Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

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Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

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THE MACHRIS BRAZILIAN EXPEDITION

GENERAL ACCOUNT

By Jean Delacour

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

FOREWORD

This is the first installment of a new series which we call Los Angeles County Museum Contributions in Science. Our institution so far has never possessed a technical publication of its own. Many important papers by members of the staff, usually based on material deposited in the Museum, have in the past appeared in various periodicals issued throughout the country. As our collections are growing rapidly, they afford excellent material for study; it has become imperative that the results of work based on them should be presented in a special publication. The recent Expedition to Brazil sponsored by Mr. and Mrs. Maurice A. Machris is a most appropriate occasion to launch our new "Contributions in Science," as it has provided us with an unusual wealth of scientific material and supplied the necessary financial resources to make a start. This first number, a general account of the Machris Brazilian Expedition, will be followed almost immediately by an introductory paper on the botanical aspects of the Expedition, and very soon by others dealing with Entomology, Ornithology, special branches of Botany and other disciplines.

The present publication is not a periodical. As is the case with many other scientific museum publications, it will appear from time to time as the need arises and resources are found.

It is an honor and a pleasure to introduce "Contributions in Science" to the scientific world.

Jean Delacour, *Director*

Los Angeles County Museum

THE MACHRIS BRAZILIAN EXPEDITION
GENERAL ACCOUNT

By Jean Delacour

The fauna and flora of the world had only begun to be known to any extent during the 18th century and the ensuing era of discovery of the bulk of the species, particularly vertebrates, can be said to have ended in the first half of the 20th century. Today, the finding of many startling novelties among mammals and birds, for example, is unlikely to happen. But there is still a great deal to be learned of the distribution, the variation and the life habits of animals. Also, in some branches of Natural History, such as Entomology and Botany, many new forms remain to be found and described. There is, therefore, a large field still open at present for collecting expeditions. Here in the west, we are especially eager to gather specimens throughout the world. Although the museums of eastern cities such as Washington, New York, Philadelphia and Cambridge (Mass.) possess world wide series which can happily compare with the great ones of Europe, there are no such collections in the western United States. Several museums can boast of excellent western American collections, but specimens from other parts of the world are comparatively scant. Material for wide general studies, representing the fauna and flora of the whole world, is simply not available west of Chicago. It has occurred to us that Los Angeles, with its County Museum, is particularly well placed to endeavor to build up such world collections. We have been working toward this ambitious but by no means impossible project the last few years. It will, no doubt, take a long time before we acquire collections which can compare with those of Chicago and of the eastern cities; but we have made a good start. In recent years, important material has been obtained in Mexico, in Australia and in East Africa, thanks to the help of generous friends: Mr. W. J. Sheffler, Mr. John B. Davidson, and Mr. and Mrs. Maurice Machris.

None of those very useful ventures can, however, compare with the Brazilian Expedition of 1956 which is among the widest in scope undertaken in recent years. The Los Angeles County administration provides the means of keeping the Museum in good order, and of progressing each year. But for funds for new acquisitions we depend largely upon the generosity of friends. It was, therefore, our good fortune that Mr. and Mrs. Mauriee Machris offered to sponsor in our interest a project of such grand scale.

Many parts of the world have been practically closed to exploration since the last World War. It seemed to us that among the still accessible countries the immense territory of Brazil offered the best chance for useful work. It was not probable that any part of it would yield many sensational novelties in the way of vertebrates, but many important insects and plants, no doubt, remained to be discovered. Furthermore, very little of the distribution and variation of the species of mammals, birds, reptiles, amphibians and fishes were yet accurately known.

We chose the headwaters of the Rio Tocantins in the State of Goiás, central Brazil (see fig. 1), as the principal field of research primarily because of its zoological promise; only a very few birds had been collected in the area previously; there had been no entomological research. Botanical interest was based on the classical early 19th century collecting in that immediate area. It was urgent to establish the inventory of its wild life as it is likely to be considerably damaged by civilization in the near future. A high plateau, 3,000 feet in altitude, with a good climate, fertile soil and abundant water, central Goiás will no doubt soon be heavily settled, just as similar areas to the south (southern Goiás, western Minas Gerais, and São Paulo) have already been. Even now progressive damage is evident as many areas have been widely burned to provide for grazing. There is also a plan to build the new federal Capital there, close to what is today the small town of Planaltina, and talk of starting soon on the project is now frequent. All this means the destruction of a good deal of animal and plant life, even if, as it is hoped, adequate national parks and nature reserves are established when such a development takes place.

Plans for a thorough survey of the selected region were organized early in 1955, and the personnel for the Expedition chosen, as follows:

Mr. and Mrs. Maurice Machris and myself, as joint leaders

Mr. Harry F. Burrell, professional cinematographer

Dr. E. Yale Dawson, Botanist

Mr. and Mrs. Milton Sperling, in charge of equipment and camping

Mr. Kenneth E. Stager, Curator of Ornithology-Mammalogy

Mr. Dean Torrence, assistant to Mr. Machris

Dr. Fred S. Truxal, Curator of Entomology

Fig. 1. Map showing route of expedition in Brazil (dotted lines). The rectangle marks the area of the headwaters of the Rio Tocantins.

It is, of course, not possible to launch a large expedition into a foreign country without the necessary permits and the help of local authorities. Accordingly, we submitted our plans to Dr. José Candido Mello Carvalho, Director of the Museu Nacional do Brasil, at Rio de Janeiro, inviting his institution to share in our efforts as well as in the results. His answer was enthusiastic, and his help and efficiency remarkable. From his staff, he provided the following additional members of the Expedition who proved to be competent naturalists and delightful companions: Mr. Antenor L. Carvalho, Herpetologist and Ichthyologist; Mr. Herbert F. Berla, Ornithologist; and Mr. Joaquim Pereira, Preparator. In July, 1955, Mr. Torrence flew to Rio de Janeiro to confer with Dr. Carvalho and make all necessary arrangements. Also, at this time, Mr. Torrence had aerial photographs made of the route that the Expedition planned to follow in the state of Goiás, including newly built roadways which make much of this country accessible to motor vehicles for the first time.

Equipment for the Expedition was selected with great care to meet our particular requirements. Four trucks and two trailers were acquired to transport the considerable camping and collecting equipment we needed, and few expeditions so far have been so well fitted. The four trucks were high-chassised and equipped with 4-wheel drive in order to negotiate the high-center oxcart roads and difficult terrain with heavy grades. Two trucks were designed with trap-door top to permit collecting and the operation of the motion picture camera while traveling. The custom-built trailers carried a 5000 watt electric generator, refrigerator and deep freeze, and a water purification unit. Tents were especially designed by Mr. Machris for protection from excessive temperatures and bothersome insects. All of the equipment, packed in the trucks and trailers, was shipped by boat to São Paulo early in February, 1956, six weeks before our departure.

Dr. Dawson preceded the rest of the party in order to make advance contacts with the Director and staff of the Museu Nacional and arrange with the Customs for the free entry of our equipment. The other Los Angeles members of the Expedition arrived in Rio de Janeiro by plane on March 16, 1956. After a week in Rio, visiting the museums and zoos and making official contacts, we went on to São Paulo to prepare for departure with the vehicles into the interior.

The Expedition left São Paulo on March 31st, taking the road northward to Goiás, a 600 mile stretch made tedious by the very poor state of the roadbed. The complete itinerary, including our overnight

Fig. 2. Equipment ready for shipment from Los Angeles. Part of the Los Angeles party in foreground, left to right: Dr. Fred S. Truxal, Dr. E. Yale Dawson, Harry F. Burrell, Kenneth E. Stager, Maurice A. Machris, and Dean Torrence.

stops (page 11), will show the numerous towns through which we passed (see also, map, fig. 1). Although the country as far as Anapolis is well settled and cultivated, we found some interesting specimens on the way. Traveling northeast from Anapolis, we crossed the divide separating the Amazon basin from the Paraná basin and approached the headwaters of the Rio Tocantins, the great affluent of the lower Amazon. Our first Base Camp was established on April 12 at an elevation of about 3,500 feet, 12 miles north of the small village of São João da Aliança. This was a plateau of extensive grasslands, and gallery forests along the streams. There was plenty of wild life, including large mammals and birds, and most of the shrubs and herbs were in bloom, many of them beautiful. We were drenched now and then, the rains being late to stop this year, and the biting insects were tiresome, but the temperature was pleasant (maximum 84°F, minimum 54°F).

From this Base Camp, collecting activities extended within a radius of several miles, and side trips were made to nearby localities by various members of the party. Mr. Torrence and I left the Expedition on April 19th, but the rest of the party continued the survey of the area until May 6 before proceeding to the second objective. Although Base Camp No. 2 was only 90 airline miles northwest from Camp No. 1, across the Tocantins River, it was necessary to retrace the route south to Anapolis and then proceed northward again on the west side of the river, a distance of nearly 500 miles. The second Base Camp was established in the Serra Dourada range, 12 miles east of the small town of

Fig. 3. Site of Base Camp #2, in the Serra Dourada.

Formoso,* at an elevation of about 3,000 feet, in a region of dense forest, interspersed with open scrub forest and scant grassland. Temperatures ranged from 94°F to 46°F. Plant and animal life differed considerably from those encountered at Base Camp No. 1. In addition to the collecting in the immediate Serra Dourada area, the scientific members of the party made a 150 mile trip north to Peixe on the Rio Tocantins. Mr. and Mrs. Machris, accompanied by Mr. Burrell, went to the Rio Araguaia to the northwest, the home of the interesting Carajá Indians, in order to gather ethnological and photographic material.

Throughout the Expedition, preparation of specimens was greatly facilitated by the excellent equipment. In the ornithological work, for example, it was possible to collect in the early morning, and spend the rest of the day in preparation under comfortable conditions in the work tent, continuing on into the night by electric light. An excess of specimens could be placed in the refrigerator or deep freeze for

*On map (fig. 1) at end of dotted spur northeast of Amaro Leite, not to be confused with the town of Formosa.

Fig. 4. Personnel of the expedition at Base Camp #2. Standing, left to right: Antenor L. Carvalho, Kenneth E. Stager, Herbert F. Berla, Maurice A. Machris, Mrs. Maurice A. Machris, Dr. Fred S. Truxal, Mrs. Milton Sperling, Milton Sperling; kneeling, left to right: Dr. E. Yale Dawson, Joaquim Pereira, Douglas Shepherd (camp helper, added to the expedition at Anapolis).

attention later. The Entomologist, likewise, made his collections daily and was able to prepare them under conditions nearly as convenient as in his own laboratory at the Museum. The availability of the electric generator enabled the Botanist to press and dry freshly collected specimens so rapidly that excellent color preservation was possible.

The results of the field preparation, in specimens returned to the Los Angeles County Museum, are as follows:

Botany — 2200 herbarium and live plant specimens

Entomology — 8100 insect specimens; 1200 arachnid specimens

Mammalogy — 200 study skins and mammal pelts

Ornithology — 859 study skins of birds

In addition, specimens of reptiles, amphibians and fishes were collected for the Museu Nacional.

The biological work terminated on June 17, whereupon the Expedition returned to São Paulo. Less than three months later, all equipment and collections had arrived in Los Angeles, marking the termination of a most interesting and successful collecting trip.

The considerable series of animals and plants are immediately being worked out either by members of the Expedition and of the Museum staff, or by specialists throughout the United States, in Canada, France, Sweden, Netherlands, Argentina and Brazil. As the study of the different groups is completed, the results will be published in subsequent numbers of the present publication.

It is an agreeable duty for me to thank here Mr. and Mrs. Machris for their generosity as well as their very efficient personal work in the field and in the preparation of the Expedition; also Dr. Carvalho, the capable Director of the Museu Nacional do Brasil, without whose help and cooperation no useful work could have been possible. All the members of the staff, both Brazilian and American, proved able, cooperative and devoted to their work. They will find here the testimony of my deep appreciation.

RECORDED FIELD TEMPERATURES (High and Low)

Base Camp #1 (4500′ elev.) Max. 84°F Min. 54°F
Base Camp #2 (3200′ elev.) Max. 94°F Min. 46°F

AVERAGE ANNUAL RAINFALL

	*Goiás, Goiás	Formosa, Goiás
Jan.	11.9 inches	12.0 inches
Feb.	11.7	8.0
Mar.	11.4	6.0
Apr.	5.0	5.0
May	.4	.5
June	.5	.4
July	.1	.4
Aug.	.4	.5
Sept.	1.8	2.0
Oct.	4.8	5.0
Nov.	8.7	8.0
Dec.	10.2	12.0

*About 170 miles south of Base Camp #2.

ITINERARY

Left Los Angeles – March 14, 1956
Arrived New York City – March 14
Left New York – March 15
Arrived Rio de Janeiro – March 16
Rio de Janeiro – expedition affairs – March 16-22
Left Rio for São Paulo – March 22
Arrived São Paulo – March 22
São Paulo – expedition affairs – to March 30 (incl.)
Left for Interior – March 31

- March 31 – Campinas, São Paulo
- April 1 – Campinas, São Paulo
- April 2 – Ribeirão Preto, São Paulo
- April 3 – Uberaba, Minas Gerais
- April 4 – Uberlandia, Minas Gerais
- April 5 – Uberlandia, Minas Gerais (1 day's collecting)
- April 6 – Morrinhos, Goiás
- April 7 – Goiania, Goiás
- April 8 & 9 Anapolis, Goiás
- April 10 – Fly camp #1 near Braslandia, Goiás
- April 11 – Fly camp #2 south of São João da Aliança
- April 12 – Established Base Camp #1, 12 miles north of São João da Aliança
- April 12 to May 6 – Field activities at Base Camp #1
- April 19 – Delacour and Torrence left Base Camp #1 for São Paulo
- May 7 – Fly camp enroute to Anapolis
- May 8 – Fly camp enroute to Anapolis
- May 9 – Anapolis, Goiás to re-supply
- May 10 – Anapolis, Goiás to re-supply
- May 11 – Fly camp enroute to the Serra Dourada
- May 12 – Fly camp near Amara Leite enroute to the Serra Dourada
- May 13 – Established Base Camp #2, 12 miles east of Formoso in the Serra Dourada range.
- May 13 to June 16 – Field operations in the Serra Dourada area
- June 17 – Fly camp enroute to Anapolis
- June 18 – Arrived in Anapolis
- June 24 – Expedition arrived in São Paulo and prepared for return to the U.S.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

nber 2 January, 24, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: General

By E. Yale Dawson

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

Hildegarde Howard

Chief Curator of Science

Editor

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: General

By E. Yale Dawson*

The botanical work of the Machris Brazilian Expedition of 1956[1] was planned as an adjunct of the ornithological and entomological investigations in Goiás, but became, as a result of favorable circumstances in the field, an independent enterprise of somewhat greater magnitude than had been anticipated.

The following brief account is intended as a preliminary to the several systematic reports on the plant collections which will be presented from time to time as the work progresses.

It is my first privilege to thank Mr. and Mrs. Maurice A. Machris for their generosity in providing the funds, the facilities, and the enthusiastic stimulus which made possible the collecting and processing of these plant materials in the field under nearly ideal conditions. However, it was the result of a suggestion of Mrs. Maybelle Machris that the expedition included a botanist and, accordingly, I am grateful to her, both for that fortunate thought, and for her generosity in contributing to the Expedition's general financial needs.

During the course of the work in Brazil the writer received help in various ways from several individuals other than the members of the Expedition. Among these he especially wishes to thank Dr. Aylthon B. Joly of the University of São Paulo.

The work of identifying and processing the collections is now being done with the help of a number of specialists here in the United States, in Canada and in Europe, whose contributions to the work will be acknowledged within each publication unit.

The photographs were taken by Mr. Antenor Carvalho.

Equipment and Itinerary

A general account and summary of the equipment and itinerary of the Expedition have been given by Jean Delacour in his paper introducing this series so that little in those respects need be repeated here. Briefly, however, the Expedition consisted of ten American and four Brazilian members, two 2-ton stake-body trucks, two custom-built carryalls, a trailer-mounted water purification unit, and a trailer-mounted Kohler electric generator and refrigeration plant. All food and equipment necessary to provide complete self-sufficiency in the field were

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*Expedition Botanist, Los Angeles County Museum.

[1]See the General Account of the Machris Brazilian Expedition by Jean Delacour: Los Angeles County Museum Contributions in Science (1): 1-12. 1957.

carried on the trucks and trailers so that base camps left little to be desired except air conditioning and freedom from black flies.

The Expedition left São Paulo on March 31, 1956 and proceeded almost due north to Anapolis near the state capital of Goiás (map 1). From this point we went during April to Base Camp I in a rolling highland known as the Chapada dos Veadeiros, and subsequently, during May, to Base Camp II in a low mountain range known as the Serra Dourada (map 2).

In going northeastward from Anapolis one travels into the Planalto Centrál of Brazil from which three major river systems arise. Here one crosses among rolling hills the east-west divide between the Amazon Basin and the Paraná Basin, a divide whose highest point is at 1380 meters in the Serra dos Pireneos. This highland region of Goiás, the Planalto Centrál, is bounded by the Rio São Francisco on the east, the Rio Grande tributary of the Paraná on the south and the Araguaia tributary of the Tocantins in the west. It is so favored climatically and so located geographically that the town known as Planaltina has been chosen as the site of the new Brazilian capital. Elevations range from 600 to over 1300 meters as one progresses from Planaltina onto the Chapada dos Veadeiros to its highest point which lies about midway between Veadeiros and Cavalcante. Our first base camp was established 20 km. north of São João da Aliança at somewhat over 1000 m. of elevation in the midst of a scrub-forest and grassland type of vegetation dissected by numerous small streams whose margins were occupied by forests of moderate height and density. From this camp the botanical collecting extended about 60 km. northward and to elevations of about 1300 m.

On the second leg of the Expedition we traveled northward from Anapolis along the west side of the Rio Tocantins drainage to as far as Peixe at S. Lat. 12° 01′. Most of the botanical collecting was done in the vicinity of the second base camp at an elevation of about 900 m.

At the established base camps dry botanical specimens were prepared for herbarium use by pressing freshly collected material in folded newsprint between building-felt driers alternating with aluminum corrugates. It was not necessary to change driers in the conventional manner, for the presses were placed in front of the warm air stream created by the radiator fan of the gasoline driven Kohler electric generator. With this excellent facility it was possible, even during rainy weather, to dry the majority of specimens in the space of 12 to 18 hours and, thus, to obtain good color preservation. Some 2000 herbarium specimens were prepared in this way during approximately forty-five field working days. After drying, the specimens were enclosed in dust-tight galvanized sheet metal containers in crates and kept dehydrated by means of silica gel.

Some living plants were collected also, particularly Cactaceae, Orchidaceae, and Bromeliaceae which are now under cultivation in an effort to bring them into identifiable flowering condition.

HISTORY OF BOTANICAL EXPLORATION

By New World standards of time the history of botanical exploration in the Planalto Centrál of Brazil is long, extending back a hundred and forty years; but it is remarkable that more botanists visited the region during the first half of the 19th Century than during the first half of the 20th. Indeed, during the decade preceding 1820 Brazil was being botanized more extensively than any other part of the Americas.

Botany began in the Planalto in 1817 with the excursion of Karl Friedrich Philipp von Martius into the Chapada dos Veadeiros southeast of the old town of Cavalcante. Within the following three years, not only he, but two other now famous botanists rode, tramped and persevered in collecting across the region. Auguste de Sainte Hilaire visited, during 1819-21, both the Serra Dourada and the Corumbá area north of present day Anapolis, while Johann Emanuel Pohl, on two expeditions within the same years, collected in the Serra Dourada, along the upper Rio Maranhão, and near the headwaters of the Paraná in the Chapada dos Veadeiros south of Cavalcante. William John Burchell worked the region of Jaraguá north of Anapolis in 1827 and the vicinity of Cavalcante the following year. The Chapada dos Veadeiros was again visited in 1839-40 by George Gardner. The Rio Santa Teresa drainage, from near present day Porangatú to Peixe, was collected in 1844 by Hugh A. Weddell and F. de Castelnau. Their work in parts of Goiás extended through 1851, but it was over 40 years before another botanist studied the region, namely, Ernst H. G. Ule. Ule collected both in the Serra Dourada and in the Chapada dos Veadeiros in 1892-93 on an expedition to study the region of the proposed new capital in the Planalto Centrál[2]. He was followed in the same areas in 1894-95 by Auguste Françoise-Marie Glaziow.

The collections and studies of these 19th Century explorers were incorporated into the monumental, sixty-six year work on Brazilian bottany, Flora Brasiliensis[3]. However, after the appearance of Ule's account in Cruls' report of 1894, virtually nothing was written on the flora

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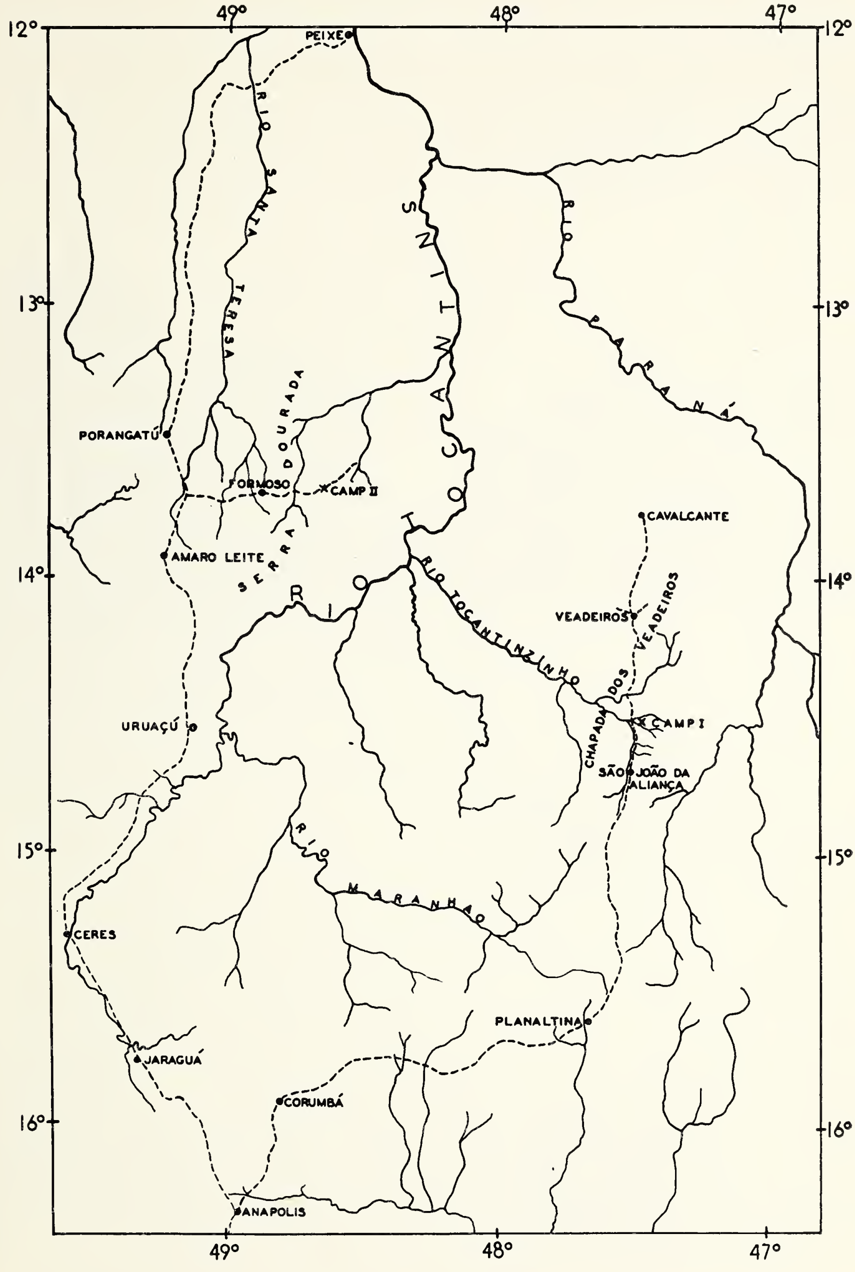
[2]L. Cruls: Commissão exploradora do Planalto Centrál do Brasil, relatorio a presentado a S. Ex. o Sr. Ministro da Industria, Viação e Obras Publicas. Rio de Janeiro, 1894, pp. 339-365.

[3]Martius, Carl F. P. von, Flora Brasiliensis. 15 fol. vol. [in 40] Monachii, Lipsiae. 1840-1906.

Map 1. The rectangle outlines the area studied by the Expedition and shown in detail in Map 2.



Map. 2. Detail of area shown by the rectangle in Map 1.

of Goiás for more than half a century until Leo Waibel published, in 1948, his "Vegetation and land use in the Planalto Centrál of Brazil."[4]

Inasmuch as Flora Brasiliensis treats of Brazilian plants as a whole, and neither Waibel's, Ule's nor any other paper deals floristically with particular localities in the Brazilian highlands, it is hoped that the present series of contributions, which are intended to provide a survey of the "spring" floras of the Chapada dos Veadeiros and of the Serra Dourada, will find a useful and unoccupied place in Brazilian botany.[5]

Ecology

Throughout the Planalto Centrál, which is essentially a post Cretaceous peneplain, sandstone is the predominant parent rock material. The resulting soils are for the most part sandy and poor, and they support an open vegetation. In some areas, however, the soils are derived from volcanics and are now, or were in past times, forested. The surface deposits largely consist of highly permeable accumulations of sand, gravel, pebbles and ferruginous concretions. The exceedingly high permeability of the soil, in which water may be stored in a quantity roughly equal to three years' rainfall, is a distinctive feature of the region and one that profoundly affects the type of vegetation occurring upon it.

The climate of the Planalto is one of marked diurnal variation in temperature and of distinctly seasonal rainfall. Daytime temperatures are generally high and the nights cool enough to induce extremely heavy dew. Rainfall is largely confined to the months from October through April with little rainfall during May or September, and rarely any at all from June through August. Our visit to the region in 1956 was met by somewhat unseasonable rainfall which extended well into the month of May and prolonged by several weeks the flowering season of the herbaceous plants. Good collecting, therefore, continued almost to the end of our encampment in mid-June.

