan, Sinaloa. Ferris 5649.

77. *Amaranthus* sp. Ferris 5620.

ALLIONACEÆ

78. *Commicarpus scandens* (L.), Standl., Contr. U. S. Nat. Herb. 12: 373. 1909. West Indies. Mason 1703, Maria Madre. Ferris 5581.

79. *Bœrhaavia caribæa* Jacq., Obs. Bot. 4: 5. West Indies. Mason 1714, Maria Madre. Ferris 5607.

80. *Bœrhaavia erecta* L., Sp. Pl. 3. Mexico. Ferris 5604 and 5719.

81. *Abronia maritima* Nutt. ex S. Watson, Bot. Cal. 2: 4. *Type locality,* San Pedro, California. Mason 1795, Maria Magdalena.

PHYTOLACCACEÆ

82. *Phaulothamnus spinescens* Gray, Proc. Am. Acad. 20: 294. 1885. Sonora, Sinaloa, Lower California. Mason 1741, Maria Madre. Ferris 5564.

83. *Stegnosperma halimifolium* Benth., Bot. Voy. Sulph. 17. t. 12. *Type locality,* Cape San Lucas. Nelson 4184, Maria Madre. Mason 1702, Maria Madre.

84. *Phytolacca octandra* L., Sp. Pl. 11: 631. Tropical America. Nelson 4293, Maria Madre.

AIZOACEÆ

85. *Trianthema portulacastrum* L., Sp. Pl. 223. Cosmopolitan. Ferris 5734.

86. *Sesuvium portulacastrum* L., Syst. ed. 10: 1058. Cosmopolitan. Mason 1847, Santa Isabella.

MENISPERNACEÆ

87. *Cissampelos pareira* L., Sp. Pl. 1031. Cosmopolitan in tropics. Nelson 4233 and 4262, Maria Madre. Mason 1704 and 1775, Maria Madre.

PORTULACACEÆ

88. *Portulaca oleracea* L., Sp. Pl. 445. Cosmopolitan. Ferris 5754.

89. *Talinum paniculatum* (Jacq.), Gaertn., Fruct. 2: 219. t. 128. Tropical America. Ferris 5628.

HERNANDIACEÆ

90. *Hernandia guianensis* Aubl., Pl. Guian. 2: 848. West Indies and South America. Ferris.

PAPAVERACEÆ

91. *Argemone mexicana* L., Sp. Pl. 508. Cosmopolitan. Flowers yellow. Mason 1716, Maria Madre.

92. *Argemone ochroleuca* Sweet., Brit. Fl. Gard. 3. t. 242. Cosmopolitan. Nelson 4318, Maria Magdalena. This is the same as *Argemone mexicana ochroleuca* Prain. Flowers white. Mason 1713, Maria Madre.

CAPPARIDACEÆ

93. *Cratæva tapia* L., Sp. Pl. 444. Tropical America. Mason 1750, Maria Madre; and 1850, Santa Isabella. Nelson 4274, Maria Madre.

94. *Capparis indica* (L.), Fawc. & Rendle in Journ. Bot. Brit. & For. 52: 144. West Indies and South America. Mason 1759, Maria Madre. This was reported as *C. breynia* L., Nelson 4219, Maria Madre.

95. *Capparis cynophallophora* L., Sp. Pl. 534. West Indies, Central America, South America. Nelson 4302, Maria Madre.

96. *Forchammeria sessilifolia* Standl., Journ. Wash. Acad. Sci. 14:212. 1924. *Type locality,* Maria Madre. Nelson 4239, type. Mason 1734 and 1735, Maria Madre. Ferris.

MIMOSACEÆ

97. *Entada polystachya* (L.), DC., Mem. Legum. 12. Tropical America. Ferris.

98. *Prosopis chilensis* (Mol.), Stuntz, U. S. Dept. Agr. Bur. Pl. Ind. Inv. Seeds 31:85. Cosmopolitan. Mason 1725, Maria Madre. Ferris 5580.

99. *Mimosa ferrisæ* Britt. & Rose, Contr. Dudley Herb. 1:70. 1927. *Type locality,* Maria Madre Island. Ferris 5563, type.

100. *Acacia cymbaspina* Sprague & Riley, Kew Bull. 1923:394. *Type locality,* Guaymas, Mexico. Ferris 5646.

101. *Acaciella ferrisiæ* Britt. & Rose, N. Am. Fl. 23:101. 1928. *Type locality,* Maria Madre. Ferris 5679 and 5610, type.

102. *Acacia pennatula* (S. & G.), Benth. in Hook. Lond. Journ. Bot. 1:390. 1842. Mexico and Central America. Mason 1840, Maria Madre.

103. *Albizzia occidentalis* Brandegee, in Proc. Cal. Acad. Sci. 11. 3:222. *Type locality,* San Jose del Cabo, Lower California. Nelson 4252 and 5592, Maria Madre. Mason 1757, Maria Madre. Ferris 5727.

104. *Pithecolobium dulce* Benth., in Lond. Journ. Bot. 3:190. 1844. Cosmopolitan tropics. Nelson 4285, Maria Madre.

105. *Pithecolobium lanceolatum* (H. & B.), Bth. in Lond. Journ. Bot. 5:105. 1846. Tropical America. Ferris 6255.

106. *Pithecolobium tortum* Mart., in Flora 20:11. 1837. Tropical America. Ferris 5625.

107. *Lysiloma microphylla* Bth., in Lond. Journ. Bot. 3:83. 1844. *Type locality,* Leon, Guanajuato. Ferris 5728 and 5659.

CÆSALPINIACEÆ

108. *Cassia occidentalis* L., Sp. Pl. 377. West Indies. Mason 1718, Maria Madre.

109. *Cassia emarginata* L., Sp. Pl. 376. Tropical America. Nelson 4192 and 4297, Maria Madre. Mason 1738, Maria Madre.

110. *Cassia atomaria* L., Mant. Pl. 68. Tropical America. Nelson 4321, Maria Magdalena. Mason 1831, Maria Madre. Ferris 5566.

111. *Cassia biflora* L., Sp. Pl. 378. Tropical America. Nelson 4194 and 4196, Maria Madre. Mason 1762, Maria Madre. Ferris 5568 and 5666.

112. *Cassia tora* L., Sp. Pl. 376. Cosmopolitan tropics. Ferris 5631.

113. *Cæsalpinia crista* L., Sp. Pl. 380. Cosmopolitan tropics. Mason 1802, Maria Magdalena.

FABACEÆ

114. *Ateleia insularis* Standley, Contr. U. S. Nat. Herb. 20: 175. 1919. *Type locality,* Maria Madre Island. Nelson 4186, Maria Madre. Mason 1843, Maria Madre. Ferris 5573 and 5742.

115. *Galactia striata* (Jacq.), Urb., Symb. Antill. 2: 320. Tropical America. Mason 1820, Maria Magdalena.

116. *Canavalia maritima* (Aubl.), Thou. in Journ. de Bot. Desv. 1: 80. 1813. Cosmopolitan tropics. Mason 1794, Maria Magdalena. Ferris 5735.

117. *Canavalia mexicana* Piper, Contr. U. S. Nat. Herb. 20: 569. 1925. *Type region,* Sinaloa, Mexico. Nelson 4190, Maria Madre. Ferris 5579. This was reported in Nelson's list as *Canavalia gladiata* DC.

118. *Crotalaria pumila* Orteg., Hort. Matr. 23. West Indies. Nelson 4248, Maria Madre. Ferris 5668. This is probably the same as *Crotalaria lupulina* H.B.K.

119. *Indigofera salmoniflora* Rose, Contr. U. S. Nat. Herb. 5: 140. 1897. *Type locality,* Imala, Sinaloa, Mexico. Ferris 5654.

120. *Meibomia procumbens* (Mill), Britt., Sci. Surv. Porto Rico and Virgin Islands 5: 404. 1924. West Indies. Ferris 5603. This is probably Nelson's 4287 reported as *Desmodium* sp., Maria Madre.

121. *Erythrina occidentalis* Standl., Contr. U. S. Nat. Herb. 20: 180. 1919. *Type locality,* Mazatlan, Mexico. Nelson 4303, Maria Madre. Mason 1787, Maria Madre. Ferris 6252. This is the same as *Erythrina lanata* Rose.

122. *Cracca arcuata* Rydb., N. Am. Fl. 24: 166. 1923. *Type locality,* Maria Madre Island. Ferris . Nelson's 4193 as *Tephrosia,* Maria Madre.

123. *Lonchocarpus sericeus* (Poir), H. B. K., Nov. Gen. et Sp. 6: 283. West Africa, American tropics. Nelson 4310, Maria Madre.

124. *Nissolia nelsoni* Rose, Contr. U. S. Nat. Herb. 5: 162. fig. 26. 1899. *Type locality,* Oaxaca Valley of Mexico. Ferris.

125. *Bauhinia* sp. Nelson 4300, Maria Madre.

126. *Phaseolus* sp. Nelson 4319, Maria Magdalena.

127. *Rhynchosia pyramidalis* (Lam.), Urb., Fedde Rep. 15: 318. West Indies. Mason 1819, Maria Magdalena.

128. *Rhynchosia minima* DC., Prodr. 2: 385. Cosmopolitan tropics. Nelson 4206, Maria Madre. Reported as *Dolicholus minimus* (L.), Medic.

129. *Rhynchosia precatoria* (H. B. K.), DC., Prodr. 2: 385. Cosmopolitan tropics. Nelson 4179, Maria Madre. Reported as *Dolicholus phaseoloides* (Swartz), Kuntze.

OXALIDACEÆ

130. *Oxalis* sp. Ferris 6818 and 6819.

ERYTHROXYLACEÆ

131. *Erythroxylon mexicanum* H. B. K., Nov. Gen. et Sp. 5: 178. *Type locality,* Chilpancingo, Guerrero. Ferris 5732.

ZYGOPHYLLACEÆ

132. *Guaiacum coulteri* Gray, Mem. Am. Acad. N. S. 5:312. 1855. Type from Sonora. Nelson 4180, Maria Madre. Mason 1760, Maria Madre. Ferris 5632.

133. *Kallistrœmia parviflora* Norton, Rep. Mo. Bot. Gard. 9:153. 1898. *Type locality,* Agricultural College, Mississippi. Ferris.

RUTACEÆ

134. *Zanthoxylon insularis* Rose, U. S. Dept. Agr. N. Am. Fauna No. 14:79. 1899. *Type locality,* Maria Madre Island, also Socorro Island. Nelson 4278, Maria Madre.

135. *Zanthoxylon nelsoni* Rose, U. S. Dept. Agr. N. Am. Fauna No. 14:79. 1899. *Type locality,* Maria Madre Island. Nelson 4279, Maria Madre.

136. *Zanthoxylon ferrisiæ* Standl., Contr. Dudley Herb. 1:72. t. 2. f. 3. 1927. *Type locality,* Maria Madre Island. Ferris 5690.

137. *Pilocarpus racemosus* Vahl., Eclog. 1:29. t. 10. West Indies. Mason 1837, Maria Madre.

138. *Pilocarpus insularis* Rose, U. S. Dept. Agr. N. Am. Fauna No. 14:80. 1899. *Type locality,* Maria Madre Island. Nelson 4307, Maria Madre.

139. *Amyris balsamifera* L., Syst. ed. X:1000. West Indies. Mason 1824, Maria Magdalena.

140. *Esenbeckia nesiotica* Standl., Contr. Dudley Herb. 1:73. 1927. *Type locality,* Maria Madre Island. Nelson 4237. Ferris 5699.

SIMAROUBACEÆ

141. *Picramnia* sp. Nelson 4276, Maria Madre.

BURSERACEÆ

142. *Bursera simaruba* (L.), Sargent, Garden & Forest 3:260. 1890. Tropical America. Mason 1767, Maria Madre.

143. *Bursera gummifera* L., Sp. Pl. ed. II: 471. Nelson 4227, Maria Madre. This is probably the same as the preceding.

MELIACEÆ

144. *Trichilia hirta* L., Syst. Nat. ed. X: 1020. Tropical America. Nelson 4214 and 4309, Maria Madre. Mason 1700 and 1737, Maria Madre. Ferris 5662.

MALPIGHIACEÆ

145. *Bunchosia palmeri* S. Wats., Proc. Am. Acad. 22: 401. *Type locality*, Tequila, Jalisco, Mexico. Ferris 5565.

146. *Bunchosia* sp. Mason 1707, Maria Madre.

147. *Heteropterys floribunda* H. B. K., Nov. Gen. et Sp. 5: 166. Tropical America. Nelson 4323, Maria Magdalena. Synonym of *Banisteria laurifolia* L., Sp. Pl. ed. II: 611.

EUPHORBIACEÆ

148. *Celænodendron mexicanum* Standl., Contr. Dudley Herb. 1: 76. 1927. *Type locality*, Mazatlan, Mexico. Mason 1850, Santa Isabella Island. Ferris 6261.

149. *Sapium pedicellatum* Huber, Bull. Herb. Boiss. Ser. 11. 6: 352. 1906. Mexico. Ferris 5663.

150. *Gymnanthes insolita* Ferris, Contr. Dudley Herb. 1: 75. 1927. *Type locality*, Maria Madre Island. Ferris 5695.

151. *Manihot carthaginensis* (Jacq.), Müell. Arg. in DC. Prod. 15^2: 1073. Tropical America. Ferris 5745.

152. *Jatropha* sp. Ferris 5710.

153. *Bernardia mexicana* (H. & A.), Müell. Arg. in Linnæa 34: 172 1865-66. Central America, South America and Mexico. Ferris 5627.

154. *Acalypha verbenacea* Standl., Contr. Dudley Herb. 1 :75. 1927. *Type locality*, Maria Madre Island. Probably Nelson 4260, Maria Madre. Ferris 5669.

155. *Acalypha setosa* A. Rich., Fl. Cub. Fanerog. 2: 204. West Indies, Mexico. Ferris 5653.

156. *Tragia volubilis* L., Sp. Pl. 980. Cosmopolitan tropics. Ferris 5655.

157. *Croton fragilis* H. B. K., Nov. Gen. et Sp. 2:75. North, Central and South America. Ferris 5601.

158. *Croton ciliato-glandulosus* Ort., Hort. Matr. 51. Central America, West Indies, Mexico. Nelson 4218. Maria Madre.

159. *Astrocasia peltata* Standl., Contr. Dudley Herb. 1:74. 1927. *Type locality,* Maria Madre Island. Ferris 5571.

160. *Phyllanthus micrandrus* Müell. Arg., in Linnæa 32:27. 1863. North, Central and South America, Mexico. Ferris 5647 and 5569.

161. *Phyllanthus adenodiscus* Müell. Arg., in Linnæa 32:23. 1863. *Type locality,* Papantla, Vera Cruz. Mason 1706, Maria Madre. Ferris 5697 and 5575.

162. *Pedilanthus* sp. Ferris 5700.

163. *Ditaxis lanceolata* (Benth.), Pax. & Hoffm., in Engler Pflanzeureich 4. 147*c*:71. 1912. *Type locality,* Magdalena Bay. Mason 1790, Maria Madre.

164. *Euphorbia schlechtendalii* Boiss., Cent. Euphorb.: 18. Central America and Mexico. Nelson 4294, Maria Madre. Mason 1849, Santa Isabella Island. Ferris 5609.

165. *Euphorbia plicata* S. Watson, in Proc. Am. Acad. 21:438. 1886. *Type locality,* Hacienda San Miguel, southwestern Chihuahua. Mason 1724, Maria Madre, and 1808, Maria Magdalena.

166. *Euphorbia incerta* Brandegee, in Proc. Calif. Acad. Sci. Ser. II. 3:171. 1891. *Type locality,* El Mogote opposite La Paz. Mason 1800, Maria Magdalena.

167. *Euphorbia* (no leaves). Mason 1840, Maria Madre.

168. *Euphorbia graminea* Jacq., Select. Am. 151. West Indies, Central America, Mexico. Ferris 5702.

169. *Euphorbia adenoptera* Bertol, Misc. Bot. 3:20. t. 23. Tropical America. Ferris 5651.

170. *Euphorbia hirta* L., Sp. Pl. 454. Cosmopolitan Tropics. Ferris 5626.

171. *Euphorbia* sp. Ferris 5640.

172. *Euphorbia nelsonii* Millsp., Bot. Gaz. 26 : 268. 1898. Nelson 4294, Maria Madre. = *Euphorbia schlechtendalii.*

173. *Euphorbia subcærulea tresmariæ* Millsp., U. S. Dept. Agr. N. Am. Fauna No. 14 : 88. 1899. *Type locality,* Maria Madre Island. Nelson 4298 and 4202, Maria Madre. = *Euphorbia tresmariæ* Standley.

174. *Euphorbia* sp. Nelson 4268, Maria Madre.

175. *Garcia nutans* Rohr., Skrivt., Nat. Hist. Selsk. Kjobenh. ii : 217. t. 9. 1792. West Indies, South America, Mexico. Nelson 4228, Maria Madre.

BUXACEÆ

176. *Buxus pubescens* Greenmann, Proc. Am. Acad. 33 : 481. 1898. *Type locality,* Maria Madre Island. Nelson 4221, Mason 1836, Maria Madre. Ferris 5676.

HIPPOCRATEACEÆ

177. *Hippocratea* sp., Nelson 4226, Maria Madre, and 4320, Maria Magdalena.

SAPINDACEÆ

178. *Paullinia sessiliflora* Radlk., Contr. U. S. Nat. Herb 1 : 317. 1891. *Type locality,* Colima, Mexico. Nelson 4210, Maria Madre. Mason 1730, Maria Madre.

179. *Thouinidium decandrum* (H. & B.) Radl., Sitzb. Math.-Phys. Akad. Munchen 8 : 284. Central America and Mexico. Mason 1832, Maria Madre. Ferris 5743.

180. *Serjania mexicana* (L.) Willd., Sp. Pl. 2 : 465. Tropical America. Nelson 4231, Maria Madre. Mason 1809, Maria Magdalena.

181. *Thouinia paucidentata* Radlk., Field Mus., Bot., i : 403. 1898. Yucatan and Campeche. Ferris 5617.

182. *Matayba spondioides* Standl., Contr. Dudley Herb. 1 : 77. 1927. *Type locality,* Maria Madre. Ferris 5721.

183. *Urvillea ulmacea* H. B. K., Nov. Gen. & Sp. 5 : 105. t. 440. Tropical America. Nelson 4210, Maria Madre.

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184. *Cardiospermum corindum* L., Sp. Pl. 366. Tropical America. Nelson 4328, Maria Magdalena. = *Cardiospermum halicacabum* L.

RHAMNACEÆ

185. *Karwinskya latifolia* Standl., Contr. U. S. Nat. Herb. 23: 716. 1923. *Type locality,* Tepic, Mexico. Mason 1833, Maria Madre.

186. *Karwinskya humboldtiana* (Roem. & Schult.) Zucc. Nov. Stirp. i: 351. Central America, Mexico and Texas. Ferris 5618.

187. *Zizyphus sonorensis* S. Watson, Proc. Am. Acad. 24: 44. 1889. *Type locality,* Guaymas, Mexico. Mason 1830 and 1766, Maria Madre. Ferris 5585.

188. *Colubrina arborea* Brandegee, Zoe 4: 401. 1894. *Type locality,* Zacatecas, Mexico. Nelson 4213, Maria Madre. = *Colubrina glomerata* (Benth.) Hemsl., Biol. Centr.-Amer. Bot.

VITACEÆ

189. *Cissus sicyoides* L., Syst. Nat., ed. X. 2: 897. Tropical America. Nelson 4198, Maria Madre.

MALVACEÆ

190. *Abutilon dugesii* S. Watson, Proc. Am. Acad. 21: 447. 1886. *Type locality,* Guanajuato, Mexico. Mason 1771. Maria Madre.

191. *Abutilon* sp. Mason 1810, Maria Magdalena.

192. *Abutilon reventum* S. Watson, Proc. Am. Acad., 21: 418. 1886. *Type locality,* Hacienda San Jose, Chihuahua. Nelson 4242, Maria Madre.

193. *Abutilon lignosum* (Cav.) Don., Hist. Dichl. Pl. i: 501. 1831. West Indies, Mexico, Central America, South Florida, Texas. Ferris 5583.

194. *Abutilon* sp. Ferris 5615.

195. *Sida acuta* Burm., Fl. Ind. 147. 1768. Cosmopolitan, tropical, and subtropical. Ferris 5749.

196. *Sida angustifolia* Lam., Encycl. i: 4. 1785. Cosmopolitan tropics. Ferris 5608.

197. *Malvastrum coromandelianum* (L.) Garcke, Bonplandia 5: 295. 1857. Cosmopolitan, tropical and subtropical. Mason 1828, Maria Madre.

198. *Hibiscus tiliaceus* L., Sp. Pl. 694. Cosmopolitan tropics. Nelson 4328, Maria Magdalena.

199. *Wissadula hirsutiflora* (Presl.) Rose, Contr. U. S. Nat. Herb. i: 306. 1895. *Type locality,* Acapulco, Guerrero. Mexico. Nelson 4250, Maria Madre.

BOMBACACEÆ

200. *Ceiba æsculifolia* (H. B. K.) Britt. & Baker, Journ. Bot. Brit. & For. 54: 175. 1896. *Type locality,* Campeche, Guatemala. Mason 1768, Maria Madre. Ferris 6260.

STERCULIACEÆ

201. *Melochia tomentosa* L., Syst. ed. X: 114. Tropical America. Nelson 4205, Maria Madre. Mason 1696, Maria Madre. Ferris 5595.

202. *Guazuma ulmifolia* Lam., Encycl. 3: 52. 1789. Tropical America. Nelson 4325, Maria Magdalena.

203. *Helicteres baruensis* Jacq., Enum. Pl. Carib., 30. 1760. Tropical America. Ferris 5693.

OCHNACEÆ

204. *Ochna* sp. Nelson 4238, Maria Madre.

THEACEÆ

205. *Taonabo maltbyana* (Rose) Rose, Contr. U. S. Nat. Herb. 8: 322. 1905. *Type locality,* Maria Madre. T. S. Maltby 105. Nelson 4242, Maria Madre.

VIOLACEÆ

206. *Hybanthus riparius* (H. B. K.) Standl. in litt. Ferris 5715 and 5718.

FLACOURTIACEÆ

207. *Prockia crucis* L., Syst. Nat., ed. X: 1074. Tropical America. Ferris 5694.

208. *Myroxylon flexuosum* (H. B. K.) Kuntze, Rev. Gen. Pl., i: 44. 1891. Central America and Mexico. Ferris 6262.

209. *Cascaria obovata* Schlecht, in Linnæa 13: 434. 1830. Mexico. Ferris 6256.

210. *Casearia dolicophylla* Standley, Contr. U. S. Nat. Herb. 23: 846. 1923. *Type locality,* Picacho, Oaxaca. Ferris 5590.

211. *Casearia nitida* (L.) Jacq., Enum. Pl. Carib. 21. 1760. Tropical America. Nelson 4270 and 4308, Maria Madre.

212. *Casearia sylvestris* Swartz, Fl. Ind., Occ. 2: 752. 1800. Tropical America. Nelson 4341, Maria Madre.

213. *Casearia* sp. Nelson 4326, Maria Magdalena.

PASSIFLORACEÆ

214. *Passiflora suberosa* L., Sp. Pl. 958. Tropical America. Mason 1772, Maria Madre. Ferris 5098.

215. *Passiflora holosericea* L., Sp. Pl. 516. *Type locality,* Vera Cruz, Mexico. Mason 1711, Maria Madre. Ferris 5586 and 5739.

216. *Passiflora* sp. Nelson 4249, Maria Madre.

LOASACEÆ

217. *Mentzelia aspera* L., Sp. Pl. 516. West Indies. Ferris 5660.

BEGONIACEÆ

218. *Begonia californica brevibracteata* Ferris, Contr. Dudley Herb. 1: 79. 1927. *Type locality,* Maria Madre. Ferris 5708.

CACTACEÆ

219. *Opuntia* sp. Ferris 5576.

220. *Pachycereus pecten-aboriginum* (Engelm.) Britt. & Rose, Contr. U. S. Nat. Herb. 12: 422. 1909. *Type locality,* Hacienda San Miguel, Chihuahua. Ferris 5744.

221. *Selenicereus vagans* (K. Brandg.) B. & R., Cactaceæ 2: 205. 1920. *Type locality,* Mazatlan. Ferris 6251.

222. *Neomamillaria* sp. Ferris 5748.

223. *Lemairocereus* sp. Ferris 6267.

224. *Cephalocereus purpusi* Britt. & Rose, Cactaceæ 2: 56. 1920. *Type locality,* Mazatlan. Ferris 6266.

RHIZOPHORACEÆ

225. *Rhizophora mangle* L., Sp. Pl. 443. Tropical America. Mason 1799, Maria Magdalena.

COMBRETACEÆ

226. *Conocarpus erectus* L., Sp. Pl. 176. Tropical America and Western Africa. Mason 1785, Maria Madre.

MYRTACEÆ

227. *Psidium* sp. Nelson 4306, Maria Madre.

ARALIACEÆ

228. *Gilibertia insularis* Rose, U. S. Dept. Agr. N. Am. Fauna No. 14: 83. 1899. Tropical America. Nelson 4282, Maria Madre. = *Gilibertia arborea* (L.) Marchal.

THEOPHRASTACEÆ

229. *Jacquinia aurantiaca* Ait., Hort. Kew, ed. II: 2: 6. 1811. Tropical America. Mason 1690 and 1784, Maria Madre.

230. *Jacquinia macrocarpa* Cav., Ic. 5: 55. t. 483. Tropical America. Nelson 4208, Maria Madre. Ferris 5698.

PLUMBAGINACEÆ

231. *Plumbago scandens* L., Sp. Pl. ed. II: 205. Tropical America. Ferris 5661.

LOGANIACEÆ

232. *Buddleia sessiliflora* H. B. K., Nov. Gen. & Sp. 2: 345. t. 183. 1817. *Type locality,* City of Mexico. Nelson 4183, Maria Madre. Mason 1780, Maria Madre. Reported in Nelson's list as *Buddleia verticillata* (HBK.).

APOCYNACEÆ

233. *Plumeria acutifolia* Poir., Encycl. Suppl. 2: 667. 1811. Mexico. Ferris 5633.

234. *Thevetia ovata* (Cav.) A. DC., in DC. Prod. 8: 344. Central America and Mexico. Ferris 5684.

235. *Rauwolfia canescens* L., Sp. Pl. ed. II, 303. Tropical America. Mason 1839, Maria Madre.

ASCLEPIADACEÆ

236. *Macroscepis obovata* H. B. K., Nov. Gen. & Sp. 3: 201. t. 133. 1819. *Type locality,* Campeche. Ferris 5577.

237. *Marsdenia macrophylla* (H. & B.) Fourn., in Mart. Fl. Bras. 6^4:321. 1885. American tropics. Mason 1701 and 1841, Maria Madre.

238. *Marsdenia edulis* S. Watson, Proc. Am. Acad. 24: 61. 1889. *Type locality,* Guaymas, Mexico. Mason 1792, Maria Madre.

239. *Vincetoxicum* probably; fruit only. Mason 1710, Maria Madre.

240. *Gonolobus* sp. Fruit only. Nelson 4313a, Maria Madre.

CONVOLVULACEÆ

241. *Jacquemontia pentantha* (Jacq.) Don., Hist. Dichl. Pl., 4: 283. 1838. Tropical America. Nelson 4251, Maria

Madre. Ferris 5671. This was reported in Nelson's list as *Jacquemontia violacea* Choisy.

242. *Operculina alatipes* (Hook.) House, Bull. Torr. Bot. Club 33: 499. 1906. Tropical America. Ferris 5657.

243. *Quamoclit coccinea* (L.) Moench., Meth. 453. 1794. Cosmopolitan tropics. Ferris 5658.

244. *Quamoclit pinnata* (Desv.) Boj., Hort. Maurit. 224. *Type locality,* Island of Mauritius. Cosmopolitan tropics. Ferris 6250.

245. *Ipomœa pedicellaris* Benth., Bot. Voy. Sulph. 135. *Type locality,* Acapulco, Mexico. Ferris 5572.

246. *Ipomœa triloba* L., Sp. Pl. 161. Tropical America. Ferris 5597.

247. *Ipomœa hederacea* (L.) Jacq., Collect. i: 124. Cosmopolitan tropics. Ferris 5644.

248. *Ipomœa minutiflora* (Mart. & Gal.) House., in Ann. N. Y. Acad. Sci. 18: 239. 1908. Ferris 5639.

249. *Ipomœa pes-capræ* (L.) Roth., Nov. Sp. Pl. 109. Cosmopolitan tropics. Ferris 5746.

250. *Ipomœa bona-nox* L., Sp. Pl. ed. II: 228. Cosmopolitan. Nelson 4269, Maria Madre. = *Calonyction aculeatum* (L.) House.

251. *Ipomœa peduncularis* Bertol, Fl. Guatim. 8. t. 2. Mexico and Central America. Nelson 4235, Maria Madre.

252. *Cuscuta* sp. Mason 1721, Maria Madre. Common on several species.

BORAGINACEÆ

253. *Cordia tinifolia* Willd., in Roem. & Schult., Syst. Veg. 4: 800. 1819. *Type locality,* Acapulco, Mexico. Mason 1740, Maria Madre.

254. *Cordia cana* M. & G., Bull. Acad. Brux. 11^2: 331. 1844. *Type locality,* Oaxaca, Mexico. Nelson 4296, Maria Madre. Mason 1779, Maria Madre. Ferris 5629.

255. *Cordia sonoræ* Rose, Contr. U. S. Nat. Herb. 1: 106. t. 9. 1891. *Type locality,* Alamos, Sonora. Nelson 4207, Maria Madre.

256. *Heliotropium indicum* L., Sp. Pl. 130. Cosmopolitan Tropics. Nelson 4253, Maria Madre. Mason 1715, Maria Madre.

257. *Heliotropium parviflorum* L., Mant. Pl. 2:201. Tropical America. Mason 1717, Maria Madre.

258. *Heliotropium curassavicum* L., Sp. Pl. 130. Cosmopolitan tropics. Nelson 4313, Maria Madre.

259. *Heliotropium phyllostachyum* Torr., Bot. Mex. Bound. 137. *Type region,* western Texas and Mexico. Ferris 5750.

260. *Tournefortia volubilis* L., Sp. Pl. 140. Tropical America. Nelson 4209, 4217 and 4229. Mason 1712, Maria Madre.

261. *Tournefortia glabra* L., Sp. Pl. 141. Tropical America. Nelson 4189, Maria Madre. Mason 1729, Maria Madre.

262. *Tournefortia hirsutissima* L., Sp. Pl. 140. Tropical America. Mason 1781, Maria Madre.

VERBENACEÆ

263. *Avicennia nitida* Jacq., Enum. Pl. Carib., 25. 1760. Tropical America. Mason 1793, Maria Magdalena.

264. *Priva echinata* Juss., Ann. Mus. Par. 7:69. Tropical America. Ferris 5643.

265. *Lantana horrida* H. B. K. Nov. Gen. & Sp. 2:261. 1817. Tropical America. Nelson 4187, Maria Madre. = *Lantana camara* L.

266. *Citharexylum affine* Don., Edinburgh New Phil. Journ. 11:238. 1831. *Type locality,* Chalco, Mexico. Nelson 4311, Maria Madre.

267. *Ægiphila pacifica* Greenm., Proc. Am. Acad. 33:435. 1898. *Type locality,* Estero, Mexico. Nelson 4245 and 4254, Maria Madre. = *Ægiphila deppeana* Steud. Nom. Bot. ed. II. 1:29.

LABIATÆ

268. *Hyptis emoryi* Torr., Ives, Rep. Colo. Riv. 20. southern Arizona and Lower California. Nelson 4223, Maria Madre. Mason 1736, Maria Madre.

269. ? *Salvia mazatlanensis* Fernald., Proc. Am. Acad. 35:515. *Type locality,* Mazatlan, Mexico. Ferris 5636.

270. *Salvia hyptoides* Mart. & Gal., Bull. Acad. Sci. Brux. 11^2:74. Central America and Mexico. Ferris 5705.

271. *Salvia aliena* Greene, Pitt. 1:157. *Type locality,* Maria Madre. Collected by W. J. Fisher. Type in Herb. Cal. Acad. Sci. Nelson 4247, Maria Madre.

272. *Stachys coccinea* Jacq., Hort. Schoenb. 3:18. t. 284. Mexico and Texas. Nelson 4265, Maria Madre.

SOLANACEÆ

273. *Nicotiana trigonophylla* Dunal., DC. Prod. 13^1:562. Mexico. Nelson 4212, Maria Madre. Mason 1694, Maria Madre.

274. *Solanum refractum* H. & A., Bot. Beech. Voy. 304. *Type locality,* Tepic, Mexico. Mason 1732, Maria Madre.

275. *Solanum,* perhaps new sp. Mason 1816, Maria Magdalena.

276. *Solanum deflexum* Greenm., Proc. Am. Acad. 32:301. *Type locality,* Cuicatlan, Mexico. Ferris 5670.

277. *Solanum torvum* Swartz, Prod. Veg. Ind. Occ. 47. Cosmopolitan tropics. Nelson 4185, Maria Madre. Mason (a leaf only).