Notwithstanding the widespread misconception to the contrary, approximately half of the lands of Brazil are covered, not with dense, tropical forests, but with poor vegetations such as grasslands, scrub forests and thorn bush. Almost the whole state of Goiás lies outside the heavily forested region and is largely occupied by a scrub forest and grass vegetation known as *campo cerrado* or, simply *cerrado*. About three quarters of the Planalto Centrál with which we are concerned here is covered with *cerrado* vegetation (Fig. 1). This consists of

[4]Geographical Review 38:529-554. 1948.

[5]A recent paper which should be mentioned here is Geraldo Mendes-Magalhães' Caracteristicas de alguns tipos floristicos de Minas Gerais (Brasil) I. Bol. Soc. Portug. Ciências Nat. ii, 5(2): 91-113. 1955.

Fig. 1. *Cerrado* vegetation as seen in the vicinity of Camp I north of São João da Aliança, April 1956.

low, twisted trees 3 to 8 m. tall, with irregular crowns, thick, corky bark, and large, leathery leaves that, for the most part, remain on the trees into the second half of the dry season, and some through to the end. The ground cover is of tall grass and scattered low shrubs.

To understand the nature of the *cerrado* one must consider the ecology of the region in comparison with that of adjoining areas supporting different floras. Firstly, as indicated above, the *cerrado* is subject to a prolonged dry season, usually completely rainless from May through September. This seasonal rainfall sets the region apart from the rainforest territories to the north and west in the Amazon Basin. Secondly, the *cerrado* vegetation occupies an extremely porous soil with immense water reserves equal to the total rainfall of two or three years. This soil condition is the principal factor governing the distinction of the *cerrado* from the *caatinga* vegetation to the east and northeast in Bahía and Pernambuco states. In the *caatinga,* which consists of thorn brush and columnar cacti, the rainfall may be from less than half to nearly as much as in the *cerrado,* but evaporation is high and there are no water reserves in the soil during the whole year. The *caatinga* does not contain a prominent element of broad-leaf, non-deciduous small trees such as occur in the *cerrado.*

The explanation of the occurrence of a broad-leaf, essentially evergreen vegetation in an area subject to intense insolation and prolonged seasonal drought has been given by Mario G. Ferri in a comparative study of the water economy of the *cerrado* and *caatinga* vegetation.[6] He found the *cerrado* to be made up of plants with three principal types of behavior, namely, 1) those without any restriction of water expenditure throughout the dry season; 2) those with a small restriction at the end of the dry season; and 3) those with some restriction at the beginning and throughout the dry season. Of these, all but a few of the plants exhibited a type 1 behavior in direct opposition to the situation in the *caatinga* vegetation where all plants showed a pronounced restriction of water expenditure even during the rainy season. He found the unrestricted transpiration in the leaves of *cerrado* plants due to the continuously open condition of the stomata. In most cases they do not close at all, and compensation for the consequent water loss is affected by efficient transport of water from the virtually unlimited reserves in the soil.

Although the majority of the deep-rooted trees and shrubs of the *cerrado* remain more or less green throughout the dry season, the herbaceous vegetation becomes completely dead and dry by June or July, and

[6]Univ. de São Paulo, Fac. de Fil., Ciên. e Letras, Boletim 195 (botanica 12): 1-170. 1955.

Fig. 2. A view on the Chapada dos Veadeiros to show a narrow gallery forest following the course of a small stream. In the foreground is *campo sujo* grading into *campo limpo* across the stream. Note the numerous low termite mounds overgrown with grass and indicating the former presence of woody vegetation.

is susceptible to man-made fires which burn over nearly the whole of the Planalto, and, indeed, much of central Brazil, every year. The firing, as currently practiced by the Brazilian *fazendeiros* to keep the land open for grazing or to clear it for agriculture, is not a modern innovation. The Indians have for centuries used burning as a means of obtaining game animals whose taste for the succulent, fresh vegetable shoots coming up after the fires made them an easy prey. As a result of these destructive practices the stature of the vegetation has steadily been reduced and the scrubby *cerrado* extended at the expense of heavier forest which has been pushed back to the margins of streams and swamps in many areas. Thus, the *cerrado* is surely not a climax vegetation, for it does not seem to represent the maximum vegetation that the ecological conditions can maintain. Indeed, one sees in areas of especially severe and frequent burning the deterioration of even the scrubby, fire-resistant *cerrado* to produce *campo sujo* or clean grasslands *(campo limpo)* in which trees and shrubs are all but eradicated (Fig. 2). On the other hand, one can find occasional small areas that have been protected in some way for several years from the fires. In these the *cerrado* vegetation has become tall and close (known as *cerradão),* and there is evidence that continued protection would give rise to the development of the *mato de segunda classe* or second class forest described by Waibel, such as now persists along most of the streams and rivers of the Planalto.

Next to the *cerrado,* this second class forest is the most prominent vegetation type in the Goiás highlands. It consists of trees 12 to 20 m.

tall that become up to 30% leafless during the dry season. It does not often occur in extensive stands, but rather in patches, in depressions or at the headwaters of streams and rivulets. Usually these island forests become narrow gallery forests downstream as they confine themselves to the banks of the streams and rivers and stand in sharp contrast to the open *cerrado* and grassy *campo sujo* vegetation which adjoin them (Fig. 2).

Occasionally in the Planalto one encounters a third type of vegetation where exceptionally favorable soil fertility, ample water, and long freedom from fire have given rise to a heavy, three-layered forest, the *mato de primeira classe.* A considerable amount of this fine forest type occurs in the Serra Dourada area (Fig. 3), and a small patch was observed in the Chapada dos Veadeiros. Its upper layer consists of a canopy of trees 20 to 30 m. tall that are almost all deciduous during the dry season; the second layer of trees is 5 to 15 m. tall and mostly retains its leaves all year, while the forest floor layer of herbs and shrubs are evergreen. Despite the magnitude of the trees and the density of growth, neither this nor any forest of the Planalto exhibits a conspicuous element of lianas or epiphytes such as are so prevalent in Brazilian forests subject to more regular and uniform rainfall.

COLLECTING AREAS

The first botanical collections were made April 13 to May 7 in the vicinity of Base Camp I located 20 km. north of São João da Aliança adjoining a small tributary of the Rio Tocantinzinho (see map 2). The camp was situated in a grassy clearing on a low, spreading knoll elevated 8 to 15 m. above two small streams to the south and north. The vegetation immediately surrounding camp consisted of *cerrado* (Fig. 1), and, where burning appeared to have been more frequent or complete, of *campo sujo* with only scattered low shrubs, sparse trees and tall grass among which numerous termite mounds indicated the former presence of woody vegetation (Fig. 2). The herbaceous vegetation was coming into full flower by mid-April, and was kept in growing condition beyond its usual time by the frequency of rains which, after two weeks drought, began to fall on April 22 and continued almost daily into May as moderate to heavy showers. It was notable that even during the heaviest rains, the large quantities of water pouring off the tents and canvas flies of the camp were almost immediately taken up by the ground with scarcely any runoff of more than a few minutes duration. The soil was constantly wet, and within only three weeks' time the bottoms of the tents had begun to rot out. The streams flowed at nearly the same volume on rainy days as on dry ones.

Nightly dew was extremely heavy, even to the point of moderate

Fig. 3. First class forest on the road east of Formoso, May 1956.

condensation inside the tents. Partial compensation for the disadvantages of the moisture was afforded by the comfort of the pleasantly cool nights, but early morning collecting excursions through the *cerrado* or the streamside vegetation were never less than a thoroughly soaking experience.

Two hundred meters to the south was the nearest forested area, consisting of moderate to well-developed second class gallery forest narrowly following the course of the stream known on the south bank as

Jatobá and on the north bank as Pedras de Amolar. This forest was conspicuous in its lack of prominent epiphytic growths, of lianas, or of large ferns. Palms were not altogether prominent, although they were common in large patches downstream a few kilometers from camp.

Upstream a few hundred meters and east of camp was a shallow pond and marsh characteristic of the Planalto throughout which shallow lakes, marshes and springs of various sizes occur abundantly on the surface of the water-filled soil.

Above the camp to the east, and westward across the river to the highest visible point (at perhaps an elevation of 1200 meters), the *cerrado* vegetation continued interruptedly, broken by larger or smaller areas of open *campo sujo*, or the clean *campo limpo* grasslands. Throughout the area there was evidence of burning during each of several previous years. Only in a small area five km. south of camp was there a well-developed *cerrado* vegetation which had been permitted, by some natural barrier against fire, to grow up during several successive years without burning. Along the road cut through this *cerradão* one could fine good specimen plants of *cerrado* trees and shrubs which elsewhere were markedly reduced.

A quality of vegetation approximating in height and luxuriance the *mato de primeira classe* as described by Waibel was encountered only in a small patch on a wet hillslope above a meandering stream 2 km. south of camp. Several species of forest palms and large ferns occurred there and not in the lower, second class forest.

Rocky outcrops in the vicinity of Base Camp I were negligible, but 35 to 60 km. to the north, in the vicinity of Veadeiros, extensive sandstone outcrops (Fig. 5) occurred in a more broken terrain of rocky hills and buttes separated by sweeping grassy valleys (Fig. 4) with numerous marshes, small lakes and countless springs. Roughly eroded sandstone hillsides provided the first collections of succulent terrestrial xerophytes, including cacti, in a semi- *caatinga* vegetation distinct from the *cerrado*. Some of these rocky outcrops, with their columnar cacti and comparatively sparse vegetation of somewhat sonoran desert aspect, were surrounded by abundant springs and seepages and extensive marshy grasslands sloping down to streamside bogs in the valleys. Even in the most elevated portion of the Chapada dos Veadeiros, near the tops of the hills on the road from Veadeiros to Cavalcante (el. 1350 m.), the ground during our visit in early May was saturated with water that poured from innumerable springs.

Collections from May 12 to June 15 were made out of Base Camp II located in the southern Serra Dourada 20 km. east-southeast of Formoso in Amaro Leite County. The camp was situated in one of the few small

Fig. 4. (Above) An extensive *campo limpo* area on the road from São João da Aliança to Veadeiros. The hills in the background are in part openly eroded sandstone.

Fig. 5. (Below) A sandstone outcrop 7 km. south of Veadeiros.

open *cerrado* areas, on a flat hill shoulder near the top of the sub-range known as Serra do Rodovalho.

The vegetation of the immediate surroundings consisted of a typical, well-developed *cerrado* on the hills and flats to the east and north for 300 to 600 meters beyond which the growth enlarged to gallery forests along converging streams. To the immediate west of camp a very small rivulet flowed through hills showing numerous rocky outcrops, into a large rock basin which provided washing facilities, and then on through an enlarging gallery forest to the north. Upstream the vegetation was typical *cerrado* except for a narrow line of small trees and bushes standing in the stream. Xerophytic bromeliads grew on the rocks of the area, but no other terrestrial succulent occurred on the typically *cerrado*-type soil of high water reserve.

During the middle of May the herbaceous vegetation was in well advanced flowering and the grasses nearly gone. The decline continued to a late stage by mid-June. The flowering of the arboreal vegetation in the *cerrado* and gallery forests was spotty in May and somewhat more widespread in June, but it was clear that flowering of perennial species occurs at various times of the year depending upon the individual species.

A few moderate to heavy showers fell during May as the unusually late rainy season drew to a close. By early June the weather became completely dry and hot by day with temperatures to 35.5° C., and cool and exceedingly dewy at night with temperatures as low as 8° C.

The Serra Dourada seems to be an area favored by the infrequency and limited extent of fires, so that the encroachment of *cerrado* into the generally prevalent second and first class forest has not been as extensive as in the Chapada dos Veadeiros. A great many small rivulets and streams dissect the low, mountainous region east of Formoso, and, not only do gallery forests follow all of these watercourses, but often fill in more or less continuously between stream beds to form extensively forested tracts. Except for small, favored spots supporting heavier and taller growth, most of the forest would correspond to the second class category described by Waibel. But, beginning on the Rio Cristalino, tributary of the Ribeirão Cannabrava of the Rio Tocantins, about 32 km. east of Formoso, a tract of forest approximating the quality of the *mato de primeira classe* extends (to judge from our aerial reconnaissance maps) continuously east, south and north for a considerable distance. The edge of this forest marks the limits of vehicular transportation and the frontier of human exploitation of the Serra Dourada lands.

The elevated region within a 10 km. radius of Base Camp II, thus, exhibited a far denser vegetation than that surrounding Base Camp I.

Instead of a dominance of *cerrado* and *campo sujo,* the former of these vegetations was only moderately developed, and the latter nearly absent. For the most part a *cerradão* occupied most of the hill slopes and crests with second class forest along the streams and bottom lands and flats, grading, in the most favorable situations, into first class forest. Unlike the Chapada dos Veadeiros area, prominent growths of large tree ferns commonly occurred along the heavily forested streams together with a greater abundance of palms (Fig. 3) and a somewhat greater prominence of epiphytes.

A partial explanation for the denser vegetation in the Serra Dourada may be found in the somewhat lower elevation there (800-1000 m.) and apparently greater rainfall and humidity. But it seems certain from a comparison with the Chapada dos Veadeiros that the lesser frequency and extend of fires has contributed in larger measure to the retention of closed forests on much of the land that might otherwise have been reduced to *cerrado.*

In the lower lands (500-650 m.), along the old trailways between Amaro Leite and Peixe, there appeared to be a much greater extent of devastation on account of fire, and the proportion of *cerrado* to second class forest was very large. Indeed, *cerrado* vegetation, broken mostly by rather low, poor, streamway gallery forests dominated much of the area between Formoso, at the foot of the Serra Dourada, and Peixe on the Rio Tocantins, 250 km. by road to the north. Between June 1 and 10 a modest number of collections of both plants and animals were made along this route as supplements to the more comprehensive collections in the immediate vicinity of Base Camp II.

COLLECTING STATIONS AND FIELD NUMBERS

The plant collections were recorded under 1104 field numbers between April 13 and June 7, 1956. All of these were obtained in central Goiás in the regions north and northeast of Anapolis. Numbers 14133 to 14815 were obtained in the Chapada dos Veadeiros region, and numbers 14810 to 15236 between Ceres and Peixe, especially in the southern Serra Dourada. More detailed locality data are given below.

* * *

14133-14232. In open grassland and *cerrado* margin on the east side of the road 20 km. north of São João da Aliança, Apr. 13-15.

14233-14260. Along the margins of a small marsh ½ km. east of the road, 20 km. north of São João da Aliança, Apr. 15.

14261-14276. In the *cerrado* area about 2 km. east of the road, 20 km. north of São João da Aliança, Apr. 16.

14277-14294. On an open grassy hilltop about 2½ km. northeast of the road, 21 km. north of São João da Aliança, Apr. 16.

14295-14376. In and along the gallery forest 20 km. north of São João da Aliança, Apr. 16-17.

14377-14424d. Between the gallery forest and the west side of the road 20 km. north of São João da Aliança, Apr. 19.
14425-14439. In the *cerrado* on the east side of the road 20 km. north of São João da Aliança, Apr. 19.
14440-14454. In the *cerrado* 16 km. north of São João da Aliança, Apr. 19.
14455-14458. On a stony hillside 14 km. north of São João da Aliança, Apr. 19.
14459-14463. Along the river bank of the Ribeirão Capetinga 19 km. north of São João da Aliança, Apr. 19.
14464-14470. In the *cerrado* 21 km. north of São João da Aliança, Apr. 20.
14471-14476. In the gallery forest margin west of the road 21 km. north of São João da Aliança, Apr. 20.
14477-14483. In a small wet ravine west of the road 21 km. north of São João da Aliança, Apr. 20.
14483. In grassland 20 km. north of São João da Aliança, Apr. 20.
14484-14496. In a grazed area along a stream east of the road 18 km. north of São João da Aliança, Apr. 20.
14497-14517a. In a forested area along a meandering stream 18 km. north of São João da Aliança, on the east side of the road, Apr. 21.
14518. On a sandstone outcrop on a hillcrest 54 km. north of São João da Aliança, Apr. 22.
14519. On a sandstone outcrop above the meadow 7 km. south of Veadeiros, Apr. 22.
14520a. On a sandstone outcrop 500 m. west of the road, 14 km. south of Veadeiros, Apr. 25.
14520-14527. On a sandstone outcrop 15 km. northwest of Veadeiros on the Cavalcante road, Apr. 22.
14529-14538. On the east side of the road, 18 km. north of São João da Aliança, Apr. 23.
14539-14557a. In grassland and margin of *cerrado* near the road, 38 km. north of São João da Aliança, Apr. 25.
14558-14570. Along the road 21 km. north of São João da Aliança, Apr. 28.
14571-14574. In a wet grotto 5 km. west of Veadeiros, Apr. 29.
14575. Along the road 8 km. west of Veadeiros, May 1.
14576-14577. On the Nova Roma road, 5 km. north of Veadeiros, Apr. 30.
14578. On a dry stony flat on the butte 5 km. west of Veadeiros, May 1.
14580-14607. On the sandstone outcrop 7 km. south of Veadeiros, Apr. 24.
14608-14638. Along the wet, sandy margins of the sandstone outcrop 7 km. south of Veadeiros, Apr. 24.
14639-14650. In the boggy field west of the road, 7 km. south of Veadeiros, Apr. 24.
14651-14656. On the edges of an island forest in the meadow 7 km. south of Veadeiros, Apr. 24.
14657. Along the dry margin of the meadow 7 km. south of Veadeiros, Apr. 24.
14658-14664. On a hillslope in the sandstone area just west of the road, 14 km. south of Veadeiros, Apr. 25.
14665-14669. At a boggy spring in the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.
14670-14673. On a grassy hillslope near the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.

14674-14675. On rocks in the stream below a small falls in the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.
14676-14688. On the sandstone rocky area along the west stream bank, west of the road, 14 km. south of Veadeiros, Apr. 25.
14689-14690. In a small spring bog in the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.
14691-14695. Along the road on the rocky ridge 14 km. south of Veadeiros, Apr. 25.
14696-14701. On bridge timbers 21 km. north of São João da Aliança, Apr. 27.
14702. On a forest log 18 km. north of São João da Aliança, Apr. 24.
14703-14705. In the sandstone rocky area on the west side of the stream and west of the road, 14 km. south of Veadeiros, Apr. 25.
14706. Along the road 7 km. south of Veadeiros, Apr. 24.
14707. On sandstone 16 km. north of São João da Aliança, Apr. 25.
14708-14709. In the sandstone area 14 km. south of Veadeiros, Apr. 26.
14710-14725. On the slopes and shoulder of the sandstone butte 5 km. west of Veadeiros, Apr. 29.
14726-14727. In a meadow grassland 6-7 km. west of Veadeiros, Apr. 29.
14728-14732. Along a stream at the fazenda 9 km. west of Veadeiros, Apr. 30.
14733-14737. Along an oxcart road 15 km. north of Veadeiros, Apr. 30.
14738-14751e. Near the road, 4 km. north of Veadeiros, Apr. 30.
14752-14765. Medicinal plants collected about the town of Veadeiros, Apr. 30.
14766-14767. Along a roadside just north of Veadeiros, Apr. 30.
14768-14803. Along the Cavalcante road 8-10 km. northwest of Veadeiros, May 1.
14804-14807. In a gallery forest 20 km. north of São João da Aliança, May 3.
14809. In a stream crossing the Cavalcante road at 15 km. north of Veadeiros, Apr. 25.
14810-14813. In a *cerrado* area 28 km. southwest of Veadeiros, May 3.
14814-14815. In *cerrado* along the road, 38 km. south of Veadeiros, May 3.
14816-14836. In the *cerrado*-gallery forest margin 20 km. east of Formoso, May 15.
14837-14923. Along banks and margins of small stream running through *cerrado* and into gallery forest 20 km. east of Formoso, May 16-17.
14924-14946. In deep forest along the Rio Cristalino 25 km. east of Formoso, May 18.
14947-14954. In the gallery forest area 20 km. east of Formoso, May 18.
14955. On the sandstone rocky outcrop about 40 km. south of Uruaçú on the Ceres road, May 12.
14956-14963. Along a small stream running through *cerrado* 20 km. east of Formoso, May 18.
14964-14988. In the margins and interior of gallery forest about 17 km. east of Formoso, May 19.
14989-14993. Near the road, 20 km. east of Formoso, May 19.
14994-15010. Along and near an affluent of the Ribeirão Cannabrava about 28 km. east of Formoso, May 20.
15011-15013. In the vicinity of the road, 20 km. east of Formoso, May 20.
15014-15016. In the forested area about 28 km. east of Formoso, May 20.
15017-15032. In the forested area east of the Rio Cristalino about 34 km. east of Formoso, May 21.
15033-15042. Along the stream margins about 22 km. east of Formoso, May 21.

15043-15071. In forest and forest margin along the road between 22 and 33 km. east of Formoso, May 22.
15072-15083. In forest margin and *cerrado* 18 km. east of Formoso, May 23.
15084-15085. In forest, 17 km. east of Formoso, May 23.
15086-15087. In forest, about 24 km. east of Formoso, May 23.
15088. In the forested area 20 km. east of Formoso, May 23.
15089-15101. Along the road 10 to 13 km. east of Formoso, May 24.
15102. In gallery forest 22 km. east of Formoso, May 23.
15103-15108. In the vicinity of the road at 20 km. east of Formoso, May 24.
15109-15110. On a sandstone outcrop 3 km. south of Uruaçú, May 25.
15111. On a sandstone outcrop 3 km. west of Formoso, May 26.
15112-15116. On a rocky sandstone hilltop 16 km. east of Formoso, May 27.
15118. In the forest 22 km. east of Formoso, May 24.
15119. On a palm in the forest margin 12 km. east of Formoso, May 25.
15120. Cultivated at Amaro Leite from a nearby woodland, May 25.
15121-15135. In heavy forest along the road, 13 km. east of Formoso, May 28.
15136. In a drying road puddle 2½ km. southwest of Peixe, June 1.
15137. Cultivated at Peixe, May 31.
15138. In a road puddle 5.8 km. southwest of Peixe, June 2.
15139-15143. In a shallow vernal swamp 11.5 km. southwest of Peixe, June 2.
15144. In a road puddle 14 km. southwest of Peixe, June 2.
15145-15146. In a road puddle 18 km. southwest of Peixe, June 2.
15147-15155. Along a small flowing stream in the sun 25 km. southwest of Peixe, June 2.
15156. In a flowing rivulet 30 km. southwest of Peixe, June 2.
15157. In a flowing rivulet 32 km. southwest of Peixe, June 2.
15158-15164. In and beside a flowing rivulet 35 km. southwest of Peixe, June 2.
15165. In a slow moving stream 41 km. southwest of Peixe, June 2.
15166. In a flowing stream 43 km. southwest of Peixe, June 2.
15167-15169. In a fast flowing stream 48 km. southwest of Peixe, June 2.
15170-15174. Along the bank of the Rio Santa Teresa 50 km. southwest of Peixe, June 2.
15175-15176. On a rock outcrop 80 km. southwest of Peixe, June 2.
15177-15178. In a very slow moving rivulet 124 km. south-southwest of Peixe, June 3.
15179-15186. Along a small rivulet 127 km. south-southwest of Peixe, June 3.
15187. In a road puddle 137 km. south-southwest of Peixe, June 3.
15188-15191. In a drying rivulet in the forest 140 km. south-southwest of Peixe, June 3.
15192-15198. In a forest stream and marginal area 143½ km. south-southwest of Peixe, June 3.
15200-15217. Along a small stream flowing over rocks 20 km. east of Formoso, June 4.
15218-15227. Along the road 15-20 km. east of Formoso, June 4.
15228-15232. In a small stream flowing over rocks 21 km. east of Formoso, June. 6.
15233-15234. In the *cerrado* area 20 km. east of Formoso, June 7.
15235. Along the road 8 km. east of Formoso, June 8.
15236. On a rocky outcrop beside a small stream flowing through *cerrado* 20 km. east of Formoso, June 10.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ber 3 January 25, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: A New Dodder from Goiás, *Cuscuta burrellii*

By T. G. Yunker*

Stems filiform, yellow or reddish when dry; flowers 5-parted, reddish-yellow in the dry state, about 4 mm. long from the base to the tip of the erect corolla lobes, on pedicels usually scarcely 1 mm. long, in compact several [5-8 or more] -flowered cymules; lower part of the calyx, the pedicels, and adjacent parts of the stem strongly papillate; calyx campanulate, deeply divided to near the base, the lobes ovate-lanceolate, overlapping at the base, medianly thickened, caudately acuminate, reaching the middle of the corolla lobes, or more; corolla shallowly campanulate, fleshy, papillate toward the base, deeply divided, the lanceolate, slenderly acuminate lobes much longer than the united basal part, erect [or spreading when fully mature?]; stamens short, in the sinuses of the corolla lobes, the ovate anther longer than the filament; infrastamineal scales reaching the stamens, strongly fringed, bridged at about the middle; styles terete, about equaling the ovoid ovary, the stigmas globose-capitate; capsule not seen.

Figs. a - d

Caules tenuissimi; flores 4 mm. longi breviter pedicellati in inflor-oscentibus compactis papillati; calycis lobi imbricati ovati-lanceolatis longe-acuminatis; corollae lobi lanceolati acuminatissimi longiores quam tubus brevis campanulatus; squamae fimbriatae ad stamina attingentes; styli tenues aequantes ovarium ovoideum; stigmata globosa; capsula non visa.

Distribution: Known only from the type locality.

Brazil: Goiás: region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 30′, on an open grassy hilltop about 2½ km. northeast of the road, 21 km. north of São João da Aliança, on herbaceous

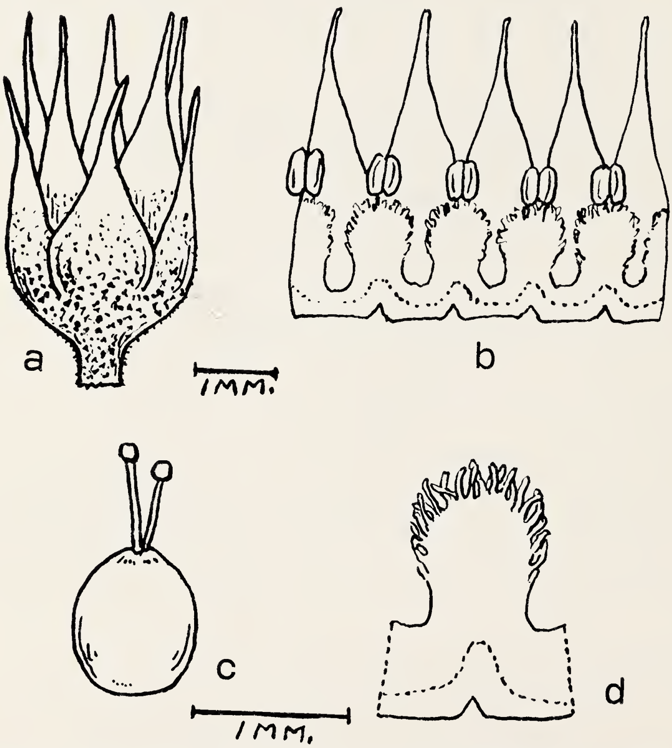
*Professor of Botany, DePauw University, Greencastle, Indiana.

hosts, April 16, 1956, *E. Yale Dawson 14278* (*type*, in herb. R; duplicate types in herb. LAM and in herb. DPU).

No mature capsules are present on the material studied, and it is impossible to determine whether they remain closed or become circumscissile when mature. The other characters, however, are sufficiently distinctive, it is believed, to warrant considering the specimen as representing an undescribed species.

The deeply divided calyx and corolla, with long-pointed lanceolate lobes and strongly papillate parts are noteworthy characters. The material bears no close resemblance to any other known species. If the capsule proves to be circumscissile it would fall in the subsection Odontolepisae which includes, for the most part, Mexican and South American species. If, on the other hand, the capsule is not circumscissile, it would be best placed in the subsection Acutae comprising mostly South American species.

The specific name honors Mr. Harry F. Burrell, Expedition Cinematographer, whose collaboration with Dr. Dawson in the field led to the discovery of this plant.



Cuscuta burrellii Yunker n. sp. *a.* flower at early anthesis; *b.* interior view of opened corolla; *c.* ovary; *d.* infrastamineal scale in detail.

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CONTRIBUTIONS
IN SCIENCE

mber 4 February 18, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: The Lichens

By Carroll W. Dodge*

The collection of lichens accounted for below was obtained on a Los Angeles County Museum expedition to Goiás, Brazil, sponsored by Mr. and Mrs. Maurice A. Machris. They were collected by E. Yale Dawson during April, 1956, in the vicinity of the Expedition's Base Camp I in the Chapada dos Veadeiros, Goiás, between the towns of São João da Aliança and Veadeiros. More detailed locality data for his field collection numbers cited below may be found in Dawson's general account of the botany of the Expedition which appeared as number 2 of this series. The first set of specimens is deposited at the Los Angeles County Museum and a partial duplicate set at Washington University, St. Louis.

Anaptychia barbifera (Nyl.) Trev. 14424b Very well developed.

Anaptychia comosa (Eschw.) Trev. 14424a An unusually well developed specimen

Anaptychia hypoleuca (Muhlenb.) Vainio 14307; 14424

Anaptychia hypoleuca var. *sorediifera* Müll. Arg. 14358

Cladonia diplotypa Nyl. 14684 Rarely collected.

Cladonia fimbriata (L.) Fr. var. *chondroidea* Vainio 14355

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*Professor, Shaw School of Botany, Washington University, St. Louis, Missouri

Coenogonium subvirescens Nyl. 14516 (fertile) This is usually sterile when collected.

Parmelia fasciculata Vainio 14336

Parmelia viridescens Lynge? 14338 The type is from Matto Grosso. *P. osseoleuca* is very close in thalline characters, but differs in apothecial characters; its type is from Colombia. This specimen is sterile.

Parmelia wettsteinii Zahlbr. 14526

Pseudocyphellaria clathrata (DNtrs.) comb. nov. 14356 Basonym: *Stichta clathrata* De Notaris, Mem. R. Accad. Sci. Torino II, 12: 150, pl. 1, f. 4. 1851. So far as I have any record this combination has not been made. In the nomenclature discussions before the Paris Congress, I preferred to recognize *Crocidia* Link for this genus instead of conserving *Pseudocyphellaria* Vainio, but I believe I was overruled. Vainio described this plant as *P. aurora* from Brazil.

Siphulastrum sp. 14322a This is perhaps an undescribed species, but it is much too young for description. The genus has not previously been reported from so far north.

Sticta (Stictina) weigelii (Isert) Stzbgr. var. *ciliata* (Müll. Arg.) Zahlbr. 14742

Usnea subhirta (Vainio) Motyka 14337

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

nber 5 February 19, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Cyanophyta

By Francis Drouet*

The specimens of Blue-green Algae listed below were obtained on a Los Angeles County Museum expedition to Goiás, Brazil, sponsored by Mr. and Mrs. Maurice A. Machris. They were collected between April 15 and June 3, 1956, by the expedition botanist, E. Yale Dawson, and bear his field collection numbers. All but two came from the region of central Goiás between the southern Serra Dourada east of Amaro Leite, and Peixe on the Rio Tocantins. Numbers 14349a and 14481 are from the Chapada dos Veadeiros north of São João da Aliança. More detailed locality data may be found by consulting Dawson's general account of the botany of the Expedition issued as number 2 of this series. The first set of specimens is deposited in the Los Angeles County Museum Herbarium, and a duplicate set is at the Chicago Natural History Museum.

Amphithrix janthina (Mont.) Born. & Flah. 15207, with *Calothix parietina*

Anacystis montana (Lightf.) Dr. & Daily 15208b, with *Calothrix adscendens* and *Scytonema myochrous*

Calothrix adscendens (Näg.) Born. & Flah. (young) 15208, with *Scytonema myochrous* and *Anacystis montana*

Calothrix parietina (Näg) Thur. 14989b, with *Capsosira brebissonii and Scytonema mirabile;* 15207a, with *Amphithrix janthina*

*Curator, Cryptogamic Botany, Chicago Natural History Museum, Chicago 5, Illinois

Capsosira brebissonii Kütz. 14989, with *Scytonema mirabile* and *Calothrix parietina*

Gloeotrichia natans (Hedw.) Rabenh. 15160

Gloeotrichia pisum (Ag.) Thur. 14845

Hapalosiphon fontinalis (Ag.) Born. 15139

Lyngbya putealis Mont. 15177; 15185; 15192

Nostoc verrucosum (L.) Vauch. 14846

Phormidium inundation Kütz. 15188

Phormidium papyraceum (Ag.) Gom. 15145

Phormidium retzii (Ag.) Gom. 15211; 15215

Plectonema tomasinianum (Kütz.) Born. 14481

Scytonema hofmannii Ag. 14349a

Scytonema mirabile (Dillw.) Born. 14989a, with *Capsosira brebissonii* and *Calothrix parietina*

Scytonema myochrous (Dillw.) Ag. 15202; 15208a, with *Calothrix adscendens* and *Anacystis montana*

Stigonema mamillosum (Lyngb.) Ag. 15231

Tolypothrix tenuis Kütz. 15204a

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

mber 6 February 20, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: A New Mint from Goiás, *Hyptis machrisae*

By Carl Epling*

Hyptis (Hypenia, Laxiflorae, 43a) *machrisae* sp. nov. Herba perennis altitudise 2 m. caulibus in basi duris superne glabris nisi sparse et minute glandulosis, internodiis quam folia brevioribus; foliorum laminis duris sessilibus ovatis 9-10 cm. longis 6-8 cm. latis in basi et apice rotundatis, marginibus crenatis utrimque glabris venulosis; floribus in paniculis amplis diffusis pedicellis filiformibus 1-2.5 cm. longis elatis; calycibus florentibus campanulatis 3 mm. longis dentibus ovatis obtusis, maturis non visis; corollarum violacearum tubo campanulato 3-4 mm. longo.

A perennial herb 2 m. tall with ascendent branches that are glabrous in the upper parts unless minutely and sparsely glandular, their internodes shorter than the leaves on the specimen at hand; leaf blades tough and apparently leathery, sessile, ovate, 9-10 cm. long, 6-8 cm. broad, rounded at both base and tip, glabrous on both surfaces and venulose: flowers in ample, diffuse panicles, borne on filiform pedicels 1-2.5 cm. long; flowering calyces campanulate, 3 mm. long, the teeth ovate and obtuse; mature calyces not seen; corolla violaceous, its tube campanulate, 3-4 mm. long.

Figs. 1, 2

Distribution: Known only from the type locality.

BRAZIL: Goiás: region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 30′, on the margin of a small, marshy pond about

*Professor of Botany, University of California, Los Angeles 24, California

Fig. 1. *Hyptis machrisae* sp. nov. The type material, sheet 1, showing a lower, vegetative part of a plant with its distinctive leaves.

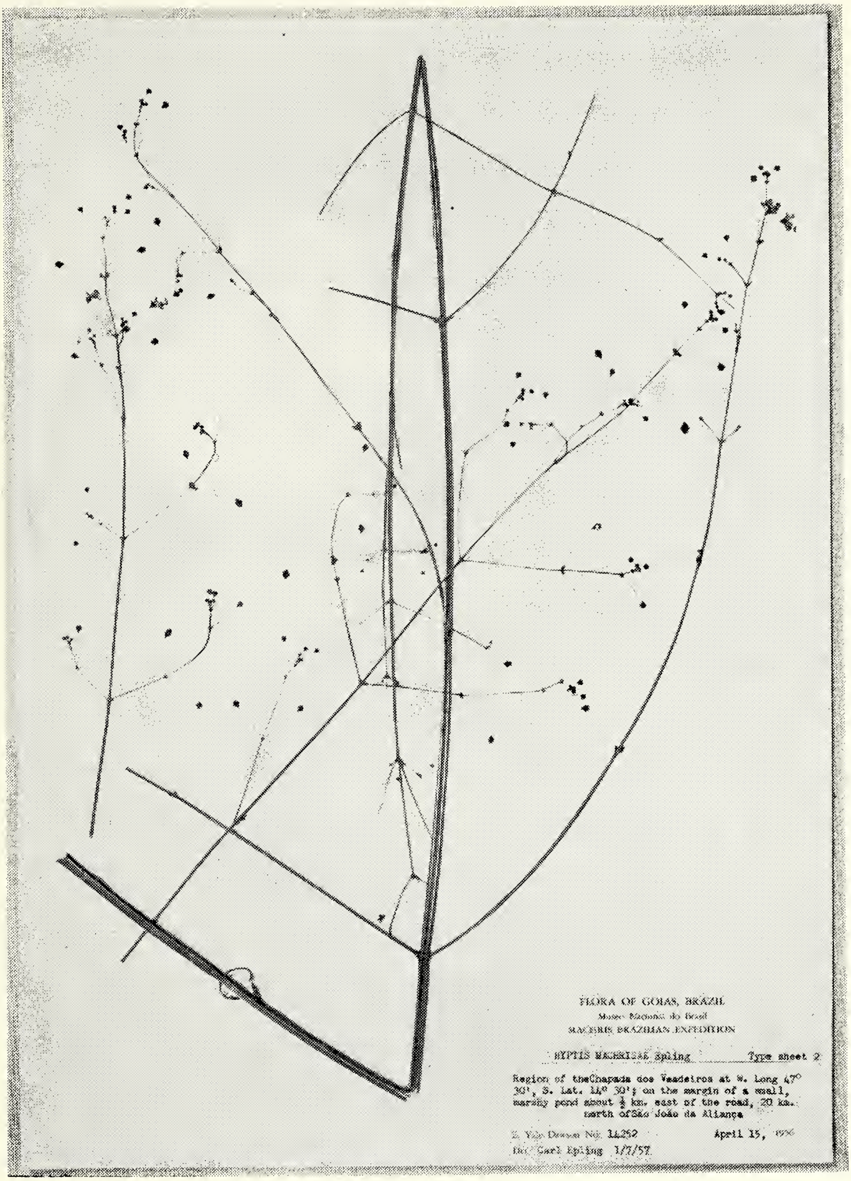

Fig. 2. *Hyptis machrisae* sp. nov. The type material, sheet 2, showing parts of an inflorescence.

½ km. east of the road, 20 km. north of São João da Aliança, April 15, 1956, E. Yale Dawson 14252 (*type*, in herb. R; duplicate types in herb. LAM and in herb. LA).

This plant is very similar in inflorescence to *Hyptis effusa* S. Moore, found at Santa Ana de Chapada, Matto Grosso, but is readily distinguished by its tough, glabrous, ovate, sessile leaves.

The specific name honors Mrs. Paquita Machris, co-sponsor of the 1956 expedition to Goiás, Brazil, from the Los Angeles County Museum.

The photographs were prepared by Mr. Lewis H. Athon.

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

mber 7 March 7, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamæ, various smaller families

Edited by E. Yale Dawson

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

HILDEGARDE HOWARD
Chief Curator of Science
EDITOR

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamæ, various smaller families

Edited by E. YALE DAWSON*

The plant collections listed below were obtained on a Los Angeles County Museum expedition to Goiás, Brazil, sponsored by Mr. & Mrs. Maurice A. Machris and conducted under the auspices of the Museu Nacional do Brasil. Each identified specimen is indicated by a citation of my field collection number. Detailed locality data for these may be found in the general account of the botany of the Expedition which appeared under my name as number 2 of this series. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13-May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15 to June 10, 1956.

The identifications have been made and annotated by a number of specialists as indicated with the name of each family. I wish here to thank them for their prompt cooperation in this work.

The first set of specimens is deposited at the Los Angeles County Museum except for holotypes which are deposited in the Museu Nacional do Brasil in Rio de Janeiro. Duplicate specimens, when available, have been retained by the respective cooperating specialists.

The photographs were prepared by Mr. Lewis H. Athon.

The families are arranged alphabetically. Reports on others will follow as the work progresses.

ANNONACEÆ

det. by Robert E. Fries, Floragatan 3, Stockholm, Sweden

Anaxagorea dolichocarpa Sprague et Sandw. 15131 This species is very variable and has a wide distribution from Venezuela to Rio de Janeiro.

Annona malmeana R. E. Fr. 14444 This species is known heretofore only from Matto Grosso, Brazil, and from Paraguay. The find in Goiás is interesting.

*Expedition Botanist, Los Angeles County Museum.

APOCYNACEÆ

det. by Joseph Monachino, The New York Botanical Garden, New York 58, N. Y.

Macrosiphonia velame (St. Hil.) Müll. Arg. 14278a; 14549

Macrosiphonia martii Müll. Arg. 14562; 14729

Allamanda angustifolia Pohl 14661

Stipecoma pettigera (Stadelm.) Müll. Arg. 14682

Mandevilla hirsuta (A. Rich.) K. Sch. 14734 This is a variant with sparsely hirsute leaves and linear bracts.

Odontadenia hypoglauca (Stadelm.) Müll. Arg. 15072

ASCLEPIADACEÆ

det. by Joseph Monachino

Barjonia linearis Dcne. 14166

Barjonia obtusifolia Fourn. 14827; 15082 These two collections may possibly be merely forms of *B. erecta* (Vell.) K. Sch.

Ditassa virgata Fourn. 14291; 14771 The latter has larger flowers.

Number 14595 is held for further study as a probable undescribed species of this family.

BIGNONIACEÆ

det. by N. Y. Sandwith, The Herbarium, Royal Botanic Gardens, Kew, England

Memora axillaris Bur. et K. Sch. 15063 This is a form with more compound leaves than usual.

Memora nodosa (Manso) Miers 15090

Phryganocydia corymbosa (Vent.) Bur. et K. Sch. 14382

Zeyheria digitalis (Vell.) Hoehne 14415

CHENOPODIACEÆ

det. by Lyman B. Smith, U. S. National Herbarium, Washington, D. C.

Chenopodium ambrosioides L. 14759

COCHLOSPERMACEÆ

det. by Lyman B. Smith

Cochlospermum regia (Mart. et Schrank.) Pilger 14821

ERICACEÆ

det. by A. C. Smith, U. S. National Herbarium, Washington, D. C.

Gaylussacia brasiliensis (Spreng.) Meissner 14688 This is a fairly *sens. lat.* identification. The species, frequent in eastern Brazil, is widely interpreted in Flora Brasiliensis, etc.

ERIOCAULACEÆ

det. by Harold N. Moldenke, 15 Glenbrook Ave., Yonkers, New York

Eriocaulon gibbosum Körn. 14881 The species is found from Goiás southward through Bahia and Minas Gerais to Rio de Janeiro and west to Matto Grosso. Previous Goiás collections were Riedel 2416 and Weddell 2128.

Eriocaulon modestum Kunth 14655 A widely distributed species found in Brazil from Pernambuco, Piauhy, and Goiás, through Bahia, Minas Gerais, Rio de Janeiro, Matto Grosso, and São Paulo, to Paraná, Santa Catarina, and Rio Grande do Sul, and into Uruguay. A previous Goiás collection is Glaziou 22309.

Pæpalanthus acanthophyllus Ruhl. 14615 The species is known also from Bahia and Minas Gerais. A previous Goiás collection is the type, Glaziou 22323.

Pæpalanthus capanemæ Alv. Silv. 14616 Known definitely only

Fig. 1. (left) *Pæpalanthus capanemæ* Alv. Silv. Part of *Dawson 14616*, x 0.6. (right) *Syngonanthus densifolius* var. *pilosior* Alv. Silv. Part of *Dawson 14639*, x 0.6.

from Goiás. The species is based on Herb. A. Silveira 629 [Herb. Rio de Janeiro 6628] with no locality of collection designated. Fig. 1 (left)

Pæpalanthus elongatus (Bong.) Ruhl. 14779 Known also from Piauhy, Minas Gerais, and São Paulo; 6 named varieties occur in these and other states of Brazil. Previous Goiás collections of the typical form are Glaziou 22311 and Riedel 2744.

Pæpalanthus manicatus V. A. Pouls 14593 The species was known hitherto only from Minas Gerais.

Pæpalanthus scandens Ruhl. 14668 The species is known only from Goiás. Previous collections from this state are Glaziou 22296, Macedo 3584, and Ule 230, in addition to the cotypes, Glaziou 22295 and s.n., and Ule 3155.

Pælpalanthus sessiliflorus Mart. 14592 Known hitherto only from Maranhão and Bahia.

Pæpalanthus speciosus var. *glaber* Ruhl. 14271; 14826 The variety is known also from Maranhão and Minas Gerais; the typical form of the species occurs also in other states of Brazil. Other Goiás collections of the variety are Macedo 3246 and 3688, and Riedel 2747, in addition to the cotypes, Burchell 5983 and 7029, and Glaziou 19975, 22319, and 22320.

Syngonanthus anthemiflorus (Bong.) Ruhl. 14631 The species is known from Minas Gerais and from Misiones, Argentina. This is the first record from Goiás, and it is a pity that the heads are so immature as to make identification uncertain.

Syngonanthus densifolius var. *pilosior* Alv. Silv. 14639 Hitherto known only from Minas Gerais. Fig. 1 (right)

FLACOURTIACEÆ

det. by H. Sleumer, Rijksherbarium, Nonnensteeg 1, Leiden, Netherlands

Casearia grandiflora St. Hil. 15012

GENTIANACEÆ

det. by Joseph Ewan, Department of Botany, Tulane University, New Orleans 18, La.

Calolisianthus speciosus (Cham. et Schlecht.) Gilg 14290

Calolisianthus amplissimus (Mart.) Gilg 14751b

Calolisianthus macranthus Gilg 14833; 15059 There is some indication that the 14833 collection may be distinct from Gilg's species, which I have seen only from a good photograph of the type, but it is a group where the size of the corolla varies a good deal, and I am doubtful that the collection, remarkable as it is for its very large corollas, represents a different species.

Dejanira nervosa Cham. et Schlecht. 14165; 15055
Dejanira erubescens Cham. et Schlecht. 14748
Dejanira pallescens Cham. et Schlecht. 15073
Curtia patula (Mart.) Knobl. 14608; 14645
Curtia tenella Cham. et Schlecht. 14648
Schultesia gracilis Mart. 14642
Schultesia guianensis (Aubl.) Malme 14794
Schultesia brachyptera Cham. 15151
Nymphoides microphyllum (St. Hil.) Ktze. 15141

HIPPOCRASTACEÆ

det. by A. C. Smith

Peritassa lævigata (Hoffmannsegg) A. C. Smith 14379 This species is distributed from Venezuela to Rio de Janeiro, but has not otherwise been known to occur in Goiás.

LABIATÆ

det. by Carl Epling, Department of Botany, University of California, Los Angeles 24, Calif.

Hyptis rubicunda Pohl ex Benth. 14199; 14385; 14898
Hyptis conferta Pohl ex Benth. 14244
Hyptis eriophylla Pohl 14449
Hyptis glomerata Mart. 14468
Hyptis lanuginosa Glaziou 14612
Hyptis ovalifolia Benth. 14664; 14735; 14727
Hyptis interrupta Pohl ex Benth. 14823
Hyptis marifolia Benth. 14824; 14872
Hyptis lutescens Pohl ex Benth. 14835
Hyptis ?monticola Mart. ex Benth. 14836
Hyptis pycnocephala Benth. 14839
Hyptis imbricata Pohl ex Benth. 15153
Hyptis mollis Pohl ex Benth. 15169
Hyptis pachyphylla Epling 14786
Hyptis machrisæ Epling 14252 This species is described as new in paper No. 6 of this series.
Hyptis crinita Benth. 14218
Hyptis nudicaule Benth. 14464
Hyptis densiflora Pohl 14476a; 15065
Leonotis nepetæfolia R. Br. 14754
Ocimun gratissimum L. 14756
Marsypianthes chamædrys (Vahl) Ktze. 15034

MALVACEÆ

det. by Thomas H. Kearney[1]

Cienfuegesia affinis (H.B.K.) Hochr. 15052
Hibiscus (aff. *H. furcellatus* H.B.K.?) 14546; 14810
Hibiscus sabdariffa L. 15186
Lopimia malacophylla Mart. (*Pavonia* m. Garcke) 14384; 14810
Pavonia mollis H.B.K. 14425
Pavonia pterocarpa R. E. Fries? 14547 Fruit not present.
Pavonia rosa-campestris A. Juss. 14811
Pavonia sessiliflora H.B.K. 15197
Sida aurantiaca St. Hil.? 14258; 14892
Sida linifolia Juss. ex Cav. 14213; 14254; 14922
Sida rhombifolia L. 14192
Sida rhombifolia L. var. *canariensis* (Willd.) K. Sch. 14167a
Urena lobata L. 14550; 15101

MARCGRAVIACEÆ

det. by Lyman B. Smith

Norantea goyazensis Camb. 15102 The specimen is topotypic from the Serra Dourada.

MAYACACEÆ

det. by Lyman B. Smith

Mayaca sellowiana Kunth 14957

MYRISTICACEÆ

det. by A. C. Smith

Virola setifera Aubl. 14498

ONAGRACEÆ

det. by Philip A. Munz, Rancho Santa Ana Botanic Garden, Claremont, Calif.

Jussiæa myrtifolia Camb. 14246; 15152
Jussiæa potamogeton Burch. 15159
Jussiæa tomentosa Camb. 15154; 15245
Jussiæ leptocarpa Nutt. 14902; 15002

PALMACEÆ

det. by Harold E. Moore, Jr., Bailey Hortorium, Cornell University, Ithaca, New York

The following determinations are preliminary, but in some cases the

[1] These were the last collections studied by Dr. Kearney who passed away a few days after having examined and identified them at the California Academy of Sciences in San Francisco.

incomplete material does not lend itself to specific identification. The seven collections of *Syagrus* will require what amounts to monographic treatment if the resulting identifications are to be trusted. Accordingly, these must wait until a point is reached where adequate attention can be given to the material.

Diplothemium sp. 14222 Mature fruits are lacking as well as staminate flowers from which specific characters are largely drawn.

Syagrus spp. 14433; 14458; 14557; 14585; 15062; 15068; 15221; 15281a

Bactris sp. 15068 (sterile)

Mauritia vinifera Mart.? 15225

Mauritia aff. *M. armata* Mart. 15218 Fruits and male inflorescences are lacking. The leaf differs from that of *M. armata,* as described and illustrated by Martius, in having prominent brown scales on the midrib below.

Euterpe edulis Mart. vel valde aff. 15219

Astrocaryum aff. *A. vulgare* Mart. 15220 This seems reasonably close to *A. vulgare,* but is less strongly armed than that species as previously described. The inner bract and male flowers are not present for comparison, and the petioles do not agree exactly with Martius' description. One must allow for some variation in armature and petioles, but there is so little material available that limits of the variation cannot yet be determined.

Acrocomia sp. 15224

PIPERACEÆ

det. by T. G. Yuncker, Department of Botany, DePauw University, Greencastle, Indiana

Piper amazonicum (Miq.) C.DC. vel aff. 15070 This is a somewhat uncertain identification.

Piper arboreum Aubl. 14765 A small-leaved variety which may prove to be undescribed when monographic studies are made.

Piper glabratum Kunth 15007

RUTACEÆ

det. by Lyman B. Smith

Spiranthera odoratissima St. Hil. 14286

THEACEÆ

det. by Lyman B. Smith

Kielmeyera rubiflora Camb. 14287

Kielmeyera rosea Mart. 14831

Fig. 2. *Lippia candicans* Hayek. Part of *Dawson 14695*, x 0.5.

UMBELLIFERÆ

det. by Mildred E. Mathias, Department of Botany, University of California, Los Angeles 24, Calif.

Eryngium pristis Cham. et Schlecht. 14553; 14751d

Eryngium paniculatum Cav. et Domb., sensu Wolff 14751 This is a polymorphic type.

VERBENACEÆ

det. by Harold N. Moldenke

Amsonia arborea H.B.K. 14859; 15013; 15026 This widespread species occurs from Venezuela and the Guianas to Brazil (Amazonas, Pará, Piauhy, Maranhão, and Matto Grosso). These are, however, the first records from Goiás.

Amsonia hirta Benth. 14726 The species is known from Pará, Goiás, and Matto Grosso to Minas Gerais and São Paulo; also in Paraguay. Previous Goiás collections are Burchell 6999, G. Gardner 3937, Glaziou 21835, and Ule 451.

Lantana hypoleuca Briq. 14228 This widespread species is known hitherto from Minas Gerais, Rio de Janeiro, São Paulo, and Rio Grande do Sul, as well as from Bolivia, Paraguay, Uruguay, and Argentina. This is, however, the first record from Goiás.