278. *Solanum bicolor* Willd. Roem. & Schult, Syst. Veg. 4^1:661. Tropical America. Nelson 4322, Maria Magdalena, as *S. callicarpæfolium.*

279. *Solanum lanceæfolium* Jacq., Coll. Bot. 2:286. Tropical America. Nelson 4240, Maria Madre.

280. *Solanum nigrum* L., Sp. Pl. 186. Cosmopolitan. Nelson 4200, Maria Madre.

281. *Solanum verbascifolium* L., Sp. Pl. 184. Cosmopolitan tropics. Nelson 4216, Maria Madre.

282. *Physalis crassifolia* Benth. var., Bot. Sulph. 40. *Type locality,* Magdalena Bay. Mason 1791.

283. *Physalis pubescens* L., Sp. Pl. 183. Probably the preceding. Nelson 4255, Maria Madre.

284. *Physalis nicandroides* Schlecht, Linnæa 19: 311. Mexico. Ferris 5582.

285. ? *Physalis lagascæ* Roem. & Schlecht, Syst. 4: 679. Cosmopolitan tropics. Ferris 5717.

286. *Datura discolor* Bernh., in Tromms., N. Journ. Pharmac. 26: 149. West Indies. Nelson 4197, Maria Madre.

287. *Bassovia stramoniifolia* (H. B. K.) Standl., Contr. U. S. Nat. Herb. 23: 1303. Central America and Mexico. Nelson 4232, Maria Madre. Reported as *Bassovia donnell-smithii* Coulter.

SCROPHULARIACEÆ

288. *Russelia sarmentosa* Jacq., Nelson 4289, Maria Madre. This is probably the same as the following.

289. *Russelia verticillata* H. B. K., Nov. Gen. & Sp. 2: 360. Central America and Mexico. Ferris 5614.

290. *Stemodia pusilla* Benth., Bot. Sulph. 114. *Type locality,* Tepic, Mexico. Ferris 5688.

291. *Capraria biflora* L., Sp. Pl. 628. Tropical America. Nelson 4195, Maria Madre. Mason 1695, Maria Madre.

BIGNONIACEÆ

292. *Cydista* sp. Mason 1770, Maria Madre.

293. *Bignonia æquinoctialis* L., Sp. Pl. 623. Tropical America. Nelson 4324, Maria Magdalena. *(Cydista).*

ACANTHACEÆ

294. *Beloperone nelsoni* Greenman, Proc. Am. Acad. 33: 488. *Type locality,* Maria Madre. Nelson, Maria Madre.

295. *Elytraria squamosa* (Jacq.) Lindau, Anal. Inst. Fis. Geogr. Costa Rica, 8: 299. *Type region,* Guadalajara, Mexico. Mason, no number. Ferris 5645.

296. *Dicliptera resupinata* Juss. Ann. du Mus. 9:263. Mason 1798, Maria Magdalena.

297. *Justicia* sp. Ferris 5692.

RUBIACEÆ

298. *Coutarea pterosperma* (Watson) Standley, N. Am. Fl. 32:127. *Type locality,* Guaymas, Mexico. Nelson 4211. Mason 1726, Maria Madre. Ferris 5602.

299. *Randia thurberi* Watson, Proc. Am. Acad. 24:53. *Type locality,* between Rayon and Ures, Sonora. Ferris 5726.

300. *Hamelia versicolor* Gray, Proc. Am. Acad. 21:416. *Type locality,* Barranca near Guadalajara, Mexico. Ferris 5578.

301. *Guettarda elliptica* Swartz, Prod. Veg. Ind. Occ. 59. West Indies and Mexico. Ferris 5723.

302. *Chiococca alba* (L.) Hitchc., Rep. Mo. Bot. Gard. 4:44. Tropical America. Ferris 5636 and 5722.

303. *Borreria asperifolia* (Mart. & Gal.) Robinson, Proc. Am. Acad. 45:409. Mexico. Ferris 5673.

CUCURBITACEÆ

304. *Corallocarpus emetocatharticus* Cogn., Bull. Soc. Bot. Belg. 30:279. 1891. Tropical America. Mason 1709, Maria Madre. Ferris 5621.

305. *Momordica charantia* L., Sp. Pl., 109. Cosmopolitan tropics. Mason 1699. Maria Madre.

COMPOSITAÆ

306. *Eupatorium* sp. Mason 1728, Maria Madre.

307. *Eupatorium* sp. Nelson 4225, Maria Madre.

308. *Eupatorium* sp. Nelson 4244, Maria Madre.

309. *Eupatorium collinum* DC. Prod., 5:164. Mexico. Nelson 4199, Maria Madre.

310. *Eupatorium quadrangulare* DC., Prod. 5:150. Central America and Mexico. Ferris 5696.

311. *Vernonia canescens* H. B. K., Nov. Gen. & Sp. 4: 35. pl. 317. 1820. Tropical America. Ferris 5713.

312. *Decachæta hænkeana* DC., Prod. 5: 133. Mexico. Ferris 5716.

313. *Mikania cordifolia* Willd., Sp. Pl. 3: 1746. Tropical America. Nelson 4299, Maria Madre.

314. *Conyza lyrata* H. B. K., Nov. Gen. & Sp. 4: 70. Ecuador. Nelson 4290 and 4312, Maria Madre.

315. *Baccharis glutinosa* Pers., Syn. Pl. 2: 425. South America, Mexico, Colorado and Texas. Nelson 4291, Maria Madre.

316. *Pluchea odorata* (L.) Cass., Dict. Sci. Nat. 42: 3. 1826. Tropical America. Nelson 4181, Maria Madre. Mason 1693 and 1773, Maria Madre.

317. *Melampodium flaccidum* Benth., Vidensk. Meddel. 86. Central America. Ferris 5638.

318. *Pectis arenaria* Benth., Bot. Sulph. 110. 1844. *Type locality,* Acapulco, Mexico. Ferris 5741.

319. *Pectis linifolia* L., Syst. Nat. ed. X: 1221. West Indies. Ferris 5634.

320. *Perityle microglossa* Benth., Bot. Sulph. 119. 1844. *Type locality,* Realejo, Mexico. Nelson 4266, Maria Madre.

321. *Parthenium hysterophorus* L., Sp. Pl. 988. Tropical America. Nelson 4267, Maria Madre.

322. *Porophyllum punctatum* (Mill) Blake, Contr. Gray Herb. n. ser. 52: 58. 1917. Central America and Mexico. Nelson 4292, Maria Madre. Mason 1797, Maria Magdalena.

323. *Trixis californica* Kellogg, Proc. Cal. Acad. Sci., 2: 182. f. 53. 1863. *Type locality,* Cedros Island. Mason 1758, Maria Madre.

324. *Trixis wrightii* Rob. & Greenm., Proc. Am. Acad. 40: 14. 1904. *Type locality,* near Mazatlan. Ferris 5593. This was reported in Nelson's list as *Trixis frutescens* R. Br. Maria Cleofa.

Species collected at Cape San Lucas, Lower Calif., May 28, 1925

1. *Phoradendron californicum* Nutt., Journ. Acad. Philad. II. 1: 185. 1884. California. This leafless parasite was collected on *Pithecolobium confine* Standl. It is partial to the *Leguminosæ*. 1868.

2. *Phoradendron peninsulare* Trelease, Univ. Ill. Bull. 18: 50. 1916. *Type locality*, Cape San Lucas. This was collected on *Jatropha*. 1873.

3. *Antigonon leptotes* H. & A., Bot. Beech. Voy. 308. t. 69. 1840. *Type locality*, Tepic, Mexico. This beautiful vine with rosy flowers is common in cultivation and is known under many names in different parts of Mexico. 1861.

4. *Batis maritima* L., Syst. Nat. ed. X. 1289. Cosmopolitan. A common plant in saline soil, widely distributed. 1860.

5. *Esenbeckia flava* Brandegee, Zoe 1; 378. t. 12. 1891. *Type locality*, San José del Cabo, Lower California. A small tree with oblong, pale, downy leaves and woody seed-pods splitting into 5 parts, very rough warty on the outside. 1675.

6. *Pithecolobium confine* Standl., Contr. U. S. Nat. Herb. 20: 11 191. 1919. *Type locality*, Cape San Lucas. Spiny shrub with long cream-color stamens and large woody pods. 1869.

7. *Cæsalpinia californica* (Gray) Standl., Contr. U. S. Nat. Herb. 23: 426. 1923. *Cæsalpinia mexicana californica* Gray, Proc. Am. Acad. 5: 157. 1862. Lower California. Flowers yellow, pods velvety. 1868.

8. *Jatropha cercidiphylla* Standl., Contr. U. S. Nat. Herb. 23: 639. 1923. *Type locality*, between San Luis Potosi and Tampico, Mexico. 1872.

9. *Jatropha multifida* L., Sp. Pl. 1006. Tropical America. A plant with stinging hairs and a large root. The leaves are palmately lobed, the divisions ending in long hairs. 1867.

10. *Cyrtocarpa edulis* (Brandegee), Standl., Contr. U. S. Nat. Herb. 23: 659. 1923. *Tapiria edulis* Brandegee, Zoe

5:78. 1900. *Type locality*, San José del Cabo, Lower California. 1862.

11. *Bumelia occidentalis* Hemsley, Biol. Centr. Amer. Bot. 2:298. 1881. *Type locality,* Sonora Alta. Coarse shrub with spreading branches and small flowers clustered in the axils of the alternate leaves. 1866.

12. *Asclepias subulata* Decaisne, DC., Prodr. 8: 571. 1844. *Type locality,* Nova Hispania. Sandy ridges on the beach. 1863.

13. *Cynanchum palmeri* (S. Watson) Blake, Contr. Gray Herb. II. 52:83. 1917. *Pattalias palmeri* S. Watson, Proc. Am. Acad. 24:60. 1889. *Type locality,* Muleje, Lower California. 1870.

14. *Ipomœa pes-capræ* (L.) Roth., Nov. Sp. Pl. 109. 1821. *Convolvulus pes- capræ* L., Sp. Pl. 159. The beach morning glory, common on tropical beaches. 1876.

15. *Beloperone californica* Benth., Bot. Voy. Sulph. 38. 1844. *Type locality,* Cape San Lucas, Shrub with red bilabiate flowers and small 2-valved seed pods on thick stems. 1871.

16. *Bebbia atriplicifolia* (Gray) Greene, Bull. Cal. Acad. Sci. 1:181. 1885. *Carphephorus atriplicifolia* Gray, Proc. Am. Acad. 5:159. 1861. *Type locality,* Cape San Lucas.

Species first described from Cape San Lucas by Bentham in the botany of the voyage of the Sulphur, 1844;

Not collected by Mason.

Ionidium fruticulosum
Galphimia angustifolia
Drymaria holosteoides
Drymaria crassifolia
Stegnosperma halimifolia
Hedyotis asperuloides
Mitracarpium lineare
Pectis multiseta
Aplopappus arenarius
Acoma dissecta
Physalis glabra
Hyptis laniflora
Euphorbia leucophylla

Species first described by Asa Gray from Xantus' Collection, at or near Cape San Lucas;

Not collected by Mason.

(Proc. Am. Acad. 5: 153-173. 1861.)

Polygala xanti
Hibiscus ribifolius
Bursera microphylla
Dalea chrysorhiza
Coursetia glandulosa
Cæsalpinia mexicana
Mimosa xanti
Pluchea subdecurrens parvifolia
Viguiera deltoidea
Viguiera tomentosa
Coreocarpus heterocarpus
Heterospermum xanti
Macreightia intricata
Hyptis tephrodes
Buddleia crotonoides
Celosia floribunda
Euphorbia gymnoclada Engelm.

Species first described by other authors

Not collected by Mason.

Bartschella schumanni (Hildmann) B. & R. Cactaceæ 4: 58.
Bœrhaavia xanti Watson. Proc. Am. Acad. 24: 69.
Elaphrium epinnatum Rose. Fl. N. Am. 25: 243.
Pectis bennetti Klatt. Leopoldina 25: 108. From N. Am.
Dudleya xanti Rose Bull. N. Y. Bot. Gard. 3: 23.

Species collected at Magdalena Bay, Lower California, May 29-30, 1925.

1. *Agave margaritæ* T. S. Brandegee, Proc. Cal. Acad. Sci. II. 2: 206. 1889. *Type locality,* Margarita Island. Lower California. This differs from the type in shorter stamens. The flowers are yellow, the leaves short and almost orbicular up to where they narrow to the horny point, stems about 6 feet high. 1892.

2. *Phoradendron dieguetii* Van Tiegh, Bull. Mus. Hist. Nat. Paris 1: 31. 1895. *Type region,* Lower California. The host of the type was *Quercus.* Brandegee collected it on *Veatchia* and Mason on *Bursera.* 1941.

3. *Atriplex barclayana* (Benth.) Dietr., Syn. Pl. 5: 537. 1852. *Obione barclayana* Benth. Bot. Voy. Sulph. 48. 1844. *Type locality,* Magdalena Bay. A common prostrate white-leaved species. 1912.

4. *Allenrolfea occidentalis* (S. Watson) Kuntze, Rev. Gen. 346. 1891. *Halostachys occidentalis* S. Watson, Bot. King Exped. 293. 1891. *Type region,* Great Basin. This grew along the beach. In California it is found in the most alkaline soil. 1917.

5. *Suæda ramosissima* (Standl.) Johnston, Proc. Cal. Acad. Sci. IV. 12: 1017. 1924. *Dondia ramosissima* Standl. N. Am. Fl. 21: 91. 1916. *Type locality,* Lees Ferry, Arizona, 1910.

6. *Hesperonia lævis* (Benth.) Standl., Contr. U. S. Natl. Herb. 12: 363. 1909. *Oxybaphus lævis* Benth. l. c. 44. *Type locality,* Magdalena Bay. With smooth wiry branches, succulent leaves and purple flowers. 1944.

7. *Abronia maritima* Nutt., in Wats. Bot. Cal. 2: 4. 1880. *Type locality,* San Pedro, California. Prostrate with thick leaves and dark purple flowers in umbels. 1951.

8. *Batis maritima* L., Syst. Nat. ed. X. 1289. 1750. A cosmopolitan plant found in saline soil. 1901.

9. *Sesuvium sessile* Pers., Synop. 2: 39. 1807. A cosmopolitan plant in saline soil. 1291.

10. *Drymaria holosteoides* Benth., l. c. *Type locality,* Cape San Lucas, Lower California. A spreading plant with slender stems; flowers small, white and together with the small leaves fascicled where the stems branch. 1908.

11. *Oligomeris glaucescens* Camb., Jacq. Voy. Bot. 24. t. 25. *Type region,* around the Mediterranean. A spreading herb on salt flats with terete leaves and small flowers in spikes. 1913.

12. *Dudleya albiflora* Rose, Bull. N. Y. Bot. Gard. 3: 13. 1903. *Type locality,* Magdalena Bay. The leaves are in dense rosettes, broad at base, apex acuminate. The flowers are white and the base of the rosette is densely clothed with dead leaves. 1898.

13. *Calliandra californica* Benth., l. c. 14. t. 11. *Type locality,* Magdalena Bay. A very poor specimen of this beautiful plant. 1945.

14. *Phaseolus filiformis* Benth., l. c. 13. *Type locality,* Magdalena Bay. A slender vine with trifoliate leaves, leaflets 3-lobed; flowers rose purple, solitary or in pairs. 1930.

15. *Hosackia bryanti* T. S. Brandegee, Proc. Cal. Acad. Sci. II. 2:144. 1889. *Type locality,* Magdalena Bay. Flowers almost sessile, tinged with pink, in umbels. The specimen is almost leafless. 1931.

16. *Parosela brandegei* Rose, Contr. U. S. Nat. Herb. 10:106. 1905. *Dalea ramosissima* Benth., l. c. 11. t. 10. *Type locality,* Magdalena Bay. The flowers are in spikes, corolla rose color and calyx clothed with white hairs. The leaflets are minute and thickly covered with glands. 1896.

17. *Parosela divaricata* (Benth.) Rose, Contr. U. S. Natl. Herb. 8:305. 1905. *Dalea divaricata* Benth. l. c. 12. *Type locality,* Magdalena Bay. Flowers small, blue and white. 1888.

18. *Phaca candidissima* Benth., l. c. 13. *Type locality,* Magdalena Bay. Foliage white-tomentose, flowers purplish, pods inflated. 1954.

19. *Krameria parvifolia* Benth., l. c. 6. t. 1. *Type locality,* Magdalena Bay. Shrubby. The specimen very poor. 1953.

20. *Bursera microphylla* Gray, Proc. Am. Acad. 5:155. 1861. *Type locality,* Sierras Tule, Sonora, Mexico. A low shrub with stout spreading branches. 1922.

21. *Bursera rhoifolia* (Benth.) Johnston, Proc. Cal. Acad. Sci. IV. 12:1058. 1924. *Elaphrium rhoifolium* Benth., l. c. 11. t. 7. *Type locality,* Magdalena Bay. The simple-leaved one was named by Bentham *E. hindsianum* and the trifoliate *E. rhoifolium* l. c. 10. t. 7. Brandegee claims that this is a variable character and the two should be considered a single species. 1901.

22. *Acalypha californica* Benth., l. c. 51. *Type locality,* Magdalena Bay. Low shrub with the leaves dark green, crenately margined, ovate and often cordate; flowers in small dense purplish spikes. 1906.

23. *Croton punctatus* Jacq., Coll. 1:166. *Type locality,* Carolina. Leaves silvery white, oblong to elliptical. 1949.

24. *Croton magdalenæ.* Millsp., Proc. Cal. Acad. Sci. II. 2:220. 1889. *Type locality,* Magdalena Bay. Leaves almost orbicular, densely white-tomentose. 1932.

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25. *Pedilanthus macrocarpus* Benth., l. c. 40. t. 23a. *Type locality,* Magdalena Bay. Stems, erect, leafless, fruits red, drooping. Native name, "Gallito." 1891.

26. *Ditaxis serrata magdalenæ* (Millsp.) Eastwood n. comb. *Argythamnia serrata magdalenæ* Millsp., Proc. Cal. Acad. Sci. II. 2:221. 1889. *Type locality,* Magdalena Bay. The specimens are poor but show the characteristic farinose seeds. The leaves of the variety are quite unlike the typical form being suborbicular to obovate and generally obtuse. The whole plant is clothed with spreading as well as appressed hairs. 1950.

27. *Euphorbia polycarpa* Benth., l. c. 50. *Type locality,* Magdalena Bay. Without a number, accidentally collected on another specimen.

28. *Simmondsia californica* Nutt., in Lond. Journ. Bot. 3:400. t. 15. 1844. *Type locality,* San Diego, California. A common spreading shrub with opposite pale leaves and diœcious flowers in capitate axillary clusters. 1902.

29. *Veatchia discolor* (Benth.) T. S. Brandegee, Proc. Cal. Acad. Sci. II. 2:140. 1889. *Schinus bicolor* Benth., l. c. 11. t. 9. *Type locality,* Magdalena Bay. This is the remarkable tree commonly known as "elephant tree." 1934, flowers white. 1935, flowers pink.

30. *Maytenus phyllanthoides* Benth., l. c. 54. *Type locality,* Magdalena Bay. Diœcious shrub with pale stems and leaves, fruit 3-sided. Male 1916, female 1915.

31. *Cardiospermum tortuosum* Benth., l. c. 8. t. 6. *Type locality,* Magdalena Bay. Tortuous spreading shrub with small white flowers and twice compound leaves, the ultimate divisions often 3-lobed. 1942.

32. *Abutilon californicum* Benth., l. c. 8. *Type locality,* Magdalena Bay. Flowers orange an inch in diameter, leaves cordate, white-tomentose. 1911.

33. *Hibiscus denudatus* Benth., l. c. 7. t. 3. *Type locality,* Magdalena Bay. Flowers rose-purple, more than an inch in diameter; leaves white-tomentose but yellowish when dried. 1884.

34. *Gossypium davidsoni* Kellogg, Proc. Cal. Acad. Sci. 5:82. 1873. *Type locality,* San Jose del Cabo, Lower Cali-

fornia. Leaves cordate, entire; flowers large, yellow. 1936. 1937 similar but flowers smaller.

35. *Melochia tomentosa* L., Syst. Nat. ed. X, 1247. *Type locality,* Jamaica. Leaves white-downy on short petioles, ovate to lanceolate-oblong, crenate, flowers rose-purple. 1894.

36. *Fouquiera splendens* Engelm., Wislez. Mem. North Mex. 98. 1848. *Type locality,* Jornada del Muerto, New Mexico. This is commonly known as *Ocotilla* and is one of the most characteristic plants of the Colorado desert. When in bloom it is a wonderful sight, the tall thorny stems crowned with clusters of brilliant red flowers. 1886.

37. *Passiflora fruticosa* Killip., Journ. Wash. Acad. Sci. 12:256. 1922. *Type locality,* Santa Maria Bay, Lower California. This is a shrubby passion flower. 1919.

38. *Rhizophora mangle* L., Sp. Pl. 443. *Type locality,* Caribbean Sea. This is commonly known as the mangrove and is common along tropical shores. The specimens seen did not grow over ten feet in height. Common in saline flats. 1914.

39.[1] *Borragea fruticulosa* (Benth.) Donn. Smith & Rose, Contr. U. S. Nat. Herb. 16:298. 1913. *Gaura fruticulosa* Benth., l. c. 75. *Gongylocarpus fruticulosa* T. S. Brandegee, Proc. Cal. Acad. Sci. II. 2:158. 1889. *Type locality,* Magdalena Bay. This is a shrub with pink flowers; the seed-pods become imbedded in the woody stem. 1885.

40. *Metastelma californica* Benth., l. c. 33. t. 18. *Type locality,* Magdalena Bay. A slender-stemmed vine with small leaves and tiny flowers on filiform pedicels at the leaf axils. 1939.

41. *Sarcostemma arenarium* Benth., l. c. 34. *Type locality,* Magdalena Bay. 1929.

42. *Asclepias albicans* S. Watson, Proc. Am. Acad. 24:59. 1889. *Type locality,* near Los Angeles Bay, Lower California. A leafless species. 1883.

43. *Jacquemontia abutiloides* Benth., l. c. 34. *Type locality,* Magdalena Bay. A shrub with white-tomentose cordate, almost sessile leaves and blue flowers. 1893.

[1] *Borragea frutescens* (Curran) Donn., Smith & Rose, Contr. U. S. Nat. Herb. 16:298. 1913. *Gongylocarpus frutescens* Curran, Proc., Cal. Acad. Sci. II. 1:231. 1889. The type is in the Herbarium of the California Academy of Sciences.

44. *Cordia palmeri* S. Watson, Proc. Am. Acad. 24:62. 1889. *Type locality,* in ravines in the high mountains above Guaymas, Mexico. According to Dr. Palmer the native name is Yerba del pasmo. The shrub is aromatic with white flowers. 1906.

45. *Cryptantha grayi* (Vasey & Rose) Macbride, Contr. Gray Herb., II. 48:43. 1916. *Krynitzkia grayi* Vasey & Rose, Proc. U. S. Nat. Mus. 11:536. 1888. *Type locality,* Lagoon Head. Along sea cliffs. 1297.

46. *Avicennia nitida* Jacq. Enum., Fl. Carib. 25. 1760. *Type locality,* Isle of Martinique. A low spreading shrub with cream-yellow flowers; leaves opposite with the upper surface darker than the lower. It grows at the edge of mangrove swamps. 1909.

47. *Hyptis emoryi* Gray in Torr. Ives Rep. Colo. Riv. 20. 1860. *Type locality,* Upper Colorado River, Arizona. Aromatic shrub with opposite leaves, the upper surface darker than the lower. Flowers small, in densely-flowered panicled spikes. The calyx is densely white-wooly and the corolla violet. 1946.

48. *Lycium brevipes* Benth., l. c. 40. *Type locality,* Magdalena Bay. A stiff spreading shrub with small purple flowers and red berries. 1918.

49. *Physalis crassifolia* Benth., l. c. 40. *Type locality,* Magdalena Bay. A spreading herb with yellow flowers and fruit a berry in an inflated calyx. 1900 and 1952.

50. *Solanum hindsianum* Benth., l. c. 30. *Type locality,* Magdalena Bay. A white-tomentose shrub growing in creek bottoms with rotate flowers and fruit a berry. 1903.

51. *Antirrhinum cyathiferum* Benth., l. c. 40. t. 19. *Type locality,* Magdalena Bay. A perennial herb with small purple flowers and the seeds like tiny shallow cups. 1953.

52. *Houstonia mucronata* (Benth.) Robinson, Proc. Am. Acad. 45:401. *Hedyotis mucronata* Benth., l. c. 19. *Type locality,* Magdalena Bay. A low, much branched shrub with opposite or fascicled, short, linear leaves and salverform, pink flowers in terminal clusters. 1947.

53. *Hofmeisteria fasciculata* (Benth.) Walp., Report. Bot. 6:106. 1847. *Helogyne fasciculata* Benth. l. c. 20. t. 14.

Type locality, Magdalena Bay. An herbaceous composite without rays, the heads on long peduncles. 1897.

54. *Ericameria diffusa* Benth., l. c. 23. *Type locality,* Magdalena Bay. Shrubby with small rayless heads in panicles and terete spreading leaves. 1938.

55. *Bebbia juncea* (Benth.) Greene, Bull. Cal. Acad. Sci. 1: 180. 1885. *Carphephorus junceus* Benth. l. c. 21. *Type locality,* Magdalena Bay. Almost leafless shrub with flowers in rayless heads in open few-flowered panicles. 1895.

56. *Perityle emoryi* Torr., in Emory Notes Mil. Recon. 142. *Type locality,* Carrizo Creek, San Diego County, California. This and the following are poor specimens with the leaves shrivelled, but the general shape, the small heads with white rays and the character of the akenes seem to indicate this polymorphic species. 1890.

57. *Perityle* sp. The akenes of this differ from the preceding, the leaves are less dissected and the heads smaller. *P. californica* Benth. collected by Hinds at Magdalena Bay is quite different having yellow rays and different leaves.

58. *Franseria magdalenæ* T. S. Brandegee, Proc. Cal. Acad. Sci. II. 2: 170. 1889. *Type locality,* Magdalena Island. The burs of this species have hooked spines. 1889.

59. *Franseria chenopodiifolia* Benth., l. c. 26. *Type locality,* Magdalena Bay. The leaves of this species are not dissected as in the preceding but are ovate, much paler on the lower than the upper surface and the spines on the burs are straight. 1887.

60. *Encelia conspersa* Benth., l. c. 26. *Type locality,* Magdalena Bay. Shrubby, the flowers on long branching peduncles, disk purplish-brown, rays yellow. 1948.

61. *Viguiera subincisa* Benth., l. c. 27. *Type locality,* Magdalena Bay. Shrubby; leaves rather thin, green, irregularly and deeply toothed, acuminate; peduncles long, branching at summit, the medium heads on slender pedicels, disk and rays yellow. 1933.

62. *Viguiera deltoidea chenopodina* (Greene) Blake, Contr. U. S. Nat. Herb. 54: 91. 1918. *Viguiera chenopodina* Greene, Leaflets 2: 154. 1911. *Type locality,* between Santo

Domingo and Mantancita, Lower California. Shrubby with opposite entire canescent leaves. 1904.

63. *Coreocarpus dissectus* (Benth.) Blake, Proc. Am. Acad. 49: 344. 1913. *Acoma dissecta* Benth., l. c. 29 t. 17. *Type locality,* Magdalena Bay. Shrubby, 2-3 feet high; leaves dissected with the ultimate divisions narrowly linear; peduncles surpassing the leaves and terminated by a few-flowered panicle of small heads, the disk and ray flowers yellow. 1899.

64. *Porophyllum gracile* Benth., l. c. 29. *Type locality,* Magdalena Bay. An aromatic shrub growing on rocky slopes; stems wiry with few, almost filiform leaves, heads rayless, the involucre of 5 bracts each having 2 rows of linear glands, pappus tawny. 1920.

65. *Porophyllum tridentatum* Benth., l. c. 30. An aromatic shrub common on the beach; leaves with 3-5 sharp teeth. heads rayless on short peduncles, the 5 bracts of the involucre with glands at the top. 1968.

List of Species first described by Bentham in the botany of the sulphur; not collected by Mason

Janusia californica
[2]*Fagonia californica barclayana*
Fagonia californica
[3]*Dalea canescens*
Phaca vestita
Mentzelia adhærens
Perityle californica
Franseria hispida
Coreocarpus parthenioides
Dysodia anthemidifolia
Cuscuta patens
Martynia althæifolia
Maurandia juncea
Abronia gracilis
Allionia malacoides
Pterostegia macroptera
Euphorbia californica
Euphorbia eriantha
Serophyton lanceolatum (Ditaxis)
Panicum californicum
Spartina leiantha
Chondrosium polystachyum

Species collected at Turtle Bay June 1-2, 1925

1. *Ephedra peninsularis* Johnston, Univ. Calif. Pub. Bot. 7: 437. 1922. *Type locality,* Magdalena Island. The scales at the joints are 2-cleft. Male 1977, female 1976.

[2] *Fagonia barclayana* (Benth) Ryd., Fl. N. Am. 25: 104.
[3] *Parosela peninsularis* Rose, Contr. U. S. Nat. Herb. 8: 304. *Dalea canescens* Benth.

2. *Eriogonum pondii* Greene, Pitt. 1:267. 1889. *Type locality*, Cedros Island, Lower California. 1960.

3. *Atriplex julacea* S. Watson, Proc. Am. Acad. 20:370. 1885. *Type locality*, Todos Santos Bay, Lower California. 1963.

4. *Atriplex linearis* S. Watson, Proc. Am. Acad. 24:72 1889. *Type locality*, Guaymas, Mexico. 1964.

5. *Suæda brevifolia* (Standl.) n. comb. *Dondia brevifolia* Standl. N. Am. Fl. 21:92. 1916. *Type locality*, Newport, California.

6. *Phaca candidissima* Benth., Bot. Voy. Sulph. 13 1844. *Type locality*, Magdalena Bay. 1967.

7. *Euphorbia misera* Benth. Bot. Voy. Sulph. 51. 1844. *Type locality*, San Diego, California. 1963.

8. *Simmondsia californica* Nutt., Lond. Journ. Bot. 3:401. 1844. *Type locality*, San Diego, California. 1961.

9. *Veatchia cedrosensis* (Kellogg) Gray, Bull. Cal. Acad. Sci. 1:4. 1884. *Rhus veatchiana* Kellogg, Proc. Cal. Acad. Sci. 2:24. 1859. *Type locality*, Cedros Island, Lower California. 1969.

10. *Rhus lentii* Kellogg, Proc. Cal. Acad. Sci. 2:16. 1859. *Type locality*, Cedros Island. 1970.

11. *Sphæralcea fulva* Greene, Pitt. 1:201. 1888. *Type locality*, Cedros Island. 1968.

12. *Frankenia grandifolia* Ch. & Schl., Linnaea 1:35. *Type locality*, San Francisco Bay, California. 1956.

13. *Frankenia palmeri* S. Watson, Proc. Am. Acad. 11:124. 1876. *Type locality*, gulf shore of Lower California. 1950.

14. *Fouquiera peninsularis* Nash, Bull. Torr. Bot. Club 30:455. 1903. *Type locality*, La Paz, Lower California. 1957.

15. *Petalonyx linearis* Greene, Bull. Cal. Acad. Sci. 1:188. 1885. *Type locality*, Cedros Island, Lower California. 1958.

16. *Asclepias subulata* Decaisne, in DC. Prodr. 8:571. 1844. 1973.

17. *Sarcostemma arenarium* Benth., Bot. Voy. Sulph. 34. 1844. *Type locality,* Magdalena Bay. 1974.

18. *Hofmeisteria pluriseta* Gray, Pac. R. R. Rep. 4:95. t. 9. 1857. *Type locality,* Cañon of the Williams River, Arizona. 1975.

19. *Trixis californica* Kellogg, Proc. Cal. Acad. 2:353. 1882. *Type locality,* Cedros Island. 1962.

20. *Aplopappus spinulosus scabrellus* (Greene) Blake, Contr. U. S. Nat. Herb. 52:24. 1917. *Eriocarpum scabrellum* Greene, Erythea 2:108. 1894. *Type locality,* Los Angeles Bay, Lower California.

21. *Gutierrezia sarothræ pauciflora* Eastwood, n. var. This differs from typical forms in having few flowers, often solitary heads terminating slender bracteate branchlets. The entire plant is intricately branched. It comes nearest to *G. divergens* Greene but has smaller heads and fewer flowers in each head. 1971.

22. *Franseria camphorata* Greene, Bull. Cal. Acad. Sci. 1:192. 1885. *Type locality,* Guadalupe Island. 1972.

Species collected at San Quintin, Lower California, June 7, 1925

1. *Ephedra californica* S. Watson, Proc. Am. Acad. 14:300. 1879. *Type locality,* San Diego. 2058 and 2059.

2. *Atriplex julacea* S. Watson, Proc. Am. Acad. 20:370. 1885. *Type locality,* Todos Santos Bay, Lower California. 2046.

3. *Suæda ramosissima* (Standley) Johnston, Proc. Cal. Acad. Sci. Ser. 4. 12:1017. 1924. *Dondia ramosissima* Standley, N. Am. Fl. 21:91. 1916. *Type locality,* Lees Ferry, Arizona. 2047.

4. *Abronia gracilis* Benth, Bot. Sulph. 44. 1844. *Type locality,* Magdalena Bay. Our material consists of two small annual plants whose identification is uncertain as the specimens are not fruiting. 2061.

5. *Mesembryanthemum crystallinum* L., Sp. Pl. 480. *Type locality,* Cape region, South Africa. The common ice plant which is on all the beaches from Santa Barbara County south. 2045.

6. *Isomeris arborea* Nutt., in Torr. & Gray. Fl. N. Am. 1:124. *Type locality,* San Diego. This is the shrub so common along the coast with yellow flowers in racemes and drooping inflated pods. The leaves are trifoliate. 2052.

7. *Dudleya cultrata* Rose, Bull. N. Y. Bot. Gard. 3:16. 1903. *Type locality,* San Quintin Bay. This does not agree in all respects but is probably this species. 2057.

8. *Simmondsia californica* Nutt., in Hook. Lond. Journ. Bot. 3:400. t. 16. 1844. *Type locality,* San Diego, California. 2060.

9. *Æsculus parryi* Gray, Proc. Am. Acad. 17:200. 1881-82. *Type locality,* northern part of Lower California. This is the shrubby buckeye of the region. 2051.

10. *Sphæralcea* sp. A shrub 2-4 feet high, with flowers white and pink tinged. This seems near *S. fulva* Greene. 2053.

11. *Frankenia grandifolia* Ch. & Schl., in Linnæa 1:35. 1826. *Type locality,* San Francisco Bay. Common in salt marshes. The common name is Yerbe del Rheuma. 2047a.

12. *Cuscuta californica graciliflora* Engelm., Trans. Acad. Sci. St. Louis 1:499. 1859. *Type locality,* Nova California. The common dodder, on a composite. 2055.

13. *Lycium richii* Gray, Proc. Am. Acad. 6:46. 1862. *Type locality,* La Paz, Lower California. A thorny shrub with spreading branches, small fleshy, obovate leaves, small, salverform, purplish flowers and red berries. It was common along the beach. 2048.

14. *Stephanomeria exigua* Nutt.,. Trans. Am. Phil. Soc. N. Ser. 7:428. 1841. *Type locality,* plains of the Rocky Mountains. This is not typical but is probably a form of this variable species. It comes near to one described as *Ptiloria exigua deani* Macbr. from Sweetwater Valley, San Diego County. 2062a.

15. *Guticrrezia sarothræ* (Pursh) Britt. & Rusby., Trans. N. Y. Acad. 7 : 10. 1887. *Type locality,* plains of the Missouri. 2062. This may be the host of the *Cuscuta.*

16. *Aplopappus fasciculatus* Vasey & Rose, Proc. U. S. Nat. Mus. 11 : 530. 1889. *Type locality,* San Quintin Bay. 2050 and 2056.

17. *Amblyopappus pusillus* H. & A. Hook. Journ. Bot. 3 : 321. 1841. *Type locality,* Chile. 2054.

Species first described from San Quintin
Not collected by Mason.

From Dr. Edward Palmer's collection, described by Vasey & Rose, Proc. U. S. Nat. Mus. 11 : 527 to 536.

Hosackia watsoni
Hosackia palmeri
Ribes palmeri
Senecio peninsularis
Gilia laxa
Phacelia palmeri
Solanum palmeri
Antirrhinum watsoni
Krynitzkia grayi

Species first described by other authors
Not collected by Mason.

Agave orcuttiana Trelease, Rep. Mo. Bot. Gard. 22 : 47.
Ribes tortuosum Benth, Bot. Sulph. 17.
Astragalus anemophilus Greene, Bull. Cal. Acad. Sci. 1 : 186. t. 213.
Hosackia disticha Greene, Bull. Cal. Acad. Sci. 1 : 186.
Œnothera crassifolia Greene, Bull. Cal. Acad. Sci. 1 : 188.
Senecio ammophilus Greene, Bull. Cal. Acad. Sci. 1 : 193.
Pholisma depressum Greene, Bull. Cal. Acad. Sci. 1 : 198.
Physalis muriculata Greene, Bull. Cal. Acad. Sci. 1 : 209.
Pterostegia galioides Greene, Bull. Cal. Acad. Sci. 1 : 213.
Stylophyllum attenuatum (Watson) B. & R., Bull. N. Y. Bot. Gard. 3 : 36.

Species collected at San Martin Island June 9, 1925

1. *Atriplex decumbens* S. Watson, Proc. Am. Acad. 12 : 275. 1877. *Type locality,* near San Diego. A low prostrate perennial on the sand dunes. 2070.

2. *Atriplex leucophylla* Dietr., Syn. Pl. 5 : 536. California. 2070. This differs from the preceding in leaves dif-

ferently shaped and alternate instead of opposite. Both are prostrate and equally white and were included under the same number.

3. *Abronia maritima* Nutt., ex S. Watson in Bot. Calif. 2:4. *Type locality,* San Pedro, California. 2072.

4. *Dudleya anthonyi* Rose, Bull. N. Y. Bot. Gard. 3:13. 1903. *Type locality,* San Martin Island. The leaves of this beautiful species are densely white-farinose in a cluster almost a foot across. The flowers become dark rose on pedicels almost an inch long and in widely spreading panicles terminating the leafy stems. 2068.

5. *Dudleya cultrata* Rose, Bull. N. Y. Bot. Gard. 3:15. 1903. *Type locality,* San Quintin Bay, Lower California. The clusters of leaves at the base are much shorter than the preceding and not farinose. The flowers are in more densely flowered panicles on pedicels shorter than the corolla. Like many in this genus the corolla is yellow turning red in fading. 2076.

6. *Hosackia watsoni* Vasey & Rose, Proc. U. S. Nat. Mus. 11:528. 1888. *Type locality,* San Quintin Bay. Stems slender, much branched; small leaves trifoliate; umbels 2-flowered on very short peduncles. 2078.

7. *Phacelia ixodes plumosa* (Kellogg) Brand, Pflanzenreich 4:112. 1913. *Phacelia plumosa* Kellogg. Mss. in Herb. Univ. Cal. *Type locality,* San Martin Island. 2080.

8. *Nicotiana clevelandi* Gray, Syn. Fl. N. Am. II. 1:242. *Type locality,* Chollas Valley, near San Diego, California. 2069.

9. *Cryptanth intermedia* (Gray) Greene, Pitt. I:114. 1887. *Eritrichium intermedium* Gray, Proc. Am. Acad. 17:225. 1881-82. Type from southern part of California. 2077.

10. *Lycium richii* Gray, Proc. Am. Acad. 6:46. 1862. *Type locality,* La Paz, Lower California. 2073.

11. *Encelia californica* Nutt., Trans. Am. Phil. Soc. N. S. 7:357. 1841. *Type locality,* San Diego or Santa Barbara, California. 2074.

12. *Franseria camphorata* Greene, Bull. Cal. Acad. Sci. 1:192. 1885. *Type locality,* Guadalupe Island. 2071.

13. *Perityle rotundifolia* (Benth.) Brandegee, Zoe 4:210. 1893. *Amauria rotundifolia* Benth., Bot. Voy. Sulph. 31. *Type locality,* San Quintin, Lower California. 2079.

14. *Senecio lyoni* Gray, ex Lyon in Coult. Bot. Gaz. 11:335. 1886. *Type locality,* Catalina Island, California. 2076.


Fig. 1. Guadalupe Cypress at the edge of the cypress grove.


Fig. 2. First cypress tree met with, just below the timber line.


Fig. 3. Cypress grove on top of the plateau.


Fig. 4. Looking north on top of the plateau. Pine forest in the distance.

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Fig. 1. Oak trees on the steep northwest slope showing fog bank coming in over the ridge.

Fig. 2. Oak trees on the northwest slope just below the highest ridge.

Fig. 3. First group of pines before reaching the plateau at the north end of the island.

Fig. 4. Pine trees on top of the plateau northeast end of the island.

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XV

DREPANIA
A GENUS OF NUDIBRANCHIATE MOLLUSKS NEW TO CALIFORNIA

BY

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Through the kindness of Dr. Myrtle E. Johnson of the San Diego State College, I received while at the Hopkins Marine Station at Pacific Grove, last September, a fine living specimen of a phanerobranchiate Dorid, collected by her at La Jolla, San Diego County, California. After a study of the general external features, the animal was preserved for further examination. The coloration showed that it agreed with a form described by Cockerell in 1901 under the name, *Thecacera velox* Ckll., from the same region, but a slightly more detailed examination made it equally evident that the animal in question is not a *Thecacera* Flem., but belongs to the genus *Drepania* Lafont, in an entirely different subfamily. To fix the status of this interesting member of our molluscan fauna, a brief anatomical study has been made of the specimen, the results of which are presented herewith.

The genus *Drepania* was discovered by A. Lafont at Arcachon on the southwest coast of France, and was described by him in a short paper in the "Journal de Conchyliologie" in 1874, with *Drepania fusca* Lafont as the type species.

Abraham (1877) in his "Revision of the Anthobranchiate Nudibranchiate Mollusca", p. 238, without a personal study of specimens, considered that the differences between *Ancula*

Lovén and *Drepania* Lafont were not adequate to separate them generically, and reduced the latter to synonymy with the older genus *Ancula* Lovén. But Bergh (1881) in describing *Drepania græffei* from Trieste, in the Northern Adriatic, showed clearly in his brief anatomical study of a single specimen that the new genus was undoubtedly distinct, not only in the external characters listed by Lafont, but also in the radula and mandibular plates. This view was not shared by Fischer in 1883, however, *Drepania* being given subgeneric rank under *Ancula* in his "Manuel de Conchyliologie", p. 525.

A third species, *Drepania tartanella* v.Ih., was described by von Ihering in 1885, from a specimen taken in the Bay of Naples. A figure of the whole animal, drawn from life, is given as one of the illustrations of the brief description. Von Ihering also records the taking of a single specimen of the Trieste species, *D. græffei* Bgh., at Naples. The close similarity of these two, the differences being practically slight ones of color details alone, warrants the conclusion that they are but variants of the same species. Their relation to *Drepania fusca* Lafont cannot at present be determined until an anatomical study of the latter has been made. In 1892 Bergh listed the three species as identical, in which case the first of them, *Drepania fusca* Lafont would have priority. Vayssière (1913) gives *Drepania* Lafont full generic rank, lists *D. tartanella* v. Ihering and *D. græffei* Bergh, but, curiously, makes no mention of the genotype *D. fusca* Lafont from Arcachon in his list of Opisthobranchs of France.

Drepania Lafont 1874

Drepania Lafont, 1874. Description d'un nouvelle genus de Nudibranches des côtes de la France. <Journal de Conchyliologie. 3S, XIV, Vol. XXII, p. 369-370.

Bergh, R. 1881. Beiträge zu einer Monographie der Polyceraden II. Verh. d. k.-k. zool.-bot. Gesellschaft in Wien. Jahrg. 1880, p. 9-12. Taf. X, F. 10-15.

von Ihering, H. 1885. Beiträge zur Kenntniss der Nudibranchien des Mittelmeeres. II. Malacozool. Blätter, N.F. 8, p. 36-39, Taf. I, F. 2, Taf. II, F. 8, 9.

Bergh, R. 1892. System der Nudibranchiaten Gasteropoden, p. 164-165.

Vayssière, A. 1913. Mollusques de la France et des Regions voisines, I. p. 356-357. Pl. 37, F. 5-6.

Body limaciform; rhinophores perfoliate, non-retractile, each with a basal external process; branchiæ trifoliate, simply pinnate, on each side a single, extrabranchial appendage; tentacles digitiform; foot narrow, its anterior angles produced.

Labial disc armed on each side with a mandibular lamella, with denticulate margin. Radula very narrow, the rhachis naked; a single pleural tooth on each side with an elongate denticulate margin. Buccal ingluvies present. Glans penis armed with a series of hooks.

1. *Drepania fusca* Lafont, Bay of Biscay, Arcachon.
2. *D. græffei* Bergh, Adriatic Sea, Trieste, Naples.
   D. tartanella, von Ihering, Bay of Naples.
3. *D. velox,* (Cockerell), La Jolla, California.

The original generic description of Lafont (1874) is as follows:

"Corpus molle, laeve, supra convexum, postice acuminatum; caput arcuatum; tentacula antica cylindrica; tentacula superna clavata, medio lamellosa, appendice falciformi, ad basin munita; branchiae 3, plumosae, appendice laterali, falciformi, utrinque munitae; pes angustus, superne dilatus et utrinque productus; orificium genitale infra tentaculum dextrum superum situm."

Bergh (1881) added to this diagnosis the general features of the radula, the mandibular plates, and the penis armature, with the doubtful statement that the buccal ingluvies is rudimentary. In his single specimen, 4.5 mm. in length, it may have so appeared, but in the one I have studied it is well developed. Hence I have modified the genus diagnosis of Bergh (1892) "buccal ingluvies rudimentary" to what is given above. The generic characters as given by Vayssière (1913) are substantially the same.

Drepania velox (Cockerell)

Thecacera velox Cockerell. Cockerell, T. D. A. 1901. Three New Nudibranchs from California. "Journal of Malacology", VIII, 3, p. 87.

The original description published by Cockerell is as follows:

"Length about 12 millim., narrow, general form of *T. pennigera.* White, marked with black stripes, appendages tipped with orange. Foot tentacles and oral tentacles both long, the first white with a purple-black line beneath, continuous with the lowest body-stripes; oral tentacles with the apical three-fourths bright orange. Rhinophores laminated, with a terminal finger-like process; apical third (including more than half of the laminated portion) bright orange. Rhinophore sheath taking the form of a thickened tentacle, about as long as the rhinophore, lateral of the rhinophore and curling behind it; this pseudotentacle is purple-black above and white beneath, with the end broadly orange; the anterior lobe of the sheath, found in *T. pennigera,* is wholly wanting in *T. velox.* Appendages latero-posterior to branchiæ formed as in *T. pennigera,* with the apical half orange (a small black spot beneath at the base of the orange), the upper side, from the base of the orange forward, with a broad purple-black stripe, these stripes passing forward and joining in the middle line of the back anterior to the branchiæ, thence sending a short process forward, and another backward on to the median branchial plume, meeting the orange of its extremity. Branchial plumes three, about as in *pennigera,* bipinate, the lateral ones with a purple-black patch and a little orange mark beyond; the middle one broadly orange at the end. Hind end of foot bright orange, the black bands stopping abruptly at the orange. The purple-black longitudinal stripes are a dorsal and two on each side; the dorsal begins very broadly on the front of the head, and thence narrows until it ends some distance before the branchiæ; posterior to the branchiæ it is continued, and goes nearly to the end of the foot. The subdorsal stripes are interrupted in the region of the branchiæ, but otherwise are nearly entire. There are very short stripes in the area between the dorsal and subdorsal stripes, about the middle of the anterior part of the back. The lateral stripes border the narrow sole, and are continuous, but end before the subdorsal ones."

The above description of the color markings and general external topography given by Cockerell is clear, but he evidently made no anatomical study of the animal, and was led astray by the superficial resemblance to *Thecacera* which it shows, overlooking, however, the very significant fact that the rhinophores are not retractile within sheaths, and that what he interpreted as representing such a sheath is actually nothing of the sort, but an external, basal, finger-like process.

For the determination of the subfamily as between the Polycerinæ and the Goniodoridinæ, a simple, anatomical examination of the pharyngeal bulb must be made to ascertain the presence or absence of an ingluvies, or crop-like diverticulum, characteristic of the Goniodoridinæ. This, together with a study of the radula would have fixed the systematic position without question, another illustration of the danger of relying solely upon external characters in identifying these beautiful animals. These become all the more untrustworthy in preserved material which often loses all semblance of its living form and color.

The specimen from Dr. Johnson was received in vigorous living condition, despite its journey by mail. After a study of its external form and coloration, it was preserved in formalin-alcohol, in which the black and orange markings remained nearly unchanged. The total length of the extended living specimen, when crawling freely, was 16 mm; in the preserved condition it shortened to 8.3 mm. The general shape (Pl. 35, figs. 1, 2) is limaciform, smooth, arched above, the sides being but slightly set off from the margin of the foot. The branchial plumes are nearly midway of the length of the animal; they are three in number, bipinnate, in part simply pinnate, non-retractile into a sheath, and are directed obliquely upward and backward. Immediately in front of the branchial plumes is a well marked cardiac elevation from the sides of which, on either side, a finger-like blunt tapering process curves horizontally backward beside and behind the plumes. The rhinophores are 2 mm. in length, clavate, perfoliate with 10-12 leaves, the stalk above terminating in a blunt point. External to the base of each rhinophore is a blunt, cylindrical or very slightly tapering process, two-thirds of the length of the organ, horizontal for the most part, and curving around on the dorsum behind the rhinophore. It is 1.2 mm. in length, and exhibits but slight movement. The interpretation of this structure as a part of a rhinophore sheath led Professor Cockerell astray. The rhinophore of *Thecacera* is retractile into a large and distinct sheath, the margin of which is prolonged into two lobes. His view that this basal, external process represents one of these lobes cannot be held valid, since the rhinophore in this animal and in *Drepania* is non-retractile into a sheath, no trace of any such structure being present. They are clearly homologous, however, to the basal processes of the rhinophore found in the allied genus *Ancula*.

The outer angles of the margin of the head are prolonged into a tentacle-like process on either side, 1.1 mm. in length, directed obliquely forward, outward and upward. These are not actively used as tactile organs, as are those formed by the angles of the foot immediately below, but seem more rigid, and comparable to the velar processes of *Polycera*. They cannot be termed oral tentacles in the strict meaning of the term.

The anterior angles of the linear foot are prolonged into long tapering processes, 1.4 mm. in length, slightly grooved ventrally (Pl. 35, fig. 3) throughout their full length. These are kept in active motion, being constantly in use as tactile organs, exploring in every direction as the animal moves. No black line, such as described by Cockerell, was found in the specimen at hand.

The anal opening is median, behind and included within the arc formed by the bases of the branchiae. The minute renal opening is close beside it. The reproductive openings are on the right side, far forward, below and slightly in front of the rhinophore.

The general ground color of the living animal is a translucent gray. The terminal one-third of the rhinophores, the terminal one-third of their basal processes, nearly the whole of the anterior, head margin processes, the tips of the branchiae and the terminal one-fourth of their lateral, basal appendages, and the tip of the tail are all a deep, rich orange. Five narrow longitudinal stripes of black, an unpaired median, a paired dorso-lateral and a lateral pair form very striking markings. The median band of black extends from the frontal margin backward, between the rhinophores to the cardiac elevation in front of the branchiæ, where it joins a crescentic transverse band, which extends out on the dorsal surface of the lateral, branchial appendages through two-thirds of their length. Behind the branchiae, the median stripe extends nearly to the tip of the tail. The paired dorsolateral bands extend from immediately behind the basal processes of the rhinophores along the dorsolateral surface of the body nearly to the tip of the tail, being interrupted opposite the lateral branchial appendages for a short distance. The lateral paired bands extend from the sides of the head, immediately behind and below the head margin processes along the body parallel to the foot, with slight interruptions, toward the tip of the tail, which they do not reach. These five longitudinal stripes of black vary in width along their course, and are probably frequently interrupted by slight breaks of continuity in some individuals. Midway between the rhinophores and the branchial plumes, on either side of the dorsal median band, is a short stripe of black. The dorsal surface of the basal appendages of the rhinophores bears a stripe of black extending from its base to the terminal orange extremity. The axis of each branchial plume bears a short, linear spot of black, in one case double, upon its outer, basal surface.

In alcohol the black stripes remain unchanged, the orange color becomes much paler.

In the endeavor to preserve the specimen as much as possible, no detailed study of its anatomy has been attempted. The pharyngeal bulb shows at once the well developed, muscular crop-like enlargement (Pl. 35, fig. 4,*c*) characteristic of the Sub-family Goniodoridinae, and not of the Polycerinae, to which *Thecacera* belongs. The bulb measured 0.55 mm. in length and 0.45 mm. in width. Close at the anterior end of the oesophagus, on either side, lie the small, rounded saccular salivary glands (Pl. 35, fig. 4,*g*). The radula sack projects but slightly as a rounded eminence below and behind in the median line. (Pl. 35, fig. 4,*s*) The oral tube is short and rather wide, its opening being a vertical slit, guarded on either side above by a triangular, mandibular plate bearing closely set, short spines, directed forward, the most anterior, marginal ones visible from in front, as in Pl. 35, fig. 6, where they project freely across the upper half of the opening of the tube, as seen from in front. The plates are approximately a right angled triangle in form, slightly wider than long (Pl. 35, fig. 5), and are covered throughout the most of their extent by these short, pointed, chitinous spines. Those nearest the anterior margin are the strongest and best developed, reaching 0.030 mm. in length and 0.007 mm. basal diameter, (Pl. 35, fig. 7). Those farther back are considerably less strong and prominent, many being quite slender. The lateral plates represent thickenings in the cuticle of the mouth cavity and are unconnected with each other, save by the general cuticular lining. Bergh (1881) describes and figures a similar armature for *Drepania graeffei* Bgh., cordate in shape and with a denticulate anterior border, the remaining surface of the plate being strongly netted, as if made up of thickened ridges and not of projecting spines, as here.

The radula is short and rather broad, its total length measuring 0.6 mm. It is made up of 24 transverse rows of teeth, each row being made up of a single lateral tooth on either side of a naked rhachis, the dental formula thus being 24 x (1.0.1). Each lateral tooth (Pl. 35, figs. 8-10) is strongly convex in front, concave behind, and wide from side to side. The rather narrow, crescentic base rests obliquely upon the basal membrane, its inner end, nearest the rhachis, being in advance of the outer one. From the anterior margin of the base arises a broad and thin convex expansion, its upper margin being coarsely and irregularly denticulate, and culminating in a strong, pointed cusp, borne on the thickened, outer margin, and directed obliquely inward and backward toward the median line. External to this cusp the shell-like plate is expanded into a smaller wing; on the inner side the margin slopes rapidly downward as a crescentic ridge toward the median end, and bears a single series of some 8 to 11 irregular, sharp denticles, triangular in form and of varying height. In Pl. 35, fig. 8 a typical lateral tooth from the right side of the radula is shown, as seen from above; in fig. 9 a similar tooth is seen from in front and slightly below; while in fig. 10 the same tooth is represented after having been rotated toward the right, so as to show most of its basal surface and the full extent of the strong outer cusp, while the inner denticulate ridge is nearly concealed by the uptilted outer margin. The real form of these teeth is by no means evident at first sight, and the radula requires prolonged study before its structure is clear. The width of one of the lateral teeth from the first or oldest row of the radula is 0.033 mm., that of one from the 9th row is 0.065 mm., while in one of the youngest rows, toward the end of the radula sheath, it reaches 0.084 mm. In *D. græffei* Bgh., according to Bergh (1881), the total number of rows in the radula is 51, over twice as many as here, and the width of the oldest lateral tooth is 0.055 mm., that of the youngest 0.16 mm. The number of denticles is much larger, varying up to 22-24 on each tooth, the whole organ being somewhat straighter and less convex than in this Californian species. Von Ihering (1885) states that the radula of *D. tartanella* von Ih. is identical with that of *D. græffei* Bgh., save for the somewhat less number of denticles, as is shown by his figure. He gives the width ("length") of a tooth as 0.085 mm., without indicating from which part of the radula the tooth in question is taken.

The short oesophagus (Pl. 35, fig. 4, *oe*) leads directly back into the stomach, which is completely inclosed in a deep furrow in the dorsal surface of the liver. The intestine is directed forward for a short distance from the posterior end of the stomach, thence looping sharply backward it passes in a straight course to the anal opening in the median region of the back, just behind the crescentic line of origin of the branchial plumes. Close to it is the renal pore, connected by a very short tube to the roomy, simple kidney sack, which in turn, communicates with the overlying pericardium by the small, elliptical renal syrinx.

The large eyes lie deep below the integument, close beside the cerebral portion of the cerebro-pleural ganglia, to which they are attached by very short optic nerves. Close behind, and slightly below the eyes, are the sessile otocysts, filled with minute otoconia. The cerebro-pleural ganglia are fused into a single ovoid mass, 0.3 mm. long by 0.18 mm. in greatest diameter, with only a shallow furrow obscurely indicating the approximate line of union. The cerebral portions of each side are connected above the oesophagus by a short and rather strong cerebral commissure. Below the cerebro-pleural ganglia are the large spherical pedal ganglia, 0.165 mm. in greatest diameter, and united to those above by the usual cerebro-pedal and pleuro-pedal connectives. The pedal pair is united below the oesophagus by a very short pedal commissure. The lack of material prevented the working out of further details.

The ovotestis is in close contact with the liver, the superior and anterior surfaces of which it nearly conceals. The anterior end overlaps the anterior genital complex, the superior oval face of the latter being beveled obliquely backward and downward. Fig. 11 of Pl. 35, shows the relationships of the conduits of the anterior genital complex as seen in dorsal view, they being displaced somewhat to render the connections evident. The accessory glands have been omitted for clearness. The short and slender hermaphroditic duct *hd,* passes directly to the ellipsoidal hermaphroditic ampulla which lies upon the dorsal, right side of the complex. From its anterior end, in close contact with the underlying nidamental-albumen gland mass the hermaphroditic ampulla *(h. a.)* narrows abruptly to a slender duct which divides into the vas deferens and the oviduct. The oviduct passes at once into the lumen of the albumen gland, the vas deferens, *v.d.,* thickens rapidly into a white, thick-walled, glandular tube, passes backward to the left of the hermaphroditic ampulla, describes a close loop at the posterior end of the anterior genital complex, returns forward along its left border to the anterior end, narrows slightly and passes into the preputium, *p.* The latter is ca. 0.5 mm. long by 0.15 mm. in greatest diameter, not as thick as the prostatic portion of the vas deferens, and contains the strongly retracted cylindro-conic glans. In Pl. 35, fig. 13, the wall of the preputium, *p,* is dissected away, except at the base, exposing the glans, *g.* In fig. 12 the distal end of the glans is represented under a higher magnification as a transparent preparation. The lumen is lined by a series of closely set, curved spines, the tips of which are directed outward. These extend back for a distance of 0.14 mm. from the tip, the longest and strongest, 0.03 mm. in length, with a basal diameter of 0.006 mm., being farthest away from the opening, forming a narrow band which is succeeded by an intermediate zone of about one half the height of the longest, and these in turn, by a more distal band of longer and more slender ones. Typical spines from each of these three regions are shown in detail in Pl. 35, figs. 14 and 15. For *D. græffei* Bergh (1881) describes and figures a glans armature of hooks, much more irregular in form, notched or toothed and reaching a height of 0.015 mm. In *D. tartanella* according to von Ihering (1885) the armature is made up of simple hooks ranging from 0.021 to 0.028 mm. in height.

The other branch of the hermaphroditic duct, beyond the hermaphroditic ampulla, is the very short oviduct, which opens at once into the lumen of the albumen gland, the cut end of the duct being shown in fig. 11. Close by it emerges the slender, uterine duct (Pl. 35, fig. 11 *u. d.*) which receives the very short duct of the nearly spherical spermatocyst, *s. c.,* 0.4 mm.

in length by 0.34 mm. in diameter. Beyond this point the uterine duct closely parallels the vaginal duct to which it is attached, and opens into the larger, nearly spherical spermatotheca, *s*, lying on the right, upper surface of the complex. From the spermatotheca the vaginal duct, *vag. d.*, leads to the vagina into which it dilates, opening externally close behind the orifice of the preputium, on the right side of the head, opposite and below the base of the right rhinophore. Immediately below it is the opening of the external duct of the mucus gland. The maximum diameter of the vagina is 0.135 mm., the diameter of the vaginal duct near the spermatotheca is 0.06 mm., the total length of both vagina and vaginal duct from the external opening to the spermatotheca is 1.78 mm.

My grateful acknowledgements are due to Dr. Myrtle E. Johnson for the specimen here reported upon, as well as for numerous other collections which I have received from her hands, and to my wife for her unfailing and skilled cooperation in the preparation of the figures of the accompanying plate.

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Plate 35

Fig. 1. *Drepania velox* (Cockerell) in side view, drawn from living specimen. × 6.

Fig. 2. *Drepania velox* (Cockerell) in dorsal view, drawn from living specimen. × 6.

Fig. 3. Ventral view of anterior region of body. × 6.

Fig. 4. Pharyngeal bulb in side view, freed from muscular attachments and the nerve collar. *c*, the buccal ingluvies, or muscular crop; *s*, the posterior median projection containing the radula sack; *oe*, the anterior end of the œsophagus; *g*, the saccular salivary gland. × 30.

Fig. 5. Inner surface of the left mandibular plate showing its armature of spines. × 122.

Fig. 6. Front view of oral tube cuticle, the muscles having been removed. The two mandibular plates, *p*, are seen obliquely from the outside, their anterior marginal spines showing at the sides of the upper half of the mouth opening. × 122.

Fig. 7. A group of the marginal spines of a mandibular plate under higher magnification. × 278.

Fig. 8. Typical first lateral tooth from middle region of right side of radula, as seen from above. × 450.

Fig. 9. Similar lateral tooth seen obliquely from in front and below. × 450.

Fig. 10. The same lateral tooth rotated to the right, showing the external face and a part of the base. × 450.

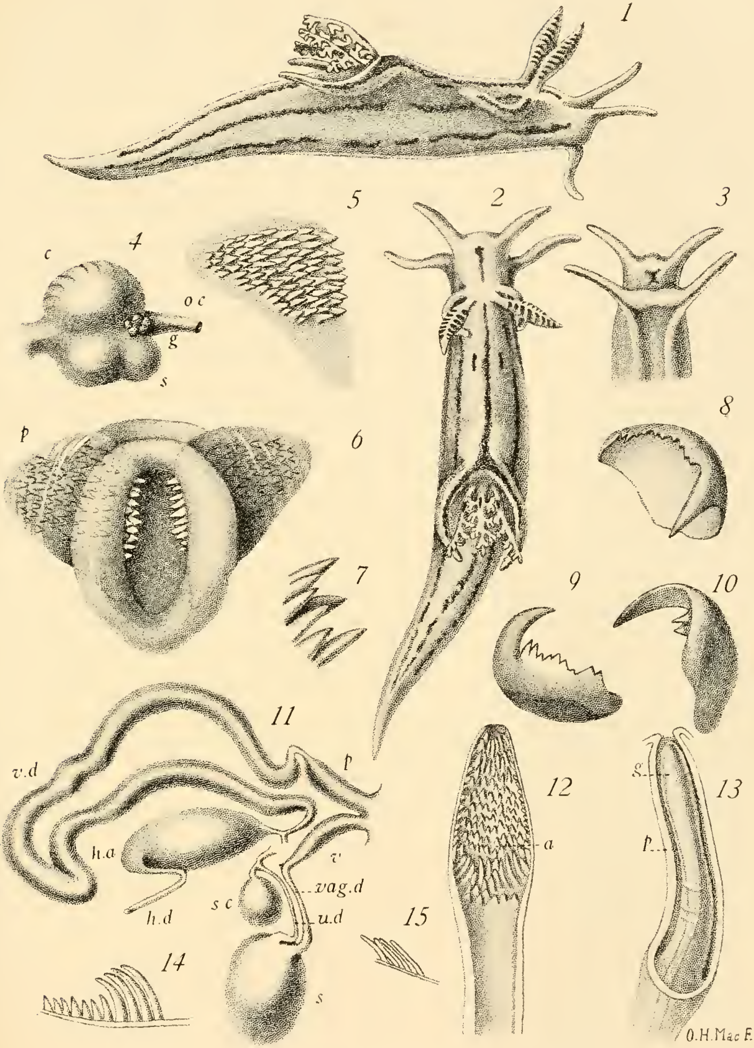
Fig. 11. Relations of the reproductive conduits in the anterior genital complex. For the sake of clearness the albumen and mucus glands have been omitted and the ducts are spread apart and separated from their closely packed condition. *h.d*, hermaphroditic duct leading from the ovotestis behind; *h.a*, hermaphroditic ampulla; at the anterior end it narrows and divides into the short oviduct, shown as a cut end, which enters the albumen gland at once, and a very much longer vas deferens, *v.d*, the thicker segment of which forms the highly glandular prostatic portion; *p*, the penis, shown in detail in Figs. 12 and 13; *s.c*, the spermatocyst, opening by a very short duct into *u.d*, the uterine duct, which extends from its emergence from the albumen gland to the spermatotheca, *s*; *vag.d*, the vaginal duct, dilating distally into the vagina, *v*. × 20.

Fig. 12. Distal end of glans penis viewed as a transparent object; *a*, its armature of spines, probably eversible. × 200.

Fig. 13. Penis. The wall of the preputium *p*, has been cut away so as to disclose the glans, *g*, within. The lumen is faintly seen extending through the organ and dilating toward its tip, where the armature shown in Fig. 12 is borne. × 80.

Fig. 14. Detail of typical spines of the penis armature, taken from the region *a* in Fig. 12. × 380.

Fig. 15. Detail of typical spines from the distal end of the penis armature. × 380.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PROCEEDINGS

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XVI

SOME UPPER CRETACEOUS FORAMINIFERA FROM NEAR COALINGA, CALIFORNIA

BY

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AND

C. C. CHURCH

In that part of the Alcalde Hills just west of the town of Coalinga, Fresno County, California, included in Section 2, T. 21 S., R. 14 E., a group of shallow wells has been drilled and oil production has been obtained at a depth of from 500 to 600 feet. The oil is of low gravity, averaging about 18 to 20 degrees Baumé and the production per well at the present time is from one to twelve barrels a day.