Lippia candicans Hayek 14695 The species is known only from Goiás. The type and only other known collection is G. Gardner 3942. Fig. 2.

Lippia mattogrossensis Moldenke 14864 Hitherto known only from Matto Grosso. Fig. 3 (left)

Lippia oxycnemis Schau. 14429 The species is known also from Bahia and Minas Gerais. A previous Goiás collection is the cotype, Pohl 137.

Stachytarpheta australis Moldenke 14534 This widespread species occurs from Cuba to Argentina, but has not previously been reported from Goiás.

Stachytarpheta chamissonis Walp. 14618 The species is known only from Goiás. Previous collections from this state are Glaziou 21909 and Macedo 3667, in addition to the cotypes, Lund s.n., Pohl s.n., and Riedel s.n. Fig. 4.

Stachytarpheta dawsonii Moldenke[2] Fig. 5.

"Suffrutex; caulibus parce ramosis gracilibus dense villoso-tomentosis, pilis albidis; foliis sessilibus subcoriaceis imbricatis ellipticis vel obovato

[2] Due to a misunderstanding, the description of this new species, here reprinted, appeared December 15, 1956, without illustration in Revista Sudamericana de Botanica 10(7): 231-232.

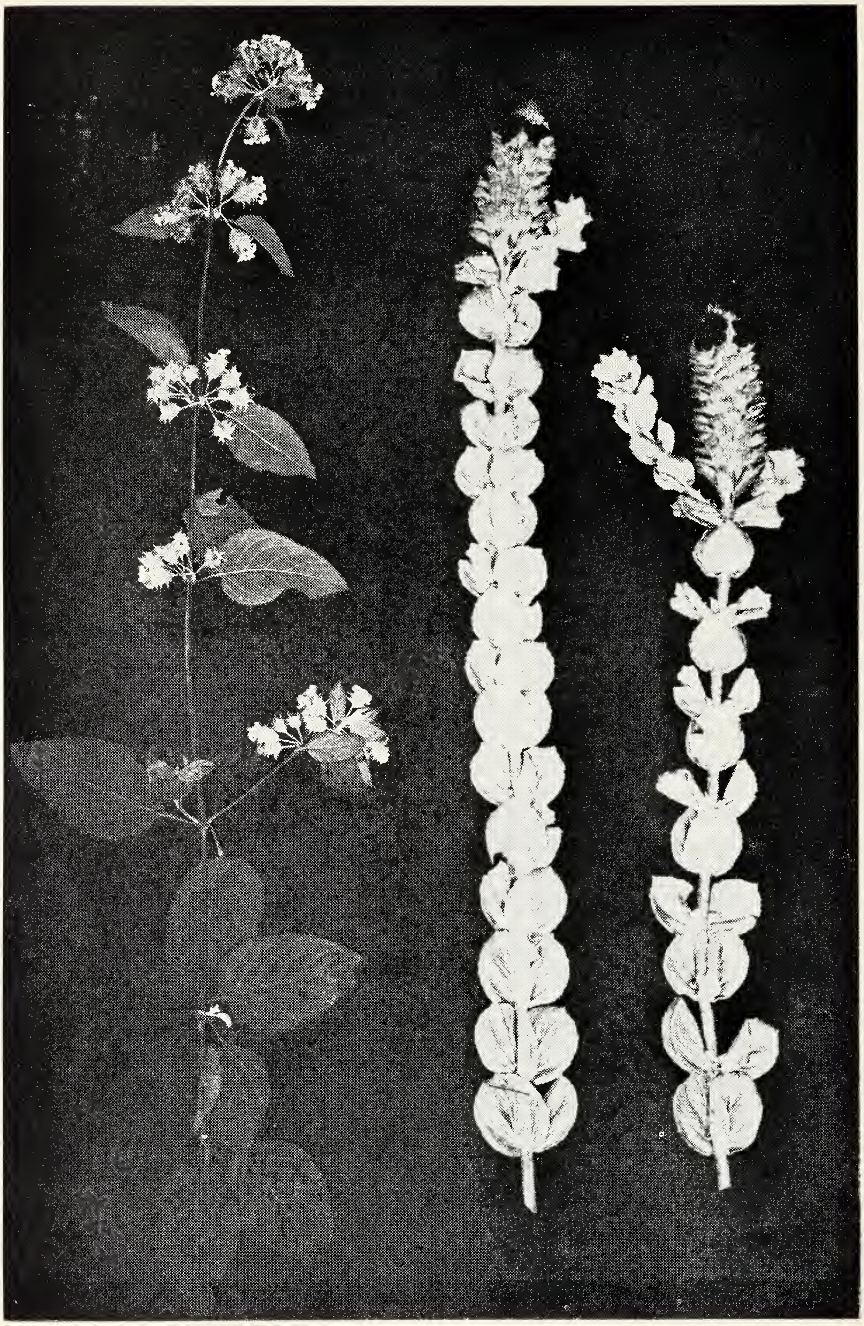

Fig. 3. (left) *Lippia mattogrossensis* Moldenke. Part of *Dawson 14864*, x 0.4. (right) *Stachytarpheta sericea* Loes. Part of *Dawson 14288*, x 0.4.

Fig. 4. *Stachytarpheta chamissonis* Walp. Part of *Dawson 14618*, x 0.36.

ellipticis rotundatis argute serratis, ad basim cuneatis, utrinque dense albo-villosis, pilis antrorso-adpressis; venis venulisque supra profunde impressis, subtus valde prominentibus; inflorescentiis spicatis dense multifloris, floribus arcte imbricatis; bracteis lanceolatis attenuato-acuminatis densiuscule albo-villosis; calyce tubuloso puberulo et adpresso-villosulo vel strigoso.

"A woody subshrub; stems apparently few-branched, slender, densely villous-tomentose with whitish hairs; leaves decussate-opposite, close together and more or less imbricate in pressing, sessile, subcoriaceous, uniformly gray-green on both surfaces, elliptic or slightly obovate-elliptic, 2.8-4 cm. long, 1.5-2.2 cm. wide, rounded at the apex, sharply serrate from below the widest part to the apex, cuneate at the base, densely white-villous on both surfaces with antrorsely appressed silvery hairs, the venation all deeply impressed above and very prominent beneath; midrib slender, plainly extending to the apex of the leaf; secondaries slender, 3 or 4 per side, arcuate-ascending, not extending directly into the marginal teeth; tertiary venation closely and conspicuously reticulate; inflorescence spicate, solitary at the apex of the stem, to 5 cm. long and 2 cm. wide, densely many-flowered, the flowers closely imbricate; bracts lanceolate, 10-15 mm. long, about 2 mm. wide at the base, attenuate-acuminate to the apex, rather densely white-villous with antrorsely appressed silvery hairs; calyx tubular, 1.7-1.9 cm. long, to 5 mm. wide, thin-textured, puberulent between the ribs, appressed-villosulous or strigose with antrorse silvery hairs on the ribs, its rim 5-toothed; corolla-tube about 2 cm. long, 4-5 mm. wide, the limb 5-lobed, the lobes about 5 mm. long, broadly ovate, rounded or subacute at the apex.

"The type of this species was collected by E. Yale Dawson (No. 14722) — in whose honor it is named — on the stony summit of a butte shoulder 5 km. west of Veadeiros, in the region of the Chapada dos Veadeiros, Goiás, Brazil, on April 29, 1956, and is deposited in the herbarium of the Museu Nacional at Rio de Janeiro."

Stachytarpheta gesnerioides var. *cuneata* Schau. 14981, 15058 The variety is also known from Minas Gerais and São Paulo; the typical form of the species occurs also in Matto Grosso. Other Goiás collections of the variety are Pohl s.n., and Riedel & Lund 2075, in addition to the cotypes, Lund s.n. and Riedel s.n.

Stachytarpheta glauca var. *subintegrifolia* Schau. 15053 The variety is known only from Goiás. The only other known collections are the cotypes, Pohl 1832 and s.n. Fig. 6.

Stachytarpheta maximiliani Schau. 14758 The species is widely distributed in eastern Brazil.

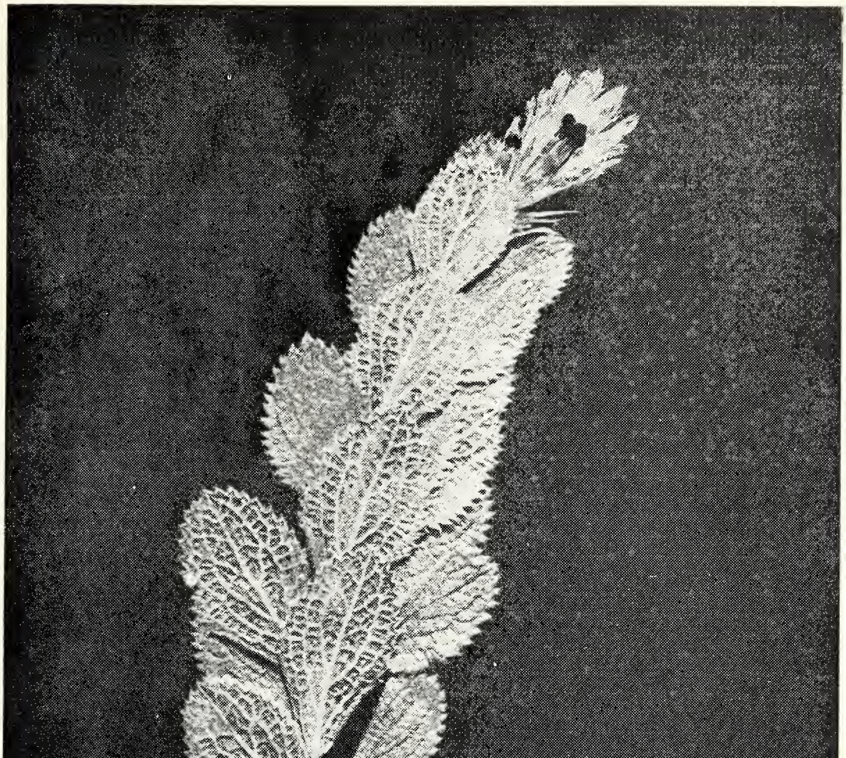

Fig. 5. *Stachytarpheta dawsonii* Moldenke. Type specimen, *Dawson 14722*, x 0.7.

Fig. 6. *Stachytarpheta glauca* var. *subintegrifolia* Schau. Part of *Dawson 15053*, x 0.36.

Fig. 7. *Stachytarpheta schauerii* Moldenke. Part of *Dawson 14659*, x 0.6.

Stachytarpheta pachystachya Mart. 14209 Known also from Piauhy and Minas Gerais. A previous Goiás collection is G. Gardner 3935, in addition to the cotype, G. Gardner 3410 (in part).

Stachytarpheta schauerii Moldenke 14659 The species is known only from Goiás. A previous collection is Glaziou 21906, in addition to the type, Pohl 2150. Fig. 7.

Stachytarpheta sericea Loes. 14288 The species is known only from Goiás. The previous known collections are only the cotypes, Glaziou 21903 and 21904. Fig. 3 (right).

VOCHYSIACEÆ

det. by F. A. Stafleu, The Herbarium, University of Utrecht, Utrecht, Netherlands

Salvertia convallariodora A. St. Hil. 14294; 15077 This is a common species in Goiás and neighboring states.

Vochysia elliptica Mart. 14716 A common species in Goiás and neighboring states.

Vochysia obovata Stafleu 14285 Especially interesting material of an uncommon species.

Vochysia rufa Mart. ssp. *rufa* 14173 A common species in Goiás.

CONTRIBUTIONS IN SCIENCE

No. 1. JEAN DELACOUR, The Machris Brazilian Expedition. General Account. January 23, 1957.

No. 2. E. YALE DAWSON, The Machris Brazilian Expedition. Botany: General. January 24, 1957.

No. 3. T. G. YUNCKER, The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii*. January 25, 1957.

No. 4. CARROLL W. DODGE, The Machris Brazilian Expedition. Botany: The Lichens. February 18, 1957.

No. 5. FRANCIS DROUET, The Machris Brazilian Expedition. Botany: Cyanophyta. February 19, 1957.

No. 6. CARL EPLING, The Machris Brazilian Expedition. Botany: A New Mint from Goiás, *Hyptis machrisæ*. February 20, 1957.

No. 7. E. YALE DAWSON (Editor), The Machris Brazilian Expedition. Botany: *Phanerogamæ,* various smaller families. March 7, 1957.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

MBER 8 JUNE 27, 1957

NOTES ON EASTERN PACIFIC INSULAR MARINE ALGAE

by E. YALE DAWSON[1]

The following records are made from incidental collections from four widely separated, oceanic, insular areas of the far eastern Pacific, namely, the Galapagos Archipelago, Clipperton Island, San Benedicto Island, and the Alijos Rocks. Although the marine flora of the Galapagos Islands has been well documented by Taylor (1945) even the present small collection, obtained for the Los Angeles County Museum through the efforts of Mr. and Mrs. Maurice A. Machris[2], has revealed a number of species previously unreported there. The algae of Clipperton Island are known from the report by Taylor (1939) which treats mainly of fresh water species from the lagoon. The present material, provided by the Scripps Institution of Oceanography, consists only of a handful of reef turf, but quadruples the number of known marine species. San Benedicto Island's marine flora is known from the writer's report following the recent volcanic activity there (Dawson 1954). The present material, obtained by him on a California Department of Fish and Game cruise, supplements that of the first report. The Alijos Rocks, nearly 200 miles off Pacific Baja California, have remained botanically unknown. The writer, in two attempts to reach and obtain algal collections from these dangerous pinnacles, succeeded on one occasion in obtaining some detached specimens from the surf zone flora. The first comprehensive collections, however, were obtained in October, 1956, by aqua lung diver Conrad Limbaugh and submitted for study by the Scripps Institution.

Most of the specimens are cited here with the writer's serial number, since no numbers were assigned by the other collectors. The first set of

[1]Research Associate, Los Angeles County Museum.
[2]Expedition sponsored by Mr. and Mrs. Maurice A. Machris, Mr. John McNabb, Mr. Hal Roach, Jr., and Mr. Dwight Hirsh.

specimens, including most of the small species preserved in liquid, is deposited in the Herbarium of the Los Angeles County Museum. Second and third sets are in the herbaria of the University of California, Berkeley, and the Allan Hancock Foundation. The several Cyanophyta from Clipperton Island were identified by Francis Drouet and deposited in the Herbarium of the Chicago Natural History Museum.

1. The Galapagos Archipelago

Tagus Cove, Albemarle Island, February 17-18, 1957; collected from rocks at low tide by Paquita Machris and J. R. Northern[3].

Ulva lobata (Kütz.) Setch. & Gard. 16292;16302 These are very young specimens epiphytic on old *Padina*. They are probably the same as the *Ulva* reported as *U. fasciata* by Farlow (1902) collected at the same place and in the same month in 1899.

Entocladia viridis Reinke 16293b This plant, growing in the membrane of *Polysiphonia*, seems to be the same as the *E. polysiphoniae* Setch. & Gard. from the Gulf of California, but the distinctions from the widespread *E. viridis* are not clear. Not previously reported from the Galapagos Islands.

Cladophora perpusilla Skottsb. & Levr. 16275 Not previously reported from the Galapagos Islands, but known from widely separated areas in the Pacific: Juan Fernandez Islands (type), Revillagigedo Islands, Viêt Nam. The cells in the present material are somewhat shorter on the average than in the type; those in the Viêt Nam plant are somewhat longer.

Padina durvillaei Bory 16272; 16291

Dictyota dichotoma (Huds.) Lamx. 16294; 16298 Fertile, well-developed material. Not previously reported from the Galapagos.

Sargassum setifolium (Grunow) Setchell 16273; 16290; 16300

Sargassum pacificum Bory 16274; 16289; 16299

Dermatolithon pustulatum (Lamx.) Foslie 16276 This tetrasporic material on *Sargassum pacificum* and on *Padina durvillaei* has conceptacles 300-360 μ in diameter and hypothallus cells 40-70 μ long. Reported from Chatham Island on *Zonaria* by Piccone (1886).

Centroceras clavulatum var. *inerme* (Kütz.) Piccone 16293a

Floating at Tagus Cove, February 17, 1957; collected by J. R. Northern

Sargassum albemarlense Taylor 16297

In tide pools on Narborough Island opposite Tagus Cove, February 18, 1957; collected by Maurice A. Machris

Ulva lobata (Kütz.) Setch. & Gard. 16278 Very young material on *Padina*, apparently like numbers 16292 and 16302 above.

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[3]Preparator, Los Angeles County Museum.

Cladophora sp. 16285 It has not been possible to place these small plants satisfactorily. They are less than 1 cm. high, in tufts on calcareous material, and have a tendency to inflated ends of the cells suggesting a relationship to *C. echinus* (Bias.) Kütz. The walls are thick, and some cells are given off in a manner like *Cladophoropsis.*

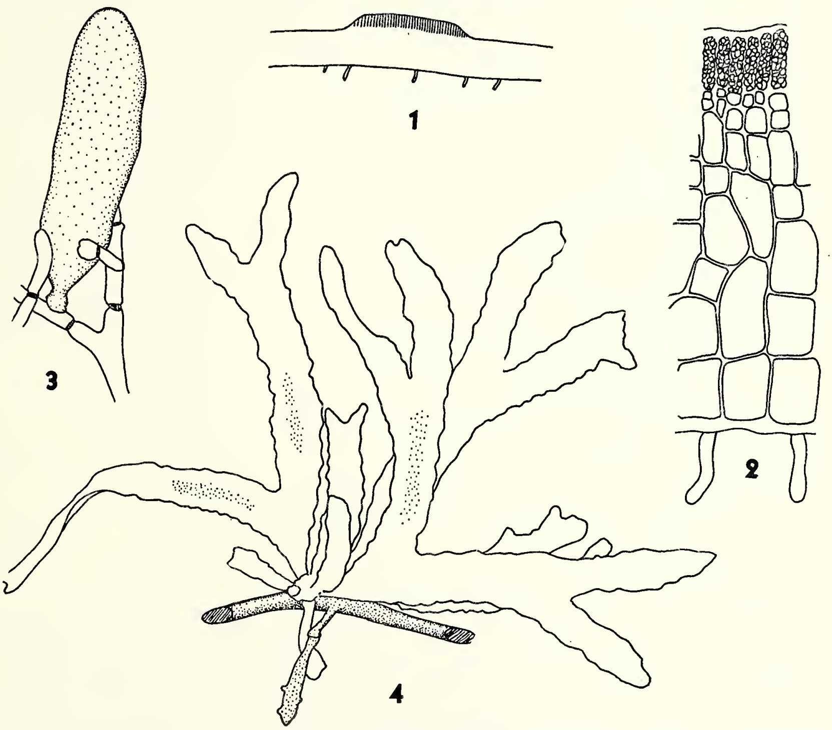
Padina durvillaei Bory 16277

Sphacelaria furcigera Kütz. 16283a Not previously reported from the Galapagos Islands.

Sargassum pacificum Bory 16288

Peyssonelia rubra var. *orientalis* Weber van Bosse 16280 Not previously reported from the Galapagos Islands. The present material is antheridial. The sori consist of scattered, low, circular elevations 40-60 μ high and 1-2 mm. in diameter (Figs. 1-2).

Lithophyllum ? *trichotomum* (Heydr.) Lemoine 16287 Not previously reported from the Galapagos Islands.



Figs. 1-2. *Peyssonelia rubra* var. *orientalis* Weber van Bosse. Fig. 1. Diagrammatic representation of an antheridial sorus in vertical section, x 35. Fig. 2. Small portion of a vertical section through a plant bearing an antheridial sorus, x 217.

Fig. 3. *Botryocladia chaijeana* (Meneghini) Kylin. A plant from the Alijos Rocks attached to *Amphiroa,* x 5.

Fig. 4. *Callophyllis violacea* var. *epiphytica* Dawson. A small tetrasporangial plant from the Alijos Rocks growing on *Pterocladia,* x 5.

Amphiroa annulata Lemoine 16286 Reported in the Galapagos Islands only from the type dredged at James Bay, James Island. Known intertidally in Mexico.

Jania capillacea Harvey 16279b Not previously reported in the Galapagos Islands.

Dermatolithon pustulatum (Lamx.) Foslie 16284

Hypnea cervicornis J. Agardh 16279 Small entangled specimens.

Ochtodes crockeri Setch. & Gard. 16281; 16282 These two collections are very different in size. The latter consists of plants only 2 cm. tall which show a great similarity to Cuban specimens of *O. secundiramea* (Mont.) Howe. There is a tendency, however, to flattening and a fairly-well-marked development of the branching in one plane to an extent not observed in the Caribbean plants. In well-developed *O. crockeri* the large size and coarseness become readily distinctive.

Ceramium serpens Setch. & Gard. ? 16283b Sterile.

Ceramium templetoni Setch. & Gard. 16279a Fragments.

Ceramium howellii Setch. & Gard. 16278a. A small amount creeping on *Padina*. This is from near the type locality on the southeastern shore of Narborough Island.

2. Clipperton Island

Previous reports of marine reef algae from Clipperton Island consist of only four species: *Caulerpa racemosa* (Försk.) J. Ag., *Jania capillacea* Harv.; *Dictyopteris delicatula* Lamx.; *Zonaria variegata* Lamx. The new collection by Limbaugh from the reef flat contains two of these and thirteen other species not heretofore reported from the seaward reefs. It consists largely of a mass of *Jania* mixed with *Chnoospora* and various smaller species as listed below.

Entophysalis conferta (Kütz.) Drouet & Daily

Hydrocoleum comoides (Harv.) seq. Gomont

Hydrocoleum glutinosum (Ag.) seq. Gomont

Lyngbya infixa Frémy

Lyngbya guaymensis Drouet

Oscillatoria subuliformis Kütz. seq. Gomont

Ulva lobata (Kütz.) Setch. & Gard. ? 16310 Very young material.

Colpomenia sinuosa (Roth) Derbes & Solièr 16311 Fragmentary.

Dictyopteris repens (Okamura) Börgesen 16308 This is probably the plant identified by Taylor as *Dictyopteris delicatula*, but to be distinguished by the lack of a delicate rib along the thallus margins.

Pocockiella variegata (Lamx.) Papenfuss 16305 This is Taylor's *Zonaria variegata*.

Chnoospora implexa Hering ex. J. Ag. 16304 Not previously known in the eastern Pacific.

Jania tenella Kütz 16303

Hypnea sp. 16312 Sterile fragments.

Polysiphonia ferulacea Suhr 16306 Diminutive specimens only 1-2 cm. tall from the *Jania* turf, but cystocarpic and tetrasporic.

Herposiphonia secunda (Ag.) Ambronn 16307

Ceramium serpens Setch. & Gard. ? 16309 The material is tetrasporic, but is too scant to make a positive distinction from the closely related *C. camouii* Dawson.

3. San Benedicto Island, Mexico

The first and only collections reported to date from this island were obtained by the writer November 17-18, 1953. At that time a flora was just beginning to appear on the fresh lava from the December 1952 flow. Only nine species were detected after rather careful search of the area adjacent to the landing cove, and only seven of these were sufficiently mature to identify specifically.

On April 17, 1955, with the help of John E. Fitch, leader of cruise 55-Y-3 of the M/V YELLOWFIN a brief landing was made at the same locality as in 1953 and some samples of the algal cover on the new lava hastily obtained. An examination of these has shown a considerable amplification of the flora during the intervening seventeen months, but less than had been expected.

Of the nine species previously found, four were detected again, namely, *Herposiphonia tenella* (Ag.) Ambronn, *Ectocarpus mitchellae* Harv., *Grateloupia versicolor* var. *prostrata* Dawson, and *Enteromorpha* sp., now identified as *E. flexuosa* (Wulfen) J. Ag. In addition, eight other species were present: *Cladophora inserta* Dickie, forma (small plants 1 cm. tall); *Centroceras clavulatum* (Ag.) Mont.; *Ceramium sinicola* Setch. & Gard., *Lomentaria* sp. (aff. *L. hakodatensis* or *L. baileyi*); *Lithophyllum decipiens* (Foslie) Foslie; *Peyssonelia* sp; *Ralfsia* sp.; *Callithamnion marshallensis* Dawson? (possible a lax form of *C. paschalis* Börg. since the branching is quite regularly distichous.)

From a distance the *Lithophyllum* was the most conspicuous alga, showing as a pinkish color against the black lava in many places within tidal range. The remainder of the flora was not evident except at close hand and consisted of discontinuous, lighter and heavier carpets of very short plants, sometimes in pure stands, often mixed, but rarely more than about 1 cm. tall. *Enteromorpha, Centroceras, Ectocarpus, Herposiphonia* and *Lomentaria* occurred in quite extensive and dense colonies. The *Grateloupia* was occasional, as were *Peyssonelia* and *Ralfsia* which were evidently just becoming established. A conspicuous epiphytic flora of diatoms occurred on much of the algal turf.

Collections from the undisturbed substrate at the north end of the island could not be obtained on this occasion because of rough seas, but in making the attempt, an area at the base of the western cliffs was found where quantities of floating pumice indicated a recent landslide into the sea. There, with the pumice, dislodged specimens of *Asparagopsis taxiformis* (Delile) Collins & Hervey were abundant, together with some *Dictyota divaricata* Lamx. Neither of these speices had been found among the earlier collections.

4. Alijos Rocks, Mexico

No previous records of marine algae exist for the Alijos Rocks, lying at North Lat. 24° 50′, 180 miles west of Magdalena Island, Baja California, and consisting of three completely isolated, precipitous pinnacles arising from ocean depths of over 2000 fathoms. The nearest oceanic island to the north is Guadalupe, and to the south, Socorro. The rocks lie far beyond the influence of coastal upwelling along Baja California and surface water temperatures apparently range largely between 20 and 22° C. Surface temperatures on November 15, 1953 were about 21° C. in the vicinity of the rocks. Accordingly, upon the writer's visit in 1953 it was anticipated that a warm water flora, lacking members of the Laminariales, would be found there. Upon that occasion our ship was unable to approach closer than about 1500 yards because of large ocean swells that produced a gigantic surf breaking over the rocks and dashing spray almost to their tops. By using a skiff to move in closer and across a foam line it was possible to collect several species by dip net from those being torn loose by the pounding sea. These included *Macrocystis pyrifera* (L.) Ag. (12036), which was apparently dominant around the base of the rocks; *Egregia australis* Hollenberg ms. (12037); and the sea grass *Phyllospadix torreyi* S. Wats (12038). In addition, a floating specimen of *Cystoseira* was observed but not secured.