In this general area the surface rocks have been mapped as Vaqueros, of Lower Miocene age,[1] but later work indicates that they are much younger, probably Santa Margarita, which is Upper Miocene. These sandy beds are separated from the Chico Cretaceous, and possibly some Tejon Eocene, below by an angular unconformity.

The above mentioned wells are thus known to penetrate a large proportion of sandy beds with interbedded shale above the known oil zone and on drilling deeper the gray clay shales of the Chico are encountered.

Through the kindness of Mr. O. F. Darling of the California Northern Petroleum Co., we received a good set of

[1] Ralph Arnold & Robert Anderson, U. S. Geol. Survey, Bull. 398, 1910.

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samples from this company's well No. 19, in Section 2, T. 21 S., R. 14 E. Oil bearing sands were cored at a very shallow depth but the well was deepened with the expectation of locating a deeper, more productive zone. At a depth of 614 feet and on down to the last sample sent in which came from a depth of 1135 feet, gray, fine grained clay shale was cored in which poorly preserved upper Cretaceous fossils were found. Those identified were, *Inoceramus* and *Baculites*. On breaking down and washing this shale, a well preserved fauna of small foraminifera was obtained which a subsequent examination proved to be not only different from that found in the Moreno above, but entirely new to California paleontology. This difference in the fauna as well as the lithology, further strengthened our view that the shale was Chico and not Moreno. The fact that such forms have not heretofore been reported from the upper Cretaceous of California, together with the possibilities of geologic correlation which they offer, makes the discovery of additional interest. This material from 1135 feet has been entered in the records of the California Academy of Sciences' records as Loc. No. 1421.

The brown and lavender organic shales of the uppermost Cretaceous in the Coalinga district known as the Moreno shales are not in evidence here but become increasingly important toward the north until at the type locality, north of Coalinga in Moreno Gulch, on the east flank of the Panoche Hills, the exposure attains a maximum thickness of 2000 feet.[2] Dr. G. D. Hanna, of the California Academy of Sciences, made an extensive collection across this section at the type locality in September, 1925, on which he later published his paper, "Cretaceous Diatoms from California.[3]" At this time he noted the presence of foraminifera, and in a short paper by J. A. Taff & G. D. Hanna, published in the Bulletin of the American Association of Petroleum Geologists in 1926, he has this to say, "The upper 200 feet of the exposure was found to be a dark brown clay shale with much organic matter but very few fossils. This gave way gradually to a light, buff-colored shale about 200 feet thick, which in its most

[2] Robert Anderson & Robert W. Pack, U. S. Geol. Survey, Bull. 603, 1915.
[3] G. D. Hanna, Occ. Pprs. Calif. Acad. Sci., Vol. 13, 1927.

fossiliferous part contained great numbers of impressions of foraminifera, chiefly belonging to the genus *Siphogenerina.* The calcareous tests of the fossils have been completely dissolved away.[4]" Through the kindness of Dr. Hanna a sample of this fossiliferous shale was obtained and good wax impressions of the prominent *Siphogenerina* were made.

This *Siphogenerina* was first listed and figured as a *Sagrina* by F. M. Anderson, along with several genera now known to have come from the Eocene.[5] In a later paper by G. D. Hanna on "The Age and Correlation of the Kreyenhagen Shale in California," reference is made to the genera listed by Anderson in which he says, "The large *Nodosaria* mentioned and the *Cristellaria* (Fig. 19, Plate 13, called *Vaginulina*) appears to be confined to that portion of the Eocene in California above the middle. The species which he identified and pictured as *Sagrina* came from the upper part of the Cretaceous shales which, north of Coalinga, at some places underlie the Eocene shale, with no apparent unconformity or change except in faunal content.[6]"

The foraminifera included in the present paper are of interest, as they represent Cretaceous species most of which were widely distributed in upper Cretaceous seas. The large majority of the species have been already described in papers by d'Orbigny, Reuss, Alth, Egger, Franke, and others, from upper Cretaceous formations of Europe. Many of these species are also present in the upper Cretaceous of Texas and other portions of the Gulf Coastal region. Some of them are known from the uppermost Cretaceous of Mexico and Trinidad. A few of the forms are striking and new, but the number is small compared to the total number of species represented. This is also true of the American Cretaceous in general, and a large proportion of the species will be found to be identical with those described from central Europe. This is not always as apparent from a study of published figures as it is when one compares actual specimens from the two areas.

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[4] J. A. Taff & G. D. Hanna, Bull. American Assoc. Petrol. Geol., Vol. 10, No. 8, 1926, pp. 812-814.

[5] Frank M. Anderson, Calif. Acad. of Sci. Proc. 3rd Ser., 1905, Vol. 2, No. 2.

[6] G. D. Hanna, Bull. American Assoc. Petrol. Geol. Vol. 9, No. 6, 1925, p. 992.

As this fauna probably represents the uppermost Cretaceous corresponding rather closely with the Navarro of Texas and the Velasco of Mexico, a comparison of those two faunas is of interest. In both cases, *Globigerina, Globorotalia* and *Gümbelina* are apparent. It is known that these forms represent pelagic adaptation. It is therefore noteworthy that *Globigerina* and *Gümbelina* are absent in the California collection and that *Globorotalia,* although typical, is rare. It may therefore be inferred that this California locality represents an area perhaps somewhat cut off from the main ocean of that time, and into which pelagic forms were not carried to any great extent.

Family Textulariidæ

Genus **Spiroplectammina** Cushman, 1927

1. **Spiroplectammina anceps** (Reuss)

Plate 36, figures 1, 2

Textularia anceps Reuss, Die Verstein. böhm. Kreide, 1845, p. 39, pl. 8, fig. 79, pl. 13, fig. 78; Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 234, pl. 13, figs. 2 *a, b*.—Beissel, Abhandl. kön. Preuss. geol. Landes., vol. 3, 1891, p. 68, pl. 13, figs. 14, 16.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 25, pl. 24, figs. 35, 36.

Test much compressed, rapidly increasing in width from the initial end, greatest width near the apertural end; early chambers especially in the microspheric form in a planispiral arrangement, later becoming biserial, chambers low and broad, thickest near the median portion of the test, thence thinning toward the periphery; sutures very slightly depressed, somewhat oblique, nearly straight; wall arenaceous, smoothly finished; aperture elongate, low, at the base of the inner median margin of the last-formed chamber. Length 0.60 mm.; breadth 0.35 mm.; thickness 0.10 mm.

This species is recorded from numerous localities in the upper Cretaceous of Germany and occurs in the equivalent formations of the Gulf Coastal Plain region of the United States.

Family Verneuilinidæ

Genus **Gaudryina** d'Orbigny, 1839

2. **Gaudryina oxycona** Reuss

Plate 36, figures 3, 4

Gaudryina oxycona Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 229, pl. 12, figs. 3 *a-c*; vol. 46, 1862 (1863), p. 33.—Franke, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 15, pl. 1, figs. 20 *a, b*.

Test elongate, conical, tapering, nearly circular in transverse section; very early chambers triserial, later ones biserial; sutures distinct, slightly depressed, nearly at right angles with the periphery; wall finely arenaceous, very smoothly finished; aperture elongate, low, at the inner median margin of the chamber in a decided depression. Length 0.55 mm.; breadth 0.30 mm.

The California specimens agree well with European Cretaceous material of this species.

3. **Gaudryina ruthenica** Reuss

Plate 36, figures 5, 6

Gaudryina ruthenica Reuss, in Haidinger's Nat. Abhandl., vol. 4, 1851, p. 25, pl. 4, fig. 4.—Franke, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 16, pl. 1, figs. 25 *a, b*.

Test elongate, tapering, greatest diameter toward the apertural end, earliest chambers triserial, later biserial, adult chambers high, becoming as high or higher than broad; sutures fairly well marked, sloping slightly backward from the center, slightly curved; wall rather coarsely arenaceous, somewhat roughly finished; aperture in the earlier stages at the base of the inner margin of the chamber, in the adult becoming terminal and rounded but without a neck or lip. Length 0.75 mm.; breadth 0.35 mm.; thickness 0.30 mm.

This species is known from several localities in the upper Cretaceous of Germany.

The peculiar change in shape and position of the aperture is characteristic. It resembles *Heterostomella* in the terminal aperture, but does not have the neck and lip characteristic of many of the species of that genus.

Family Silicinidæ

Genus **Silicosigmoilina** Cushman & Church, new genus

Genoholotype, *Silicosigmoilina californica* Cushman & Church, n. sp.

Test in the early stages nearly planispiral, later becoming sigmoid; wall finely arenaceous with siliceous cement; aperture at the end of the tubular chamber without apertural teeth.

This genus strongly resembles *Sigmoilina* in the calcareous imperforate group. *Sigmoilina* has calcareous cement even though the wall is, in some species, encrusted with arenaceous material, and is divided into definite chambers and the aperture typically has a simple, linear tooth.

The strongest acid fails to make any impression on these Californian Cretaceous forms and they occur with such thin-walled calcareous forms as *Bulimina* in great abundance. *Silicosigmoilina* is most closely related to *Rzehakina,* another genus characteristic of the upper Cretaceous.

4. **Silicosigmoilina californica** Cushman & Church, new species

Plate 36, figures 10, 11, 12

Test compressed, nearly circular or oval in side view, somewhat rhomboid in end view, periphery subacute, usually with a definitely marked portion in side view; chambers in the earliest stages planispiral, later sigmoid; sutures fairly well marked, not deeply depressed; wall finely arenaceous, firmly cemented with a siliceous cement, smoothly finished; aperture simple, oval, without a tooth; white or light gray in color. Length 0.75 mm.; breadth 0.55-0.65 mm.; thickness 0.25-0.40 mm.

Holotype: No. 4714; *paratypes:* Nos. 4713, 4715, Mus. Calif. Acad. Sci., from Loc. 1421 (C. A. S.), California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., M. D. M., Fresno County, California; depth, 1135 feet; upper Cretaceous.

This is probably the most abundant species in the collection, and occupies the same place in the fauna that *Rzehakina* does in the upper Cretaceous material of Trinidad.

Family MILIOLIDÆ

Genus **Quinqueloculina** d'Orbigny, 1826

5. **Quinqueloculina** sp.?

Plate 36,. figures 7, 8, 9

There is a single specimen figured here which belongs to *Quinqueloculina,* but lack of further material makes it difficult to place it specifically. It is the only specimen of this family which is rare in most other upper Cretaceous faunas related to this California one.

Family LAGENIDÆ

Genus **Lenticulina** Lamarck, 1804

6. **Lenticulina rotulata** Lamarck

Plate 37, figures 1, 2

Lenticulina rotulata LAMARCK, Ann. Mus., vol. 5, 1804, p. 188; vol. 8, 1806, pl. 62, fig. 11.

The synonymy of this species is very difficult to straighten out without a reference to original specimens representing the various authors' ideas. The type specimens in the Defrance Collection at Caen, France are intact and show that this is a very definite species of the upper Cretaceous. Identical specimens occur in the upper Cretaceous of other parts of Europe and in this country. Very many of the records for the species from Recent seas and from Tertiary deposits do not belong to the species however.

7. **Lenticulina williamsoni** (Reuss)

Plate 36, figures 13, 14

Cristellaria williamsoni REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 327, pl. 6, fig. 4.—EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 120, pl. 11, figs. 7, 8.

There are a few specimens in the California collection that are very close to this species of Reuss as developed in the upper Cretaceous of various parts of Germany.

8. **Lenticulina** sp.?

Plate 37, figures 11, 12

The figured specimen is left under the genus only as there are not enough specimens to give full specific characters.

Genus **Robulus** Montfort, 1808

9. **Robulus trachyomphalus** (Reuss)

Plate 37, figures 6, 7

Robulina trachyomphala Reuss, in Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 34, pl. 2, fig. 12.

The figured form seems very closely related to Reuss's species from the Cretaceous of Europe. Bagg records the species from the Cretaceous of New Jersey, but no specimens are figured.

10. **Robulus lepidus** (Reuss)

Plate 36, figures 15, 16

Robulina lepida Reuss, Verstein. böhm. Kreide, vol. 2, 1845-46, p. 109, pl. 24, fig. 46.

Cristellaria lepida Reuss, Sitz. Akad. Wiss. Wien, vol. 52, pt. 1, 1865, p. 454; in Geinitz, Palaeontographica, vol. 20, pt. 2, 1874, p. 106, pl. 23, fig. 4.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, pt. 1, 1899, p. 117, pl. 12, figs. 27, 28; Ber. nat. Ver. Passau, 1907, p. 36, pl. 2, figs. 1, 2.—Franke, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 75, pl. 6, figs. 14 *a, b*.—Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 599, pl. 19, figs. 10 *a, b*.

This species has been recorded from numerous localities in the Cretaceous of central Europe. It occurs also in the Cretaceous, Velasco Shale, of Mexico.

Genus Saracenaria Defrance, 1824

11. Saracenaria triangularis (d'Orbigny)

Plate 37, figures 13, 14

Cristellaria triangularis d'Orbigny Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 27, pl. 2, figs. 21, 22.—Reuss, Verstein. Böhm. Kreide, 1845, p. 34, pl. 8, fig. 48; in Geinitz, Grundr. Verstein, 1845-46, p. 663, pl. 24, fig. 29.—d'Orbigny, Prod. Pal., vol. 2, 1850, p. 281, No. 1375.—Reuss, Denkschr. Akad. Wiss. Wien, vol. 7, 1854, p. 68; Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), pp. 70, 93.—Berthelin, Mém. Soc. Géol. France, sér. 3, vol. 1, 1880, p. 55.—Beissel, Abhandl. kön. Preuss. geol. Landes., n. ser., vol. 3, 1891, p. 53, pl. 10, figs. 1-9.—Matouschek, Lotos., vol. 43, 1895, p. 146.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 117, pl. 12, figs. 5, 6; Ber. nat. Ver. Passau, 1907, p. 36, pl. 2, figs. 19-21.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1910, p. 421.—Franke, Verh. Nat. Hist. Ver., vol. 59, 1912 (1913), p. 279.—Chapman, Bull. Geol. Surv. W. Australia, No. 72, 1917, p. 30, pl. 9, fig. 80.

Test fairly large, the early portion completely coiled, later chambers somewhat uncoiled and the test becoming triangular in transverse section; chambers distinct, few in number; sutures distinct but not depressed, curved; wall smooth except for the sides of the apertural face which are somewhat thickened; aperture at the angle of the upper end, radiate. Length of figured specimen 0.90 mm.; breadth 0.55 mm.; thickness 0.45 mm.

This species was described by d'Orbigny from the Cretaceous of the Paris Basin and is recorded from the upper Cretaceous of various parts of Europe and Australia. Bagg records it without figures from the Cretaceous of New Jersey.

Genus Marginulina d'Orbigny, 1826

12. Marginulina humilis (Reuss)

Plate 37, figures 3, 4, 5

Cristellaria humilis Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 65, pl. 6, figs. 16, 17.—Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 601, pl. 19, fig. 8.

Specimens very similar to those figured from the Velasco Shale of Mexico occur in this California Cretaceous material.

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It was described by Reuss from the Cretaceous of Germany, and has been recorded from England in formations of similar age.

13. **Marginulina modesta** Reuss

Plate 37, figures 8, 9, 10

Marginulina modesta REUSS, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 207, pl. 7, fig. 5.—FRANKE, Verh. Nat. Hist. Ver., vol. 59, 1912 (1913), p. 275.

The specimen figured is a typical one of this species with its rounded transverse section, uncoiling form slightly compressed in the earlier stages. It is already known from the upper Cretaceous of central Europe.

14. **Marginulina elongata** d'Orbigny

Plate 38, figures 1, 2, 3

Marginulina elongata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 17, pl. 1, figs. 20-22.—REUSS, Verstein. Böhm. Kreide, vol. 1, 1845-46, p. 29, pl. 13, figs. 28-32; vol. 2, p. 106, pl. 24, fig. 30.—MATOUSCHEK, Lotos, vol. 43, 1895, p. 144.—FRANKE, Verh. Nat. Hist. Ver., vol. 59, 1912 (1913), p. 275; Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 54, pl. 4, fig. 23.

Test elongate, the early chambers close coiled and somewhat compressed; later chambers uncoiling and increasing in thickness so that the last-formed ones are nearly circular in transverse section, chambers increasing in length as added in the uncoiled portion; sutures distinct but only slightly depressed in the last, uncoiled portion; wall smooth; aperture in the adult terminal, radiate. Length of figured specimen, 1.00 mm.; breadth 0.30 mm.; thickness 0.28 mm.

This species is known from the Cretaceous of central Europe, being described originally by d'Orbigny from the Cretaceous chalks of the Paris Basin.

15. **Marginulina bullata** Reuss

Plate 38, figures 4, 5, 6

Marginulina bullata Reuss, Die Verstein. böhm. Kreide, 1845-46, vol. 1, p. 29, pl. 13, figs. 34-38; in Geinitz, Grundr. Verstein, 1845-46, p. 656, pl. 24, fig. 16; Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 205, pl. 6, figs. 4-6.—Matouschek, Lotos, vol. 43, 1895, p. 144.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 96, pl. 9, figs. 12, 13 (not 9, 10).—Franke, Verh. Nat. Hist. Ver., vol. 59, 1912 (1913), p. 275; Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 55, pl. 4, fig. 25.—Cushman and Jarvis, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 96, pl. 14, figs. 7, 8.

Test composed of few chambers, the earlier ones close coiled, the last two or three uncoiled and globular, all chambers strongly inflated; sutures distinct, slightly depressed; wall smooth throughout; aperture in the adult terminal, radiate. Length of figured specimen, 0.70 mm.; breadth 0.35 mm.; thickness 0.32 mm.

This species is known from the Cretaceous of Europe and of Trinidad. It also occurs in the upper Cretaceous of Texas.

16. **Marginulina jonesi** Reuss

Plate 38, figures 7, 8, 9

Marginulina jonesi Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 61, pl. 5, figs. 19 *a, b*.—Berthelin, Mém. Soc. Géol. France, sér. 3, vol. 1, 1880, p. 34.—Chapman, Quart. Journ. Geol. Soc., vol. 50, 1894, p. 709; Journ. Roy. Micr. Soc., 1894, p. 164, pl. 4, fig. 24.—Sherlock, Geol. Mag., dec. 6, vol. 1, 1914, p. 259, pl. 18, fig. 15.—Neaverson, Geol. Mag., 1921, p. 462.

Test elongate, early portion compressed and chambers close coiled, later becoming uncoiled; periphery acute and keeled in the early portion; later chambers nearly circular in section; sutures more or less obscured but the ornamentation of the surface which consists of elongate costæ continuing throughout the length of the test unbroken at the sutures, terminal face smooth; aperture in the adult terminal, radiate, with a slight neck. Length of figured specimen, 0.90 mm.; breadth 0.36 mm.; thickness 0.27 mm.

This species is known from the upper Cretaceous of various parts of Europe and is recorded by Chapman from the Gault.

Genus **Vaginulina** d'Orbigny, 1826

17. **Vaginulina simondsi** Carsey

Plate 38, figure 10

Vaginulina simondsi Carsey, Bull. 2612, Univ. Texas, 1926, p. 40, pl. 2, fig. 4.

Test elongate, very much compressed, dorsal edge straight, ventral convex; chambers numerous, very elongate, curved, on ventral side extending far toward the base; sutures distinct, raised, broken by short costæ which are, in general, parallel to the dorsal edge which is itself thickened and bicarinate; aperture terminal, radiate. Length nearly 2 mm.

This species occurs commonly in the upper part of the upper Cretaceous of Texas in the Navarro formation. The specimen figured here is very similar to Texas ones in its general characters.

Genus **Frondicularia** Defrance, 1824

18. **Frondicularia decheni** Reuss

Plate 38, figures 11, 12, 13

Frondicularia decheni Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 191, pl. 4, fig. 3; Palaeontographica, vol. 20, pt. 2, 1872-75 (1874), p. 96.—Egger, Ber. Nat. Ver. Passau, 1907, p. 28, pl. 1, figs. 13, 14.—Franke, Verh. Nat. Hist. Ver., vol. 59, 1912 (1913), p. 273.—Chapman, Bull. Geol. Surv. W. Australia, No. 72, 1917, p. 24, pl. 6, fig. 53.

Test very much compressed, the proloculum thicker than the remainder of the test; sides nearly parallel, but slightly increasing in width as chambers are added; periphery concave; sutures slightly depressed, distinct; wall ornamented by a few longitudinal costæ, those of each chamber somewhat independent of each other; aperture terminal, radiate.

This species is known from the upper Cretaceous of central Europe, and from Australia. It probably also occurs in the upper Cretaceous of Mexico, and the Coastal Plain region of the United States.

19. **Frondicularia** sp.?

Plate 38, figure 14

There are broken specimens, one of which is here figured, of a large *Frondicularia* not well enough preserved for a full description. It is figured here for future reference.

Genus **Dentalina** d'Orbigny, 1826

20. **Dentalina** sp.?

Plate 38, figure 15

This fragment of a spinose species is figured here for reference. No complete specimens were obtained.

21. **Dentalina catenula** (?) Reuss

Plate 39, figure 1

The figured fragment representing the terminal chambers of a large species is close to this species of Reuss known from the upper Cretaceous of Europe.

22. **Dentalina polyphragma** Reuss

Plate 39, figure 2

Dentalina polyphragma REUSS, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 189, pl. 3, fig. 1.—BEISSEL, Abhandl. kön. Preuss. geol. Landes, n. ser., vol. 3, 1891, p. 38, pl. 7, figs. 53-65.—FRANKE, Verh. Nat. Hist. Ver., vol. 59, 1912 (1913), p. 271.

Nodosaria polyphragma EGGER (?), Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 74, pl. 8, fig. 26; pl. 24, fig. 37.

There are fragmentary specimens similar to that figured which have numerous costæ, and the aperture toward one side which may be referred to this species of Reuss known from the upper Cretaceous of numerous localities of Europe.

23. **Dentalina commutata** Reuss

Plate 39, figure 3

Dentalina commutata Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 183, pl. 2, fig. 4; vol. 44, pt. 1, 1861 (1862), p. 306; vol. 46, pt. 1, 1862 (1863), p. 42.

The specimen figured is close to Reuss's species which is known from the upper Cretaceous of Germany. The whole test is slightly curved, and the chambers increasing regularly in size as added; wall smooth and the sutures depressed.

Genus **Nodosaria** Lamarck, 1812

24. **Nodosaria nuda** Reuss

Plate 39, figures 4, 5, 6

Nodosaria nuda Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 38, pl. 2, figs. 8, 9.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 64, pl. 7, fig. 17; 1907, p. 23, pl. 5, fig. 26.—Franke, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 40, pl. 3, fig. 32.

Test small, slender, composed of a few, 5 - 8, chambers, the earlier ones slightly more involute than later ones; sutures distinct, depressed; wall smooth; aperture terminal, radiate. Length 0.60 mm.; diameter 0.10 mm.

Reuss and others have recorded this species from the upper Cretaceous of central Europe.

25. **Nodosaria ewaldi** (?) Reuss

Plate 39, figure 7

There are a few elongate, cylindrical chambers of a *Nodosaria* in this California material, but no complete specimens were found.

Genus **Glandulina** d'Orbigny, 1826

26. **Glandulina cylindracea** Reuss

Plate 39, figures 8, 9

Glandulina cylindracea Reuss, in Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 23, pl. 1, fig. 5; Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 190, pl. 4, fig. 1; vol. 44, pt. 1, 1861 (1862), p. 307; Palaeontographica, vol. 20, pt. 2, 1872-75 (1874), p. 89.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 84, pl. 5, figs. 19, 20.

Nodosaria cylindracea Reuss, Verstein. böhm. Kreide, 1845, p. 25, pl. 13, figs. 1, 2.

Nodosaria (Glandulina) cylindracea Cushman, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 594, pl. 18, fig. 1.

Figures of two specimens are given, one with the initial end having a spine, the other bluntly rounded. Such forms are common in the upper Cretaceous of many parts of Europe, and occur in the upper Cretaceous of America.

27. **Glandulina manifesta** Reuss

Plate 39, figure 10

Glandulina manifesta Reuss, in Haidinger's, Nat. Abhandl., vol. 4, pt. 1, 1851, p. 22, pl. 1, fig. 4.

The form figured is a megalospheric one and as a result the initial end is broadly rounded whereas in the microspheric form the initial end is much more pointed. The amount of overlap of the chambers is very variable. This form is abundant in the upper Cretaceous of many parts of the world and many names have been applied to the same species. It may be noted that *Nodosaria larva* Carsey (Bull. 2612, Univ. Texas, 1926, p. 31, pl. 2, fig. 2) from the Navarro formation of Texas is the same species, and varies in form in that formation as it does elsewhere.

Genus **Lagena** Walker & Jacob, 1798

28. **Lagena** (?) sp. (?)

Plate 39, figure 11

The specimen figured has some characters which make it seem that it may be a costate *Glandulina,* but the details are obscure, and full determination must await further and better material.

29. **Lagena** sp. (?)

Plate 39, figure 16

This form is too rare to allow full designation of characters, and it must be left under the genus without name for the present.

Family Heterohelicidæ

Genus **Ventilabrella** Cushman, 1928

30. **Ventilabrella ornatissima** Cushman & Church, new species

Plate 39, figures 12, 13, 14, 15

Test compressed, all chambers in one plane, subglobular, the early ones biserial, later ones spreading out irregularly, sides in the adult nearly parallel, periphery rounded; sutures distinct, somewhat depressed; wall calcareous, perforate, the earlier ones ornamented by longitudinal costæ, each somewhat beaded; aperture in the adult irregular, near the base of the chamber.

Holotype: No. 4746; *paratype:* No. 4745, Mus. Calif. Acad. Sci. from Loc. 1421 (C. A. S.), California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., M. D. M., Fresno County, California; depth, 1135 feet; upper Cretaceous.

This is one of the most striking species of the collection. It is in some respects nearer the European than the Coastal Plain Cretaceous species, but is distinct from them all.

Family Buliminidæ

Genus **Bulimina** d'Orbigny, 1826

31. **Bulimina obtusa** d'Orbigny

Plate 39, figures 17, 18, 19

Bulimina obtusa d'Orbigny, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 39, pl. 4, figs. 5, 6.

Both microspheric and megalospheric forms of this species are figured. There are numerous Cretaceous records for this species but not usually accompanied by illustrations, so without comparing the original material, it is difficult to determine whether or not they all represent one species.

This is apparently the same as the very abundant large species in the middle portion of the upper Cretaceous, Navarro formation of Texas.

Genus **Chrysalogonium** Schubert, 1907

32. **Chrysalogonium cretaceum** Cushman & Church, new species

Plate 39, figures 23, 24

Test uniserial, at least in the adult; chambers elongate, elliptical in side view, the sutures depressed; wall smooth, finely perforate; aperture consisting of numerous pores in a sieve plate at the tip of the last-formed chamber. Length of last-formed chamber 0.40 mm.; diameter 0.18 mm.

Holotype: No. 4762, Mus. Calif. Acad. Sci. from Loc. 1421 (C. A. S.), California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., M. D. M., Fresno County, California; depth, 1135 feet; upper Cretaceous.

This is one of the most interesting species of the collection. The only other known species is *Chrysalogonium polystoma* (Schwager) described from the Pliocene of Kar Nicobar (Schwager, *Novara* Exped., Geol. Theil, vol. 2, 1866, p. 217, pl. 5, fig. 39.) and recorded from the late Tertiary of Kabu, Java (Koch, Bericht Schweiz. Pal. Ges., vol. 18, 1923, p. 346). The Tertiary species has pyriform chambers and the

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apertures are more in a ring. The Cretaceous one has elongate, elliptical chambers, and the apertures are scattered over the whole disc composing the apertural face.

Family Ellipsoidinidæ

Genus **Nodosarella** Rzehak, 1895

33. **Nodosarella coalingensis** Cushman & Church, new species

Plate 39, figures 20, 21, 22

Test elongate, tapering, greatest breadth made by the last-formed chamber; early chambers biserial, later ones irregularly uniserial; sutures distinct, depressed; wall smooth throughout; aperture terminal, semicircular with a curved portion forming the inner margin and standing well above the general contour of the apertural end of the test which is somewhat drawn out. Length of largest specimen 1.15 mm.; diameter 0.40 mm.

Holotype: No. 4751; *paratype:* No. 4750, Mus. Calif. Acad. Sci. from Loc. 1421 (C. A. S.), California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., M. D. M., Fresno County, California; depth, 1135 feet; upper Cretaceous.

This is a much more tapering species than others of the genus. The early biserial portion includes several chambers and when the irregular uniserial chambers are added, they at once start to greatly enlarge in size over the earlier ones.

Genus **Ellipsobulimina** A. Silvestri, 1903

34. **Ellipsobulimina** (?) sp. (?)

Plate 40, figures 1, 2, 3

The figured specimens may belong to this genus, but were not in sufficient quantity to section. There is a possibility that they may represent the largest megalospheric form of the preceding. It is sufficient at present to note their occurrence until more material is available.

Family Rotaliidæ

Genus **Discorbis** Lamarck, 1804

35. **Discorbis cretacea** (Franke) (?)

Plate 40, figures 4, 5, 6

Discorbina cretacea Franke, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 91, pl. 8, figs. 12 *a-c*.

The figured specimen may belong to this upper Cretaceous species described by Franke. The original figures do not show the complete details and our figured specimen is somewhat broken so that the identification cannot be positively made. The figured specimen is but 0.25 mm. in diameter.

Genus **Eponides** Montfort, 1808

36. **Eponides umbonella** (Reuss)

Plate 40, figures 7, 8, 9

Rotalia umbonella Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 221, pl. 11, figs. 5 *a-c*.

Test trochoid, biconvex, seven or eight chambers in the last-formed whorl, periphery acute; chambers distinct, slightly inflated on the ventral side; sutures distinct, on the dorsal side flush with the surface, very slightly limbate, curved, strongly oblique to the periphery, on the ventral side nearly radial, slightly curved; wall smooth; aperture ventral, under the border of the chamber margin. Diameter 0.45 mm.; height 0.22 mm.

Reuss described this species from the upper Cretaceous of Westphalia.

Genus **Gyroidina** d'Orbigny, 1826

37. **Gyroidina depressa** (Alth)

Plate 41, figures 4, 5, 6

Rotalina depressa Alth, in Haidinger's Nat. Abhandl., vol. 3, 1850, p. 266, pl. 13, fig. 21.

Test much compressed, trochoid, biconvex, the dorsal side often nearly flat, periphery rounded, umbilicus often open; chambers numerous, ten to twelve in the last whorl, distinct; sutures distinct, on the dorsal side nearly flush, slightly limbate, curved, ventrally slightly curved, nearly radial, slightly depressed; wall smooth; aperture on the ventral side between the periphery and the umbilicus, low. Diameter of figured specimen 0.25 mm.; height 0.12 mm.

Alth described and figured this species from the upper Cretaceous of Lemberg. The form has since had other names. This same species is common in the upper Cretaceous of the Coastal Plain region of the United States. It is the *Rotalia cretacea* of Carsey (Bull. 2612, Univ. Texas, 1926, p. 48, pl. 5, figs. 1 *a, b*).

38. **Gyroidina quadrata** Cushman & Church, new species

Plate 41, figures 7, 8, 9

Test small, trochoid, six chambers making up the last-formed whorl, dorsal side concave, with a deep sulcus at the spiral suture in the last-formed whorl, ventral side strongly convex, in peripheral view test nearly quadrate, periphery very broad and only slightly curved; chambers distinct, slightly inflated; sutures distinct, depressed, dorsally slightly limbate, slightly curved, ventrally radiate; wall smooth; aperture ventral, between the umbilicus and the periphery. Diameter of holotype 0.20 mm.; height 0.13 mm.

Holotype: No. 4754, Mus. Calif. Acad. Sci. from Loc. 1421 (C. A. S.), California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., M. D. M., Fresno County, California; depth, 1135 feet; upper Cretaceous.

This is a very distinctive small species with its deeply excavated spiral suture, concave dorsal side and quadrate shape in side view.

Genus **Epistomina** Terquem, 1883

39. **Epistomina caracolla** (Roemer)

Plate 41, figures 10(?), 11, 12, 13

Gyroidina caracolla ROEMER, Verstein. Norddeutsch. Kreide, 1840-41, p. 97, pl. 15, fig. 22.

Pulvinulina caracolla CHAPMAN, Journ. Roy. Micr. Soc., 1898, p. 7, pl. 1, figs. 9 *a-c*.

Epistomina caracolla FRANKE, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 88, pl. 8, figs. 10 *a-c*.

The large specimen figured on Plate 40, figures 11, 12, 13 has many of the characters of Roemer's species although later figures give various interpretations of the specific characters. The sutures are limbate and well marked and there is a thickened keel and large umbo in the ventral umbilical region. The small irregular specimen, figure 10, is figured largely for comparison. It is a slightly eroded specimen, and its characters are not well shown.

Family CHILOSTOMELLIDÆ

Genus **Allomorphina** Reuss, 1850

40. **Allomorphina cretacea** Reuss

Plate 41, figures 12, 13

Allomorphina cretacea REUSS, in Haidinger's Nat. Abhandl., vol. 4, 1851, p. 43, pl. 4, fig. 7; Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 320.—FRANKE, Abhandl. geol. pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 28, pl. 2, fig. 26.

The figured form is an irregular one and tends somewhat toward *A. obliqua* Reuss. Both species were described by Reuss from the upper Cretaceous of Lemberg.