It was surprising to find these cool water elements, characteristic of the temperate shores of California, so far outside of their known geographical and temperature ranges. An explanation for this seems to be found in the violent agitation around the rocks. This causes exceptional aeration sufficient partly to compensate for the higher temperatures by providing adequate available metabolic gases, notwithstanding the lower solubilities in the warmer water. The marine flora in the vicinity of the surface, thus, shows a distinctly northern facies.

The 1956 collections, hand picked by Conrad Limbaugh in depths of 25 to 90 feet, stand in marked contrast to those from the the surface area mentioned above. Nine species of tropical character appear whose Pacific Coast distributions are not known to extend north of warm Guadalupe Island at North Lat. 29°, nor, except for local warm spots, along the cool Pacific shores of Baja California. Their presence at moderate depths in very clear water seems to indicate that below the surface region, influenced strongly by the extreme aeration, the normal effects of higher temperature are reflected by the presence of a prominent complement of warm water species. In the annotated list below, these warm water elements are marked with an asterisk.

Phyllospadix scouleri Hooker 16151 This was found unattached and presumably drifted down from a colony in the surf zone. It may be considered a fifth species known from the surface region.

Lyngbya gracilis Gomont 16157c

Codium setchellii Gardner 16161

**Pocockiella variegata* (Lamx.) Papenfuss 16168

Pterocladia pyramidale (Gardner) Dawson 16152 This plant was most abundant in the samples and in very luxuriant condition.

**Asparagopsis taxiformis* (Delile) Collins & Hervey 16160 Common in the samples.

**Liagora farinosa* Lamx. near var. *pinnatiramosa* Yamada 16170 Sterile.

Melobesia mediocris (Foslie) Setch. & Mason 16151a A few crusts on the detached *Phyllospadix scouleri.*

**Jania tenella* Kütz. 16168a

**Amphiroa crosslandii* Lemoine 16162

Plocamium pacificum Kylin 16159 Very small male plants only 2 cm. high, epiphytic on *Pterocladia.*

Binghamiella forkii (Dawson) Silva 16157 A rare species known previously only from two collections, at La Jolla, California, and at Punta Baja, Baja California.

Callophyllis violacea var. *epiphytica* Dawson 16156; 16169 These small, delicate plants do not at first suggest the genus *Callophyllis* although their structure identifies them here. Some are tetrasporic, but only 2-3 cm. tall. (Fig. 4)

Botryocladia chaijeana (Meneghini) Kylin 16163 The several tetrasporic plants are in good agreement with the account of Geneviève Feldmann (1945). The gland cells are in isolated groups of 3 or 4. This is the first record of this species in the Pacific. (Fig. 3)

Antithamnion breviramosus Dawson 16153a These are like the southern California type in overall size and habit, but have somewhat longer and more slender branches than the type.

**Crouania attenuata* (C. Ag.) J. Ag. 16172 Small male plants, to

2 cm. long, creeping on *Liagora* and on *Pterocladia.*

Ceramium zacae Setch. & Grad. 16154 Luxuriant tetrasporic and cystocarpic plants on *Pterocladia.*

Ceramium sinicola Setch. & Gard. var. *sinicola* 16155 Tetrasporic plants epiphytic on *Pterocladia.*

**Ceramium clarionense* Setch. & Gard. 16165a Tetrasporic plants on *Codium.*

Ceramium camouii Dawson 16171 Tetrasporic plants creeping on *Liagora.* Note that all the involucres are not symmetrical.

Heterosiphonia erecta Gardner em. Setch & Gard. 16158;16164 Tetrasporic plants on *Pterocladia.*

**Dasya pedicellata* (C. Ag.) C. Ag. 16165 Dwarf male plants only 2 cm. tall, epiphytic on *Codium.*

Branchioglossum woodii (J. Ag.) Kylin 16166 Tetrasporic.

Cryptopleura corallinara (Nott) Gardner 16157 Tetrasporic.

Polysiphonia mollis Hooker & Harvey 16161a According to Cribb (1956) this name represents an earlier designation of plants known in the central Pacific as *P. tongatensis* Harvey, and along the Pacific Coast of North America as *P. synderae* Kylin.

**Chondria lancifolia* Okamura 16157a This material, although rather scant and small, agrees very well with this western Pacific species, especially as illustrated by Tseng (1945) from Hong Kong. It has not been reported previously from the American coasts.

Laurencia sp. aff. *L. spendens* Hollenberg 16157b Dwarfish.

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Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

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A NEW SPECIES OF PASSERINE BIRD FROM THE MIOCENE OF CALIFORNIA

By HILDEGARDE HOWARD

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

HILDEGARDE HOWARD
Chief Curator of Science
EDITOR

A NEW SPECIES OF PASSERINE BIRD FROM THE MIOCENE OF CALIFORNIA

By HILDEGARDE HOWARD*

INTRODUCTION

In 1955, the Los Angeles County Museum acquired two rock slabs containing obverse and reverse impressions (with some bone still present) of the nearly complete skeleton of a Miocene fossil bird. The slabs were originally purchased as flagstones by Mr. Edward H. Metcalf of Pasadena, who realized their significance and presented them to Dr. Dale Arvey of Long Beach State College. Dr. Arvey recognized that the bird represented on the slabs would require considerable study. As the Los Angeles County Museum has long specialized in research in fossil birds, he contacted the museum and an exchange was effected to the mutual advantage of the two institutions.

By contacting the vendor of the flagstones, the quarry from which they came was located approximately ten miles east of the town of Santa Maria, in the San Rafael mountains, Santa Barbara County, California. It is operated by G. Antolini and Sons. According to Dr. Raymond Barber, late Curator of Mineralogy and Petrology of the Los Angeles County Museum, the rock in which the fossil lies is a siliceous limestone. The matrix was analyzed for possible microfossils by Mr. Harry Turver of the Standard Oil Company. He established the deposit as of the Monterey Formation, middle Miocene (Mohnian) in age, but found no evidence of either foraminifera or diatoms. Other fossil specimens from the area have been collected by the Santa Barbara Museum of Natural History and include fish, porpoise, palm and two species of marine birds: a shearwater (*Puffinus,* sp.) and a new species, *Osteodontornis orri* Howard (1957), assigned to an extinct order, Odontopterygiformes.

I should like to take this opportunity to express my appreciation of the understanding generosity and cooperation of Mr. Metcalf and Dr. Arvey. I wish also gratefully to acknowledge the assistance of Dr. Jean Delacour, Director of the Los Angeles County Museum, in taxonomic problems involving living birds. My thanks are extended to Dr. Herbert Friedmann of the United States National Museum, Dr. Dean Amadon of the American Museum of Natural History, and Dr. Alden H. Miller of the California Museum of Vertebrate Zoology for the loan of modern skeletal material for comparison.

*Chief Curator, Division of Science, Los Angeles County Museum.

DESCRIPTION

The larger of the two flagstones (slab no. 1) measures 19 x 12 inches and is 7½ inches thick. The smaller (slab no. 2) is of uneven surface dimensions; the greatest length and breadth are approximately 14½ and 7½ inches respectively, and the thickness 1¼ inches.

The major part of the skeleton of the fossil bird is represented by impression and some actual bone on slab no. 1. The skull and body parts, disarranged but not completely disassociated, extend approximately 6¾ inches along the surface of the slab. A number of tracheal rings are scattered in the matrix below the skull. The leg bones and pelvis lie about two inches posterior to the other body parts. Slab no. 2 has been broken just at the tip of the furcula, and the portion bearing the sternum and legs is not present. By faint impression and discoloration, the outline and partial feather venation of one wing are apparent on this small slab. Areas of faint discoloration around the body and individual bones indicate chemical reaction from the flesh in the process of disintegration. Detailed characters of the articular ends of the individual skeletal elements are indistinct on both slabs.

A good endocranial cast of the right side of the head and a fragment of the bony cranium are exposed on slab no. 2, a poor impression of endocranium on no. 1. The upper and lower mandibles are better delineated on the latter, the upper by impression, the lower by bone exposed in the matrix. The outline of the external naris of the right side is preserved. The sternum is represented by the clear impression of the left side of the carina and manubrium; the actual bone of the left posterior lateral process and the portion of the xiphisternum bordering the sternal notch have been exposed by preparation. The outline of the furcula is impressed on both slabs, and the internal surface of the bone is exposed at the upper end of the right clavicle on no. 2. The upper half of the anterior face of the right coracoid, and the dorsal surface of the right scapula have been exposed by preparation on this slab. Parts of broken bone lie in the impression of the left coracoid. The left scapula is poorly indicated on either slab.

Both right and left humeri are present. On slab no. 2 the right lies with the anconal surface of the entepicondyle of the distal end exposed by preparation, and the contours of the palmar side of the proximal end impressed in the matrix; an impression of the anconal surface of the proximal end appears on slab no. 1. The left humerus lies on the small slab with the palmar surface of the external condyle of the distal end exposed by preparation, and the contours of the anconal side of the proximal end impressed in the matrix; the impression of the palmar side of the proximal end appears on the large slab. The position of both bones is such that the ectepicondylar prominence is buried in the matrix. The impression of the internal side of the left ulna is fairly well marked on slab no. 2. A cast made from this impression reveals quite clearly the impression of the brachialis anticus muscle near the proximal end. The impression of the external side of the ulna is deeply cut on slab no. 1, but a cast from this reveals no details. The right ulna is imperfectly impressed on both slabs. The radius is represented by impression of actual bone of both left and right sides on the small slab, and by impression only, on the large. The right carpometacarpus lies 3 inches apart from the body, and above the skull; it is represented in slab no. 2 by the actual bone of the external side of the distal tip and part of the shaft of metacarpal 3, together wtih the impression of the internal side of metacarpal 2 and the head; the impression is somewhat altered by the presence of fragments of bone within it; on slab no. 1, the bone of the process of metacarpal 2 is still adhering to the impression of the external side of this metacarpal. The left carpometacarpus is poorly impressed on the small slab, but on no. 1 the bone of the external side of the distal end of metacarpal 3 is preserved, as well as the impression of the internal side of the remainder of the element, with fragments of bone adhering. The phalanx of alar digit 3 and both phalanges of digit 2 are represented; there is no evidence of digit 1.

As stated above, the pelvis and leg bones are represented only on the large slab. The pelvis appears as an imperfect impression of the dorsal surface. The anterior end is incomplete, obliterated by the right femur which lies across it. The right leg is represented by the external impression of the femur, tibiotarsus and trasometatarsus, with digits 1, 3 and 4 in place (the ungual of digit 3 is missing). The left leg is represented by the external impression of the femur and anterior impression of tibiotarsus with fibula, approximately in place; the left tarsometatarsus, however, is separated and lies below the right tarsometatarsus with its internal side impressed; metatarsal 1 and digits 1, 2, and 3 are present and approximately normally placed (the unguals for digits 1 and 3 are missing).

As the deposit in which this fossil was found is marine, it would be natural to suppose that the bird here entombed was a small sea bird, such as a petrel, or even one of the smaller shorebirds. Careful scrutiny of the specimen, however, indicates that relationship lies rather with the perching birds, Order Passeriformes, and with the suborder Oscines (Passeres).

The fossil was compared with available skeletons of all living and fossil passerines that seemed possibly to bear any resemblance. These represented 59 species, 53 genera and over 20 families. The Miocene bird was found to be distinct, both generically and specifically, from all forms compared. It is accordingly here described as new to science. The relationships of this extinct bird can be better discussed following its description.

Palaeoscinis turdirostris* new genus and species

Figures 1 and 2

Type. — L. A. County Mus. no. 2604; nearly complete skeleton and outlines of a portion of the feathering of one wing, represented by impression and parts of actual bone on two flagstone slabs.

Locality and age. — L. A. County Mus. Vert. Paleon. loc. no. 1127; Tepusquet Peak Quadrangle, 1942 ed.; T 10 N, R 31 W, NE¼ of NW¼, Sect. 15; west side Tepusquet Creek S 25° E of Los Coches mountain, N 45° W of Tepusquet Peak. Middle Miocene (Mohnian).

Diagnosis. — Upper mandible long and slender with large, oval external nares; sternum with long, slender, upcurved manubrium, and short sternal notch bordered by broad posterior lateral process; blade of scapula broad; humerus lacking deep undercut below head; skeleton of leg (excluding toes) 90 per cent of length of wing skeleton, including phalanges 1 and 2 of alar digit 2; tarsometatarsus shorter than humerus or femur, and femur approximately ⅝ the length of tibiotarsus; ungual of first pedal digit very long; middle toe longest of pedal digits, first and fourth approximately identical in length, second digit shortest.

Detailed description. — SKULL AND MANDIBLE: Brain well developed; upper mandible 49 per cent of total skull length; external nares occupying 40 per cent of total rostral length; lower mandible slender, symphysis approximately 25 per cent of total mandibular length and marked centrally for about half its length with a distinct groove; rami only moderately angled (slightly forward of midpoint, anteroposteriorly). Bill similar to that of *Ixoreus naevius* in proportions, position of nares, angle of lower mandible and groove in symphysis.

STERNUM: Height of carina approximately 37 per cent of length of sternum; manubrium long, slender and upcurved; anterior border of carina nearly straight; sternal notch 34 per cent of length of sternum (from xiphisternum to base of manubrium dorsally), and bordered by broad posterior lateral process.

*The scientific name indicates that the fossil is an ancient oscine bird with a thrushlike beak.

Fig. 1. *Palaeoscinis turdirostris,* new species. Type slab no. 1. Approximately natural size.

FURCULA: Relatively long and narrow with slender symphysis; furcular process long and slender, but details of shape not discernible.

CORACOID: General shape and slenderness similar to condition found in Oscines; no other diagnostic characters noted.

SCAPULA: Blade broad and flat near articular end, equalling or even exceeding depth of shaft of ulna; blade becoming broadly depressed as it continues distally.

HUMERUS: Pectoral crest extending distally well below level of bicipital crest and (as viewed anconally) depressed in middle, flaring slightly proximally and distally; head bent anconally and towards internal crest so that proximal end of pectoral crest is high with respect to head; apex of shaft angular near proximal end (anconally); anconal surface of proximal end depressed internally adjacent to median crest but not deeply undercut beneath head; diagnostic characters of distal end not visible, except entepicondyle prominently developed as in the Passeriformes.

ULNA: Size and proportions similar to those of *Ixoreus naevius* and *Microscelis leucocephalus*; bone shorter, stouter and with more circumscribed impression of brachialis anticus muscle than in *Tyrannus verticalis*; no diagnostic characters of value within the suborder Oscines notable.

RADIUS: Undiagnostic.

CARPOMETACARPUS: Distal end of metacarpal 3 extending well distal to metacarpal 2 with essentially straight contours, as in the Oscines.

PHALANX 1, ALAR DIGIT 2: Slender and straight in contours, in contrast to condition found in the Tyranni, where bone is flared.

WING FEATHERS: Length of feather impressions 4¼ - 4⅜ inches; impossible to ascertain whether or not impressions represent full length of wing; if they do, wing is short for size of skeleton.

PELVIS: Ilia separate anteriorly as well as posteriorly and their borders appearing to converge anteriorly (may be illusion owing to imperfect impression); posterior ilia protruding distally, forming marked points at their external margins; sacrum broad, greatest breadth equal to more than half of greatest breadth of pelvis across posterior ilia; central raised area of sacrum bulbous and broad anteriorly, tapering and flattened posteriorly. Great breadth of sacrum most closely paralleled in Turdidae and Pycnonotidae; characters of central raised area suggestive of *Cinclus* and *Aphelocoma*.

Fig. 2. *Palaeoscinis turdirostris*, new species. Type slab no. 2. Natural size.

TABLE I

Palaeoscinis turdirostris compared with selected living and extinct avian species

Measurements in Millimeters

	Palaeoscinis turdirostris	Microscelis leucocephalus	Bombycilla cedrorum	Aphelocoma californica	Cinclus mexicanus	Ixoreus naevius	Paleospiza bella*	Laurillardia longirostris*
Length of skull	48.3	47.1	32.7	55.2	44.8	46.7	......	43
Length of beak	23.7	24.7	13.2	26.0	21.2	22.3	......	22
Length of sternum	25.5	25.5	20.3	24.0	24.7	28.7	......	....
Length, posterior sternal notch	8.7	11.8	8.9	8.1	9.0	11.5	......	....
Breadth, blade of scapula	2.4	2.3	1.7	2.3	2.0	2.0	......	....
Length of humerus	27.0	26.7	19.6	30.7	23.4	28.3	23.4	23
Length of ulna	33.1	33.3	24.2	36.2	27.3	34.7	22.0	28
Depth, shaft of ulna	2.3	2.3	1.8	2.2	2.0	2.2	......	....
Length (lesser), carpometacarpus	17.0	15.7	13.7	17.0	17.1	19.4	12.6	14
Length, alar phalanx 1 digit 2	9.0	8.4	7.9	7.9	8.3	10.1	5.9	7
Length of femur	24.5	22.4	18.6	32.1	21.4	27.9	18.0	17
Length of tibiotarsus	35.0	31.3	27.8	52.6	40.6	45.8	27.0	28
Length of tarsometatarsus	23.0	19.6	15.5	38.8	30.4	31.7	17.5	16

*Extinct

TABLE II

Palaeoscinis turdirostris compared with selected living and extinct avian species

Proportions, in Per Cent

Ratios of lengths	Palaeoscinis turdirostris	Microscelis leucocephalus	Bombycilla cedrorum	Aphelocoma californica	Cinclus mexicanus	Ixoreus naevius	Paleospiza bella*	Laurillardia longirostris*
Beak to skull	49	52	40	47	47	48	....	51
Sternal notch to sternum	34	46	43	33	36	40	....	....
Humerus to ulna	81	80	81	84	86	81	106	82
Femur to humerus	90	84	94	104	91	98	76	74
Femur to tibiotarsus	70	71	67	61	52	60	66	60
Tarsometatarsus to humerus	85	70	79	126	130	112	74	70
Tarsometatarsus to femur	93	83	83	120	142	113	97	94
Tarsometatarsus to tibiotarsus	65	62	55	73	74	69	64	57
Leg to wing	90	81	88	127	115	113	87	81

*Extinct

LEG AND FOOT BONES: Digits 2, 3 and 4 articulated forward on tarsometatarsus in a straight line, as typical for the Passeriformes; digit 1 articulated backward from well developed metatarsal 1, also as in Passeriformes; length of digits 1 and 4 approximately equal, digit 2 shorter, digit 3 longer; ungual of digit 1, 70 per cent of length of phalanx 1, digit 1; unguals for digits 2 and 4 short; tarsometatarsus 93 per cent of length of femur, 85 per cent of length of humerus; femur 90 per cent of length of humerus. No diagnostic contours of individual bones evident.

Measurements and proportions. — See Tables I and II.

DISCUSSION

Of all the elements described in the foregoing section, the sternum, scapula, and humerus seem to present characters of greatest phylogenetic significance at a possible family level. In the sternum, the combination of long, slender manubrium with short posterior notch bordered by broad lateral process does not occur in any of the living species examined. The short notch and strong lateral process occur in members of the Cinclidae and Corvidae, but in these families the manubrium is short and heavy. On the other hand, in the Pycnonotidae, Turdidae, Mimidae and others that have a long, slender manubrium, the posterior notch is deep and the lateral process slender. In the Bombycillidae the notch is long, but the bordering processes are strong; the manubrium in members of this family is fairly heavy although less so than in the Corvidae. The broad, flat blade of the scapula most closely resembles the condition found in *Microscelis* (Pycnonotidae) and *Aphelocoma* (Corvidae); the depressed area of the blade posteriorly is most closely approximated in the first-named family. The humerus shows closest resemblance to that of *Microscelis,* particularly in the shape, position and length of the pectoral crest, anconal thrust of the head, and absence of undercut below the head. *Bombycilla* is somewhat similar, but the pectoral crest is short. Most of the passeriform species examined show a marked depression below the head. Representatives of the Alaudidae, Pycnonotidae, Bombycillidae and Corvidae lack this deep undercutting and resemble the fossil in this respect.

The thrushlike bill and the relatively short legs, while notable characteristics of *Palaeoscinis turdirostris,* are considered to be of no more than generic or specific value. Of the living oscine species examined in which the leg is found to be shorter than the wing, the following resemble *Palaeoscinis* in having the tarsometatarsus shorter than the femur: *Bombycilla cedrorum* (Bombycillidae), *Saroglossa madagascariensis* (Sturnidae), *Bias musicus* (Muscicapidae), and the three available species of *Microscelis* (Pycnonotidae), *M. amaurotis, M. leucocephalus* and *M. madagascariensis.* None of the present authorities on passerine taxonomy suggest close relationship between all four of the families represented.

In my opinion, *Palaeoscinis* does not fit clearly into any one family of living oscine birds as now defined. Closest similarities in the significant characters above mentioned are found in the Pycnonotidae, Bombycillidae, Corvidae and Cinclidae.

Among the fossil passerines of North America, all but one are assignable to living families. The excepted species, *Paleospiza bella* Allen, is the single representative of the extinct family Paleospizidae, placed taxonomically near the Alaudidae. *Paleospiza* came from the Florissant shales of Colorado, of Oligocene age. It, like *Palaeoscinis,* is preserved in two rock slabs, with nearly the entire skeleton represented. The bill, however, is missing. Careful comparison of *Palaeoscinis* has been made with the description and illustrations of *Paleospiza* offered by Wetmore (1925, pp. 185-191 and plates 1-4). See Table III. Unfortunately none of the characters of the sternum, scapula or humerus that are considered of probable family significance in *Palaeoscinis* have been described in detail for *Paleospiza.* In fact it is doubtful that these significant areas are discernible in the Colorado specimen. However, other characters, such as the short, broad furcula, the heavily built wing bones, and possibly the very long distal phalanx of alar digit 2, seem to be equally as distinctive as family characters of the Paleospizi-

TABLE III

Comparison of *Palaeoscinis turdirostris* and *Paleospiza bella*

Palaeoscinis turdirostris	Paleospiza bella
Bones of wing long and slender	Bones of wing strong and heavy
Humerus shorter than ulna	Humerus slightly longer than ulna
Pectoral crest of humerus extending distally below level of bicipital crest	Pectoral crest of humerus not extending distally below level of bicipital crest
Phalanx 2 of alar digit 2 less than ⅓ the length of the carpometacarpus	Phalanx 2 of alar digit 2 nearly ½ the length of carpometacarpus
Furcula long, with slender symphysis	Furcula short and broad
Pedal digit 2 shortest	Pedal digit 1 shortest

dae. In no way, except for the relatively short legs, do *Palaeoscinis* and *Paleospiza* bear any resemblance to each other. Assignment of *Palaeoscinis* to the family Paleospizidae is therefore not justified.

Among the European fossil passerines, only three Tertiary species suggest similarity to *Palaeoscinis*. All of these are assigned to the genus *Laurillardia* and come from the Upper Eocene of France. Their preservation is similar to that of *Palaeoscinis* so that comparisons are facilitated. *Laurillardia longirostris* Milne-Edwards (1869-1871, p. 374) was originally placed with the Oscines with not attempt at family allocation. *Laurillardia parisiensis* and *L. munieri* were described by Flot (1891). Flot reviewed all three species of *Laurillardia* and concluded that the closest similarity was to be found with the Turdidae except for the fact that the legs of the fossil birds were much shorter than those of the thrushes. In *Saroglossa madagascariensis* (Family Sturnidae) he found a combination of characters similar to those of *Laurillardia*. According to Flot, *Saroglossa* appears to combine the habits of the Sturnidae with the characters of the Turdidae, differing from either, however, in its short legs.

Comparison of *Palaeoscinis* has been made with the three species of *Laurillardia* on the basis of descriptions and illustrations offered by Milne-Edwards (1869-1871, pp. 374-377 and pl. 161) and Flot (1891). This comparison demonstrates that *Laurillardia* bears a general similarity to *Palaeoscinis* in the length of the beak and in the relatively short legs, but differs in having a deeper (higher) upper mandible with greater dorsal curvature, and shorter femur and tarsometatarsus. These differences, together with the great discrepancy in age between the French and American birds, justify the recognition of the two distinct genera. As with *Paleospiza*, the detailed characters of the sternum, scapula and humerus that are considered of importance in *Palaeoscinis* are not discussed for *Laurillardia*.

The family allocation of *Laurillardia* has not been precisely defined although both the Turdidae and the Sturnidae were mentioned (Flot, 1891). The comparison with *Saroglossa madagascariensis* referred mainly to the similar proportions of short legs and long wings, proportions that, as mentioned above, are of questionable phylogenetic value. Assignment of *Palaeoscinis* to either the Turdidae or the Sturnidae is contra-indicated.

Inasmuch as *Palaeoscinis* cannot be assigned to any established family of birds either living or extinct, the family Palaeoscinidae is hereby proposed to contain it.

Family Palaeoscinidae

Type. — *Palaeoscinis turdirostris* Howard.

Diagnosis. — Sternum with long, slender manubrium, and short sternal notch bordered by broad posterior lateral process; scapula with broad blade near the articulation; humerus lacking undercut below head, head bent anconally and pectoral crest high proximally with respect to head, pectoral crest flaring proximally and distally and depressed in middle. Other characters as for the type species so long as it remains the sole representative of the family.