Genus **Pullenia** Parker & Jones, 1862

41. **Pullenia quinqueloba** (Reuss)

Plate 41, figures 10, 11

Nonionina quinqueloba REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 71, pl. 5, fig. 31.

Although described by Reuss from the Middle Oligocene of Germany, this name has been applied to most forms of *Pullenia* that have five chambers in the last-formed coil. Its apparent range is from Cretaceous to Recent at least, and an examination of large series from different formations should be studied to determine the relationships of all these forms. The figured specimen is somewhat collapsed.

Family Globorotaliidæ

Genus **Globotruncana** Cushman, 1927

42. **Globotruncana arca** (Cushman)

Plate 41, figures 1, 2, 3

Pulvinulina arca Cushman, Contr. Cushman Lab. Foram. Res., vol. 2, 1926, p. 23, pl. 3, figs. 1 *a-c*.

Globotruncana arca Cushman, l. c., vol. 3, 1927, pl. 19, fig. 11; Journ. Pal., vol. 1, 1927, p. 169, pl. 28, fig. 15.

This abundant and characteristic species of the American upper Cretaceous occurs in the California material. The edges of the chamber are not as ornamented as usual.

Family Anomalinidæ

Genus **Cibicides** Montfort, 1808

43. **Cibicides convexa** (Reuss)

Plate 41, figures 14, 15, 16

Truncatulina convexa Reuss, in Haidinger's Nat. Abhandl., vol. 4, 1851, p. 36, pl. 3, fig. 4.

The figured specimen is very typical of this species figured and described by Reuss from the upper Cretaceous of Lemberg. The dorsal side is concave and the ventral strongly convex. The wall is coarsely perforate and the periphery very broadly rounded.

PLATE 36

Fig. 1. *Spiroplectammina anceps* (Reuss). Plesiotype, No. 4710, C. A. S., × 60; front view; p. 500.

Fig. 2. *Spiroplectammina anceps* (Reuss). Plesiotype, No. 4710, C. A. S., × 60; apertural view; p. 500.

Fig. 3. *Gaudryina oxycona* Reuss. Plesiotype, No. 4711, C. A. S., × 60; front view; p. 501.

Fig. 4. *Gaudryina oxycona* Reuss. Plesiotype, No. 4711, C. A. S., × 60; apertural view; p. 501.

Fig. 5. *Gaudryina ruthenica* Reuss. Plesiotype, No. 4712, C. A. S., × 60; front view; p. 501.

Fig. 6. *Gaudryina ruthenica* Reuss. Plesiotype, No. 4712, C. A. S., × 60; apertural view; p. 501.

Fig. 7. *Quinqueloculina* sp. (?). Plesiotype, No. 4716, C. A. S., × 60; side view; p. 503.

Fig. 8. *Quinqueloculina* sp. (?). Plesiotype, No. 4716, C. A. S., × 60; side view; p. 503.

Fig. 9. *Quinqueloculina* sp. (?). Plesiotype, No. 4716, C. A. S., × 60; end view; p. 503.

Fig. 10. *Silicosigmoilina californica* Cushman & Church, n. sp. Holotype, No. 4714, C. A. S., × 60; side view; p. 502.

Fig. 11. *Silicosigmoilina californica* Cushman & Church, n. sp. Paratype, No. 4713, C. A. S., × 60; side view; p. 502.

Fig. 12. *Silicosigmoilina californica* Cushman & Church, n. sp. Paratype, No. 4715, C. A. S., × 60; transverse section of young specimen; p. 502.

Fig. 13. *Lenticulina williamsoni* (Reuss). Plesiotype, No. 4719, C. A. S., × 60; side view; p. 503.

Fig. 14. *Lenticulina williamsoni* (Reuss). Plesiotype, No. 4719, C. A. S., × 60; apertural view; p. 503.

Fig. 15. *Robulus lepidus* (Reuss). Plesiotype, No. 4718, C. A. S., × 60; side view; p. 504.

Fig. 16. *Robulus lepidus* (Reuss). Plesiotype, No. 4718, C. A. S., × 60; apertural view; p. 504.

All of the specimens illustrated on this plate are from Calif. Acad. Sci. Loc. No. 1421; California Northern Petroleum Company Well No. 19, Section 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California; depth 1135 feet, upper Cretaceous.

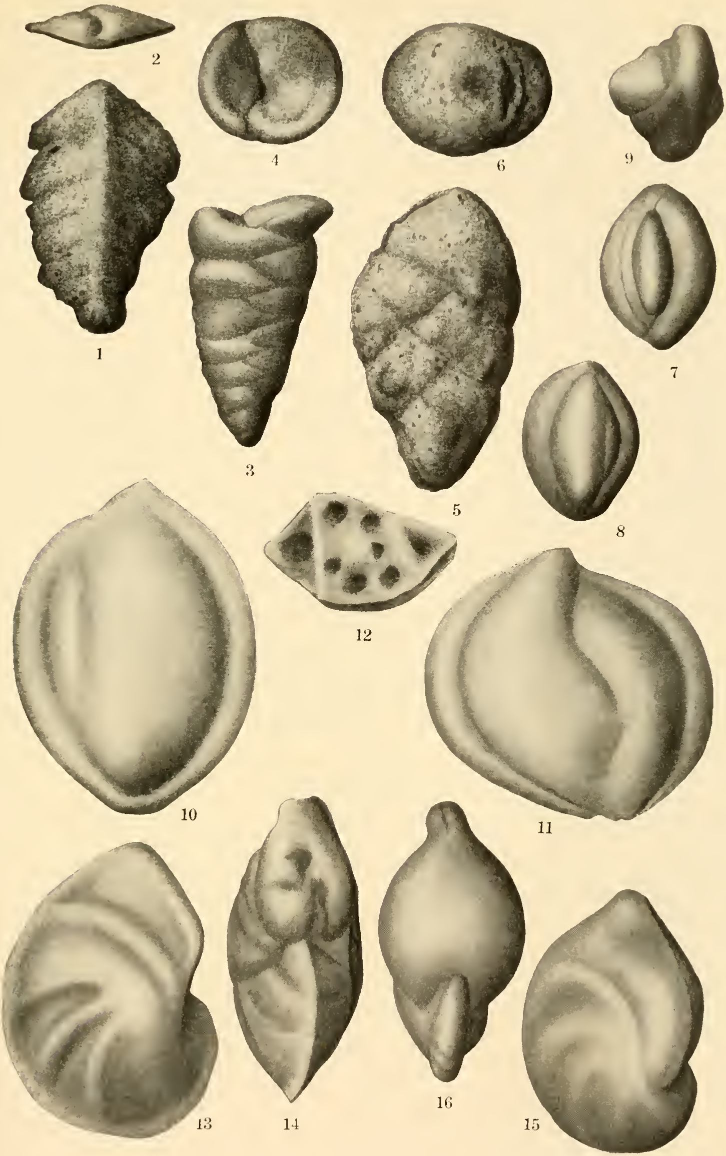

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PLATE 37

Fig. 1. *Lenticulina rotulata* Lamarck. Plesiotype, No. 4717, C. A. S., × 60; side view; p. 503.

Fig. 2. *Lenticulina rotulata* Lamarck. Plesiotype, No. 4717, C. A. S., × 60; apertural view; p. 503.

Fig. 3. *Marginulina humilis* (Reuss). Plesiotype, No. 4725, C. A. S., × 60; side view; p. 505.

Fig. 4. *Marginulina humilis* (Reuss). Plesiotype, No. 4725, C. A. S., × 60; front view; p. 505.

Fig. 5. *Marginulina humilis* (Reuss). Plesiotype, No. 4725, C. A. S., × 60; apertural view; p. 505.

Fig. 6. *Robulus trachyomphalus* (Reuss). Plesiotype, No. 4720, C. A. S., × 30; side view; p. 504.

Fig. 7. *Robulus trachyomphalus* (Reuss). Plesiotype, No. 4720, C. A. S., × 30; apertural view; p. 504.

Fig. 8. *Marginulina modesta* Reuss. Plesiotype, No. 4723, C. A. S., × 60; side view; p. 506.

Fig. 9. *Marginulina modesta* Reuss. Plesiotype, No. 4725, C. A. S., × 60; front view; p. 506.

Fig. 10. *Marginulina modesta* Reuss. Plesiotype, No. 4723, C. A. S., × 60; apertural view; p. 506.

Fig. 11. *Lenticulina* sp. (?). Plesiotype, No. 4721, C. A. S., × 60; side view; p. 504.

Fig. 12. *Lenticulina* sp. (?). Plesiotype, No. 4721, C. A. S., × 60; apertural view; p. 504.

Fig. 13. *Saracenaria triangularis* (d'Orbigny). Plesiotype, No. 4738, C. A. S., × 60; side view; p. 505.

Fig. 14. *Saracenaria triangularis* (d'Orbigny). Plesiotype, No. 4738, C. A. S., × 60; apertural view; p. 505.

All of the specimens illustrated on this plate are from Calif. Acad. Sci. Loc. No. 1421; California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California, depth 1135 feet; upper Cretaceous.

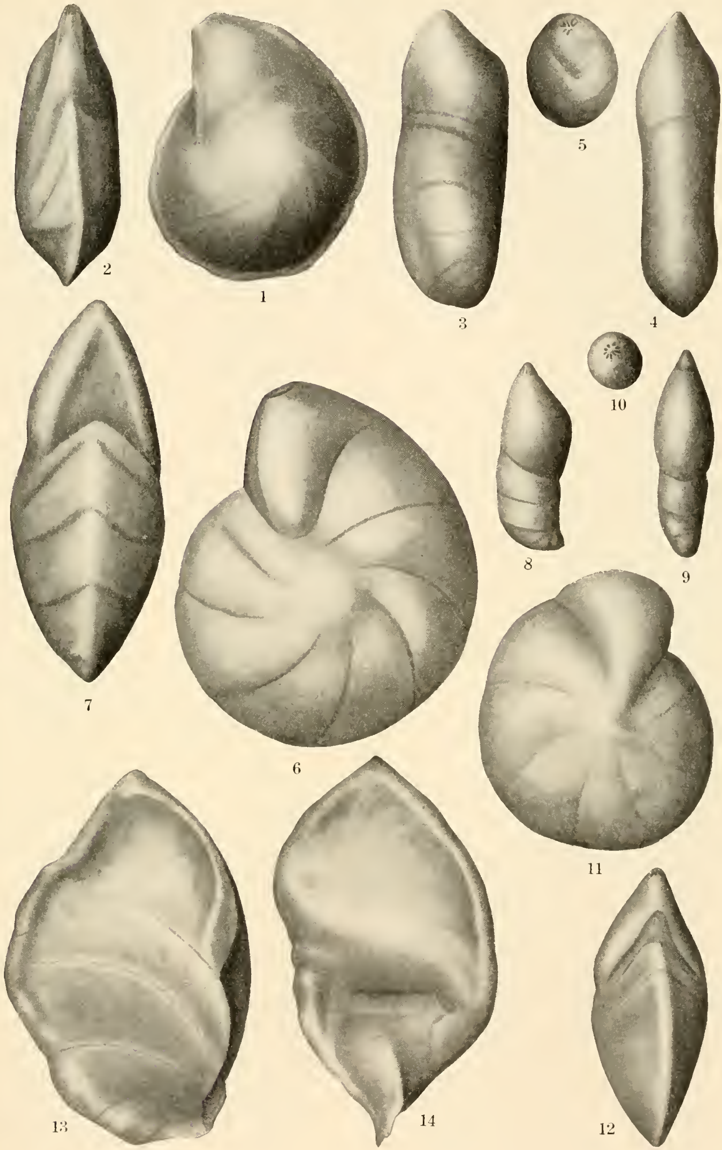
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PLATE 38

Fig. 1. *Marginulina elongata* d'Orbigny. Plesiotype, No. 4726, C. A. S., × 60; side view; p. 506.

Fig. 2. *Marginulina elongata* d'Orbigny. Plesiotype, No. 4726, C. A. S., × 60; front view; p. 506.

Fig. 3. *Marginulina elongata* d'Orbigny. Plesiotype, No. 4726, C. A. S., × 60; apertural view; p. 506.

Fig. 4. *Marginulina bullata* Reuss. Plesiotype, No. 4724, C. A. S., × 60; side view; p. 507.

Fig. 5. *Marginulina bullata* Reuss. Plesiotype No. 4724, C. A. S., × 60; front view; p. 507.

Fig. 6. *Marginulina bullata* Reuss. Plesiotype, No. 4724, C. A. S., × 60; apertural view; p. 507.

Fig. 7. *Marginulina jonesi* Reuss. Plesiotype, No. 4722, C. A. S., × 60; side view; p. 507.

Fig. 8. *Marginulina jonesi* Reuss. Plesiotype, No. 4722, C. A. S., × 60; front view; p. 507.

Fig. 9. *Marginulina jonesi* Reuss. Plesiotype, No. 4722, C. A. S., × 60; apertural view; p. 507.

Fig. 10. *Vaginulina simondsi* Carsey. Plesiotype, No. 4742, C. A. S., × 45; p. 508.

Fig. 11. *Frondicularia decheni* Reuss. Plesiotype, No. 4740, C. A. S., × 45; front view; p. 508.

Fig. 12. *Frondicularia decheni* Reuss. Plesiotype, No. 4740, C. A. S., × 45; apertural view; p. 508.

Fig. 13. *Frondicularia decheni* Reuss. Plesiotype, No. 4740, C. A. S., × 45; p. 508.

Fig. 14. *Frondicularia* sp. (?). Plesiotype, No. 4739, C. A. S., × 30; p. 509.

Fig. 15. *Dentalina* sp. (?). Plesiotype, No. 4736, C. A. S., × 60; p. 509.

All of the specimens illustrated on this plate are from Calif. Acad. Sci. Loc. 1421; California Northern Petroleum Company Well No. 19, Section 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California; depth, 1135 feet; upper Cretaceous.

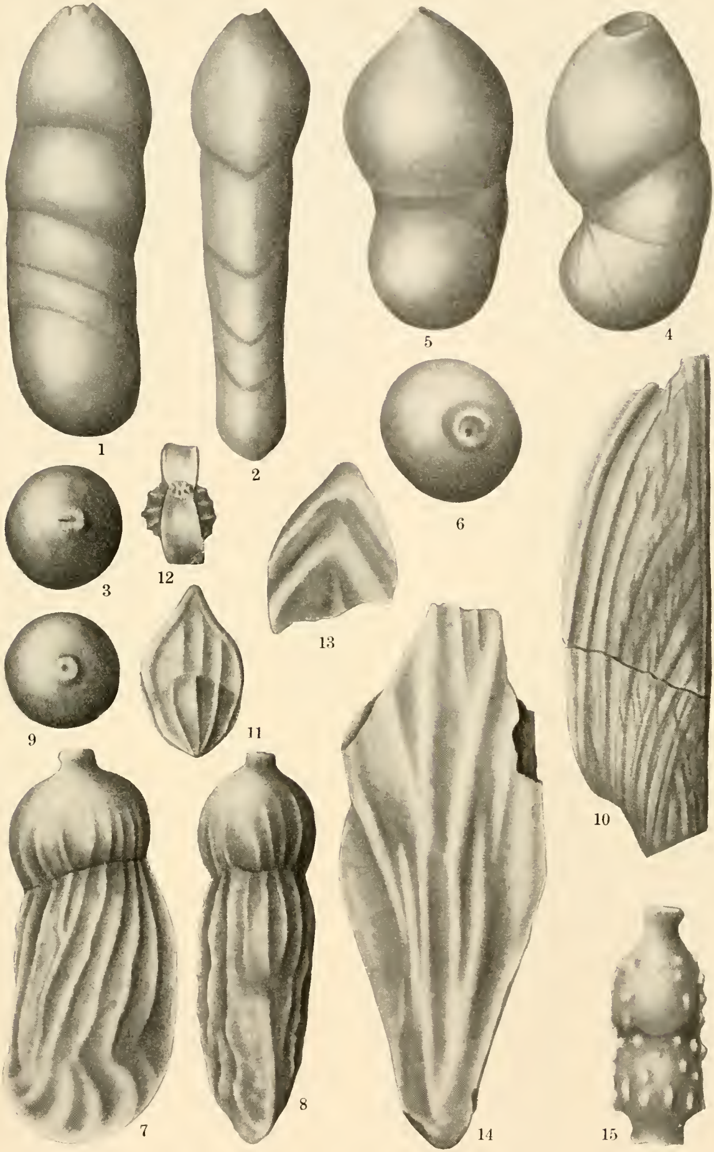
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Plate 39

Fig. 1. *Dentalina catenula* Reuss. Plesiotype, No. 4729, C. A. S., × 60; p. 509.

Fig. 2. *Dentalina polyphragma* Reuss. Plesiotype, No. 4731, C. A. S., × 60; p. 509.

Fig. 3. *Dentalina commutata* Reuss. Plesiotype, No. 4734, C. A. S., × 60; p. 510.

Fig. 4. *Nodosaria nuda* Reuss. Plesiotype, No. 4733, C. A. S., × 60; p. 510.

Fig. 5. *Nodosaria nuda* Reuss. Plesiotype, No. 4727, C. A. S., × 60; p. 510.

Fig. 6. *Nodosaria nuda* Reuss. Plesiotype, No. 4728, C. A. S., × 60; p. 510.

Fig. 7. *Nodosaria ewaldi* (?) Reuss. Plesiotype, No. 4729, C. A. S., × 60; p. 510.

Fig. 8. *Glandulina cylindracea* Reuss. Plesiotype, No. 4735, C. A. S., × 60; p. 511.

Fig. 9. *Glandulina cylindracea* Reuss. Plesiotype, No. 4732, C. A. S., × 60; p. 511.

Fig. 10. *Glandulina manifesta* Reuss. Plesiotype, No. 4737, C. A. S., × 60; p. 511.

Fig. 11. *Lagena* (?) sp. (?). Plesiotype, No. 4743, C. A. S., × 60; p. 512.

Fig. 12. *Ventilabrella ornatissima* Cushman & Church, n. sp. Holotype, No. 4746, C. A. S., × 60; front view; p. 512.

Fig. 13. *Ventilabrella ornatissima* Cushman & Church, n. sp., Holotype, No. 4746, C. A. S., × 60; side view; p. 512.

Fig. 14. *Ventilabrella ornatissima* Cushman & Church, n. sp. Holotype, No. 4746, C. A. S., × 60; end view; p. 512.

Fig. 15. *Ventilabrella ornatissima* Cushman & Church, n. sp. Paratype, No. 4745, C. A. S., × 60; front view; p. 512.

Fig. 16. *Lagena* sp. (?). Plesiotype, No. 4744, C. A. S., × 60; p. 512.

Fig. 17. *Bulimina obtusa* d'Orbigny. Plesiotype, No. 4748, C. A. S., × 60; megalospheric form; p. 513.

Fig. 18. *Bulimina obtusa* d'Orbigny. Plesiotype, No. 4747, C. A. S., × 60; microspheric form; p. 513.

Fig. 19. *Bulimina obtusa* d'Orbigny. Plesiotype, No. 4747, C. A. S., × 60; apertural view; p. 513.

Fig. 20. *Nodosarella coalingensis* Cushman & Church, n. sp. Holotype, No. 4751, C. A. S., × 45; front view; p. 514.

Fig. 21. *Nodosarella coalingensis* Cushman & Church, n. sp. Holotype, No. 4751, C. A. S., × 45; apertural view; p. 514.

Fig. 22. *Nodosarella coalingensis* Cushman & Church, n. sp. Paratype, No. 4750, C. A. S., × 45; side view; p. 514.

Fig. 23. *Chrysalogonium cretaceum* Cushman & Church, n. sp. Holotype, No. 4762, C. A. S., × 60; front view; p. 513.

Fig. 24. *Chrysalogonium cretaceum* Cushman & Church, n. sp. Holotype, No. 4762, C. A. S., × 60; apertural view; p. 513.

All of the specimens illustrated on this plate are from Calif. Acad. Sci. Loc. No. 1421; California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California; depth 1135 feet; upper Cretaceous.

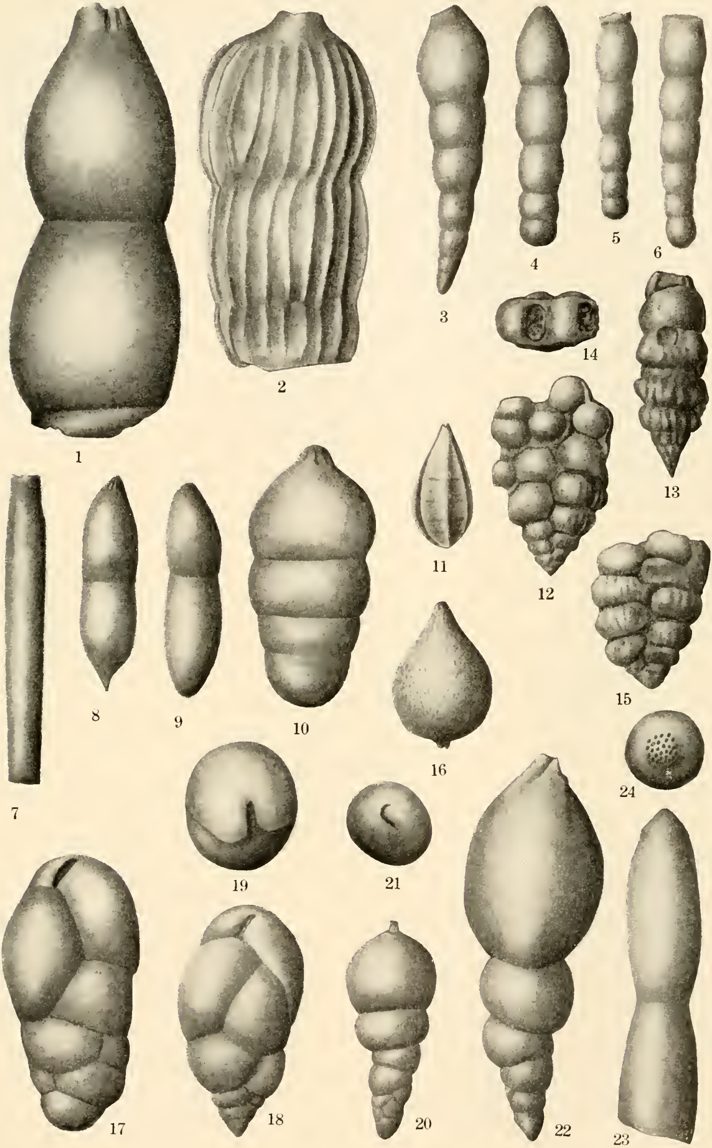
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Plate 40

Fig. 1. *Ellipsobulimina* (?) sp. (?). Plesiotype, No. 4749-a, C. A. S., × 60; front view; p. 514.

Fig. 2. *Ellipsobulimina* (?) sp. (?). Plesiotype, No. 4749-a, C. A. S., × 60; apertural view; p. 514.

Fig. 3. *Ellipsobulimina* (?) sp. (?). Plesiotype, No. 4749, C. A. S., × 60; front view; p. 514.

Fig. 4. *Discorbis cretacea* (Franke) (?). Plesiotype, No. 4752, C. A. S., × 60; dorsal view; p. 515.

Fig. 5. *Discorbis cretacea* (Franke) (?). Plesiotype, No. 4752, C. A. S., × 60; ventral view; p. 515.

Fig. 6. *Discorbis cretacea* (Franke) (?). Plesiotype, No. 4752, C. A. S., × 60; peripheral view; p. 515.

Fig. 7. *Eponides umbonella* (Reuss). Plesiotype, No. 4757, C. A. S., × 60; dorsal view; p. 515.

Fig. 8. *Eponides umbonella* (Reuss). Plesiotype, No. 4757, C. A. S., × 60; ventral view; p. 515.

Fig. 9. *Eponides umbonella* (Reuss). Plesiotype, No. 4757, C. A. S., × 60; peripheral view; p. 515.

Fig. 10. *Epistomina caracolla* (?) (Roemer). Plesiotype, No. 4756, C. A. S., × 45; (?); p. 517.

Fig. 11. *Epistomina caracolla* (Roemer). Plesiotype, No. 4755, C. A. S., × 45; dorsal view; p. 517.

Fig. 12. *Epistomina caracolla* (Roemer). Plesiotype, No. 4755, C. A. S., × 45; ventral view; p. 517.

Fig. 13. *Epistomina caracolla* (Roemer). Plesiotype, No. 4755, C. A. S., × 45; peripheral view; p. 517.

All of the specimens illustrated on this plate are from Calif. Acad. Sci. Loc. No. 1421; California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California; depth 1135 feet; upper Cretaceous.

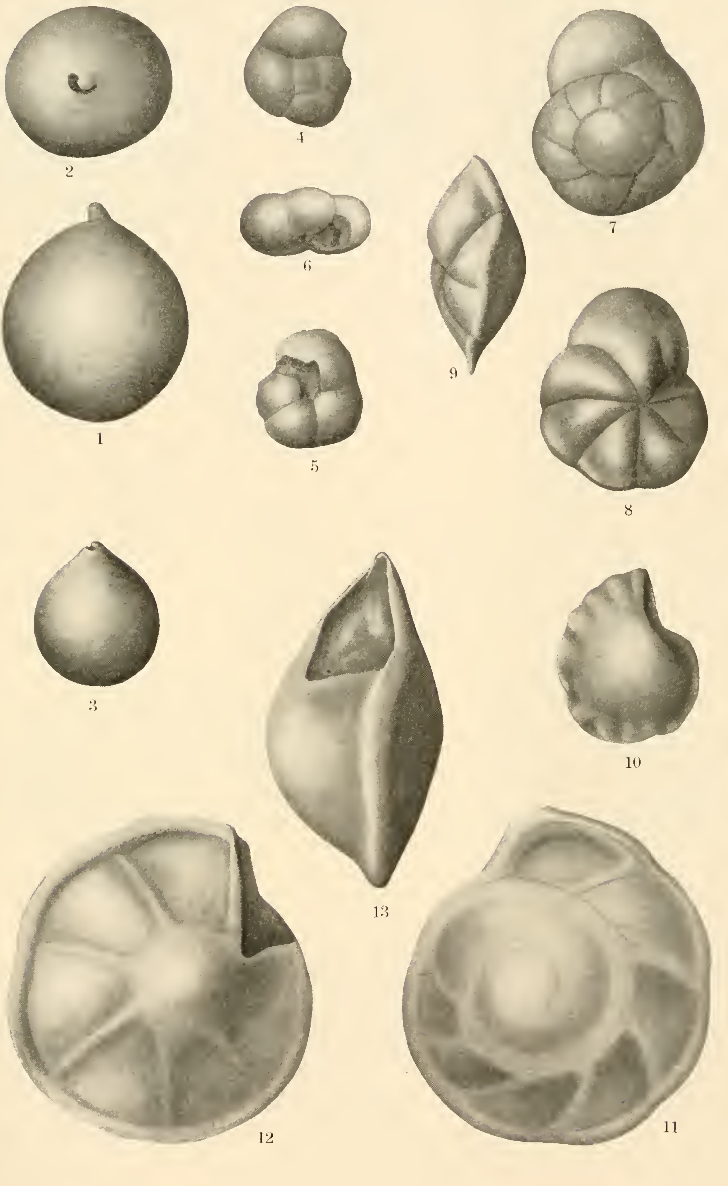
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Plate 41

Fig. 1. *Globotruncana arca* (Cushman). Plesiotype, No. 4760, C. A. S., × 60; dorsal view; p. 518.

Fig. 2. *Globotruncana arca* (Cushman). Plesiotype, No. 4760, C. A. S., × 60; ventral view; p. 518.

Fig. 3. *Globotruncana arca* (Cushman). Plesiotype, No. 4760, C. A. S., × 60; peripheral view; p. 518.

Fig. 4. *Gyroidina depressa* (Alth). Plesiotype, No. 4753, C. A. S., × 60; dorsal view; p. 515.

Fig. 5. *Gyroidina depressa* (Alth). Plesiotype, No. 4753, C. A. S., × 60; ventral view; p. 515.

Fig. 6. *Gyroidina depressa* (Alth). Plesiotype, No. 4753, C. A. S., × 60; peripheral view; p. 515.

Fig. 7. *Gyroidina quadrata* Cushman & Church, n. sp. Holotype No. 4754, C. A. S., × 60; dorsal view; p. 516.

Fig. 8. *Gyroidina quadrata* Cushman & Church, n. sp. Holotype, No. 4754, C. A. S., × 60; ventral view; p. 516.

Fig. 9. *Gyroidina quadrata* Cushman & Church, n. sp. Holotype, No. 4754, C. A. S., × 60; peripheral view; p. 516.

Fig. 10. *Pullenia quinqueloba* (Reuss). Plesiotype, No. 4759, C. A. S., × 60; side view; p. 517.

Fig. 11. *Pullenia quinqueloba* (Reuss). Plesiotype, No. 4759, C. A. S., × 60; peripheral view; p. 517.

Fig. 12. *Allomorphina cretacea* Reuss. Plesiotype, No. 4758, C. A. S., × 60; side view; p. 517.

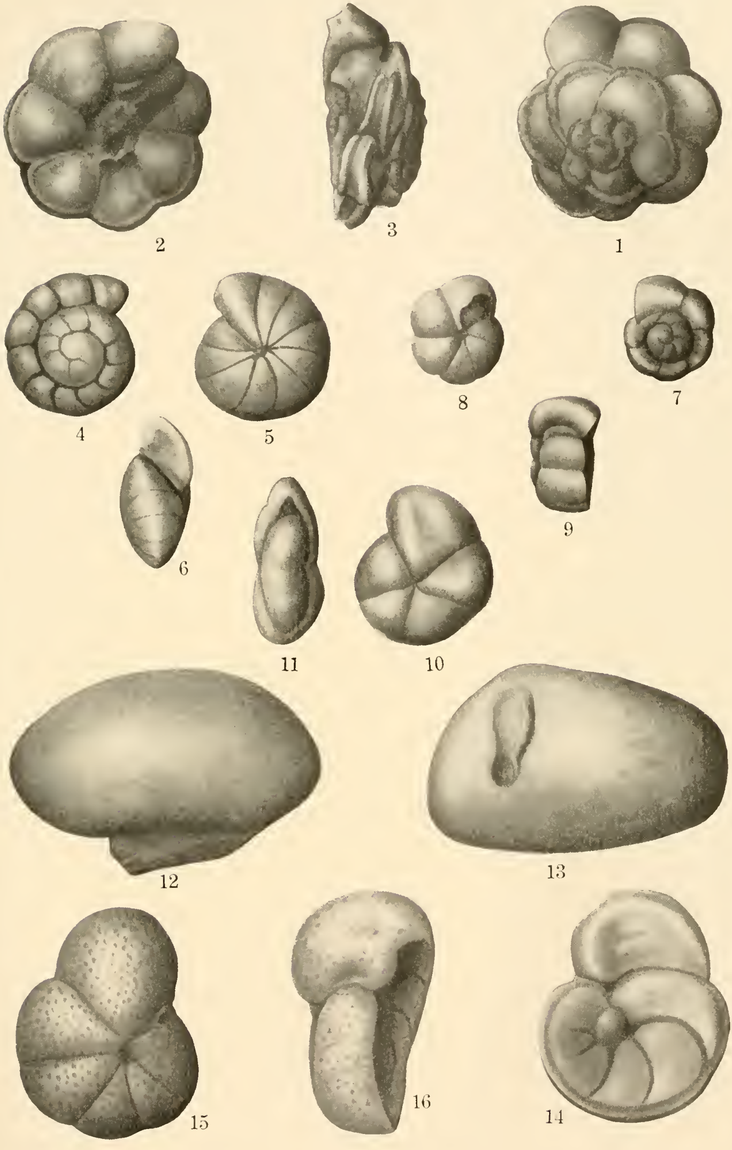
Fig. 13. *Allomorphina cretacea* Reuss. Plesiotype, No. 4758, C. A. S., × 60; opposite side; p. 517.

Fig. 14. *Cibicides convexa* (Reuss). Plesiotype, No. 4761, C. A. S., × 60; dorsal view; p. 518.

Fig. 15. *Cibicides convexa* (Reuss). Plesiotype, No. 4761, C. A. S., × 60; ventral view; p. 518.

Fig. 16. *Cibicides convexa* (Reuss). Plesiotype, No. 4761, C. A. S., × 60; peripheral view; p. 518.

All of the specimens illustrated on this plate are from Calif. Acad. Sci. Loc. No. 1421; California Northern Petroleum Company Well No. 19, Sec. 2, T. 21 S., R. 14 E., near Coalinga, Fresno County, California; depth, 1135 feet; upper Cretaceous.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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVIII, No. 17, pp. 531-541 APRIL 8, 1930

XVII

REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1929

BY

C. E. GRUNSKY

President of the Academy

In last year's annual report attention was called to the needs of the Academy for the proper functioning of the different departments. An appeal was made to public-spirited citizens in California to consider carefully and sympathetically the matter of helping the Academy in one or more of its activities. It is regretted that this appeal has not received the attention that it should. It is, therefore, necessary again to call attention to the opportunity which the Academy would afford any one who is able, to render financial assistance in a manner which would prove of lasting benefit to the community and the state. The opportunity for helping to advance popular education and science is one which should appeal strongly to many of our public-spirited citizens.