Relationships. — Determination of the taxonomic position of this family within the suborder Oscines is rendered difficult in the light of the uncertainties that exist concerning relationships of living passerine families. It has been stated above that closest similarities of the fossil lie with members of the families Pycnonotidae, Bombycillidae, Corvidae and Cinclidae. Within the last six years, at least three publications of importance have provided studies of the taxonomy of the Passeriformes. Wetmore (1951, p. 12) states that his arrangement "is in part necessarily arbitrary, through the easily perceptible and often remarked fact that we are under necessity of listing groups in linear order . . . when actually they stand in three-dimensional relationship to one another." Of the four families with which *Palaeoscinis* may be most closely compared, he (*op. cit.* p. 121) lists the Corvidae 6th among oscine families, the Pycnonotidae 18th, the Cinclidae 19th and the Bombycillidae 29th. Mayr and Greenway (1956, pp. 8-9) present the sequence of oscine families as approved by a committee appointed by the XI International Ornithological Congress. In this listing the Pycnonotidae appear 5th in the sequence, the Bombycillidae 10th, Cinclidae 11th and Corvidae last (40th). Beecher (1953) bases his conclusions regarding relationships of the passerines on anatomical studies and presents a chart showing a radiating arrangement. He places the four groups above-mentioned in the same superfamily and suggests (*op. cit.* p. 286) that the Bombycillidae and Corvidae "appear traceable to the bulbuls, here regarded as a specialized branch (Pycnonotinae) of the Sylviidae." It would be beyond the scope of the present paper to discuss the relative merits of the passerine sequences presented in these three publications. The characters of *Palaeoscinis turdirostris,* however, do appear to provide some substantiating evidence of an ancestral relationship between the bulbuls, waxwings and corvids, and possibly the dippers as well. In a linear arrangement, the placement of the Palaeoscinidae near the Pycnonotidae or the Bombycillidae must suffice until the relationships of the living forms have been more fully determined.

SUMMARY

A new species of passerine bird, *Palaeoscinis turdirostris*, is described from the Miocene of Tepusquet Creek, Santa Barbara County, California. Beak and body proportions resemble some of the thrushes, but the legs are relatively much shorter, and a number of skeletal details distinguish the fossil from all existing families of birds. The species is placed in the suborder Oscines, and the family Palaeoscinidae is established to contain it. Closest affinities of the Palaeoscinidae lie with the Pycnonotidae, Bombycillidae, Corvidae and Cinclidae.

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Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ıber 10 July 15, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: A New Columnar Cactus from Goiás

By E. Yale Dawson[1]

Columnar forms of cacti are well represented in Brazil as a whole from which some sixty species are described, but nearly all of these are known only from a small part of the country east and northeast of the Rio São Francisco. Those of the interior are virtually unknown, and *Cephalocereus cuyabensis* (Backeberg) comb. nov.[2] is the only species reported from the vast central region south of the Amazon River. Accordingly, it was of greatest interest to discover, in several localized habitats in the vicinity of the headwaters of the Rio Tocantins in Goías[3], colonies of what appear to be at least three different species of *Cephalocereus.* Cuttings of one of these flowered recently in cultivation both in Berkeley and in Santa Monica, California, and has proved to be of a species unlike any previously known. It is described below.

Cephalocereus machrisii sp. nov.
Pls. 1-3

Plantis ad 3.5 m. altis, ad basim ramificatis, ramis simplicibus, 7-8 cm. diametro, circa 11-13 costas habentibus, glaucis; areolis dense positis, 3-4(5) mm. distantibus, pulvino capillorum rectorum 3-4 mm. longorum, caespite lanato croceo vel fusco, canescente, ad ultimum deciduo; spinis 15-17 flavis, fuscescentibus straminescentibusve, haud distinctis ad situs radicales vel centrales, aliis 12-13

[1]Expedition Botanist.
[2]*Pilocereus cuyabensis* Backeberg, Blätter für Kakteenforschung, 1935-1, genus 98, species 4. 1935. This and other new combinations are made in *Cephalocereus* due to the illegitimate status of *Pilocereus.*
[3]For localities and the general account of the botany of the Expedition see No. 2 of this series (Jan. 1957).

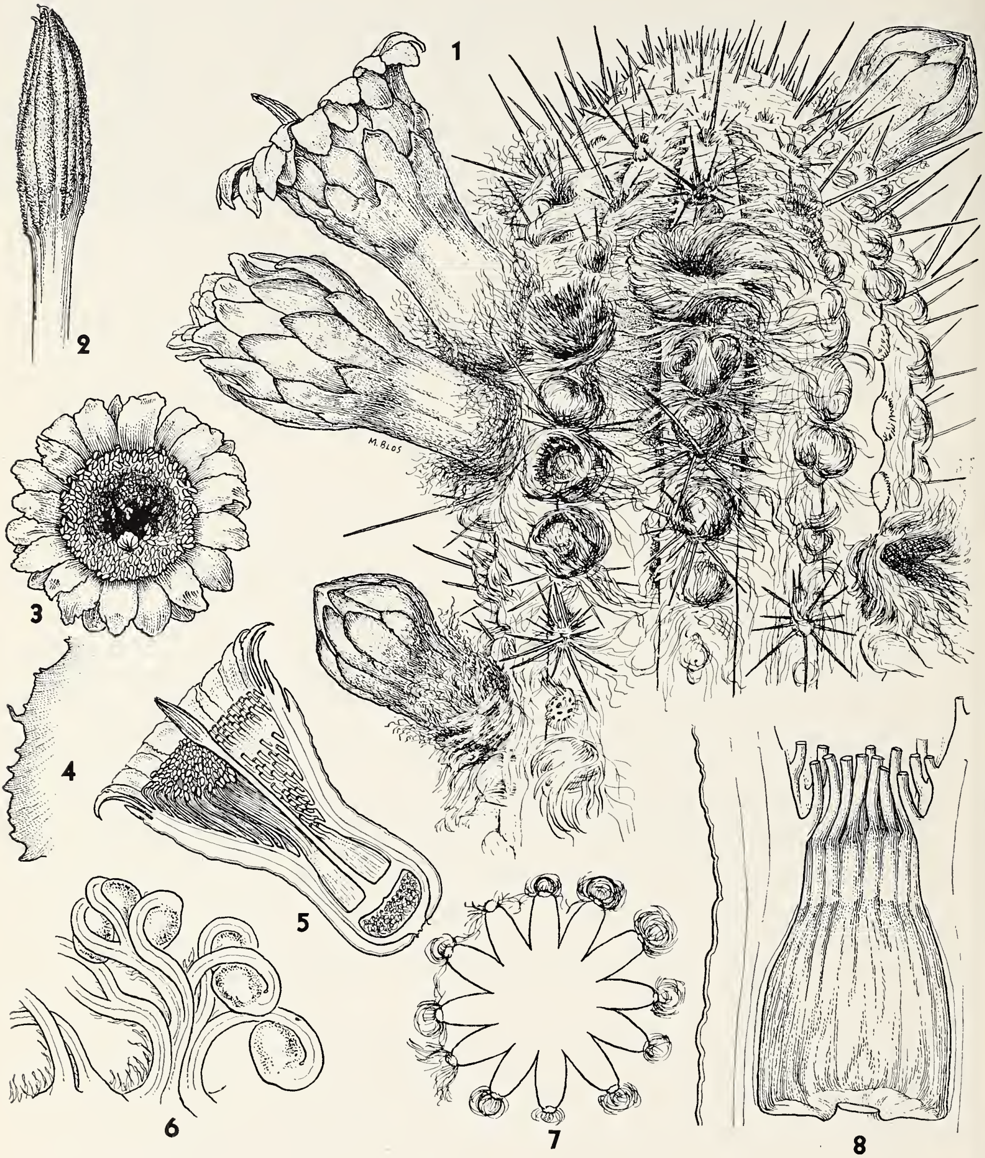

PLATE 1

Cephalocereus machrisii Dawson, from a plant of the type collection, University of California Botanical Garden 56.879-1. Fig. 1. Stem, buds, open flower and closing flower, x 1; Fig. 2. Stigma, x 3.5; Fig. 3. Flower in apical view, x 1; Fig. 4. Edge of inner tepal, x 7.5; Fig 5 Longitudinal section of flower showing stamen insertion, x 1; Fig. 6. Funicles, x 27; Fig. 7. Stem cross section (in somewhat shrunken condition) x 0.5; Fig. 8. Nectary chamber, x 3. Drawing by Mrs. M. Blos.

radialioribus 5-8 cm. longis, aliis 2-4 centralioribus semierectis et 10-15 (20) cm. longis; floribus abundantibus, radialiter sustentis a totis lateribus partis superioris 10-15 cm. ramorum maturorum, orientibus e areolis densis fusci-lanatis, gemmis porphyreis, haud glaucis, se aperientibus ad 4-5 cm. longis, corolla reflexa, 30-35 mm. transversa, intra alba, nuda, haud squamata; segmentis periantheis minute denticulatis ad brevifimbriatis secundum margines exteriores; stigmatibus antherisque flavis; ovulis in funiculis ramificatis e 9 placentis sustentis; fructu haud viso.

Plants to 3.5 m. tall, with 8 or more branches from the base; branches closely erect, simple, 7-8 cm. in diam. when well filled out (5.5-6.0 cm. in somewhat shrunken cultivated cuttings); ribs 11-13, 1.0-1.5 cm. high; upper parts of stems appearing yellow-brown from a distance because of the brown wool and yellow spines; epidermis grey-green to bluish-pruinose on upper parts, but not powdery; areoles closely set, mostly separated only 3-4 (5) mm., consisting of a cushion of short, straight hairs 3-4 mm. long and a tuft of yellow-brown wool which becomes grey with age (developing white in cultivation) and is ultimately lost; wool tufts prominent and individually distinct on mature flowering heads; spines mostly 15-17, yellow at first, becoming brown or straw-colored, not distinct as to radial and central positions, the 12-13 more or less radial ones 5-8 mm. long, the 2-4 central ones semi-erect and longer, 10-15 mm. and occasionally to 20 mm. long; flower buds dull red, abundant, 8 or more borne radially and equally from all sides of the upper 10-15 cm. of the mature branches, arising from densely brown wooly areoles from which part of the wool is lost during development; flowers reaching 4.0-4.5 cm. in length when open, the corolla 30-35 mm. across the spread limb, dull reddish without, not glaucous, grading into pale green at the receptacle, naked, scaleless but somewhat fluted in the lower third; perianth reflexed, white within except the tips of the outermost segments; stamens with white filaments and yellow anthers; stigma yellow, with 9 non-spreading lobes; perianth segments all irregularly, minutely denticulate to short-fimbriate along their outer margins; anthesis occurring in early May about 11-12 days after appearance of buds which develop in close succession, the flowers opening about an hour after sunset and closing about 4 hours after sunrise, turning black, if unfertilized, and falling off the second day; ovules 275-325μ long, their integument cells prominent, 16-21μ in diameter, appearing to suggest that the mature seed coat is pebbled rather than smooth, borne on twice, or thrice-branched

PLATE 2

Cephalocereus machrisii Dawson. Above. A mature plant at the type locality, May 1956; Below. A cutting in flower at Santa Monica, May 1957.

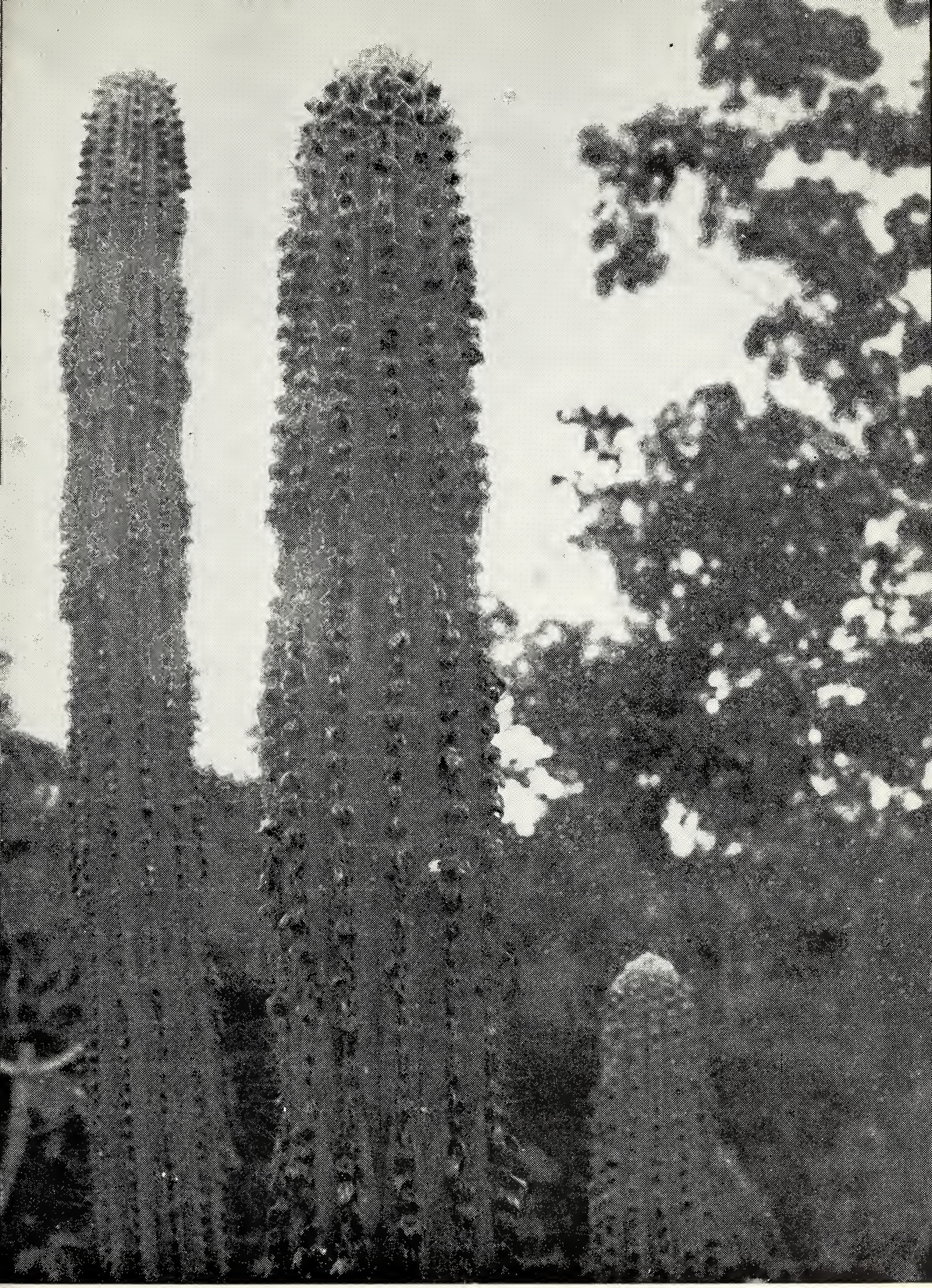

PLATE 3
Cephalocereus machrisii Dawson. Apical portion of the plant shown in Plate 2 (upper). fig. 1.

funicles; placentae 9, the roof of the ovary clearly showing 9 radiating locular ribs; fruits not seen; attempted crosses with *Cephalocereus arrabidae* and *C. nobilis* negative for all three plants.

Holotype: Dawson 15110, from a sandstone outcrop on the east side of the Ceres road 3 km. south of Uruaçú, Goiás, Brazil, May 26, 1956, deposited in the Museu Nacional, Rio de Janeiro. A duplicate type, representing the other half of the same cutting, is in the Los Angeles County Museum Herbarium.

The species is named in honor of Mr. Maurice A. Machris, cosponsor with his wife of the 1956 Brazilian Expedition.

This new plant appears to be most closely related to *Cephalocereus cuyabensis* (Backbg.) Dawson from Cuyabá, Matto Grosso, but that species has more slender branches and its flowers are described as "much powdered and creamy white." In *C. machrisii* the flowers cannot be interpreted as "powdered" at all, and the tepals are pure white within and reddish without.

Four other Brazilian species are somewhat similar, but still markedly distinct. *Cephalocereus piauhyensis* (Gürke) Britton & Rose differs in being treelike rather than basally branched, in having unilateral instead of radial flowering areoles, and white rather than yellow-brown hairs and wool. *Cephalocereus minensis* (Werdermann) comb. nov.[4] differs in being smaller, in having more slender branches with more ribs, and in having scales on the ovary with some hairs in their axils. *Cephalocereus bradei* (Backeberg & Voll) comb. nov.[5] differs in its unilateral flower zone, its grey felted areoles, chocolate brown rather than yellow spines, and greenish white flowers. *Cephalocereus hapalacanthus* (Werdermann) comb. nov.[6] differs by its grey wool and white hairs, by its shorter spines and longer, curved rather than straight flowers with a green midrib on the tepals.

The colony at the type locality consisted of about a dozen mature plants scattered in open places on the north end of the sandstone outcrop and occupying an area of about 150 by 50 meters. The associated vegetation was moderately heavy and, with the exception of an occasional bromeliad, did not contain other succulent plants. Although a number of similar sandstone outcrops were visited in the Serra Dourada and along the road to Peixe over 300 km. to the

[4]*Cereus minensis* Werdermann, Brasilien und siene Säulenkakteen, 93, 1933.
[5]*Pilocereus bradei* Backeberg & Voll, in Backeberg, Cactaceae, Jahrbücher der Deutschen Kakteen-Gesellschaft, 78, June 1942.
[6]*Pilocereus hapalacanthus* Werdermann, Brasilien und seine Säulenkakteen, 110, 1933.

PLATE 4

Above and lower left. *Cephalocereus* sp. growing on a sandstone outcrop 40 km. south of Uruaçú, Goiás; Lower right. *Cephalocereus* sp. growing on a sandstone outcrop 15 km. northwest of Veadeiros, Goiás.

north, no other terrestrial cacti were encountered. To the south, however, about 40 km. below Uruaçú on the Ceres road, another colony of *Cephalocereus* was found (pl. 4). These plants have the same habit as *C. machrisii* but lack the bluish pruinose character and have a somewhat heavier and longer armament. The specimens now under cultivation may prove upon flowering to be a distinct but closely related species.

The only other columnar cacti found in the nearly three months of botanizing in Goiás in 1956 were collected in three localities in the Chapada dos Veadeiros at 15 km. northwest of Veadeiros on the Cavalcante road, and at 7 and 14 km. south of Veadeiros on the São Joâo da Aliança road. All were on sandstone outcrops and appeared in the field to be variants of a single species of *Cephalocereus,* but none were found in flower or mature fruit. These plants, unlike *C. machrisii,* were characterized by a unilateral wooly flowering zone on the north side of mature stems (pl. 4). Cultivated cuttings of this species have not yet flowered.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ıber 11 August 20, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Chlorophyta; Euglenophyta

By G. W. Prescott

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THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Chlorophyta; Euglenophyta

By G. W. Prescott[1]

The collections upon which the following list of algae is based were taken on an expedition sponsored by Mr. and Mrs. Maurice A. Machris and under the direction of the Los Angeles County Museum[2]. The 26 samples were collected by Dr. E. Yale Dawson, Expedition Botanist, from May 16 through June 6, 1956. All of them came from the vicinity of the Rio Santa Teresa, a tributary of the upper Rio Tocantins between the Serra Dourada and Peixe in central Goiás, Brazil. After tripartite division of each sample, the collections will be deposited in the Museu Nacional do Brasil at Rio de Janeiro, in the Los Angeles County Museum, and in the personal herbarium of the author.

Most of the samples were taken from shallow, rapidly flowing streams and rivulets. This offers one explanation for the paucity of algal species, inasmuch as such habitats are usually not supporters of luxuriant growths. Only nine collections were made in pools and puddles. One of these, No. 15212, from a small stagnant pool, yielded the largest number of species (25). We are not able to state what bearing seasonal conditions and water-chemistry factors may have on the algal flora, but it is obvious that the following list represents a flora which might very well be decidedly different at another time of year.

The fairly large number of acidophilic species in the samples suggests that the waters from which the collections came were not rich in calcium; possibly relatively soft. Two few samples are at hand to provide much generalization, yet it may be worth pointing out that among the desmids (which far exceed other groups in number of species) there is a conspicuous Closterietum-Cosmarietum composition. This is an association which ordinarily is indicative of a reaction approaching neutrality (pH 6.8-7.4). There are few *Staurastrum, Euastrum* and *Micrasterias;* no *Arthrodesmus, Xanthidium, Triploceras* or *Tetmemorus.* The region from which the collections came is tropical, but there appear few of the species previously reported from tropical and subtropical Brazil; rather, they are species mostly of world-wide distribution. This is in contrast to algal col-

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[2] See: The Machris Brazilian Expedition, Botany: General, by E. Yale Dawson. Los Angeles County Museum Contributions in Science (2): 1-20. 1957.

lections gathered in other parts of Brazil, most of which have been very rich. (See: Bohlin, 1897; Borge, 1892, 1895, 1899, 1903, 1918, 1925; Börgesen, 1890; Grönblad, 1945; Krieger, 1950; Moebius, 1899, 1890; Nordstedt, 1870, 1878, 1889; Schmidle, 1901; Tiffany, 1937; Wille, 1884, for important contributions to our knowledge of Brazilian freshwater algae.)

The following list summarizes the field data corresponding to Dawson's field collection numbers which appear with the determinations of species below.

14844. Along a small stream flowing over rocks and through *cerrado,* 20 km. east of Formoso, May 16, 1956.
15136. In a drying road puddle , 2½ km. southwest of Peixe, June 1.
15146. In a road puddle (green water), 18 km. southwest of Peixe, June 2.
15148; 15149. In a slowly flowing small stream in the sun, 25 km. southwest of Peixe, June 2.
15156. In a flowing rivulet, 30 km. southwest of Peixe, June 2.
15157. In a flowing rivulet, 32 km. southwest of Peixe, June 2.
15161. In a flowing rivulet, 35 km. southwest of Peixe, June 2.
15165. In a slowly moving stream, 41 km. southwest of Peixe, June 2.
15166. In a flowing stream, 43 km. southwest of Peixe, June 2.
15178. In a slowly moving rivulet, 124 km. south-southwest of Peixe, June 3.
15187. In a road puddle, 137 km. south-southwest of Peixe, June 3.
15190. In a drying rivulet in the forest, 140 km. south-southwest of Peixe, June 3.
15200. In a small stream flowing over rocks, 20 km. east of Formoso, June 4.
15203. Seepage among rocks along a small stream, 20 km. east of Formoso, June 4.
15204. On an aquatic plant in a pool below a small waterfall on a rivulet, 20 km. east of Formoso, June 4.
15205. On rocks at the edge of a swiftly flowing small stream, 20 km. east of Formoso, June 4.
15206. On rocks along a small stream, 20 km. east of Formoso, June 4.
15212. In a stagnant pool among rocks near a small stream, 20 km. east of Formoso, June 4.

15216. In a swiftly flowing part of a small stream flowing over rocks, 20 km. east of Formoso, June 4.
15217. Along a small stream flowing over rocks, 20 km. east of Formoso, June 4.
15226. In a sluggish stream in the forest, 18 km. east of Formoso, June 4.
15227. In a forest puddle polluted by cattle, 15 km. east of Formoso, June 4.
15228; 15230. In a small stream flowing over rocks, 21 km. east of Formoso, June 6.
15232 In a palm culvert from a small stream, 21 km. east of Formoso, June 6.

SYSTEMATIC LIST

CHLOROPHYTA

ULOTRICHACEAE

Ulothrix tenerrima Kütz. 15156 Pl. 1, fig. 1

Filaments 9.8-10 μ in diameter, slightly constricted at the joints; chloroplast a broad, incomplete, parietal band with one pyrenoid (or sometimes two); cells both shorter than, and a little longer than wide, up to 10.5 μ long. Entangled with *Spirogyra* and *Mougeotia.*

MICROSPORACEAE

Microspora willeana Lag. 15156 Pl. 1, fig. 2

Filaments slightly constricted at the cross walls; cells 13.5 μ in diameter, 13.5-15 μ long; wall thin; chloroplast a close net-work of pads and narrow strands, covering most of the wall. This occurred as the dominant species in a tangle of filamentous algae.

CHAETOPHORACEAE

Chaetophora elegans (Roth) Ag. 15157; 15166 Pl. 1, fig. 4-7

Colonies soft and amorphous, up to 20 mm. in diameter; filaments loosely spreading, but in general radiate; branching mostly confined to the apical portion of the thallus, the branches both obtusely rounded at the apices and tapering to colorless hairs; cells of the main axis 4.9 μ in diameter, 8.1 μ in diameter in the upper portions, 2-3 times as long as wide.

Chaetophora pisiformis (Roth) Ag. 15165 (det. by Francis Drouet)

Draparnaldia glomerata (Vauch.) Ag. 15148 Pl. 1, fig. 3

Filaments embedded in soft, watery mucilage; main axis slightly constricted at the joints; cells 52.2 μ in diameter, 68 μ long; chloroplast a narrow median band with numerous pyrenoids; branches in glomerate tufts, mostly alternate.

OEDOGONIACEAE

Oedogonium crenulatocostatum Wittr. fa. (?) 15146 Pl. 1, fig. 11-13

Plants macrandrous, dioecious; vegetative cells cylindric, 13 μ in diameter, 42μ long; oogonia ovoid, mostly solitary, 26 μ in diameter, 50 μ long, opening by a superior pore; suffultory cell 16 μ in diameter, 55μ long; oospore with median wall crenulate-costate, with about 6 costae visible; antheridial cells 12 μ in diameter, 5.5-6 μ long.

Oedogonium dawsonii sp. nov. Pl. 1, fig. 14-16

Planta macrandra, dioecia; cellulae elongatae, non capitellatae; (cellula basalis?); cellulae vegetativae 8.4-9.8 μ diam., 46-55 μ long.; oogonia unum vel duo, ovata, 26 μ diam., 49-55 μ long., e poro superiore aperientia, cellula suffultoria paulum ampliata; oospora late ovata, oogonium lateraliter, non, autem, longitudinaliter fere complens; mesosporium scrobiculatum, cellulae antherideae duo antherozoidea 8.5 μ diam., 6.5 μ long. habentes.

Plants macrandrous, dioecious; cells elongate, not capitellate; (basal cell ?); vegetative cells 8.4-9.8 μ in diameter, 48-55μ long; oogonia 1 or 2, ovoid, opening by a superior pore, 26 μ in diameter, 49-55 μ long; suffultory cell very slightly enlarged; oospore broadly oval, nearly filling the oogonium laterally but not in length; median spore wall scrobiculate; antheridial cells with 2 antherozoids, 8.5 μ in diameter, 6.5 μ long.

Type collection: *Dawson 15187*, floating clots in a road puddle, 137 km. south-southwest of Peixe, Goiás, June 3, 1956.

This species should be compared with *Oe. tiffanyi* Achley and with *Oe. wyliei* Tiff., both of which are larger throughout. Also it should be compared with *Oe. discretum* Tiff. which is somewhat larger throughout and has globose rather than oval oospores.