The membership of the Academy is made up of persons interested in science. It should have a membership of 5,000 to 10,000 instead of the 1,100 at which membership has stood for some years. Dues are not onerous—only $5.00 per annum, and no admission fee.

Special effort should be made during the ensuing year to increase the membership roll which has not changed materially during the year 1929. The membership is now made up of:

Patrons		17
Honorary Members		15
Life Members		85
Fellows		63
Members		911
Junior Members		5
		1096
5 of the Life Members are also Fellows	5	
2 of the Patrons are also Life Members	2	
1 Fellow is also an Honorary Member	1	
2 Fellows are also Patrons	2	
Less		10
		1086

On January 1, 1929, the number of members stood at		1096
New members added during the year	53	
Members lost by death	23	
Members resigned	27	
Members dropped for non-payment of dues	13	
	63	
Net loss during the year		10
Leaving the membership on January 1, 1930, at		1086

The Academy carries on its list of benefactors the following names:

Deceased

Mr. James Lick Mr. Ignatz Steinhart

The Academy carries on its list of patrons the following names:

Living

Mr. George C. Beckley
Dr. Frank E. Blaisdell
Mr. William B. Bourn
Hon. William H. Crocker
Mr. Peter F. Dunne
Dr. Barton Warren Evermann
Mr. Herbert Fleishhacker
Hon. Joseph D. Grant
Mr. Edward Hohfeld
Mrs. Albert Koebele
Mr. A. Kingsley Macomber
Mr. John W. Mailliard
Mr. Joseph Mailliard
Mr. M. Hall McAllister
Mr. William C. Van Antwerp
Mr. Edward P. Van Duzee
Dr. E. C. Van Dyke

Deceased

Mr. William Alvord
Mr. Charles Crocker
Mr. W. M. Giffard
Mr. John W. Hendrie
Mr. William F. Herrin
Mr. Henry M. Holbrook
Mrs. Charlotte Hosmer
Mr. Ogden Mills
Mr. Alexander F. Morrison
Mr. Amariah Pierce
Dr. John Van Denburgh

Academy members who were called by death in 1929 are as follows:

Mr. Harry Aldous	Member	March 15, 1929
Mr. R. Curtis Baird	Member	November 22, 1929
Mrs. Mary D. Barker	Member	January 20, 1929
Miss Katherine D. Burke	Member	January 10, 1929
Mr. W. M. Fitzhugh	Life Member	May 18, 1929
Mr. Walter M. Giffard	Patron and Fellow	June 30, 1929
Mr. Harry D. Hawks	Member	July 15, 1929
Judge Frederick W. Henshaw	Member	June 8, 1929
Mr. Edgar L. Hoage	Member	April 19, 1929
Mrs. William E. Keith	Life Member	April 28, 1929
Dr. John Sterling Kingsley	Fellow	August 29, 1929
Mr. George R. Kleeberger	Life Member	December 11, 1929
Dr. E. Ray Lankester	Honorary Member	August 15, 1929
Mr. Frank A. Leach	Member	June 19, 1929
Dr. F. A. Lucas	Honorary Member	February 10, 1929
Mr. Ogden Mills	Patron	January 29, 1929
Mrs. Louis F. Monteagle	Member	June 26, 1929
Judge W. W. Morrow	Member	July 24, 1929
Mr. George A. Newhall	Life Member	December 22, 1929
Professor Robert Ridgway	Honorary Member	March 25, 1929
Mr. William T. Sesnon	Member	June 30, 1929
Mr. James A. White	Member	July 15, 1929
Mr. William K. Winterhalter	Member	January 28, 1929

In the year 1929 eleven free lectures were delivered at the stated meetings of the Academy, as follows:

January 2. "Reasons why an Elk Refuge should be established in the San Joaquin Valley." By Dr. Barton Warren Evermann, California Academy of Sciences, San Francisco.

March 6. "The Work of the Food, Drug, and Insecticide Administration." By Mr. Perry Bruce Clark, Assistant Chemist, United States Food, Drug and Insecticide Administration, San Francisco.

April 3. "The Story of the California State Geological Survey under Whitney and Brewer." By Mr. Francis P. Farquhar, San Francisco.

May 1. "The Big Trees of the High Sierra." Illustrated. By Mr. Harold Stein, Field Executive, Boy Scouts of America, San Francisco.

June 5. "The California Valley Quail." Illustrated. By Mr. Donald D. McLean, Field Naturalist, California Fish and Game Commission, San Francisco.

July 3. "Flora of the Apache Trail and adjacent country." By Miss Alice Eastwood, Curator, Department of Botany, California Academy of Sciences, San Francisco.

August 7. "The Pistache Tree, its history, culture, and economic importance." Illustrated. By Mr. G. P. Rixford, Physiologist, Bureau of Plant Industry, United States Department of Agriculture, San Francisco.

September 4. "Reminiscences of old California." By Mr. Otto von Geldern, Second Vice-President, California Academy of Sciences, San Francisco.

October 2. "Some Peculiarities of the California Flora." By Miss Alice Eastwood, Curator of Botany, California Academy of Sciences, San Francisco.

November 6. "In the By-paths of Chamisso in Alaska." By Dr. George Haley, Professor of Biology, St. Ignatius College, San Francisco.

December 4. "Experiences with Hawks in California." Illustrated. By Mr. Donald D. McLean, Field Naturalist, California Fish and Game Commission, San Francisco.

The Sunday lectures at the Museum of the Academy in Golden Gate Park retain their popularity, and the kindness and good-will of those who contribute of their knowledge and experience on these occasions is sincerely appreciated. The following 33 Sunday lectures were delivered at the Museum of the Academy in Golden Gate Park during the year 1929:

JANUARY 6. "Western Reptiles and Amphibians." Illustrated. By Dr. C. L. Camp, University of California, Berkeley.

JANUARY 13. "A Zoological Student in Germany." By Dr. J. S. Kingsley, Berkeley.

JANUARY 20. "Fossil Hunting in New Mexico." Illustrated. By. Dr. C. L. Camp, University of California, Berkeley.

JANUARY 27. "Educating the Summer Vacationists." Illustrated. By Dr. Harold C. Bryant, State Fish and Game Commission.

FEBRUARY 3. "The Stars." Illustrated. By Dr. J. H. Moore, Astronomer, Lick Observatory, Mount Hamilton, California.

FEBRUARY 10. "The Nebulæ." Illustrated. By Dr. J. H. Moore, Astronomer, Lick Observatory, Mount Hamilton, California.

FEBRUARY 17. "Systems of the Stars." Illustrated. By Dr. R. G. Aitken, Astronomer and Associate Director, Lick Observatory, Mount Hamilton, California.

FEBRUARY 24. "Stars and Atoms." Illustrated. By Dr. S. F. Meyer, Professor of Astro-Physics, University of California, Berkeley, California.

MARCH 3. "Minor Planets and Comets." Illustrated. By Dr. N. T. Bobrovnikoff, Martin Kellogg Fellow, Lick Observatory, Mount Hamilton, California.

MARCH 10. "The Distance of the Sun." Illustrated. By Dr. R. H. Tucker, Palo Alto, California.

MARCH 17. "Variable Stars." Illustrated. By Dr. S. D. Townley, Professor of Mathematics, Stanford University, California.

MARCH 24. "Twins and Monsters, Their Etiology." Illustrated. By Dr. Charles E. von Geldern, Sacramento, California.

MARCH 31. "The Deer Problem in California." Illustrated. By Mr. J. S. Dixon, Economic Mammalogist, University of California, Berkeley.

APRIL 7. "The Elk Problem in California." Illustrated. By Mr. J. S. Dixon, Economic Mammalogist, University of California, Berkeley.

APRIL 14. "Personal Observations on a Recent Trip in Europe." By Mr. C. B. Lastreto, San Francisco.

APRIL 21. "Forestry in Switzerland, Sweden and California." Illustrated. By Prof. Walter Mulford, Professor of Forestry University of California, Berkeley.

APRIL 28. "California's Fishery Resources." Illustrated. By Dr. H. C. Bryant, California Fish and Game Commission, San Francisco.

MAY 5. "Literary Trails and Tracks." Illustrated. By Mr. Winfield Scott, Forest and Park Club of California, San Francisco.

MAY 12. "Choosing a State Bird for California." Illustrated. By Mr. C. A. Harwell, Chairman for Northern California, State Bird Commission.

MAY 19. "How the Yosemite Region was formed." Illustrated. By Mr. Harold Stein, Field Executive, Boy Scouts of America, San Francisco.

MAY 26. "History of the Yosemite Region." Illustrated. By Mr. Harold Stein, Field Executive, Boy Scouts of America, San Francisco.

JUNE 2. "Plant and Animal Life of the Yosemite." Illustrated. By Mr. Harold Stein, Field Executive, Boy Scouts of America, San Francisco.

OCTOBER 6. "Forestry and Reforestation in California." Illustrated. By Mr. Winfield Scott, California Forest Protective Association, San Francisco.

OCTOBER 13. "The Redwood in Sentiment, in Industry and in Reforestation." Illustrated. By Mr. Winfield Scott, California Forest Protective Association, San Francisco.

OCTOBER 20. "Forestry and Reforestation in the Sierran Region." Illustrated. By Mr. Winfield Scott, California Forest Protective Association, San Francisco.

OCTOBER 27. "As an Astronomer Sees the World." Illustrated. By Prof. Earle G. Linsley, Director, Chabot Observatory, Oakland, California, and Professor of Astronomy and Geology, Mills College, California.

November 3. "Impressions of Java." Illustrated. By Prof. Earle G. Linsley, Director, Chabot Observatory, Oakland, California, and Professor of Astronomy and Geology, Mills College, California.

November 10. "The Historical Development of Surgical Anæsthesia." Illustrated. By Dr. C. D. Leake, Professor of Pharmacology, University of California Medical School, San Francisco.

November 17. "Food Poisoning." Illustrated. By Dr. J. C. Geiger, Associate Professor of Epidemiology, University of California, Berkeley.

November 24. "The Quarantine Service and Control of the Mediterranean Fruit Fly." Illustrated. By Mr. C. A. Colmore, President, San Francisco High School Teachers' Association, San Francisco.

December 1. "The proposed new building of the California Academy of Sciences with particular reference to the Simson African Mammal Hall." Models of the habitat groups shown. By Dr. Barton Warren Evermann, Director, California Academy of Sciences and Mr. Frank Tose, Chief of Exhibits, California Academy of Sciences.

December 8. "Human History of the Lassen Region." Illustrated. By Mr. Harold Stein, Field Executive, Boy Scouts of America, San Francisco.

December 15. "Experiences on a Journey to Nias, an Island Southwest of Sumatra." Illustrated. By Prof. Olaf P. Jenkins, Chief Geologist, State Division of Mines.

List of Academy Publications in 1929

That the Academy is actively prosecuting scientific research is evidenced by its publications. The following have been issued within the year:

Proceedings, Fourth Series

Vol. XVII, Nos. 11 and 12, pp. 297-360. No. 11—Report of the President of the Academy for the Year 1928, by C. E. Grunsky. No. 12—Report of the Director of the Museum for the year 1928, by Barton Warren Evermann. (Issued May 22, 1929.)

Vol. XVIII, No. 1, pp. 1-27, plates 1-3—A New Species of Corambe from the Pacific Coast of North America, by Frank M. MacFarland and Charles H. O'Donoghue. (Issued January 29, 1929.)

Items of Interest

The Treasurer's report presents the facts relating to the Academy's financial standing. There has been, during the year, a further reduction of the Academy's indebtedness by $10,000, leaving a balance of $195,000 mortgage on the Commercial Building.

On December 7 a new mortgage was placed on the Commercial Building for $450,000 at 5½ per cent. The new mortgage was placed with the Pacific Mutual Life Insurance Company of California. The placing of the new mortgage of $450,000 was undertaken for the purpose of paying off the old mortgage of $195,000 to the Hibernia Savings and Loan Society, which leaves a balance of $255,000 for building purposes. The membership already is acquainted with the fact that the Academy is proposing to build an east wing to the present building, a portion of which will be "The Leslie Simson African Mammal Hall." This is being made possible by the generous offer of Mr. Leslie Simson which was explained in last year's report. The Architect is now working upon the plans for this new building.

The Academy possessed 319 shares of American Company stock. This was deposited with the American Trust Company for exchange for stock of the Goldman Sachs Trading Corporation August 7, 1929. In this transfer the Academy received 410 shares of stock of the Goldman Sachs Trading Corporation. October 1 a stock dividend of six shares was received, making a total of 416 shares, which were sold by Mr. William H. Crocker, acting for the California Academy of Sciences, October 11 at $105 per share, the net proceeds being $43,557.92. Had the stock been held a few weeks longer only about one-third as much could have been realized.

In June 1929 a reappraisal of the land on which the Commercial Building is located was made. In 1909, for the purposes of the lease, the land was valued at $544,000. A reappraisal in 1919 placed its value at $580,000. The reappraisal in 1924 advanced the value to $820,000. In 1929 the land was valued at $860,000.

In July an appraisal was made of the Commercial Building which resulted as follows:

New replacement value	$666,504.33
Depreciated value	469,414.57
Insurable value	407,682.55

Under this appraisement the total amount of insurance that the Academy can carry on the basis of 80 per cent is $325,000. Formerly the Academy carried $525,000, but the Trustees voted to reduce the insurance to $325,000, the legal maximum.

It is with sorrow that I report the death of one of our Trustees, Mr. William M. Fitzhugh, who died May 18, 1929. The Academy has also lost by death three Honorary members, viz: Dr. F. A. Lucas of New York, who died February 10; Prof. Robert Ridgway of Olney, Illinois, who died March 25; and Dr. E. Ray Lankester of London, England, who died August 15. The Academy has suffered another great loss in the tragic death in an automobile accident, June 26, of Mrs. Louis F. Monteagle, wife of Mr. Louis F. Monteagle, a member of the Board of Trustees.

At a meeting of the Trustees August 26 Mr. Norman B. Livermore was unanimously elected a Trustee to serve for the remainder of the term caused by the death of Mr. William M. Fitzhugh which expires in February 1931. The Academy is very fortunate in securing Mr. Livermore as a member of the Board of Trustees.

Certain amendments to the Constitution were adopted May 25, 1929, which changed the manner relating to the method of electing members. Under these amendments members are now elected by the Council. Three new classes of members were established, viz: Benefactors, Sustaining and Junior Members.

In September the Director, Dr. Evermann, accompanied by the Assistant Curator of Fishes, Mr. H. Walton Clark, left for Indiana to superintend the packing and shipping to the Museum of the Jordan-Eigenmann Indiana University Collection of Fishes which had been purchased by the Academy. They were joined at Bloomington by the Superintendent of the Aquarium, Mr. Seale, who assisted them. The collection came through to San Francisco in perfect condition and is now temporarily stored in the basement of the Aquarium.

In December, Mr. M. Hall McAllister, our Treasurer, and also Chairman of the Committee on the Conservation of Wild Animal Life, donated $100 to that fund. Mr. McAllister has been very efficient in looking after this committee.

Mr. Edward Hohfeld of the law firm of Morrison, Hohfeld, Foerster, Shuman and Clark has continued to look after the legal affairs of the Academy and I feel sure that I voice a unanimous sentiment when I take this opportunity to express our appreciation of his deep interest in the Academy.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVIII, No. 18, pp. 542-586 April 8, 1930

XVIII

REPORT OF THE DIRECTOR OF THE MUSEUM AND OF THE AQUARIUM FOR THE YEAR 1929

BY

BARTON WARREN EVERMANN

Director of the Museum and of the Aquarium

The Annual Report of the Director for the year 1928 was presented to the Academy at the Annual Meeting, February 20, 1929.

The present report submitted at this Annual Meeting, February 19, 1930, sets forth briefly the scientific and educational activities of the Academy for the calendar year 1929.

Personnel

The employees of the Museum as of January 1, 1930, were as follows: Dr. Barton Warren Evermann, Director and Executive Curator of the Museum and of the Aquarium, and Editor of the Academy publications; Susie M. Peers, Secretary to the Board of Trustees; Joseph W. Hobson, Recording Secretary of the Academy; Alice Eastwood, Curator, Kate E. Phelps and John Thomas Howell, assistants, Department of Botany; Edward P. Van Duzee, Curator, J. O. Martin and Amy Williamson, assistants, Dr. Edwin C. Van Dyke, Honorary Curator, Dr. Frank E. Blaisdell, Reasearch Associate, and Dr. Frank R. Cole, Associate Curator in Dipterology, Department of Entomology; Frank Tose, Chief, and Richard Cayzer, Russell Hendrick and Cecil Tose, assistants, Department of Exhibits; Dr. Barton Warren Evermann, Curator, and H.

Walton Clark, Assistant Curator, Department of Fishes; Joseph R. Slevin, Curator, Department of Herpetology; Dr. Walter Kendrick Fisher, Curator, Department of Invertebrate Zoology; Thomas Cowles, Assistant Librarian, and May Peffer assistant; Harry S. Swarth, Curator, Mary E. McLellan Davidson, Assistant Curator, and Joseph Mailliard, Curator Emeritus, Department of Ornithology and Mammalogy; Dr. G. Dallas Hanna, Curator, Dr. Leo George Hertlein, Assistant Curator, John L. Nicholson, Jr., assistant, Frank M. Anderson, Honorary Curator, and Dr. Roy E. Dickerson, Research Associate, Department of Paleontology; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Raymond L. Smith, general assistant; Mabel E. Phillips, check-room attendant; William C. Lewis, janitor; Hugh Jones, assistant janitor; Robert L. Thompson, Jr., lecture attendant; Patrick O'Brien, day watch; Archie McCarte, night watch.

The Aquarium staff and employees as of January 1, 1930, were as follows: Dr. Barton Warren Evermann, Director; Susie M. Peers, Secretary, part time; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Alvin Seale, Superintendent; Phyllis Beardslee, doorkeeper; Clynt S. Martin, chief engineer; B. T. Culleton, first assistant engineer; John A. Dwyer, second assistant engineer; Clyde E. Guidry, chief attendant; Jack Solini, first assistant attendant; L. R. Solini, second assistant attendant; J. N. Angelucci, third assistant attendant; Frank J. Maxwell, relief engineer and attendant; S. J. Shenefield, carpenter and general utility man; Charles W. Hibbard, assistant collector; Patrick O'Neill, janitor; Patrick McArdle, assistant janitor; James Cavanaugh, day watch.

Only a few changes have taken place in the personnel. Mrs. Johanna E. Wilkens, who had been employed as charwoman by the Academy for many years (in fact ever since 1895), met with a rather severe accident in which her shoulder was broken May 6, since which date she has been unable to return to her regular duties.

Aris Partidos, who served as usher at the Sunday lectures from March 13, 1927, to January 31, 1929, when he resigned. His place was taken February 3, 1929, by Robert Thompson, Jr.

Day-Officer Patrick O'Brien, after a protracted illness, was able to return to duty April 24.

Miss Clara Tose, preparator, Department of Exhibits, resigned October 6. Miss Dora Arnold, who had been doorkeeper and typist in the Aquarium since November 10, 1925, resigned August 31, to accept a better position, and Miss Phillis Beardslee was appointed to the position September 12.

The most important change in the personnel was the resignation, December 31, of Mr. Wallace Adams, Assistant Superintendent of the Steinhart Aquarium, a position which he had held since July 20, 1923. Mr. Adams leaves the Academy to accept the position of Chief of the Division of Fisheries, Bureau of Science, Manila, Philippine Islands.

During the years that Mr. Adams was with the Academy as Assistant Superintendent of the Steinhart Aquarium, he showed himself a faithful and efficient employee, and it is with great regret that we lose him.

Cooperation with Public and Private Schools, with Other Institutions, and with Individuals

The Museum continues to be of service to the schools, other institutions and individuals in their educational and scientific work.

In spite of the fact that all space available for public exhibits has long since been occupied, we have nevertheless continued to add to our educational exhibits, in the hope that facilities for putting them on exhibition may be provided in the near future.

Our research collections in several departments have increased greatly, as may be seen from the reports of the respective curators.

The Museum continues to loan portable habitat animal groups for circulation in the public schools, particularly in the Berkeley schools, where real interest in that form of education is strong.

ISITORS TO THE MUSEUM

	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Jan......	......	23,170	25,260	17,241	27,013	25,755	19,038	15,270	32,364	34,989	26,528	33,791	35,859	26,757
Feb......	......	22,058	23,698	17,586	23,450	25,679	18,534	20,529	44,439	29,295	34,183	24,580	36,669	29,769
March	......	31,606	26,810	27,397	25,419	28,279	27,922	26,341	39,935	39,168	38,677	34,624	31,414	40,680
April.	......	32,175	23,274	25,994	32,208	24,939	36,057	21,911	41,332	40,257	36,746	38,452	42,965	31,419
May..	......	26,154	26,391	28,369	37,107	25,517	27,237	37,597	48,152	38,137	52,913	47,414	43,129	41,318
June..	......	32,123	29,843	32,248	36,207	29,406	27,131	39,511	58,281	51,775	53,799	51,630	51,100	65,998
July..	......	37,193	31,420	48,028	52,492	43,186	36,263	64,530	91,329	69,921	83,707	84,282	84,406	68,658
Aug...	......	24,619	31,137	43,730	53,470	39,422	34,787	50,849	105,130	77,847	81,362	66,870	73,282	62,880
Sept..	16,448	27,866	29,847	34,007	42,013	31,458	28,408	69,870	82,814	63,737	57,615	56,443	54,882	55,015
Oct...	36,933	20,629	14,743	30,463	33,500	24,861	19,459	66,894	43,074	40,418	44,654	43,520	36,094	39,120
Nov...	27,718	21,810	8,531	25,246	19,347	18,593	19,080	48,766	37,611	35,634	30,420	30,581	26,685	34,545
Dec...	15,002	21,693	19,588	21,188	21,340	15,062	13,339	36,707	21,572	32,245	34,555	30,827	24,217	29,837
Totals for the years.	96,101	321,096	290,542	351,497	403,566	332,157	307,255	498,775	646,033	553,423	575,159	543,014	540,702	525,996

Grand total since opening of the Museum September, 1916..5,985,316

Visitors to the Aquarium

	1923	1924	1925	1926	1927	1928	1929
Jan....	....	82,283	72,153	38,259	44,300	53,454	41,160
Feb....	....	119,001	61,213	66,032	39,515	54,105	44,070
March..	....	88,172	97,986	82,153	58,151	57,083	75,876
April...	....	83,245	79,021	64,830	65,337	78,735	50,583
May...	....	97,083	75,187	94,521	87,961	104,230	92,048
June...	....	112,785	94,717	91,451	70,151	110,206	91,936
July....	....	145,703	128,261	127,999	142,738	151,881	115,018
Aug....	....	148,899	144,208	124,635	115,230	115,915	106,681
Sept....	29,800	116,032	106,492	86,645	87,909	92,755	121,143
Oct....	209,671	71,273	72,350	79,108	66,117	51,521	68,304
Nov...	145,434	67,500	59,074	49,741	44,643	50,554	72,149
Dec....	96,757	48,376	52,929	48,423	43,582	36,406	53,658
Totals for the years	481,662	1,180,352	1,043,591	953,797	865,634	956,845	932,626

Grand total since opening of the Aquarium September, 1923........6,414,507

Schools Visiting the Museum and the Aquarium in 1929

A detailed report of the schools whose classes, accompanied by their teachers, and the number of pupils that visited the Museum and the Aquarium in 1929, is in the files and may be consulted by anyone interested. Following is a summary:

Museum

	In San Francisco	Outside	Total
Number of schools represented...........	71	32	103
Number of classes represented............	181	38	219
Number of teachers accompanying the classes...............................	184	40	224
Number of pupils......................	5,416	1,202	6,618
Total............................	5,852	1,312	7,164

Aquarium

	In San Francisco	Outside	Total
Number of schools represented...........	82	34	116
Number of classes represented............	236	75	301
Number of teachers accompanying the classes...............................	216	51	267
Number of pupils......................	6,113	1,318	7,431
Total............................	6,647	1,478	8,115
Total for Museum and Aquarium.........	12,499	2,790	15,279

Department Activities

The year has been marked by more than normal activity in the different departments, as is shown in detail by the reports of the respective curators. The growth of the research collections in each department has been very gratifying.

In the Department of Botany more than 10,000 sheets were added to the Herbarium, which raises the total number of sheets to over 171,000.

The Department of Botany can always be depended upon to make very great growth every year, and its accomplishments in 1929 have not fallen behind those of previous years. Miss Eastwood seems to be an adept in securing and holding the enthusiastic support and cooperation of botanists all over the country, among whom are always to be found one or more friends of means who are so enthusiastic and so anxious to be with Miss Eastwood in the field that they insist on paying all the field expenses themselves, as Miss Eastwood will no doubt set forth in her report.

In Entomology more than 32,000 specimens were added to the research collections. These include the J. O. Martin collection of Coleoptera numbering 11,200 specimens, a miscellaneous collection of about 4,000 specimens donated by Dr. Van Dyke, and 2,000 specimens, many of them very desirable moths, donated by Mr. Louis S. Slevin of Carmel.

The growth of this department in recent years under Mr. Van Duzee's direction has been phenomenal, and it can now be said that the California Academy of Sciences has become the entomological center for the Pacific area. Any entomologist who wishes to carry on studies of the insect faunas of the Pacific area must make use of the collections in the California Academy of Sciences.

The activities of the Department of Exhibits are fully set forth in the report of Mr. Tose. From his report it may be seen that the Department has been active in caring for the exhibits, adding new ones, and in improving the general attractiveness of the Museum.

The Department of Fishes has, in a single bound, come to be one of the most important departments of the Academy, through the acquisition of the Jordan-Eigenmann collection of

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fishes of about 220,000 specimens. The Academy and Stanford University with its more than 100,000 specimens, will thus become the ichthyological center for the Americas and the Pacific area. No one can do satisfactory work on the fishes of South America, western North America, the islands of the Pacific, or Japan without consulting the collections here and at Stanford.

The Library, under Assistant Librarian Cowles's efficient management, is rapidly becoming accessioned, catalogued and properly arranged on the shelves. The number of accessions for the year, through exchange, donation and purchase, has been about 9000, including parts of volumes, pamphlets, and unbound volumes. The most urgent needs of the Library are more funds for completing sets of the publications of learned societies, for binding, and for additional clerical help.

The Department of Ornithology and Mammalogy has been very active during the year, not only in field work, in securing large and important additions to its research collections, but in scientific research, as is fully set forth in the Curator's report.

Two very important expeditions were in the field for the Department in 1929, one in the Lake Atlin region in northern British Columbia, the other in the Republic of Panama. Each of these expeditions secured large and valuable collections of birds greatly needed in the Department studies of avifauna of those regions.

The Academy has been fortunate in securing a number of important collections of bird skins, the most important being the H. S. Swarth collection of 3150 specimens and the G. Frean Morcom collection of 3000 specimens. The details of these valuable donations are given in the Curator's report.

The Department of Paleontology has been active in field work and in scientific research, for which the research collections of the Department are growing more and more attractive every year.

It is very gratifying to note that the members of the staff of this Department are called upon so frequently by oil companies and other commercial interests for assistance and advice. They have come to realize that the Academy can be of real service to them in many ways.

Department Reports

Department of Botany

The herbarium now numbers over 171,000 mounted sheets of specimens, an increase of about 10,000 during the year. Besides, there are many duplicates to be used as exchange material when time permits their distribution to other institutions.

Several collecting trips were made by the curator with no expense to the Academy. In March the curator was invited to Santa Barbara to address the members of the Museum of Natural History and the Garden Club. On the return a day was spent at San Luis Obispo and 40 specimens were collected, among them being specimens of a most interesting cypress. The month of May was spent in Arizona in the region of the Apache Trail as the guest of Mrs. S. D. McKelvey and Mr. and Mrs. Roland Still of the Apache Lodge. Railroad transportation was furnished by the Southern Pacific Railroad. The results of the trip will be published later. 829 specimens were added to the collection besides many duplicates. A short trip to the Calaveras Grove of Big Trees was made in early September with the Alpine Club which added 33 specimens. Mrs. E. C. Van Dyke made a collection of 60 specimens on Mt. Hood and Three Sisters in Oregon and was aided by a small contribution.

Duplicates have been sent to the following institutions: Dudley Herbarium, Stanford University, 35 from Lower California; Royal Herbarium, Kew, Surrey, England, 36 specimens of Lessingia; Arnold Arboretum of Harvard University, 473 exotics; University of Montreal, Canada, 200 from Alaska and the Yukon; University of Asiae, Mediae, Turkestan, 456 miscellaneous; Charles Piper Smith, San Jose High School, 20 lupines.

Specimens have been received in continuation of exchange from the following institutions:

Dudley Herbarium, 110 from Southern California collected by Prof. LeRoy Abrams; Field Museum, Chicago, 913 unmounted and 247 mounted miscellaneous; University of Montreal, 502 chiefly from Northern Canada; Pomona College, Claremont, Calif., 230, chiefly duplicates from the Jones Herbarium; University of Asiae Mediae, 175 from Turkestan. Arnold Arboretum, Harvard University, 150; J. F. Rock's collection in China, 54 from Australia and 18 North America; University of California, 385 flowering plants and 38 fungi; Dr. S. F. Blake, U. S. Dept. of Agriculture, 51 miscellaneous.

The following have been received by purchase: S. Venturi, 403, Argentina, South America; J. W. Blankinship, 599, Lake County; J. Aug. Kusche, 100, Southern Arizona; Ines Mexia, 351 Mt. McKinley National Park, Alaska.

The following gifts have been received: William Vortriede, 138 from Sacramento and mountains adjacent; The Swarth family, 179 from Lake Atlin region, British Columbia, collected on H. S. Swarth Ornithological Expedition to the region; Eric Walther, 500 exotics from Californian gardens; Mrs. Sidney Eastwood, 22 from Colorado; Mrs. S. D. McKelvey, 137 from Arizona; Mrs. Geo. H. Phelps, 100 from Idaho, Utah and Colorado; Julia McDonald, 32 from Fresno County, Calif.; Gwendolan Newell, 50, Silver Lake, Amador County, Calif.; Ines Mexia, 35, Mexico; Ivan Branson, 51, Tuolumne County, Calif.; John Thomas Howell, 1103 miscellaneous California plants; S. Jussel, 127 from Lake Tahoe region, Calif.; Ralph Hoffmann, 304 chiefly from the islands of Santa Rosa and Santa Cruz, Calif.; George Kramer, 25 from near Mt. Lassen. Several smaller gifts have been received, chiefly specimens for identification, and the names of the donors will be found in the general list.

The California Botanical Club has given a collection of water-color paintings of California flowers and also the case on which they will be exhibited in the Museum.

The herbarium has become the only reference place for the numerous exotics that are cultivated in the parks and gardens of California, and is consulted by gardeners and botanists from all parts of the state. The collection of Californian species is now necessary to those making special studies, and loans are sent to institutions and individuals for revisions and monographs.

The curator continues to give popular addresses on botanical subjects to schools and clubs, carries on the California Botanical Club which has meetings or excursions almost every week. The class of gardeners meets twice a month in the evenings at the herbarium. It enables the more ambitious gardeners to learn the names of the plants in the park.

The exhibition of native and the exotic flowers growing out-of-doors is kept up throughout the year by my assistant, Mrs. George H. Phelps. Mrs. E. C. Sutcliffe and Mr. Ivan Branson have helped greatly by collecting native species while Eric Walther is very faithful in furnishing the exotics, chiefly from the park. Hundreds of species are exhibited at the entrance of the Museum during the year, each labelled with scientific and common name also where collected, or, in the case of exotics, the native country. These exotics come from all parts of the world and the exhibit is one of the most valuable educational features of the Academy. My assistant also mounts all the specimens, does most of the distributing into the herbarium, attends to the care of fresh specimens that need drying, and in every way relieves the curator of much detail. During the past year John Thomas Howell has been employed as extra assistant for three months, doing valuable work in rearranging the herbarium, and in labelling and distributing specimens.

Alice Eastwood, *Curator.*

Department of Entomology

Additions to the Department of Entomology during 1929 numbered 32,173 specimens. This number includes the J. O. Martin collection of Coleoptera which was announced as received two years ago but was not then enumerated among our accessions. Mr. Martin has now completed the incorporation of this collection, numbering 11,200 specimens, into the general collection of the Academy. The next largest single addition by gift was a series of 3859 miscellaneous insects other than Coleoptera, presented by Dr. E. C. Van Dyke from various localities in California, largely from the Sequoia National Park. Another gift of much value was a collection of 2,000 insects received from Mr. Louis S. Slevin of Carmel, a considerable portion of which are moths taken by him at night. These moths will add to our series of many interesting and valuable species and are especially welcome as the department staff has little opportunity of doing such collecting. Mr. Gorton Linsley presented to the Academy 601 exotic insects, mostly European. From Mr. George Swarth the Academy secured by purchase 907 insects from about Atlin, B. C., among which was a good representation of the butterflies of that district, heretofore very poorly represented in our collection. From Mr. H. S. Parish the Academy secured by purchase 1,194 insects, mostly Coleoptera from the Province of Czechuen, China. Dr. F. E. Blaisdell gave us 279 insects other than beetles, from Santa Barbara, Calif., and New Hampshire. By exchange we received 92 South American insects from Dr. F. W. Goding, and by purchase 61 Edessas from South America needed to fill vacancies. Other valuable additions were 109 moths from Glacier National Park presented by Dr. E. H. Nast; 71 from Colombia, South America, presented by Mrs. S. C. Capp, 45 moths from Nicaragua, mostly beautiful specimens, presented by Mr. J. M. Nicol through Dr. G. Dallas Hanna; 17 collected by Mr. G. W. Heid in Sumatra and presented by Mr. Graham Heid; 14 Hemiptera from the Orient presented by Prof. T. D. A. Cockerell; 37 miscellaneous insects from California presented by Mr. E. R. Leach; 20 from Samoa presented by Mr. Alvin Seale, and by field work were added 2,336 specimens taken by Mr. J. O. Martin in Texas, and 8,620 secured by the curator. In addition should be mentioned probably three or four thousand beetles taken by Dr. Van Dyke which will be included in the final count of the Van Dyke collection and several hundred added by Dr. Blaisdell and Mr. L. S. Slevin to their collections of Coleoptera, now a part of the Academy collection.

The Department field work in 1929 consisted of a collecting trip by auto through Owen's Valley, going by Bakersfield and returning by Carson City and Tahoe. This was a section of the state almost unrepresented in our collections. Mr. Robert Usinger accompanied the curator as assistant. He proved to be an efficient and enthusiastic collector and should be credited with about half of the specimens taken. The curator also made a brief trip to Yorkville, Mendocino County, and another to Santa Cruz. Mr. Martin spent about two months near the former home of G. W. Belfrage near Waco, Texas, with the object of securing topotypical material of some of the many species described from material taken by Belfrage.

In 1929 the Department of Entomology suffered a sad loss in the death of Mr. Walter M. Giffard of Honolulu, who in the past, has been a good friend to the Academy and an active worker in its interest. It was through his influence that the Academy secured the very valuable Koebele collection, and only last year he presented to the Academy his large collection of North American Delphacidæ.

During 1929 the rearrangement in our unit boxes of the Academy's large collections of Coleoptera and Hemiptera progressed as rapidly as the acquisition of cases and drawers would permit. Work on the material in other orders of insects has had to await the purchase of necessary cases. As heretofore, Mr. Martin has worked on the Coleoptera, assorting and arranging the material in the various components of the Academy collection. For much of the past year Dr. Blaisdell has spent two days each week at the Academy working up the Academy material, including his own collection, in certain families of beetles, and Dr. Van Dyke has spent one day a week at the same work and has studied monographically several families at his home. The curator has found time to study and arrange a few more families of the Hemiptera and has begun the arrangement of our butterflies in which work he has had help from Mr. Graham Heid.

The publication of the Pan-Pacific Entomologist has continued. Five volumes have been completed and volume six in is course of publication. This journal has furnished an outlet for all the shorter papers on the Academy collection of insects.

The need for more insect cases is as pressing as ever. The Academy accepted several large private collections of insects when it had no cases in which to place them. Each year a large proportion of the funds alloted to the Department of Entomology must go for cases and even that proves hardly more than enough to care for the natural growth of the department. A special appropriation is needed to secure cases for the rich material acquired with the Van Dyke, Blaisdell and Koebele collections.

E. P. Van Duzee, *Curator.*

Department of Exhibits

The work of overhauling the habitat groups in the Bird Hall was completed early in the year. Two floor cases were reconstructed to hold groups of Great Horned Owl and American Barn Owl respectively. These groups are of the same dimensions as our series of panel groups, and can be installed as such whenever opportunity offers.

The collection of modelled Fungi has been placed upon exhibition.

On May 17 I left San Francisco for the purpose of attending the annual meeting of the American Association of Museums in Philadelphia. The object of this visit was to organize a section of the association whose purpose should be the exchange of knowledge for betterment of all arts and crafts connected with the making and installation of museum exhibits. Thanks to the splendid cooperation received, this object was accomplished, and the Technical Section of the American Association of Museums is now functioning to the benefit of all concerned. Upon the return trip several eastern museums were visited and, thanks to the kindness and courtesy of the directors, curators, and preparators of these institutions, much information of value was secured. I returned to San Francisco June 8.

Several months of the year were taken up with the preparation of a scale model of our proposed African Mammal Hall. With the help of my assistants this has been completed. This scale model is as complete as it is possible to make it, and depicts one of the three halls that will be necessary to house the Simson African Mammal collection. It has been placed on exhibition in the California Mammal Hall, and is proving of value in many ways.

Miss Clara Tose rendered valuable assistance during the greater part of the year, leaving the department October 6. Mr. Richard Cayzer has been employed as assistant since October 30. Cecil Tose and Russell Hendrick have also been employed as part time assistants during the year.

Frank Tose, *Chief.*

Department of Fishes

In the year 1929 the Curator and the Assistant devoted considerable time to reading proof of the new Check-List of the Fishes and Fishlike Vertebrates of North and Middle America north of the northern Boundary of Venezuela and Colombia, by Jordan, Evermann and Clark, which was published by the U. S. Bureau of Fisheries February 8, 1930.

As this Check-List includes 4137 species and subspecies admitted as valid, together with the reference to the original description of each, also to each of the more than 4,000 synonyms, it is really a check-list of all the names that have ever been applied to American freshwater and saltwater fishes. The publication contains 670 pages of which 158 are devoted to the Index in which there are more than 15,500 page references. This will give some idea of the great amount of labor and time that the proof-reading required.

The report on the fishes collected by the Academy's expedition to the Revillagigedo Islands in 1925 was completed in 1929, and the manuscript is now ready to send to the printer.

For several years the Assistant Curator has been assisting *Biological Abstracts* in the preparation and editing of abstracts of current ichthyological publications.

Abstracts prepared by the authors or others are referred to us by Biological Abstracts office from time to time for editing or completing. In many cases they are prepared here.

As a side product of this work, all new genera were card catalogued as they appeared, for use in a supplement to Jordan's Genera of Fishes, thus bringing that publication up-to-date. New species described from the territory covered by the new Check-List of Fishes were noted for inclusion in an addendum to that Check-List to be published in the near future.

From June 9 to June 16, was spent by the Assistant Curator with the aquarium collector on a trip to the desert about Salton Sea in search of desert minnows, *Cyprinodon macularius*. It was found that in the irrigation ditches this species had been mostly or altogether replaced by the Mosquito fish, *Gambusia affinis*. The desert minnows, of which a good number were finally secured, were found only in the highly saline waters of the lower stretches of San Felipe Creek, and in the Salton Sea itself. The Gambusias were at first not recognizable, being a brilliant turquoise blue, which is, indeed, the color of the male *Cyprinodon*. After a half-year's sojourn in the Aquarium they lost much of this color.

The general collection of fishes has been gone over from time to time and fresh alcohol added as needed. In addition to the general catalogue of serial numbers, a card catalogue has been made of all specimens as they are arranged on the shelves. Puzzling specimens when brought in are identified, and if not in the collection, or desired for any other purpose, are added, accessioned and cared for.

The most important event of the year in connection with the Department of Fishes was the securing of the Jordan-Eigenmann collection of fishes, by purchase from Indiana University.

This enormous and valuable collection of more than 220,000 specimens was begun in the early eighties by Dr. David Starr Jordan and his students at

Indiana University. It was greatly enlarged by Dr. Carl H. Eigenmann who was professor of zoology at Indiana University from 1891 until his death in 1927, assisted by his students. Dr. Eigenmann was especially interested in the fishes of South America, and the collections resulting from his many expeditions to that continent form, in the aggregate, the most complete and valuable ever assembled by any one ichthyologist. Besides the North American and the South American components, the Jordan-Eigenmann fish collection contains large representations of the fish faunas of Europe, Asia, the Philippines, the Hawaiian Islands, and many other parts of the world.

Last September, the Curator, the Assistant Curator and Superintendent Seale of the Aquarium went to Bloomington, Indiana, where they, assisted by local help, devoted the entire month of October to packing the collection and preparing it for shipment to San Francisco.

The collection was packed in 100 large earthen jars, 13 large boxes, and 500 large cartons.

A large freight car, such as is used in which to ship automobiles, was used and so securely were the many containers packed in the car that the shipment came through to San Francisco without loss or injury to a single specimen.

This great collection contains many types and cotypes and will be invaluable to specialists who are interested in the ichthyological fauna of the Americas and other countries of the Pacific area.

It is now temporarily installed in the basement of the Steinhart Aquarium where it is being unpacked, segregated and placed on shelves for further assortment and study.

In the East Wing of the Museum, upon which it is hoped construction will begin soon, will be provided a basement specially designed and up-to-date in every respect in which the fish collections will be installed and which will provide proper shelving, laboratory and library facilities and offices.

Howard Walton Clark, *Assistant Curator.*

Department of Herpetology

Owing to the proposed field work for the year 1929 which would necessitate a long period of absence in the field the entire collection of alcoholics was overhauled and specimen jars refilled when necessary to ensure the safety of the collection. This occupied considerable time, there being several thousand jars to be gone over. A thorough overhauling and examination was also given the collection of Galapagos tortoises, the work on both collections occupying about three months.

The greater part of the year 1929 was given to field work in Australia, the curator being absent in the field from June 27 to the end of the year. By the end of December 1,052 specimens from various localities had been collected and preparations made to continue the work during January and February of 1930.

Friends of the department have been generous during the year and gifts of specimens have been received as follows: From L. S. Slevin, 16; D. R. Bull, 2;

Charles E. Burt, 10; Hans Geyer, 6; Don C. Meadows, 1; Charles Toftley, 2; Dr. E. C. Van Dyke, 1; Dr. G. Dallas Hanna, 3; Dave G. Gamon, 1; H. S. Swarth, 17.

JOSEPH R. SLEVIN, *Curator.*

DEPARTMENT OF LIBRARY

The work of the Library during 1929 proceeded mainly in accordance with the plans announced in last year's report. Temporary wooden shelves were installed early in the year. These, together with the space released by moving the stock of Academy publications from the store room to the lower corridor, and the mass of uncatalogued material from the lower library to the store room in turn, furnished room for shifting the whole collection forward, so that the badly crowded condition of the shelves could be relieved.

During the process all separate titles were inventoried by the shelf-list as they were moved. This took longer than it was expected to for it was found that many of the books had never been shelf-listed and most of those that were had no record of accession numbers. Consequently a large number of temporary shelf-list cards had to be made, thus slowing up the project so that it was not quite finished by the end of the year. Sets of serials were not inventoried at the time of moving. It is planned to begin doing this systematically as soon as the shifting is completed, when unbound volumes will be carefully checked and tied up and the missing numbers acquired if it is found still possible to get them.

The accessions for the year were as follows:

	Bd. vols.	Unbd. vols.	Parts of vols.	Pamphlets	Maps
Exchange	50	125	4063	89	127
Gift	54	46	1812	269	53
Purchase	363	239	1690	17	1
Total	467	410	7565	375	181

Among the reference books obtained for the main Library may be mentioned the United States Catalog of Books in Print January 1, 1928; the Union List of Serials in Libraries of the United States and Canada; the World List of Scientific Periodicals; Minerva, Jahrbuch der Gelehrten Welt, 1928; the 12th edition of the Dewey Decimal Classification. These have been in almost daily use since their acqusition. Other titles of unusual interest are: Index Londinensis to Illustrations of Flowering Plants, volume 1; Hegi's Illustrierte Flora von Mittel-Europa; Nouvelles Archives du Muséum d'Histoire Naturelle, Paris, 2d series, 3d series, and volumes 1-7, 9-10 of the 4th series; Donovan's Natural History of British Birds, 1794-1819; Rothschild's Extinct Birds, 1907; Bellardi & Sacco's Molluschi del Piemonte e della Liguria, 1873-1904; Bolten's Museum Boltenianum, part 2, 1906; Born's Testacea Musei Caesarei Vindobonensis, 1780; Martyn's Universal Conchologist, 1784.

The cataloguing accomplished during the year was practically none, due to every effort being expended on the shifting of the bookstock. New exchanges added total 27, a small number but also due to the emphasis of the year's work elsewhere. The number of volumes bound was 144.

Miss Dora Arnold's part-time assistance in the Library ceased early in September when she left the Aquarium. The loss of her help, little as it was each day, is keenly felt and the amount of unshelved accessions that have accumulated in three months seriously congests the available working space in the Library. This will be quickly cleared up, however, early in 1930 upon the arrival of a temporary full-time assistant which the Council has kindly granted because of the assistant librarian's plans to undertake graduate work in bibliography at the University of California. Miss Phyllis Beardslee, Miss Arnold's successor, handled the Library's secretarial work very efficiently for the remainder of the year.

An item of passing interest is the adoption by the American Association of Museums of the practice of printing the Dewey classification number at the head of each article in The Museum News that is sponsored by and published for its Technical Section, the group formed by Mr. Tose of the Academy staff last Summer. The suggestion of thus printing the Dewey number, made by the assistant librarian and proposed by Mr. Tose, was intended as an aid not only to librarians but also to workers in the field who wish to keep their literature systematically arranged. The practice has been in use for some time by the American Museum of Natural History in their Novitates. The Dewey classification is the one used in the Academy Library, which will be greatly benefitted by the plans of the Library of Congress shortly to print the Dewey numbers on its catalogue cards.

The assistant librarian was appointed, in the Fall, secretary of the Special Libraries Section of the California Library Association, whose annual convention will be held next July in Los Angeles in conjunction with that of the American Library Association. He also served on the convention committee and was chairman of the directory committee of the local chapter of the national Special Libraries Association, and was elected in December president for 1930. The local chapter will be hosts in June to the national Association at their annual convention, the first on the Pacific coast. This convention will be significant to the Academy for among its meetings will be the first regular one to be held by the Museum Group of the Association.

The crying need of the Library is the same as emphasized in last year's report,—namely, sufficient income to provide not only the old and current literature so badly needed for the use of both staff and membership, but also adequate personnel so that the collection may be made to serve its clientele efficiently and constructively by anticipating in many cases its requirements.

THOMAS COWLES, *Assistant Librarian.*

DEPARTMENT OF ORNITHOLOGY AND MAMMALOGY

The Curator and the Assistant Curator each spent about three-fourths of the year in curatorial duties and at studies that they have undertaken, the remaining quarter being devoted to field work. The Curator has continued to allot to the study of the Academy's collection of Galapagos Islands' birds just as much time as could possibly be spared from routine office duties for that purpose; other minor researches (with the possible consequent publication of short papers) have been almost entirely abandoned for the time being. Mrs. Davidson's research program has included further work upon Mr. Loomis's unfinished "Monograph of the Tubinares," and on fossil whale material from the collection of the Department of Paleontology.

The Curator spent the period from June 9 to September 26 on a field trip to Atlin, in extreme northern British Columbia, making further observations and collections in a region wherein he has pursued field work on several previous years. The Swarth family participated in this trip, and members thereof collected plants and insects for other Academy departments. A special effort was made toward the collecting of juvenal and other little-known plumages of various northern birds, practically all of which material was new to the Academy collection. Mrs. Davidson left on October 25 for a three months' stay in the Republic of Panama. Her time was spent in Chiriqui Province and collections were made near the Costa Rican boundary at various elevations from sea level to 4,500 feet.

Mr. Joseph Mailliard, Curator Emeritus, has been actively engaged in bird-banding during the fall and winter months of the last year, in Golden Gate Park and at Woodacre, Marin County. Approximately 800 birds have been banded, and information of importance is gradually being accumulated and placed in proper shape for future use. An unexpected side-issue of the bird-banding was the collection of a series of microscope slides of blood-smears of *Zonotrichia nuttalli* and *Z. coronata*, gathered at the request of Dr. Clay G. Huff of the Harvard Medical School, and, according to information received from that gentleman, proving to be of unusual value in the research in which he is engaged.

Two important donations were received during the year. First, the H. S. Swarth collection of bird skins (3,150 specimens) was purchased and presented to the Academy by a donor who prefers to withhold his name. Then, the G. Frean Morcom collection of bird skins (3,000 specimens) was received as a gift from Mr. Morcom. These two collections are complementary to each other in some respects, and together they contain long series of specimens of species that heretofore were poorly represented or not contained at all in the Academy collection. The Morcom collection in particular contains many specimens of rare, near-extinct, and extinct species, mostly collected by Mr. Morcom, himself, forty or fifty years ago. While it is a matter of unqualified congratulation that the Academy should receive these rich additions to its collection, their acceptance entails heavy responsibilities on our part, for these gifts serve to emphasize still further the impossibly crowded condition in which the bird collection is now housed. As the storage rooms now are it will be impossible to rearrange cases and contents to incorporate the acquisitions of the year, so as to have the specimens properly convenient of access and hence of greatest possible use.

The department continues, as heretofore, to serve as a local bureau of information on questions pertaining to birds and mammals. Of greater importance is the use that is being made of our material by research students in other institutions. Our entire series of several species of birds and mammals are now on loan, giving important aid to studies of just the sort that the Academy should foster to the utmost of its ability. On the other hand, it is proper to point out that the department is in receipt of quite as generous aid from other institutions, in recognition of the value of the work that we are carrying on.

In May, 1929, the annual meeting of the Cooper Ornithological Club was held in the Bay region, and on one of the two-day sessions the club was the guest of the Academy. About sixty members of the Cooper Club were in attendance.

On the whole, growth of the collections during the year was eminently satisfactory, and departmental work progressed about as satisfactorily as could be hoped for under existing crowded conditions. The outstanding needs of the department continue to be, in increasing measure: (1) Floor space, for storage cases and also for tables or benches to be used in cataloguing, studying and otherwise handling specimens. (2) A new metal-lined storage room for large mammals. (3) An additional assistant, the greater part of whose time could be devoted to field work. In addition, it would be desirable if an Assistant Curator of Mammals could eventually be appointed. There is not now, and never has been, anyone in the department primarily interested in mammals, and the mammal collection has not attained to the importance that it should.

Details of the several accessions are as follows: Birds. *Gift:* Anonymous, 3150; C. R. Boatright, 1; F. E. Booth, 4; D. B. Bull, 1; California Department of Natural Resources, Division of Fish and Game, 1; Department of Exhibits, California Academy of Sciences, 50; Mrs. Barton Warren Evermann, 315; E. E. Eyer, 1; E. W. Gifford, 7; F. W. Goding. 5; Hugh Logan, 1; Joseph Mailliard, 1; John McLaren, 3; James Moffitt, 2; G. Frean Morcom, 3000; Mori Bird Store, 5; J. V. Patton, 2; M. S. Ray, 1; A. W. Robison, 12; W. J. Steinbeck, 3; R. L. Thompson, 1; Henry Trost, 6; Henry Warrington, 1. *Expedition:* H. S. Swarth, 300. *Purchase:* 114.

Eggs. *Gift:* G. Dallas Hanna, 22 sets; Hugo Lotzen, 1 nest. *Expedition:* H. S. Swarth, 6 sets and nests.

Mammals. *Gift:* Brooklyn Museum, 2; Department of Exhibits, California Academy of Sciences, 37; Barton Warren Evermann, 15 (colored plates); Mrs. Barton Warren Evermann, 1; H. A. Haskell, 3; Joseph Mailliard, 2. *Expedition:* H. S. Swarth, 32 skins and 33 skulls.

HARRY S. SWARTH, *Curator.*

DEPARTMENT OF PALEONTOLOGY

In order to prevent the collections of the department from completely outgrowing the available space for housing, exploratory work for the time being must be confined to the procuring of only such fossil material as will substantially aid in projects already under way. Much virgin territory remains to be examined for fossils and living shells in western North America, but much care must be exercised to prevent the accumulation of such a great amount of research material that effective study and orderly arrangement becomes impossible.

Following out the lines of investigation already begun, Mr. F. M. Anderson made several trips to northern California during 1928 and secured a fine lot of Cretaceous fossils. Since the ammonites of this period are to be found at only a few favorable localities in the state and are greatly damaged by weathering, it is highly desirable that the ground be gone over thoroughly at frequent intervals.

Other important Cretaceous collections were obtained in Alberta by Dr. Leo George Hertlein while engaged in geological investigations for the Hudson's Bay Marland Oil Company of Canada. During this time he was on temporary leave of absence from the Academy.

The work of identification and cataloguing of the collection was continued as rapidly as possible. Through the efforts of Dr. Fred Baker and Mr. A. M. Strong several additional families of marine shells from Mexican waters were classified. As this work progresses the wealth of material obtained by the Academy's three recent expeditions becomes more evident. Mr. Strong likewise was responsible for the preparation of lists of the marine shells from Guadalupe Island and the Revillagigedo Islands.

During the summer Dr. H. B. Baker, of the University of Pennsylvania, collected land and freshwater mollusca extensively in the west and it was possible for Mr. John L. Nicholson and the curator to accompany him to Klamath Lake, Oregon, for a few days. A large amount of excellent material was obtained on this short field trip.

More valuable collections of foraminifera were added to the collections during 1929 than during any previous year of existence of the department. Fortunately such fossils take up little room. The field work was done by Mr. C. C. Church and the curator through the sympathetic cooperation of Mr. L. C. Decius, Chief Geologist of the Associated Oil Company. Additional fossil diatom material of great value was obtained through many channels.

The acquisition of the great Baldwin collection of shells has been noted in the report of the Director for 1928. This fine accession was a gift to the Academy and a direct result of the interest in the institution held by Mr. Church. It is a matter of great regret on the part of the staff of the department that sufficient storage cases are not available for the unpacking of the entire collection and there is no available room for them if cases were on hand. By condensing and consolidating some of the present collections to the greatest possible degree it is hoped that room will be provided for the placing of the most important of the Baldwin shells in the research series.

Much use has been made of the Academy's paleontological collections by students elsewhere, particularly from the University of California and Stanford University. Among others who should be mentioned are: Dr. H. A. Pilsbry, Academy of Natural Sciences, Philadelphia; Prof. Junius Henderson, University of Colorado; Dr. H. B. Baker, University of Pennsylvania; Mr. Allyn G. Smith, Berkeley, California; and Dr. Mary J. Rathbun, U. S. National Museum.

The research work carried on in the department has been greatly facilitated by the assistance rendered by Mr. Thomas Cowles, Assistant Librarian. His ever ready willingness to take the necessary steps to procure needed books, either by purchase or loan, has been of much help in the progress of our investigations.

Outstanding loans of research material at the end of the year were as follows: Mr. A. M. Strong, Los Angeles, Calif.; Dr. Fred Baker, Point Loma, Calif.; Dr. Bryant Walker, Detroit, Mich.; Mr. Allyn G. Smith, Berkeley, Calif.; Dr. S. Stillman Berry, Redlands, Calif.; Dr. Paul Bartsch, U. S. National Museum, Washington, D. C.; Dr. Hubert G. Schenck, Stanford University, Calif.; Miss Nellie M. Tegland and F. Earl Turner, University of California, Berkeley, Calif.; Dr. Arthur Hollick, New York Botanical Garden, New York, N. Y.; Dr. H. McMillan, Natural History Museum, Stanford University, California.

G. Dallas Hanna, *Curator.*

Department of Steinhart Aquarium

The year 1929 has been a very satisfactory one for the Aquarium. The exhibits have steadily increased in number, interest and attractiveness. The attendance has been large. More than six million people have visited the institution since its opening in 1923.

Gifts received have been numerous and valuable. A friend of the Aquarium has written into her will a legacy to provide a comfortable and proper place for turtles and amphibians. The donor desires her name withheld for the present. An interesting collection of 81 live Australian fishes, including 40 sea horses, was received from the Aquarium in Sydney. The New York Aquarium presented six horseshoe crabs. Superintendent John McLaren presented six large clusters of bamboo, which add greatly to the attractiveness of the swamp room. The total number of gifts exclusive of several thousand small fishes, numbered 429 and includes seven live alligators, one crocodile, two seals, two sea lions, and a large number of other live animals. A complete list with the name and address of each donor will be found in the files of the Aquarium.

From April 25 to June 14 a collecting trip to Pago Pago, Samoa, was made by the Superintendent and 321 beautifully colored tropical fishes were brought back alive and placed in the exhibition tanks. Volunteer assistance on this trip was given by Mrs. Seale, who by special invitation visited Samoa as a guest of the Matson Navigation Company.

During the months of October and November all of the large aquariums in the United States were visited by the Superintendent and their exhibits and methods of operation carefully observed and noted. The annual convention of Park and Aquarium Executives at Miami, Florida, was attended on November 19-21, at which an address on public aquariums was given by the Superintendent.

On December 31 Mr. Wallace Adams resigned as Assistant Superintendent of the Aquarium to accept a position in the Bureau of Science, Philippine Islands. The entire personnel of the Aquarium will miss the cheerful presence of Mr. Adams.

On December 31, 1929, the following animals were on exhibition at the Aquarium:

Mammals	11 of	3 species
Birds	1 of	1 species
Reptiles	208 of	33 species
Batrachians	53 of	9 species
Fishes	9375 of	282 species
Invertebrates	41 of	31 species
Total	9689 of	359 species

For the coming year the following improvements are suggested: That we ask the city for a new wing for additional tropical saltwater fishes, as suggested by President Grunsky; that the court in front of the Aquarium and around the seal pools be properly paved; that filters for the water in the seal pools be installed; that a collector be sent to Lower California; that the guide book be published; that the swamp be revamped and more plants be placed in the building.

Alvin Seale, *Superintendent.*

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4. Note on Two Berytidæ. <Pan-Pacific Entomologist, vol. 5, p. 166, May 31, 1929.

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6. Additions to the Oshanin Katalog. <Pan-Pacific Entomologist, vol. 5, p. 182, May 31, 1929.
7. Some New Western Hemiptera. <Pan-Pacific Entomologist, vol. 5, pp. 186-191, May 31, 1929.
8. A New Corimelæna. <Pan-Pacific Entomologist, vol. 6, p. 10, October 10, 1929.
9. Mr. Walter M. Giffard—An Appreciation. <Pan-Pacific Entomologist, vol. 6, pp. 46-47, October 10, 1929.
10. A Rare Wasp from Oregon. <Pan-Pacific Entomologist, vol. 6, p. 47, 1929.
11. Note on Genus Clastoptera. <Pan-Pacific Entomologist, vol. 6, p. 62, December 19, 1929.
12. A New Oliarus. <Pan-Pacific Entomologist, vol. 6, p. 72, December 19, 1929.
13. Book Review. (General Catalogue of the Hemiptera. Fasc. II The Mesoveliidæ.) <Pan-Pacific Entomologist, vol. 6, p. 77, December 19, 1929.
14. Some Hemiptera taken by Professor Cockerell in the Orient. <Pan-Pacific Entomologist, vol. 6, pp. 91-95, December 19, 1929.

Acknowledgments

The number of those who in the past year have donated valuable specimens to the Museum or who have assisted the Academy in other ways, has been unusually large. To all who have thus shown their interest in the Academy, and their appreciation of what the Academy is doing, our grateful thanks are due. The research materials in every department have been greatly increased through the many large and valuable collections that have been received.

Special mention should be made of the courtesies extended to the Academy by the Southern Pacific Company, the Atchison, Topeka, and Santa Fe Railway System, the Matson Navigation Company, and the Los Angeles Steamship Company. Each of these companies continues to cooperate with the Academy by furnishing reduced transportation to members of the staff when engaged in field work.

Accessions to the Museum and to the Library

Following is a List of Accessions to the Museum and Library received in 1929:

Adams, Wallace, Steinhart Aquarium, San Francisco: 1 book, Standard Specifications and Tests for Portland Cement, 1917; 5 U. S. Government pamphlets; 1 pamphlet on Salmon; 2 pamphlets with set of charts; 40 folded maps; 4 numbers of Tycos. Gift.

Anderson, Frank M., California Academy of Sciences, San Francisco: 1 geological pamphlet. Gift. 1,000 fossil shells from northern California. Exploration.

Alepretti, Joe, Fishermen's Wharf, San Francisco: 1 Boa (*Boa imperator*), received in a shipment of bananas from Central America. Gift.

Allyne, Misses E. and L., 2609 Gough Street, San Francisco: 2,938 shells from numerous localities. Gift.

Anonymous: The H. S. Swarth collection of 3,150 bird skins, from California, Arizona, and Illinois. Gift.

Apolinar-Maria, Father, Bogota, Colombia, S. A.: 226 miscellaneous Hemiptera from Colombia, South America. Gift.

Arnold Arboretum, Jamaica Plain, Mass.: 150 botanical specimens from Asia, 54 from Australia, and 18 from America. Exchange.

Art, Historical and Scientific Association of Vancouver, B. C.: 3 pamphlets on miscellaneous subjects. Gift.

Asociaciön Argentina de Electrotécnicos, Buenos Aires, Argentina: 1 copy Boletin, número extraordinario (Volta). Gift.

Associated Oil Company, San Francisco: 65 numbers of California Oil World; 10 numbers of Oil Weekly, 1929; 24 periodicals of the oil industry; 1 lot of well cores. Gift.

Baker, Dr. Fred, San Diego, Calif.: 1 lot of paratypes of freshwater and marine shells; 3 volumes on natural science. Gift.

Barker, Fred, Parkers Prairie, Minnesota: 4 bird skins from Minnesota. Purchase.

Barnhart, P. S., Scripps Institution, La Jolla, Calif.: 2 minnows (*Leuciscus balteatus*), from Sweetwater Reservation, October 11, 1929, and two Trunkfish (Sphœroides), from the stomach of a Tuna taken near Soccoro Island, May 1, 1929. Gift.

Barry, David, Jr., 1001 S. La Brea Ave., Los Angeles: 2 Blue-headed Quail-Doves (*Starnœnas cyanocephala*). Gift.

Bird, Henry, Rye, New York: 1 pamphlet: A Proposed Type of American Garden, by Henry Bird and Louise Knapp. Gift.

Bishop Museum library, Bernice P., Honolulu, T. H.: 1 pamphlet on San Francisco. Gift.

Blaisdell, Dr. F. E., California Academy of Sciences, San Francisco: 231 miscellaneous insects from Santa Barbara, Calif., and 48 from New Hampshire; 1 pamphlet on annelid worms; 1 U. S. Agriculture Dept. Leaflet 37, 1929. Gift.

Blankinship, J. W., Berkeley, Calif.: 599 botanical specimens from Lake County, Calif. Gift.

Boatright, C. R., 534 Eleventh Ave., San Francisco: 1 Nicobar Pigeon (*Calœnas nicobarica*). Aviary specimen. Gift.

Booth, F. E., Woodland, Calif.: 1 Martineta Tinamou (*Calopezus elegans*); 3 Bornean Argus Pheasants (*Argusianus grayi*), and 1 Burmese Peacock (*Pavo muticus*). Aviary specimens. Gift.

Bransom, Ivan, 1290 Hayes Street, San Francisco: 51 botanical specimens from California. Gift.

British Columbia, University of, Vancouver, B. C.: 1 pamphlet. Gift.

Brooklyn Museum, Eastern Parkway, Brooklyn, N. Y.: 2 skulls of the Southern Elephant Seal (*Macrorhinus leoninus*), from South Georgia. Gift.

Building Owners and Managers Association, Los Angeles, Calif.: 1 book: Southern California Geology and Los Angeles Earthquakes, 1928, by Robert T. Hill. Gift.

Bull, D. B., San Jose, Calif.: 1 Trudeau's Tern (*Sterna trudeaui*), from Argentina, S. A.; 2 lizards from Bahia, Brazil. Gift.

Burt, Charles E., Ann Arbor, Mich.: 6 lizards from Kansas, 2 frogs from Michigan, 1 snake from Michigan, and 1 lizard from Texas. Gift.

California Botanical Club, San Francisco: 244 water-color pictures of California wild flowers painted by Sophie H. Fauntleroy, with rack for their exhibition. Gift.

California State Department of Natural Resources, Division of Fish and Game, 510 Russ Building, San Francisco: 1 Whistling Swan (*Olor columbianus*), from Merced Co., Calif.; 1 Red-throated Loon (*Gavia stellata*). Gift.

California Division of Mines and Mining, San Francisco: 1 Geological Map of the State of California. Gift.

California Taxpayers' Association, 417 South Hill Street, Los Angeles: 1 pamphlet. Gift.

Campbell, Mrs. Constance W., California Academy of Sciences, San Francisco: 1 pamphlet. Gift.

Capp, Mrs. S. C., San Francisco: 71 miscellaneous insects from Colombia, South America. Gift.

Carnegie Institution of Washington, Washington, D. C.: 17 publications Gift.

Chambers, W. Lee, Los Angeles, California: Publication, nos. 1, 2, Pasadena Academy of Sciences. Gift.

Christoffersen, A., L. C. Smith Building, Seattle, Washington: 1 copy of Report of Alaska Fishery Investigations in 1914, by E. Lester Jones. Gift.

Clark, H. Walton, California Academy of Sciences, San Francisco: 1 pamphlet of Indiana University; 4 specimens of California plants; 41 numbers of various periodicals. Gift.

Collings, Ralph, P. O. Box 684, San Francisco: 2 pamphlets; A Philosophy of Gravitation, by Ralph Collings. Gift.

Compagne de Saint-Gobain, Direction Générale des Glaceries, 1 bis, Place des Saussaies, Paris, VIII, France: 1 pamphlet on Astronomy. Gift.

Comparative Zoology, Museum of, Cambridge, Mass.: 1 mounted skeleton of the Great Auk (*Plautus impennis*), from Funk Island. Purchase.

Cook, Melville T., Insular Experiment Station, Rio Piedras, Porto Rico: 1 pamphlet: The Gummosis of Sugar Cane, by Melville T. Cook. Gift.

Cooper Ornithological Club, Calif.: Program of 4th Annual Meeting, May 17-19, 1929 at San Francisco and Berkeley. Gift.