Oedogonium hirnii Gutw. 15178 (det. by L. H. Tiffany)

SCENEDESMACEAE

Scenedesmus bijuga (Turp.) Lag. 15212 Pl. 1, fig. 17

Cells ovate, the poles broadly rounded, adjoined along three-fourths of their lateral walls, 7.9 μ in diameter, 15-20 μ long.

Scenedesmus incrassatulus Bohlin 15212 Pl. 1, fig. 10

Cells ovate, the poles bluntly pointed and the cell walls thickened at the apices, 4.6-5.2 μ in diameter, 14-16 μ long.

Scenedesmus quadricauda var. *quadrispina* (Chodat) G. M. Smith 15212 Pl. 1, fig. 9

Cells oval, 9.2 μ in diameter, 19.5 μ long, the poles broadly rounded; terminal cells with a fine, sharp spine at each pole.

CHARACIACEAE

Schroederia setigera Lemm. 15146 Pl. 1, fig. 18

Cells sigmoid fusiform, the poles drawn into long, slender, spine-like tips; chloroplast reticulate, parietal; cells 6.5 μ in diameter, 85 μ long, including spines.

OOCYSTACEAE

Oocystis eremosphaera G. M. Smith 15212 Pl. 1, fig. 8

Cells solitary, broadly oval, 26.5 μ in diameter, 37 μ long, with a nodular thickening of the wall at the poles; chloroplasts many, plate-like, with irregular margins.

ZYGNEMATACEAE

Spirogyra fluviatilis Hilse 15203 Pl. 3, fig. 1-3

Vegetative cells with plane end walls, 49-51 μ in diameter, chloroplasts three; spore ovoid, the median spore wall rugose-scrobiculate, brown, 52.2 μ in diameter, 75 μ long; conjugation scalariform, the fertile cells swollen medianly.

Spirogyra hyalina Cleve 15190 Pl. 3, fig. 4-5

Vegetative cells 52.2 μ in diam., 81.7 μ long; chloroplasts 3, making one turn; spores elliptic, the membranes smooth, yellow, 42.5 μ in diam., 78.4 μ long; conjugation scalariform, the fertile cells cylindric.

Spirogyra machrisiana sp. nov. Pl. 3, fig. 14-16

Cellulae vegetativae dissepiementis planis, 24-28 μ in diam., 42-45 μ long.; chloroplastus unus, latus, conjugatio scalariformis, tubis e gametangiis contribuentibus plerumque emissis; cellulae fructiferae tumidae aut inflatae, 40.8 μ diam., 83 μ long.; sporae ellipticae, 32.7 μ diam., 55-62 μ long.; mesosporium crasse punctatum, flavum.

Vegetative cells with plane end walls, 24-28 μ in diameter, 42-45 μ long; chloroplast one, broad; conjugation scalariform, the tubes formed mostly by the contributing gametangium; fertile cells swollen or inflated, 40.8 μ in diameter, 83 μ long; spores elliptic, 32.7 μ in diameter, 55-62 μ long; median spore wall coarsely punctuate, yellow.

Type collection: *Dawson 15161,* in a flowing rivulet 35 km. southwest of Peixe, Goiás, June 2, 1956.

This species should be compared with *Sp. taftiana* Trans. which is about the same size, but which has fusiform-inflated, not bullate-swollen, fertile cells, and in which conjugating tubes are formed from both gametangia.

Spirogyra neglecta (Hass.) Kütz. 15203

Cells elongate-cylindric, with plane end walls; chloroplasts three, making four or five turns; conjugation scalariform, the tubes formed from both gametangia; fertile cells slightly swollen medianly; spores elliptic or elliptic-ovoid, 55.5 μ in diameter, 81.7 μ long, or nearly globose, 58 μ in diameter, 65 μ long, the walls smooth, colorless (?).

Spirogyra submarina (Collins) Trans. 15203 Pl. 3, fig. 13

Cells long, with plane end walls, 22.9 μ in diameter, 98 μ long; chloroplasts three, making one and one-half turns; conjugation scalariform, with tubes formed from both gametangia; fertile cells swollen; spores variable, irregularly ovoid or nearly globose, their wall layers smooth, brown, 29.0 μ in diameter, 32-52 μ long.

Spirogyra subsalsa Kütz. 15203 Pl. 1. fig. 21-22

Cells with plane end walls, 23-26 μ in diameter; chloroplast one; conjugation scalariform, the receptive cell enlarged to 33 μ in diameter, 87 μ long; spores elliptic, 24 μ in diameter, 33.3-51.2 μ long, the median spore wall dimpled or slightly rugose, with a longitudinal suture.

Mougeotia rava Trans. (?) 15203 Pl. 1, fig. 19-20, 24

Filaments of long, cylindrical cells 7.5 μ in diameter, 117 μ long; reproduction by akinetes only (?), formed in the midregion of the cell and mostly projecting from the cell or protruding, the cell sharply bent or recurved, the spores occurring on alternate sides of the filament so that it is zig-zag; spores 16-17 μ in diameter, with smooth, gray walls.

DESMIDIACEAE

Cylindrocystis crassa De Bary 15232 Pl. 2, fig. 3

Cells broadly oval, 22.9 μ in diameter, 35.9 μ long.

Netrium digitus var. *naegelii* (Bréb.) Krieg. 15216 Pl. 2, fig. 29

Cells elongate-fusiform, the poles narrowly rounded, 17 μ in diameter, 89 μ long; chloroplast one in each semicell, with longitudinal ridges.

Netrium digitus var. **naegelii** fa. **minus** fa. nov. Pl. 1, fig. 25

Cellulae varietati typicae similes sed minores; chloroplasti duo utraque in semicellula, omnibus pyrenoideo magno praeditis; cellulae 13 μ diam., 62.4 μ long.

Cells similar in shape to the typical variety but smaller, 13 μ in diameter, 62.4 μ long; chloroplasts two in each semicell, with a large pyrenoid in each.

Type collection: *Dawson 15146,* in a road puddle 18 km. southwest of Peixe, Goiás, June 2, 1956.

The interrupted chloroplast in each semicell together with the small size might be considered to be characters that warrant a species designation for this Brazilian plant. The form of the chloroplast is a fundamental attribute.

Penium australe Racib. 15203 Pl. 1, fig. 23

Cells broadly oval, 33 μ in diameter, 51 μ long, the semicell dome-shaped; median constriction a broad, shallow notch.

Penium phymatosporum Nordst. 15216 Pl. 2, fig. 1-2

Cells small, cylindrical, with broadly rounded apices, without a median constriction, 9 μ in diameter, 26 μ long.

Pleurotaenium cylindricum var. *stuhlmanii* (Hier.) Krieg. 15204 Pl. 3, fig. 6-7, 17, 19-20, 32

Cells elongate-cylindric, rectangular in outline, with a slight swelling at the base of the semicell, the poles truncate and furnished with an intra-marginal circle of granules, about 16 showing; chloroplasts in the form of parietal ribbons, widened to inclose the pyrenoids which are numerous; cells 46-53 μ in diameter at the base, 32-48 μ at the poles, 285-690 μ long.

Pleurotaenium maximum (Reinsch) Lund. 15156 Pl. 3, fig. 11-12

Cells stout, elongate-cylindric, with a prominent inflation at the base of the semicell, and strongly invaginated just above the inflation, the margins of the cell nearly parallel, the poles truncate, the angles broadly rounded; walls coarsely punctate, the punctae appearing prominently in the thickened wall at the poles; cells 35.9 μ in diameter at the base, 39 μ in diameter at the poles, 483 μ long.

Pleurotaenium trabecula (Ehr.) Näg.
15204; 15205; 15212 Pl. 3, fig. 9-10, 18

Cells elongate-cylindric, with a slight basal inflation just above the isthmus, the lateral margins subparallel (in ours slightly diverging toward the apex which may be as much as 3 μ wider); walls densely punctate, prominently so in the apex; cells (in ours) frequently occurring in chains because of adherence of mucilaginous sheath (which may be firm and appear as a wall outside the cell wall) 34-39 μ in diameter, up to 455 μ long.

This species occurs in many proportions (width/length). It may be quite stout, the semicells relatively wide toward the apices, and often with one semicell curved.

Pleurotaenium trabecula var. **minutissimum** var. nov. Pl. 2, fig. 30-31

Varietas parva, plantae typicae forma atque proportionibus similis, marginibus parallelis aut subparallelis, non attenuatis; membrana levis (?); cellula 8.8 μ diam., 44 μ long.; isthmus 6.5 μ lat.

A small variety with cells 8.8 μ in diameter, 44 μ long, the isthmus 6.5 μ., similar in shape and proportions to the typical, the margins parallel or subparallel and not tapering; wall smooth (?).

Type collection: *Dawson 15227,* in a forest puddle polluted by cattle, about 25 km. east of Formoso, Goiás, June 4, 1956.

This plant should be compared with *Pl. minutum* (Ralfs) Delp. which is about the same size, but which has no swelling at the base of the semicell.

Pleurotaenium trabecula var. *rectissimum West & West* 15230

Cells much elongated, with parallel margins, the poles truncate, 21-26 μ in diameter, 496-628 μ long.

Our specimens are relatively more slender than described for typical *P. trabecula.* This varietal designation is probably not tenable because of the tendency of this species to vary in proportions and in shape in different situations as well as in the same habitat.

Pleurotaenium truncatum (Bréb.) Näg. 14844 Pl. 3, fig. 8

Cells elongate-ovoid in general outline, the margins of the semicells convex, broadest above the base, about one-third the distance to the poles; semicells with a slight swelling just above the isthmus, narrowed toward the poles which are truncate and furnished with an intramarginal circle of six granules, four of them showing in face view; cells 40 μ in diameter at the base, up to 85 μ in diameter in the broadest place, 350-560 μ long.

Closterium acerosum (Schrank) Ehr. 15227 Pl. 4, fig. 2-3

Cells straight or nearly so, 52 μ in diameter, 565 μ long, the dorsal margin convex, the ventral margin straight or slightly convex in the midregion; walls smooth, colorless; pyrenoids numerous, scattered.

Closterium cornu Ehr. 15216 Pl. 2, fig. 16-17

Cells slightly convex on the dorsal margin, straight on the ventral margin, not tumid in the midregion, 6.8 μ in diameter, 68.6-100 μ long; walls smooth, colorless; apices bluntly rounded.

Closterium cynthia De Not. 15161 Pl. 3, fig. 28

Cells short, stout, strongly curved, but the ventral margin straight in the midregion, 14.7 μ in diameter, 88 μ long; walls smooth, colorless.

Closterium kuetzingii Bréb. 15216 Pl. 3, fig. 30

Cells slightly curved, tumid in the midregion, narrowed to the poles which are produced, the lateral margins subparallel, 16.3 μ in diameter, 226 μ long; poles truncately rounded and slightly enlarged at the apices; walls smooth, tan colored; pyrenoids four or five in each semicell.

Closterium kuetzingii var. læve (Racib.) Krieg.
15226 Pl. 3, fig. 29

Plants smaller than the typical, 16 μ in diameter, 280 μ long.

Closterium leibleinii Kütz. 14844: 15200 Pl. 4, fig. 1

Cells with both margins about equally curved, the ventral margin slightly tumid in the midregion, 18.5 μ in diameter, 105-150 μ long.

Closterium moniliferum var. *concavum* Klebs 15226 Pl. 3, fig. 31

Cells equally curved on both margins, the ventral margin not tumid, 46 μ in diam., 270 μ long; walls smooth, colorless.

Closterium parvulum Näg. 15212; 15216; 15156 Pl. 3, fig. 25

Cells small, 10 μ in diameter, 75 μ between poles, both margins equally curved; poles narrow but bluntly rounded; walls smooth, colorless.

Closterium prælongum var. *brevius* Nordst. 15216 Pl. 3, fig. 21-22

Cells elongate, slightly curved, rather abruptly narrowed at the poles which are slightly recurved, 16 μ in diameter, 220 μ long; walls striated (or smooth?), yellow.

Closterium validum West & West 15156 Pl. 3, fig. 23-24

Cells strongly curved, the poles bluntly rounded, 26 μ in diameter, 106 μ between apices; walls striated, brown.

Euastrum dubium Näg. 15216 Pl. 2, fig. 4

Cells 22.9 μ in diameter, 36 μ long.

Euastrum dubium var. *tritum* West & West 15216 Pl. 4, fig. 17-18

An unusual variety with smooth walls; cells 22.9 μ in diameter, 47.5 μ long; isthmus 8 μ.

This variety has been reported previously only from Burma.

Euastrum spinulosum Delp. 15204; 15212 Pl. 4, fig. 12-13

Cells 48 μ in diameter, 62 μ long; isthmus 14 μ.

Euastrum turneri West 15204 Pl. 4, fig. 15-16

Cells 34 μ in diameter, 50.5 μ long; isthmus 7.9 μ.

Micrasterias conferta var. *hamata* fa. *spinosa* Presc. & Scott 15156 Pl. 4, fig. 7

Cells 81.7 μ in diameter, 83.2 μ long; isthmus 16.3 μ.

Micrasterias depauperata var. **kitchellii** fa. **minor** fa. nov. Pl. 4, fig. 6

Forma parva; lobus apicalis productus; incisionibus subapicalibus latis, introrsus late rotundatis; lobi laterales semicellularum bifurcati, omni lobulo bifido; membrana punctata; cellula 58-62 μ lat. in basi, 44-48 μ lat. in apice, 74-76 μ long.

A small form with apical lobe produced; subapical incisions wide and broadly rounded inwardly; lateral lobes of semicells bifurcate, each lobule bifid; walls punctate; cells 58-62 μ in diameter at base, 44-48 μ wide at apex, 74-76 μ long.

Type collection: *Dawson 15212*, in a stagnant pool among rocks near a small stream 20 km. east of Formoso, Goiás, June 4, 1956.

Micrasterias depauperata var. **quadrum** var. nov. Text fig. 1

Varietas differens lobis inferioribus semicellularum quadratis, et invaginationibus marginis minoribus quam in planta typica; lobus apicalis subcuneiformis, lobuli spinis brevibus obtusis praediti; medius sinus angustus, fere per longitudinem inapertus; cellulae 62 μ diam., 85 μ long.

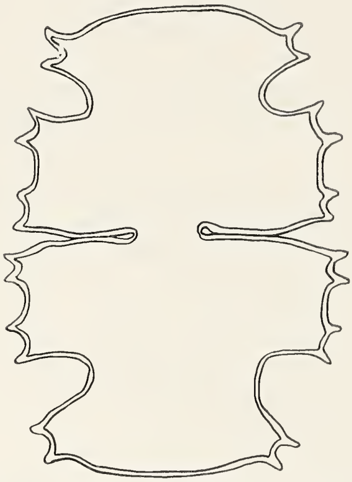

Fig. 1. *Micrasterias depauperata* var. *quadrum* var. nov.

A variety with the lower lobes of the semicell quadrate, the invaginations of the margin less than in the typical plant; apical lobe subcuneiform, the lobules furnished with short, blunt spines; median sinus narrow and closed for most of its length; cells 62 μ in diameter, 85 μ long.

Type collection: *Dawson 15216,* in a swiftly flowing part of a small stream 20 km. east of Formoso, Goiás, June 4, 1956.

This variety approaches some forms of *M. decemdentata* (Näg.) Bréb. and *M. truncata* (Corda) Bréb.

Micrasterias integra Nordst. 15203; 15204; 15212 Pl. 4, fig. 8-10

Cells 107-117 μ in diameter, 110-177 μ long; isthmus 32 μ; lateral angles either bifid (typical) or simple and with one short, stout spine.

Micrasterias laticeps var. *æquilobata* (Borge) Krieg.
15217 Pl. 4, fig. 11

Semicells with equally wide lobes, 90 μ in diameter at base, 85 μ wide at the poles, 100 μ long; walls coarsely punctate.

Micrasterias truncata (Corda) Bréb. 15212 Pl. 4, fig. 4

Cells 125 μ in diameter, 136 μ long; isthmus 25 μ.

Micrasterias truncata var. *pusilla* G. S. West 15232 Pl. 4, fig. 5

Cells smaller than the typical, 62 μ in diameter, 58.7 μ long; isthmus 14 μ.

Actinotænium cruciferum (De Bary) Teiling 15156 Pl. 3, fig. 26

Cells small, 19.6 μ in diameter, 29 μ long; isthmus 17.5 μ; semicells dome-shaped.

Actinotaenium subglobosum (Nordst.) Teiling 15146 Pl. 3, fig. 27

Cells 32.7 μ in diameter, 42.4 μ long; walls finely punctate.

Cosmarium arthrodesmiforme Borge 15156 Pl. 4, fig. 14

Cells 49 μ in diameter, 32.7 μ long; isthmus 11.5 μ.

Cosmarium boeckii Wille 15212; 15228 Pl. 2, fig. 38

Cells 27-31 μ in diameter, 32-35 μ long; isthmus 9.5-9.8 μ.

This species shows considerable variation in the arrangement of granules on the face of the semicell. The semicells are somewhat more nearly trapeziform than in *C. quinarium* Lund. with which it should be compared.

Cosmarium conspersum var. *capense* Hodgetts 15206 Pl. 2, fig. 37

Semicells quadrate-rotund; walls evenly granular, thick; cells 43 μ in diameter, 62 μ long; isthmus 16 μ.

This is an anomalous form which approaches several species in shape of semicell and in its pattern of granulation, but does not conform precisely to any. It should be compared with such species as *C. subbroomei* Schm. and *C. margaritatum* Lund. *C. conspersum* var. *subrotundatum* is larger than our form, but has the same rotund semicell.

Cosmarium hammeri Reinsch fa. 15205 Pl. 2, fig. 23

Cells 26.5 μ in diameter, 39 μ long; isthmus 6.9 μ.

This species should be compared with *C. sexangulare* Grun. and with *C. subcucumis* Schm. Our plants are very similar to a form illustrated by Fritsch and Rich from South Africa.

Cosmarium hammeri var. *javanicum* Bern. 15204 Pl. 2, fig. 19

Cells 24 μ in diameter, 38.7 μ long; isthmus 6.9 μ.

Cosmarium hammeri var. *protuberans* West & West
15230 Pl. 2, fig. 12

Cells 21.2 μ in diameter, 26 μ long; isthmus 5.9 μ.

Cosmarium logiense Biss. fa. 15204; 15212 Pl. 2, fig. 34-36

Semicells hemispherical or rotund; cells 30-33.5 μ in diameter, 43.5-46 μ long; isthmus 11.5 μ.

This material apparently represents a small form of the species. It should be compared with *C. gayanum* De Toni.

Cosmarium margaritatum (Lund.) Roy & Biss.
15204; 15206; 15230 Pl. 4, fig. 24

Cells 50-59 μ in diameter, 64-80 μ long; isthmus 16-18 μ.

Cosmarium notabile var. *minor* Wille 15156 Pl. 2, fig. 5-6

Cells quadrate, the lateral margins of semicell with four undulations, 14.7 μ in diameter, 22.9 μ long; isthmus 12 μ.

Cosmarium polymorphum Nordst. 15156 Pl. 2, fig. 32

Semicells trapeziform in outline; granules on face of semicell hollow; cells 26.2 μ in diameter, 26.2 μ long.

Cosmarium (Actinotænium?) pseudoconnatum Bréb.
15204 Pl. 4, fig. 23

Sinus a broad, shallow notch; semicells dome-shaped; end view round; walls finely punctate; cells 35 μ in diameter, 52 μ long; isthmus 33.5 μ.

Cosmarium pseudopyramidatum var. **peixei** var. nov. Pl. 2, fig. 7-8

Cellulae forma speciei typicae similes sed admodum minores; semicellulæ semipyramidatæ; membrana punctata; cellulae 19.8 μ diam., 35 μ long.; isthmus 6.6-6.9 μ lat.

Cells similar in shape to those of the typical variety, but distinctly smaller, 19.8 μ in diameter, 35 μ long; isthmus 6.6-6.9 μ; semicells semipyramidate; walls punctate.

Type collection: *Dawson 15156,* in a flowing rivulet 30 km. southwest of Peixe, Goiás, June 2, 1956. Additional material: *Dawson 15205,* on rocks at the edge of a swiftly flowing small stream 20 km. east of Formoso, June 4, 1956.

This simple plant is difficult of assignment. Because of its semipyramidate semicells it seems best to place it in the *C. pseudopyramidatum* group in which there is considerable variation in size and shape.

Cosmarium punctulatum var. *pindanum* Skuja 15156 Pl. 2, fig. 13

Margin of cells crenate; poles slightly produced and flattened; granules in midregion more regularly arranged in rows and more prominent than in the marginal region; cells 26 μ in diameter, 26 μ long; isthmus 9.8 μ.

This form is questionably assigned here. It has some characteristics of *C. punctulatum* Bréb., of *C. bipunctatum* Börg., and of *C. furcatospermum* West & West.

Cosmarium quadrifarium Lund. 15232 Pl. 4, fig. 19-20

Cells 39.2 μ in diameter, 52 μ long; isthmus 14 μ.

Cosmarium quadrum var. **depressum** var. nov. Pl. 2, fig. 33

Forma minor; semicellulæ transverse ovato-quadratæ; membrana granulis æqualiter dispositis prædita; cellulae 51 μ diam., 33 μ long.; isthmus 11.5 μ lat.

A small form; semicells transversely ovoid-quadrate; wall with evenly disposed granules; cells 51 μ in diameter, 44 μ long; isthmus 11.5 μ.

Type collection: *Dawson 15212,* in a stagnant pool among rocks near a small stream 20 km. east of Formoso, Goiás, June 4, 1956.

This form should be compared with *C. subbroomei* Schm. which has round-quadrate semicells, but is larger, and is not so compressed vertically.

Cosmarium quinarium var. **granulosum** var. nov. Pl. 2, fig. 9-11

Semicellulæ transverse ovatæ ad semicirculares, angulis inferioribus basalibus par granulorum coniformium prominetium habentibus; superficies semicellulæ ordinatione centrali granulorum magnorum prædita; semicellulæ a vertice visae ovatae, poli par granulorum coniformium atque ordines duos granulorum media in linea, granulis ad centrum magnitudine decrescentibus, præbentes; semicellulæ a latere visæ fere circulares, ordinibus duobus granulorum media in linea atque zona granulosa utroque in latere præditæ; cellulae 30 μ diam., 31 μ long.; isthmus 9.2 μ diam.

Semicells transversely oval to semicircular; lower basal angles with a pair of prominent cone-shaped granules; face of semicell with a central pattern of large granules; end view oval, the poles with a pair of cone-shaped granules and with a double row of granules in the median line, the granules decreasing in size toward the center; lateral view of semicell nearly circular, with a double row of granules in the median line and a granular zone on either side; cells 30 μ in diameter, 31 μ long; isthmus 9.2 μ.

Type collection: *Dawson 15205,* on rocks at the edge of a swiftly flowing small stream 20 km. east of Formoso, Goiás, June 4, 1956.

Cosmarium rectangulare var. *hexagonum* Borge
15156 Pl. 2, fig. 20

Cells 26-29 μ in diameter, 32-33 μ long; isthmus 9.8 μ.

Cosmarium subcucumis var. **parvum** var. nov. Pl. 2, fig. 14-15

Semicellulae quadrato-semiciculares, constrictione profunda, sinu angosto; a vertice visae ovatae, a latere visae ellipticae; membrana levis; cellulae 16 μ diam., 26.5 μ long.; isthmus 3.4 μ lat.

Semicells quadrate-semicircular, the constriction deep, the sinus narrow, oval in end view, elliptic in side view; walls smooth; cells 16 μ in diameter, 26 μ long; isthmus 3.4 μ.

Type collection: *Dawson 15200,* on rocks along a small stream 20 km. east of Formoso, Goiás, June 4, 1956.

Cosmarium ungerianum (Näg.) De Bary 15156 Pl. 2, fig. 18

Cells 29 μ in diameter, 32.7 μ long; isthmus 9.8 μ.

Staurastrum alternans Bréb. 15149 Pl. 2, fig. 21-22

Cells 22.9 μ in diameter, 39 μ long; isthmus 9.8 μ.

Staurastrum crenulatum (Delp.) Näg. 15212 Pl. 2, fig. 24

Cells slightly campanulate but with the upper angles produced to form arms, in end view three-five radiate, 30-32 μ in diameter, 25.5 μ long; isthmus 8 μ.

Staurastrum pseudolagerheimii var. minor var. nov. Pl. 4, fig. 21-22

Varietas minor quam specie typica; membrana spinis verrucis praedita; semicellulae campanulatae, inflatione bigranulosa admodum super isthmum; semicellula a vertice visa triangularis, duas verrucas perspicuas bispinatas medio in margine atque verrucam minorem utroque in latere paris, atque 3-4 spinas breves secundum margines angulorum paululum productorum habens; apices angulorum 4 spinis muniti; semicellula a vertice visa etiam seriem intramarginalem spinarum ac verrucarum praebens, regione media, autem, levi; cellulae 34-36 μ diam., 40.8-42 μ long.; isthmus 11.4 μ lat.

A variety smaller than the typical; walls furnished with spines and verrucae; semicells campanulate, with a bigranular swelling just above the isthmus, in end view triangular, with two prominent bispinate verrucae in the midregion of the margin, with a smaller verruca on either side of the pair and with three or four short spines along the margins of the slightly produced angles; apices of the angles tipped with four spines; an intramarginal series of spines and verrucae present; midregion of the semicell smooth when seen in end view; cells 34-36 μ in diameter, 40.8-42 μ long; isthmus 11.4 μ.

Type collection: *Dawson 15216,* in a swiftly flowing part of a small stream 20 km. east of Formoso, Goiás, June 4, 1956.

This variety approaches and includes characteristics of several species of *Staurastrum,* but its combination of features, together with its smaller size renders it difficult to make a precise assignment. It should be compared with *St. submanfeldtii* West & West (approaching var. *elegans* West & West), with *St. manfeldtii* Delp., *St. proboscideum* (Bréb.) Arch., *St. cerastes* Lund., and *St. sebaldii* var. *brasiliense* Börg. It has some features of Turner's questionable *St. opimum* and also of *St. javanicum* (Nordst.) Turner. Thomasson's description of *St. pseudolagerheimii* does no include the vertical view, nor does he illustrate other than the front view. Our plant seems to agree with this northern species, however, except for the much smaller size, being only about half as large as the typical variety.