Eastwood, Miss Alice, California Academy of Sciences, San Francisco: 39 botanical specimens from San Luis Obispo County, Calif., 825 from Arizona, and 23 from Calaveras Grove of Big Trees, Calif. Exploration. 2 books, 2 pamphlets, and 59 periodicals on various subjects. Gift.

Eastwood, Mrs. Sidney, 4360 Umatilla Street, Denver, Colorado: 22 botanical specimens from Colorado. Gift.

Edwards, Harmon, Hayward, Calif.: 1 Indian bead necklace. Gift.

Ellis, Ralph, Jr., 2420 Ridge Road, Berkeley, Calif.: 3 Eastern Brook Trout (*Salvelinus fontinalis*), summit of Secret Pass, Ruby Mountains, Elko County, Nev. Gift.

Evermann, Dr. Barton Warren, California Academy of Sciences, San Francisco: 15 colored pictures of mammals; 7 zoological periodicals, 1,324 copies of various magazines, and 48 pamphlets and periodicals; 1 pamphlet and 2 periodicals of the Milwaukee Public Museum; 51 numbers of Tea Bee and 5 reprints from Proceedings of Third Pan-Pacific Science Congress, Tokyo, 1926. Gift.

Evermann, Meadie Hawkins (Mrs. Barton Warren Evermann), Berkeley, Calif. (through Dr. Evermann): 315 bird skins from Indiana, Wyoming, Oregon, Washington, California, and District of Columbia; 58 sheets of marine algæ from Woods Hole, Massachusetts, and 1 specimen of *Primula suffrutescens* Gray, collected by Dr. Evermann on Mt. Whitney, July 27, 1904. Gift.

Ewetz, Carl Evert: 1 book: Weitere Beiträge zur Kenntnis der Visingsöformation, by Carl Evert Ewetz, 1929. Gift.

Exhibits, Department of, California Academy of Sciences, San Francisco: 1 skeleton of California Otter (*Lutra pacifica brevipilosus*) from Sutter County, Calif.; 50 bird and 35 mammal skins from San Diego and Imperial counties, Calif. Gift.

Eyer, E. E., Marshall, Calif.: 1 Western Robin, in flesh, from Marin County, Calif. Gift.

Far Eastern Geophysical Observatory, Vladivostock, U. S. S. R.: 1 copy, Everfrozen of Soil in the Boundaries of U. S. S. R., by M. Soumgin. Gift.

Field Museum of Natural History, Chicago, Illinois: 913 specimens of unmounted and 247 of mounted plants from various regions. Exchange.

Fisher, Russell, Culver, Indiana: 27 specimens (8 species) of fishes, from Indiana; 13 reptiles from Lake Maxinkuckee, Indiana. Purchase.

Földtani Szemle, Múzeum-Körut 4, Budapest VIII, Hungary: 1 Geological pamphlet. Gift.

Fox, C. L., England (presented before his death): 142 miscellaneous insects. Gift.

Gamon, Dave. G., San Francisco: 1 Rattlesnake (*Crotalus cerastes*) from Muroc, California. Gift.

Gaylord Bros., Inc., Stockton, Calif.: 2 pamphlets on bookbinding. Gift.

Geiser, S. W. Southern Methodist University, Dallas, Texas: 1 copy of Naturalists of the Frontier, by Samuel W. Geiser, and 1 copy of Professor Jacob Boll and the Natural History of the Southwest, 1929. Gift.

Geyer, Hans, Regensburgh, Germany: 6 salamanders. Gift.

Gifford, E. W., Museum of Anthropology, Affiliated Colleges, San Francisco: 2 Verreaux's Dove (*Leptoptila verreauxi*), 1 Picui Dove (*Columbula picui*), 2 Slender-billed Cuckoo Doves (*Macropygia tenuirostris*), 1 Red Turtle Dove (*Oenopopelia tranquebarica*), and 1 Barred-wing Dove (*Chrysauchœna humeralis*). Aviary specimens. Gift.

Goding, Dr. F. W. (through Mrs. E. P. Van Duzee), Livermore Falls, Maine: 5 bird skins from South America; 92 miscellaneous insects from Guayaquil, Equador. Gift.

Grinnell, Fordyce, Jr.: 98 miscellaneous insects from the Philippine Islands. Gift.

Grunewald, Richard, 3043 Clement Street, San Francisco: 1 volume: Chamisso's Werke. Gift.

Grunsky, Dr. C. E., 57 Post Street, San Francisco: 1 volume: Ways to National Prosperity, by C. E. Grunsky. Gift.

Haley, Dr. George, Berkeley, Calif.: 47 botanical specimens from Mt. Washington, New Hampshire. Exploration.

Hall, William Hammond, 3855 Jackson Street, San Francisco: 9 photographs of the California Academy of Sciences Building taken after the earthquake and fire of 1906. Gift.

Halperin, A. Z., Chicago, Illinois: Subscription to "The Reflex." Gift.

Hanna, Dr. G. Dallas, California Academy of Sciences, San Francisco: 68 miscellaneous insects from Poso Creek, Calif., 3 sets of eggs from Kern County and 18 sets from San Mateo, Lake, Santa Clara, and Mendocino counties, Calif.; eggs of California Horned Lark, ⅓ from McLure Valley, Kings County, Calif.; 3 salamanders from Guyama River, 9 miles S. E. of Santa Maria, Calif.; 1 geological map, 129 pamphlets and 9 periodicals on various subjects; 6 pamphlets on diatoms and 1 on mollusks; 1 excerpt and 9 pamphlets on geological subjects; 58 numbers of various periodicals. Gift.

Hanna, Dr. G. Dallas, and Nicholson, J. L., California Academy of Sciences, San Francisco: 5,000 living shells from northern California and southern Oregon. Exploration.

Hart, Cecil, 132 North Third Street, Montebello, Calif.: 5 specimens of California plants. Gift.

Haskell, Dr. H. A., Grand Southern Hotel, San Francisco: Some limb bones of the California Sea Lion (*Zalophus californianus*), and 2 tympanic bones of a Sulphur-bottom Whale (*Sibbaldus musculus*). Gift.

Heid, Graham, Alameda, Calif.: 17 miscellaneous insects from Sumatra. Gift.

Herron, Miss Katherine, San Francisco: 1 copy of Who's Who in California, 1928-29. Gift.

Hertlein, Leo George, California Academy of Sciences, San Francisco: 2 boxes of Cretaceous fossils from Alberta, Canada; 1 pamphlet on mollusca; 1 pamphlet on San Francisco, and 1 geological pamphlet; 4 numbers of San Diego Natural History Museum Bulletin. Gift.

Hendrick, Russell, San Francisco: 1 snake (*Thamnophis ordinoides elegans*) from Baltimore Park, Marin County, Calif. Gift.

Hoffmann, Ralph, Santa Barbara, Calif.: 304 botanical specimens from Santa Cruz and Santa Rosa islands, Calif. Gift.

Holme, Adolph, Redwood City, Calif.: 4 specimens of cultivated plants. Gift.

Howell, John Thomas, University of California, Berkeley, Calif.: 1201 specimens of California plants, 18 of them duplicates. Gift.

Illinois, University of, Museum of Natural History, Urbana, Illinois: 2 pamphlets on natural history subjects. Gift.

Indiana University, Bloomington, Ind.: The Jordan-Eigenmann Collection of Fishes, consisting of more than 220,000 specimens and containing many types and cotypes. Purchase.

Institute of International Education, New York, N. Y.: 1 copy, Directory of Russian Educators, Research Specialists, and Scientists now living in Europe. Gift.

Irving-Cloud Publishing Co., Chicago, Illinois: 1 book on motor maintenance. Gift.

Istituto di Zoologia ed Anatomia Comparata, Siena, Italy: 28 separates by members of the staff of the Istituto. Gift.

Israelsky, Merle C., Shreveport, Louisiana: 1 pamphlet on Cretaceous Ostracoda of Arkansas, 1929. Gift.

Jordan Game Farm, Woodland, Calif.: 1 Green Peacock (*Pavo muticus*). Gift.

Jussel, M. S., Polytechnic High School, San Francisco: 127 specimens of California plants. Gift.

Kahn, Mrs. Florence, Washington, D. C.: 1 book, The Tariff Bill of 1929; a copy of the Congressional Directory, 71st Cong. 2d Sess. Gift.

Kavanaugh, James, Steinhart Aquarium, San Francisco: 3 numbers of San Francisco Police and Peace Officers Journal. Gift.

Klocker, Mrs. Ada, Medford, Oregon: 3 specimens of Oregon plants. Gift.

Kusche, J. August, Los Angeles, Calif.: 100 botanical specimens from Arizona. Purchase.

Lamme, Sam, Colusa, Calif.: 1 river otter (*Lutra canadensis brevipilosus*) female, from Sacramento Valley. Purchase.

Lastreto, Carlos B., San Francisco, Calif.: 1 pamphlet on South America and 68 miscellaneous periodicals. Gift.

Laycock, H., Tegucigalpa: Jaws of a large Tiger Shark (*Galeocerdo arcticus*) from the Gulf of Fonseca. Gift.

Leach, E. R., 217 Hillside Avenue, Piedmont, Calif.: 37 miscellaneous insects from California. Gift.

Linsley, Gorton, 2050 Tenth Avenue, Oakland, Calif.: 601 miscellaneous exotic insects. Gift.

Logan, Hugh, Inverness, Calif.: 1 Harlequin Duck (*Histrionicus histrionicus pacificus*); and 1 Emperor Goose (*Philacte canagica*) from Marin County, Calif. Gift.

Lotzen, Hugo, 3144 22nd Street, San Francisco: 1 nest of the Water Ouzel (*Cinclus mexicanus unicolor*) from Nevada County, Calif. Gift.

Lowe, H. N., Los Angeles, Calif.: 1 lot of paratypes of land snails. Gift.

Mailliard, Joseph, California Academy of Sciences, San Francisco: 1 Gambel's Sparrow (*Zonotrichia gambelii*) and 2 California Pocket Gophers (*Thomomysottæ bottæ*) from Marin County, Calif.; 1 land snail from Bohemian Grove, Calif. Gift.

Martens, Carl F., 2320 Webster Street, Berkeley, Calif.: 1 piece of quartz from Tioga Pass, Calif. Gift.

Martin, Half Moon Bay, Calif.: 1 fish (*Hemilepidotus hemilepidotus*) from Half Moon Bay, Calif. Gift.

Martin, H. M., 503 Lemon Avenue, Arcadia, Calif.: 15 reptiles from southern California. Gift.

Martin, J. O., California Academy of Sciences, San Francisco: The J. O. Martin Collection of Coleoptera, 11,200 specimens; 1 Report of the U. S. National Museum, 1928. Gift.

Marvin, Mrs. L. F., 1230 Geary Street, San Francisco: 1 feather pom-pom from South American Indians; 2 bundles of pig bristles. Gift.

McAllister, M. Hall, California Academy of Sciences, San Francisco: 1 periodical; 12 numbers of the Scientific American. Gift.

McCorkle, Kenneth, 38 Uplands, Berkeley, Calif.: 1 Alaska Grayling (*Thymallus signifer*) from outlet of Surprise Lake, east of Atlin, B. C. Gift.

McDonald, Miss Julia, 1221 Lombard Street, San Francisco: 32 botanical specimens from Fresno, Calif. Gift.

McGuire, Ignatius, Princeton, New Jersey: 1 periodical; 1 scientific pamphlet. Gift.

McKelvey, Mrs. Susan D., 1666 Riverway, Boston, Mass:. 71 botanical specimens from Arizona. Gift.

McLaren, John, Golden Gate Park, San Francisco: 1 Chattering Lory (*Lorius garrulus*); 1 Beaver, 1 Chukar Partridge (*Alectoris græca chukar*); 1 Sulphur-crested Cockatoo (*Kakatoë galerita*). Gift.

Meadows, Don C., Santa Catalina Island, Calif.: 1 water snake. Gift.

Mexia, Mrs. Inez, 1909 Lake Street, San Francisco: 22 botanical specimens from Mexico and 13 from California. Gift. 351 botanical specimens from McKinley National Park, Alaska. Purchase.

Milks, Jack, Padre Hotel, Bakersfield, Calif.: 1 shark tooth from Shark Tooth Hill, Kern County, Calif. Gift.

Moffitt, James, 1879 Broadway, San Francisco: 1 Farallon Cormorant (*Phalacrocorax auritus albociliatus*), and 1 Baird's Cormorant (*Phalacrocorax pelagicus resplendens*) from Marin County, Calif. Gift.

Montandon, Dr. George, Rue Louis-Guespin, 22, Paris-Clamart, France: 1 pamphlet. Gift.

Morcom, G. Frean, 243 N. Coronado Street, Los Angeles, Calif.: The Morcom collection of 3,000 bird skins from the United States. Gift.

Mori, T., 94 Golden Gate Avenue, San Francisco: 1 Swinhoe Pheasant (*Gennæus swinhoii*); 1 Fire-back Pheasant (*Lophura ignita*); 2 Bullfinches (*Pyrrhula pyrrhula*); 1 Forsten's Lory (*Trichoglossus forsteni*). Gift.

Morrice, Charles, Bakersfield, Calif.: 1 small box of fossils from Kettleman Hills; 1 box of fossils from Kern County, Calif., and some vertebrate fossil material from Shark Tooth Hill, Kern County, Calif. Gift.

Morse, Elizabeth, Department of Botany, University of California, Berkeley, Calif.: 1 small box of concretions from between El Centro and San Diego, Calif. Gift.

Morrison, Mrs. A. F., San Francisco: 1 copy of Who's Who in California, 1928-29. Gift.

Museum of Comparative Zoology, Cambridge, Mass.: 1 mounted skeleton of the Great Auk (*Plautus impennis*) from Funk Island. Purchase. One photograph of a mounted specimen of the Great Auk. Gift.

National Research Council of Japan, Tokyo, Japan: 2 volumes: Proceedings of the Third Pan-Pacific Science Congress, Tokyo, 1926. Gift.

Natuurwetenschappelijke Raad voor Nederlandsch-Indië: 1 pamphlet, a catalogue of literature on the study of science in the Dutch East Indies. Gift.

Netherlands Indies Medical and Sanitary Service, Weltevreden, Java: 1 volume: Control of Endemic Diseases in the Netherlands Indies, 1929. Gift.

Newell, Mrs. Gwendolen, 180 Duboce Street, San Francisco: 60 specimens of plants from Silver Lake, Amador County, Calif. Gift.

Nicholson, J. L., Jr., Berkeley, Calif.: Vermont State Geologist's 16th Annual Report. Gift.

Nicol, J. M., Babilonia Mines, La Labertad, Chontales, Nicaragua: 45 moths from Nicaragua. Gift.

Nolla, J. A. B., Insular Experiment Station, Rio Piedras, Porto Rico: 1 copy of The Black-shank of Tobacco in Porto Rico, by J. A. B. Nolla. Gift.

Nye, Clarice, Prospect, Oregon: 5 botanical specimens from Oregon. Gift.

Pammel, Dr. L. N., Iowa State College, Ames, Iowa: 2 pamphlets. Gift.

Parish, H. S., 15 Briarcroft Road, Toronto, Canada: 66 moths from the Southwestern States. Gift; 838 miscellaneous insects from China and 290 from Mexico and Tiinidad Island, B. W. I. Purchase.

Patton, J. V., Hollister, Calif.: 1 Formosan Partridge (*Arboricola crudigularis*) and 1 Chukar (*Alectoris græca chukar*). Aviary specimens. Gift.

Peers, Miss Susie, M., California Academy of Sciences, San Francisco: Current files of Science, Manchester Guardian, weekly edition, and Standard Oil Bulletin. Gift.

Phelps, Mrs. G. H., 580 McAllister Street, San Francisco: 100 botanical specimens from Idaho, Utah, and Colorado. Gift.

Philippines, University of, Agricultural College, Laguna, P. I.: 1 copy of A Preliminary Study of the Life History and Habits of Kanduli in Laguna de Bay, July 1929. Gift.

Pierce, J. H., Paso Robles, Calif.: 1 whale skull. Purchase.

Port of New York Authority, The, New York, N. Y.: The Port of New York Authority, 8th Annual Report, December 31, 1928. Gift.

Purdy, Carl, Ukiah, Calif.: 4 specimens of cultivated plants. Gift.

Quayle, Ernest, Stanford University, Calif.: 1 photostat copy of map of the world showing coral reefs. Gift.

Ransier, H. E., Manlius, N. Y.: 9 photographs of California Academy of Sciences's mammal habitat groups. Gift.

Ray, Milton S., 2901 Broadway, San Francisco: 1 Black-billed Magpie (*Pica pica hudsonia*) from Placer County, Calif. Gift.

Rhodda, Mrs. Anna, 2616 Sacramento Street, San Francisco: 6 botanical specimens from Sonoma County, Calif. Gift.

Robison, Ansel, 1072 Market Street, San Francisco: 2 Kuhl's Ruffed Lories (*Vini kuhli*) from Washington Island; 1 Hyacinthine Macaw(*Anodorhynchus hyacinthinus*); 1 White Cockatoo (*Kakatoë galerita*); 1 Petz' Paroquet (*Eupsittula canicularis*); 1 Tovi Paroquet (*Brotogeris jugularis*) from Central America; 1 Blue Java Sparrow (*Munia oryzivora*); 1 Society Finch (*Uroloncha striata*); 1 Black-headed Nun (*Munia atricapilla*); 2 Strawberry Finches (*Amandava amandava*); 1 Philippine Hanging Paroquet (*Loriculus apicalis*). Aviary specimens. Gift.

Rosenberg, W. F. H., 57 Haverstock Hill, London, N. W. 3., England: 113 bird skins. Purchase.

Rountree, Mrs. Lester, Carmel, Calif.: 14 botanical specimens. Gift.

Royal Library, The Hague, Holland: 4 pamphlets on various subjects. Gift.

Sanford, Mrs. O. N., 152-7th Avenue, San Francisco: 8 boxes of shells; 21 bound volumes and 12 pamphlets on various subjects; 1 pamphlet on Indians. Gift.

Science Society of China, Nanking, China: 1 pamphlet. Gift.

Scripps Institution of Oceanography, La Jolla, Calif.: 1 pamphlet on Diatoms. Exchange.

Seale, Alvin, Steinhart Aquarium, San Francisco: 20 miscellaneous insects from Samoa. Gift.

Siebenbürgischer Verein für Naturwissenschaften, Hermannstadt, Roumania: 2 publications. Exchange.

Sinseheimer, Miss Gertrude, San Luis Obispo, Calif.: 2 botanical specimens from California. Gift.

Slevin, L. S., Carmel, Calif.: 26 land and freshwater shells from Paso Robles, Calif.; 2 snakes and 1 salamander from San Jose Canyon, Carmel, Calif.; 1 snake from Aptos, Santa Cruz County, Calif.; 6 salamanders from Carmel, Calif.; 1 small lot of freshwater snails from Paso Robles, Calif.; 2000 insects, mostly moths, from California. Gift.

Smith, A. G., Berkeley, Calif.: 3 specimens of Red Abalone from the coast 3 miles north of Gualala, Calif. Gift.

Smith, James Perrin, Stanford University, Calif.: 1 copy of The Transitional Permian Ammonoid Fauna of Texas, by James Perrin Smith. Gift.

Sociedad de Anthropologia y Etnographia de Mexico, D. F., Mexico: 1 copy of Monografia de los Tarahumaras, by Carlos Basauri. Gift.

Society of Motion Picture Engineers, 29 West 39th Street, New York, N. Y.; 1 copy of The Society of Motion Picture Engineers; Its Aims and Accomplishments; Synopses of Papers Published; with author and subject indices; committees, July, 1916-April, 1928. Gift.

Staudinger, O., and Bang-Haas, A., Germany: 61 Hemiptera. Purchase.

Steinbeck, J. W., 611 Bristol Avenue, Stockton, Calif.: 2 Chinese Peacock Pheasants (*Polyplectrum chinquis*); 1 Indian Bronze-wing Dove (*Chalcophaps indica*). Aviary specimens. Gift.

Steinhart Aquarium, Golden Gate Park, San Francisco: 1 fish (*Thalassoma fuscum*); 11 specimens of two species of fishes; 2 Lampreys (*Entosphenus tridentatus*), from mouth of San Lorenzo River, March 29, 1929. Gift. 3 Mosquito Fish (*Gambusia affinis*), from Irrigation ditch near Coachella, Calif. Exploration.

Stevens, J. B., Bakersfield, Calif.: 2 specimens of fossil nuts; 100 fossil shells from Kern County. Gift.

Stewart, George W., Box 1132, Sacramento, Calif.: 1 copy of Prehistoric Basins in the Sierra Nevada of California, 1929. Gift.

Stohler, Dr. Rudolf, Hooper Foundation for Medical Research, San Francisco: 3 biological pamphlets. Gift.

Sutcliffe, Mrs. E. C., 700 Lake Street, San Francisco: 20 botanical specimens from Yosemite National Park; 15 botanical specimens from Sullivant Moss Society, Superior, Wisconsin; 3 volumes of The Bryologist. Gift.

Swarth, George, 2800 Prince Street, Berkeley, Calif.: 907 miscellaneous insects from Atlin, British Columbia. Purchase.

Swarth, Harry S., California Academy of Sciences, San Francisco: 32 mammal skins and 33 skulls, 296 bird skins, 6 sets (26 eggs), and 5 bird nests from British Columbia; 4 specimens of birds from Colusa County, Calif. Exploration. The Museum, vol. 1, nos. 2, 7, 11; 46 ornithological separates; 51 periodicals on scientific subjects; 2 pamphlets; 1 copy, 59th Annual Report, American Museum of Natural History. Gift.

Swarth, Mrs. Winifern W., 2800 Prince Street, Berkeley, Calif.: 179 botanical specimens from Lake Atlin Region, British Columbia. Gift.

Taylor, Mrs. Ross, Calif.: 3 mud wasps. Gift.

Thompson, Robert L., Jr., 726-11th Ave., San Francisco, Calif.: 1 White-tailed Kite (*Elanus leucurus*). Gift.

Tiran, G., P. O. Box 116, Saigon, French Indo-China: 1 pamphlet: Big Game Hunting in French Indo-China. Gift.

Toftley, Charles, San Francisco: 2 lizards from San Francisco, Calif. Gift.

Tose, Frank, California Academy of Sciences, San Francisco: 1 snake (*Thamnophis ordinoides atratus*), from Marin County, Calif.; 2 reprints from Museum News of October 15, 1920; 3 bound volumes and 2 pamphlets. Gift.

Trost, Henry, de Young Memorial Museum, San Francisco: 6 House Sparrows (*Passer domesticus*), from San Francisco. Gift.

Van Duzee, E. P., California Academy of Sciences, San Francisco: 77 miscellaneous insects from Santa Cruz, Calif. Exploration. 1 small box of land snails; 2 Mexican agricultural pamphlets; 1 volume of Entomological Paper of the University of California; 10 volumes and 47 numbers of various periodicals. Gift.

Van Duzee, E. P., and Usinger, Robert, California Academy of Sciences, San Francisco: 8261 miscellaneous insects from Owens Valley, Calif. Exploration.

Van Dyke, Dr. E. C., University of California, Berkeley, Calif.: 1 salamander from Woodacre, Marin County, Calif.; 6 small lots of land snails from California; 25 specimens of land snails from various localities; 1931 miscellaneous insects from Sequoia National Park, 174 from the Black Mountains, North Carolina, and 1928 from southern California. Gift.

Van Dyke, Mrs. E. C., 2440 Stuart Street, Berkeley, Calif.: 60 botanical specimens from Mt. Hood and the Three Sisters, Oregon. Gift.

Venturi, S., Tucuman, Argentina, South America: 403 botanical specimens from Argentina. Purchase.

von Geldern, Otto, Pacific Building, San Francisco: 1 copy of Reminiscences of the Pioneer Engineers of California, 1929. Gift.

Vortriede, William, Capitol Park, Sacramento, Calif.: 138 specimens of California plants. Gift.

Walther, Eric, Golden Gate Park, San Francisco: 500 specimens of exotic plants. Gift.

Warrington, Henry, Sutter Creek, Amador County, Calif.: 1 Lewis's Woodpecker (*Asyndesmus lewisi*) from Amador County, Calif. Gift.

Watson, Dr. Elba Emanuel, Michigan State College, East Lansing, Michigan: 1 book: Contributions to a Monograph of the Genus Helianthus, 1929. Gift.

Wright, J. T., California Academy of Sciences, San Francisco: 1 woodpecker (*Picus canus guerini*), from China. Gift.

April 8, 1930

FINANCIAL STATEMENTS

REPORT OF THE TREASURER

For the fiscal year ending December 31, 1929

January 1, 1929, Balance due Crocker First National Bank.... $ 3,782.56

Receipts:

Dues	$ 3,540.75	
Charles Crocker Scientific Fund Endowment Income	1,749.56	
James Lick Endowment Income	70,411.08	
General Income	19,866.94	
John W. Hendrie Endowment Income	1,157.85	
Post Card Sales	972.82	
Publication	674.21	
Interest	1,237.72	
Ignatz Steinhart Trust Interest	833.97	
Duplicate Sales Account	15.10	
W. G. Wright Fund	10.00	
Bills Receivable	1,000.00	
Sale of 416 shares stock Goldman Sachs Trading Corporation	43,561.11	
Great Auk Donation	75.00	
Sale of Dodge Car	75.00	
Ignatz Steinhart Trust Bills Receivable	7,000.00	
Wild Life Protection Fund	100.00	
Total Receipts		$152,281.11
		$148,498.55

REPORT OF THE TREASURER—Continued

Expenditures:

Interest	$ 10,543.45
Contingent Fund	504.42
Salary Expense General	19,430.75
Department Salaries	20,993.90
Earthquake Insurance Sinking Fund	1,200.00
Bills Payable	10,000.00
Bills Receivable	49,000.00
Steinhart Aquarium Equipment	7,127.71
Insurance	1,697.49
Wild Life Protection Fund	47.56
Appraiser's and Attorneys Fees	1,200.00
Henry M. Holbrook Fund	25.28
Post Card Sales Account	43.21
Great Auk Donation	253.55
Sundry Creditors	1,862.35
Museum Department Appropriations	12,993.38
Expense	2,631.09
Publications	4,852.60
Library	4,976.73
Total Expenditures	$149,383.47

January 1, 1930, Balance due Crocker First National Bank.... $ 884.92

M. HALL McALLISTER, *Treasurer.*

Examined and found correct,

PACE, GORE & McLAREN, *Certified Public Accountants.*

San Francisco, Calif., February 18, 1930.

INCOME AND OPERATING EXPENSES

For the fiscal year, January 1, 1929, to December 31, 1929

Income:

Charles Crocker Scientific Fund Endowment Income	$ 1,749.56	
James Lick Endowment Income	70,411.08	
General Income	19,866.94	
Dues	3,540.75	
Interest on Temporary Investments	1,237.72	
Profit on Post Card Sales	603.07	
Total Income		$ 97,409.12

Expenditures:

General Expense	$ 2,784.83	
Salaries	40,595.71	
Interest	11,258.45	
Insurance	1,697.49	
Appraiser's Fees	1,200.00	
Total Expenditures		$ 57,536.48
Net Income Transferred to Surplus Account		$ 39,872.64

SUMMARY OF SURPLUS ACCOUNT

December 31, 1929

Balance January 1, 1929		$546,531.53
Additions:		
Net Income for the year ended December 31, 1929	$ 39,872.64	
Profit on Securities Sold	2,665.57	
Sale of Duplicate Books	15.10	
Donations toward Purchase of Great Auk Skeleton	75.00	
Library Purchases from W. G. Wright Fund	8.97	
Total Additions to Surplus		$ 42,637.28
		$589,168.81
Deductions:		
Depreciation	$ 16,226.42	
Loss on Sale of Automobile	198.75	
Total Deductions from Surplus		$ 16,425.17
Surplus, December 31, 1929		$572,743.64

BALANCE SHEET

December 31, 1929

Assets

Property:		
Real Estate, 831-833 Market Street	$600,000.00	
Commercial Building, 833 Market Street	516,818.66	
Real Estate, Jessie Street	8,083.65	
		$1,124,902.31
Museum, Golden Gate Park:		
Building Construction	$192,025.92	
General Collections	201,611.26	
Library and Equipment	149,748.43	
Tools and Equipment	45,780.93	
Office Furniture	5,752.84	
		$ 594,919.38
Investment Securities		$ 5,763.64
Ignatz Steinhart Trust:		
Bills Receivable	$ 5,000.00	
Steinhart Aquarium Construction	263,390.29	
Steinhart Aquarium Equipment	34,257.58	
Steinhart Aquarium Revolving Fund	5,000.00	
Uninvested cash on hand	977.28	
		$ 308,625.15
Current Assets:		
Bills Receivable	$ 58,000.00	
Post Cards in stock	267.54	
Cash on hand	125.49	
Advances to employees doing field work	1,836.69	
		$ 60,229.72
Total		$2,094,440.20

BALANCE SHEET—Continued

Liabilities

Endowments:		
James Lick Endowment	$804,902.31	
Charles Crocker Scientific Fund Endowment	20,000.00	
John W. Hendrie Endowment	32,770.85	
		$ 857,673.16
Funds Held for Special Purposes:		
Alvord Bequest Botanical	$ 5,000.00	
John W. Hendrie Endowment Income	1,157.85	
Earthquake Insurance Sinking Fund Income	463.64	
W. G. Wright Fund	32.57	
Park Birds Handbook Fund	20.00	
Wild Life Protection Fund	122.35	
		$ 6,796.41
Reserve for Depreciation		$ 149,603.19
Ignatz Steinhart Trust:		
Principal	$250,000.00	
Interest	58,625.15	
		$ 308,625.15
Notes and Accounts Payable:		
Bills Payable	$195,000.00	
Accounts Payable and Accruals	2,136.45	
Due Crocker First National Bank (Overdraft)	1,862.20	
		$ 198,998.65
Surplus		$ 572,743.64
Total		$2,094,440.20

SUSIE M. PEERS,
Secretary, Board of Trustees.

We have examined the foregoing Balance Sheet, together with the books and accounts of the California Academy of Sciences, and in our opinion, it is properly drawn up so as to exhibit a true and correct view of the Academy's affairs, as shown by the books.

PACE, GORE & MCLAREN,
Certified Public Accountants.

San Francisco, Calif.,
February 18, 1930.

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New names in **heavy-faced** type

May 8, 1930

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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVIII, No. 1, pp. 1-27, plates 1-3 JANUARY 29, 1929

I

A New Species of Corambe from the Pacific Coast of North America

BY

FRANK M. MACFARLAND
Stanford University

AND

CHARLES H. O'DONOGHUE
University of Edinburgh

SAN FRANCISCO
PUBLISHED BY THE ACADEMY
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FOURTH SERIES

VOL. XVIII, No. 2, pp. 29-43, 6 text figures JANUARY 29, 1929

II

A New Bird Family (Geospizidæ) from the Galapagos Islands

BY

HARRY S. SWARTH

Curator, Department of Ornithology and Mammalogy

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

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FOURTH SERIES

VOL. XVIII, No. 3, pp. 45-71, plates 4-7 JANUARY 29, 1929

III

A Contribution to Our Knowledge of the Nesting Habits of the Golden Eagle

BY

JOSEPH R. SLEVIN

Curator, Department of Herpetology

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

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VOL. XVIII, No. 4, pp. 73-213, plates 8-23 MARCH 29, 1929

IV

Marine Miocene and Related Deposits of North Colombia

BY

FRANK M. ANDERSON

Honorary Curator, Department of Paleontology

SAN FRANCISCO
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By LEO GEORGE HERTLEIN

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A New Species of Land Snail from Kern County, California

By G. DALLAS HANNA

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A New Species of Land Snail from Coahuila, Mexico

By G. DALLAS HANNA and LEO GEORGE HERTLEIN

No. 8, pp. 221-227, plate 24, figs. 1-4

Some Notes on Oreohelix

By JUNIUS HENDERSON

SAN FRANCISCO

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VOL. XVIII, No. 12, pp. 267-383, plates 27-32, 7 text figures APRIL 26, 1929

XII

The Faunal Areas of Southern Arizona: A Study in Animal Distribution

BY

HARRY S. SWARTH

Curator, Department of Ornithology and Mammalogy

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

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VOL. XVIII, No. 13, pp. 385-391 SEPTEMBER 6, 1929

XIII

The Escallonias in Golden Gate Park, San Francisco, California, with Descriptions of New Species

BY

ALICE EASTWOOD

Curator, Department of Botany

SAN FRANCISCO
PUBLISHED BY THE ACADEMY
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XIV

Studies in the Flora of Lower California and Adjacent Islands

BY

ALICE EASTWOOD

Curator, Department of Botany

SAN FRANCISCO

Published by the Academy

1929

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XV

Drepania
A Genus of Nudibranchiate Mollusks New to California

BY

F. M. MACFARLAND

Department of Anatomy, Stanford University, California

SAN FRANCISCO

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XVI

Some Upper Cretaceous Foraminifera from Near Coalinga, California

BY

J. A. CUSHMAN

AND

C. C. CHURCH

SAN FRANCISCO

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Report of the President of the Academy for the Year 1929

BY

C. E. GRUNSKY

President of the Academy

XVIII

Report of the Director of the Museum and of the Aquarium for the Year 1929

BY

BARTON WARREN EVERMANN

Director of the Museum and of the Aquarium

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