Staurastrum spongiosum Bréb. fa. 15216 Pl. 5, fig. 17

Semicells in outline broadly oval to nearly spherical, the lateral angles scarcely discernible as such, bearing stout, spinate verrucae; median incision relatively slight, the isthmus broad; semicells in face view with a transverse median series of granular verrucae; cells 45.7 μ in diameter, 55.5 μ long; isthmus 24.6 μ.

This species should be compared with Carlson's questionable *St. skottsbergii* and with *St. subscabrum* Nordst., the latter having a much deeper incision and a narrow sinus.

Desmidium cylindricum Grev. 15149; 15166 Pl. 5, fig. 3-4

Cells 55.5 μ in diameter, 32.7 μ long.

Bambusina borreri (Ralfs) Cleve 15156 Pl. 5, fig. 6-7

Cells 15 μ in diameter, 29.4 μ long.

Hyalotheca dissiliens (Smith) Bréb. 15232 Pl. 5, fig. 1

Cells 24.6 μ in diameter, 13.6 μ long.

Hyalotheca mucosa (Dillw.) Ehr. 15166; 15217 Pl. 5, fig. 2

Cells 27.7 μ in diameter, 19 μ long.

Hyalotheca indica Turner 15212 Pl. 5, fig. 5

Cells 13.5 μ in diameter, 15-16 μ long.

EUGLENOPHYTA

Euglena caudata Hübner 15136 Pl. 5, fig. 20-22

Cells 14-17 μ in diameter, 65 μ long; chloroplasts showing as irregular plates surrounded by paramylum rings.

Euglena ignobilis Johnson (?) 15216 Pl. 5, fig. 13

Cells 6.5 μ in diameter, 58 μ long.

This form is questionably assigned here because preserved material does not disclose all taxonomic features. It might be compared with *E. intermedia* (Klebs) Schmidt which is a much larger species and has much larger paramylum grains. The prominent rings characteristic of *E. ignobilis* do not show, however, in our specimens, but only smaller rings and rods.

Euglena spirogyra Ehr. 15216 Pl. 5, fig. 14-15

Cells 11.5 μ in diameter, 80 μ long.

Trachelomonas cylindrica var. *decollata* Playf. 15226 Pl. 5, fig. 16

Lorica 11.5 μ in diameter, 20.5 μ long.

Trachelomonas hispida var. *coronata* Lemm. 15226 Pl. 5, fig. 8-9

Lorica 23 μ in diameter, 33 μ long; wall brown; spines showing as mucilaginous plugs.

Trachelomonas hispida var. *duplex* Defl.
15212; 15226 Pl. 5, fig. 10-11

Lorica 27-28 μ in diameter, 42-44 μ long; color golden brown.

Trachelomonas oblonga Lemm. fa. 15226 Pl. 2, fig. 27-28

Lorica 10.5 μ in diameter, 11.5-12.5 μ long, golden brown, smooth; flagellum aperture with a slight marginal thickening which also projects inwardly.

Trachelomonas oblonga var. *truncata* Lemm. 15226 Pl. 2, fig. 25-26

Lorica 14 μ in diameter, 18.5 μ long, (often flattened at the anterior end).

Phacus brachykentron Poch. 15226 Pl. 5, fig. 18

Cells 18.5 μ in diameter, 30 μ long, ending posteriorly in a short, straight spine.

Phacus curvicauda Swir. 15226 Pl. 5, fig. 12

Cells 18.5 μ in diameter, 24 μ long, ending posteriorly in a short, curved tail piece.

Phacus oscillans Klebs (?) 15226 Pl. 5, fig. 19

Cells ovate-pyriform, 11.5 μ in diameter, 38 μ long, ending posteriorly in a blunt, spine-like tail piece.

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PLATES

PLATE 1

Fig. 1. *Ulothrix tenerrima* Kütz.
Fig. 2. *Microspora willeana* Lag.
Fig. 3. *Draparnaldia glomerata* (Vauch.) C. A. Ag.
Fig. 4-7. *Chaetophora elegans* (Roth) C. A. Ag. (4: habit of thallus on substrate; 5: habit of branch apex)
Fig. 8. *Oocystis eremosphaera* G. M. Smith
Fig. 9. *Scenedesmus quadricauda* var. *quadrispina* (Chod.) G. M. Smith
Fig. 10. *Scenedesmus incrassatulus* Bohlin
Fig. 11-13. *Oedogonium crenulatocostatum* Wille fa. (12: antheridial cells)
Fig. 14-16. *Oedogonium dawsonii* sp. nov. (14: antheridial cells)
Fig. 17. *Scenedesmus bijuga* (Turp.) Lag.
Fig. 18. *Schroederia setigera* Lemm.
Fig. 19-20. *Mougeotia rava* Trans.
Fig. 21-22. *Spirogyra subsalsa* Kütz.
Fig. 23. *Penium australe* Racib.
Fig. 24. *Mougeotia rava* Trans., aplanospore
Fig. 25. *Netrium digitus* var. *naegeli* fa. *minus* fa. nov.


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PLATE 2

Fig. 1-2. *Penium phymatosporum* Nordst.
Fig. 3. *Cylindrocystis crassa* De Bary
Fig. 4. *Euastrum dubium* Näg.
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Fig. 7-8. *Cosmarium pseudopyramidatum* var *peixei* var. nov.
Fig. 9-11. *Cosmarium quinarium* var. *granulosum* var. nov.
Fig. 12. *Cosmarium hammeri* var. *protuberans* West & West
Fig. 13. *Cosmarium punctulatum* var. *pindanum* Skuja
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Fig. 16-17. *Closterium cornu* Ehr.
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Fig. 20. *Cosmarium rectangulare* var. *hexagonum* Borge
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Fig. 24. *Staurastrum crenulatum* (Delp.) Näg.
Fig. 25-26. *Trachelomonas oblonga* var. *truncata* Lemm.
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Fig. 29. *Netrium digitus* var. *naegelii* (Bréb.) Krieg.
Fig. 30-31. *Pleurotaenium trabecula* var. *minutissimum* var. nov.
Fig. 32. *Cosmarium polymorphum* Nordst. fa.
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Fig. 34-36. *Cosmarium logiense* Biss. fa.
Fig. 37. *Cosmarium conspersum* var. *capense* Hodgetts
Fig. 38. *Cosmarium boeckii* Wille

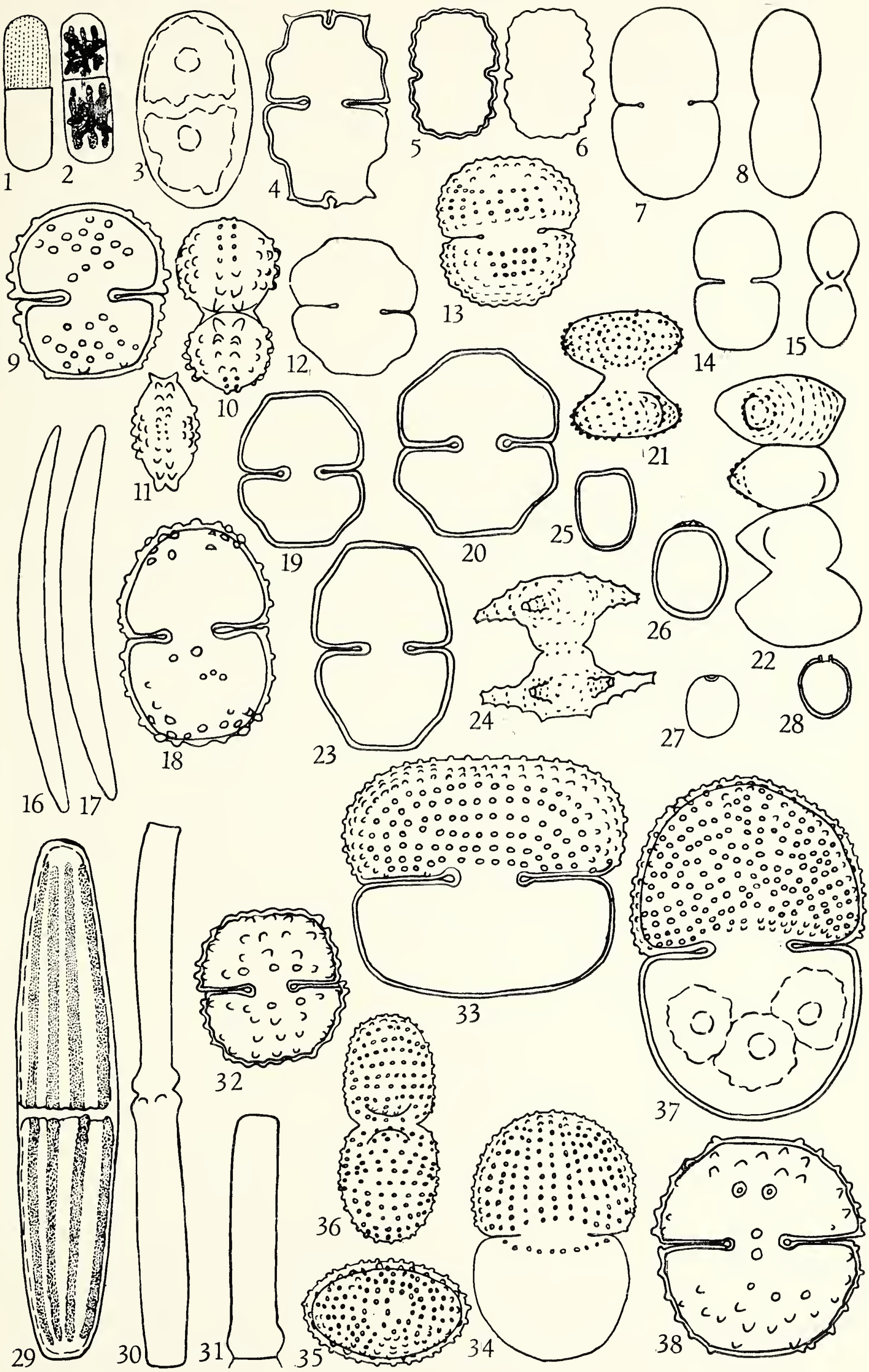
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PLATE 3

Fig. 1-3.	*Spirogyra fluviatilis* Hilse
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Fig. 8.	*Pleurotaenium truncatum* (Ehr.) Näg.
Fig. 9-10.	*Pleurotaenium trabecula* (Ehr.) Näg.
Fig. 11-12.	*Pleurotaenium maximum* (Reinsch) Lund.
Fig. 13.	*Spirogyra submarina* (Collins) Trans.
Fig. 14-16.	*Spirogyra machrisiana* sp. nov.
Fig. 17.	*Pleurotaenium cylindricum* var. *stuhlmannii* (Hier.) Krieg.
Fig. 18.	*Pleurotaenium trabecula* (Ehr.) Näg.
Fig. 19-20.	*Pleurotaenium cylindricum* var. *stuhlmannii* (Hier.) Krieg.
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Fig. 23-24.	*Closterium validum* West & West
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Fig. 29.	*Closterium kuetzingii* var. *laeve* (Racib.) Krieg.
Fig. 30.	*Closterium kuetzingii* Bréb.
Fig. 31.	*Closterium moniliferum* var. *concavum* Klebs
Fig. 32.	*Pleurotaenium cylindricum* var. *stuhlmannii* (Hier.) Krieg.

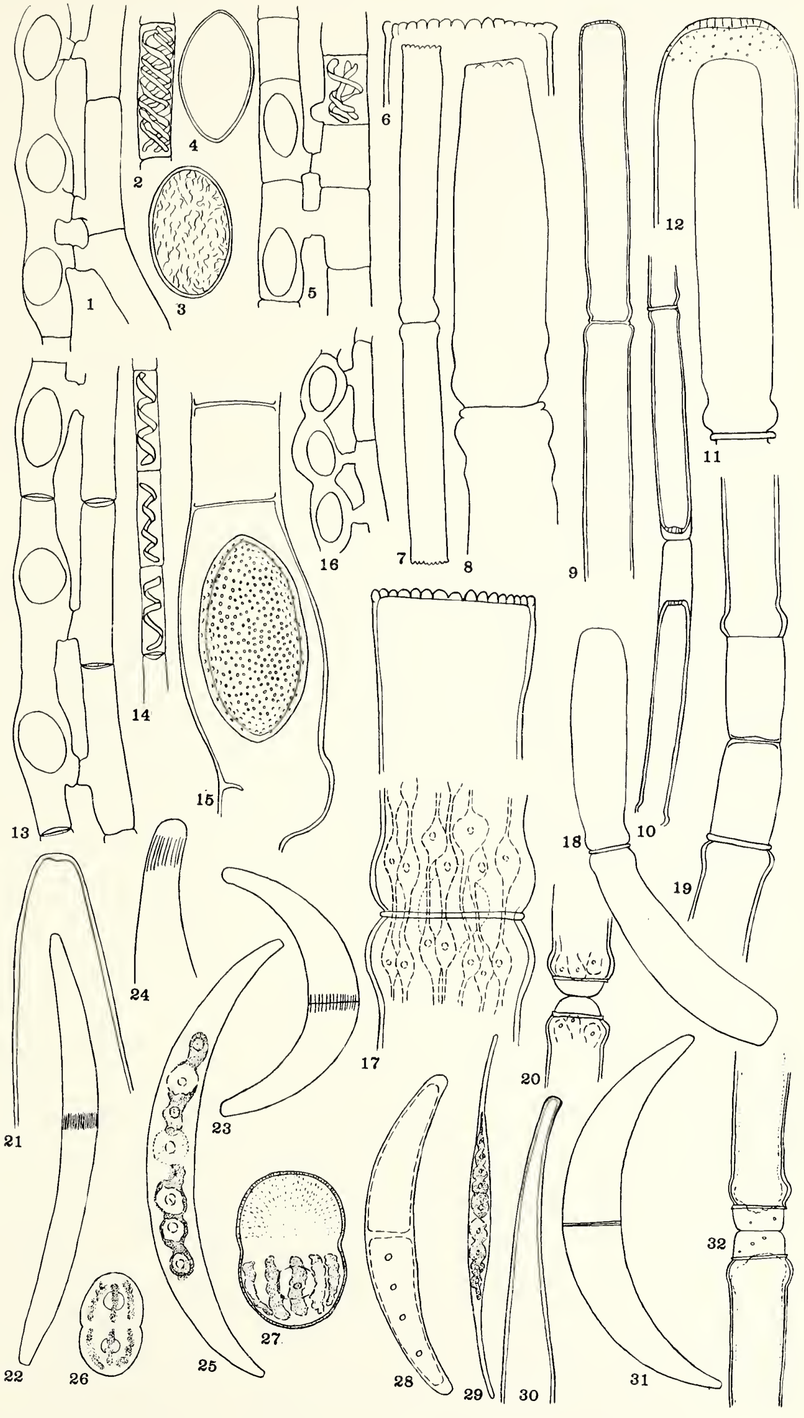
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PLATE 4

Fig. 1. *Closterium leibleinii* Kütz.
Fig. 2-3. *Closterium acerosum* (Schrank) Ehr. fa.
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Fig. 12-13. *Euastrum spinulosum* Delp.
Fig. 14. *Cosmarium arthrodesmiforme* Borge
Fig. 15-16. *Euastrum turneri* West fa.
Fig. 17-18. *Euastrum dubium* var. *tritum* West & West
Fig. 19-20. *Cosmarium quadrifarium* Lund.
Fig. 21-22. *Staurastrum pseudolagerheimii* var. *minor* var. nov.
Fig. 23. *Cosmarium pseudoconnatum* Bréb.
Fig. 24. *Cosmarium margaritatum* (Lund.) Roy & Biss.

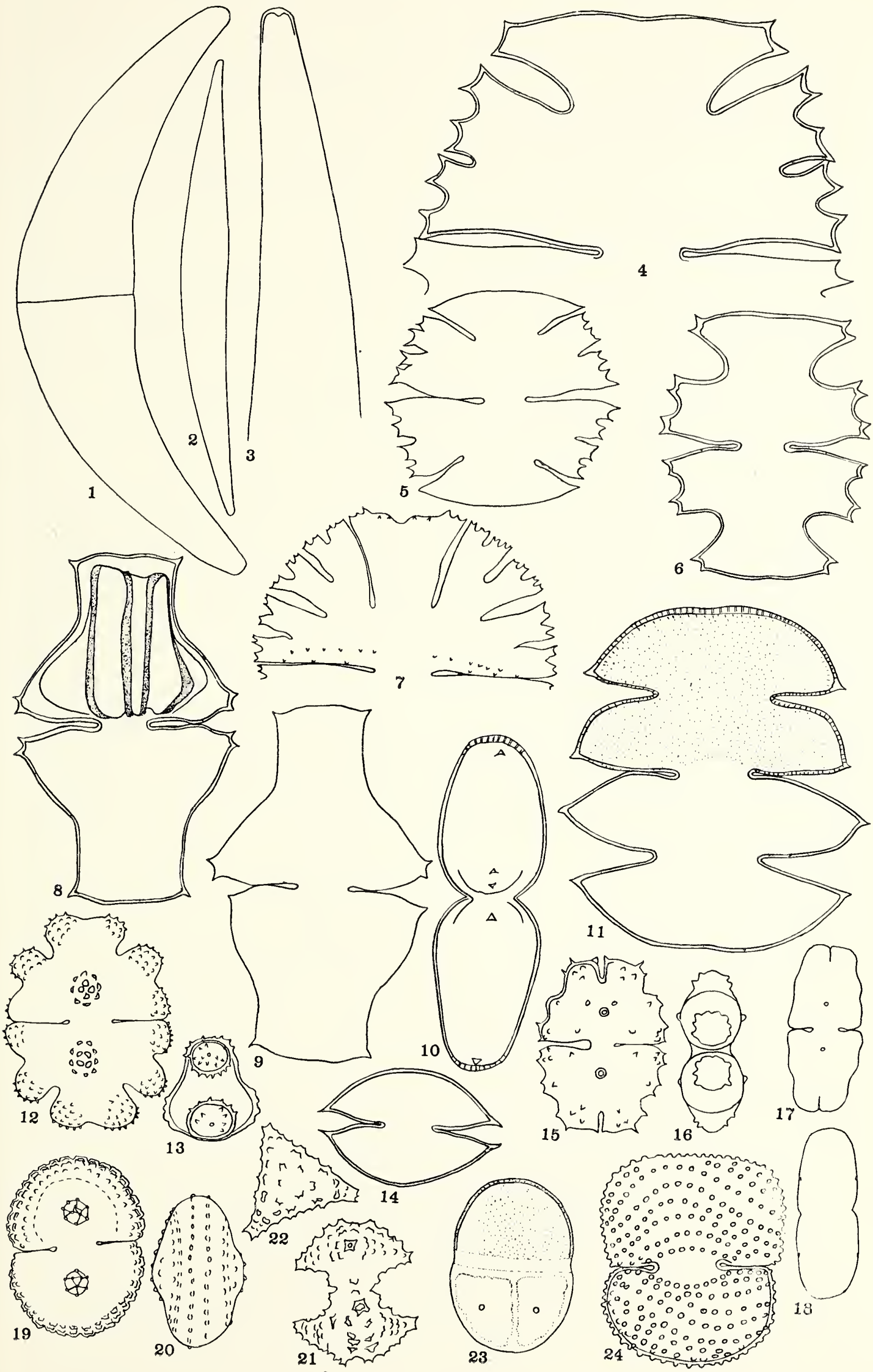
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PLATE 5

Fig.	1.	*Hyalotheca dissiliens* (Smith) Bréb.
Fig.	2.	*Hyalotheca mucosa* (Dillw.) Ehr.
Fig.	3-4.	*Desmidium cylindricum* Grev.
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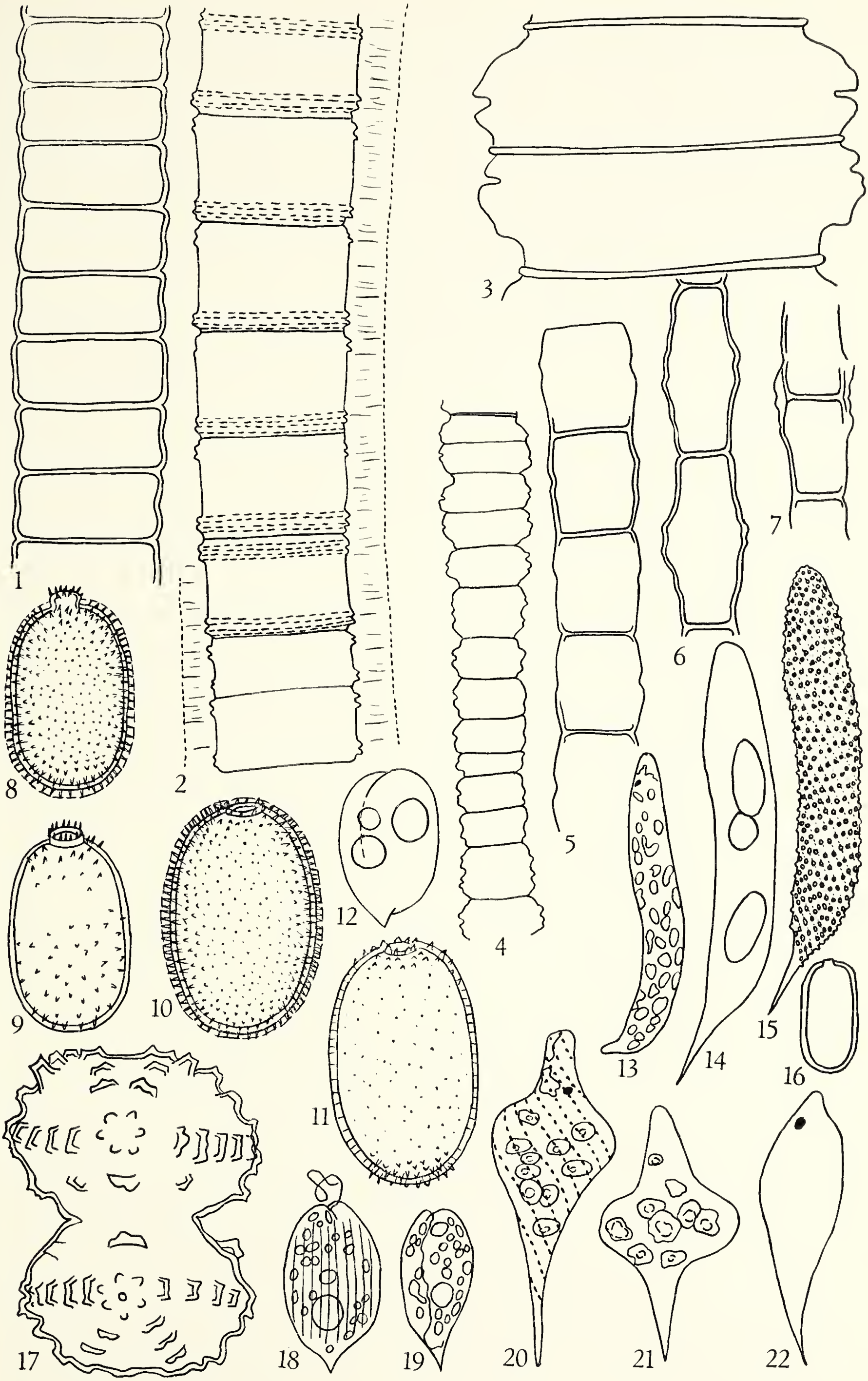
Fig.	10-11.	*Trachelomonas hispida* var. *duplex* Defl.
Fig.	12.	*Phacus curvicauda* Swir.
Fig.	13.	*Euglena ignobilis* Johns. (?)
Fig.	14-15.	*Euglena spirogyra* Ehr.
Fig.	16.	*Trachelomonas cylindrica* var. *decollata* Playf.
Fig.	17.	*Staurastrum spongiosum* Bréb. fa.
Fig.	18.	*Phacus brachykentron* Poch.
Fig.	19.	*Phacus oscillans* Klebs (?)
Fig.	20-22.	*Euglena caudata* Hübn.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LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

No. 1. The Machris Brazilian Expedition. General Account, by Jean Delacour. 11 pp., 4 figures. January 23, 1957.

No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson. 20 pp., 5 figures, 2 maps. January 24, 1957.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii,* by T. G. Yuncker. 2 pp., 1 figure. January 25, 1957.

No. 4. The Machris Brazilian Expedition. Botany: The Lichens, by Carroll W. Dodge. 2 pp. February 18, 1957.

No. 5. The Machris Brazilian Expedition. Botany: Cyanophyta, by Francis Drouet. 2 pp. February 19, 1957.

No. 6. The Machris Brazilian Expedition. Botany: A New Mint from Goiás, *Hyptis machrisae,* by Carl Epling. 4 pp., 2 figures. February 20, 1957.

No. 7. The Machris Brazilian Expedition. Botany: Phanerogamae, various smaller families, edited by E. Yale Dawson. 18 pp., 7 figures. March 7, 1957.

No. 8. Notes on Eastern Pacific Insular Marine Algae, by E. Yale Dawson. 8 pp., 4 figures. June 27, 1957.

No. 9. A New Species of Passerine Bird from the Miocene of California, by Hildegarde Howard. 16 pp., 2 figures. June 28, 1957.

No. 10. The Machris Brazilian Expedition. Botany: A New Columnar Cactus from Goiás, by E. Yale Dawson. 8 pp., 4 plates. July 15, 1957.

No. 11. The Machris Brazilian Expedition. Botany: Chlorophyta; Euglenophyta, by G. W. Prescott. 29 pp., 5 plates, 1 text figure. August 20, 1957.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ber 12 August 21, 1957

THE MACHRIS BRAZILIAN EXPEDITION

ENTOMOLOGY: General; Systematics of Notonectidae (Hemiptera)

By Fred S. Truxal

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

THE MACHRIS BRAZILIAN EXPEDITION

ENTOMOLOGY: General;

Systematics of the Notonectidæ (Hemiptera)

By Fred S. Truxal[1]

INTRODUCTION

The Machris Brazilian Expedition of 1956 was sponsored for the Los Angeles County Museum by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. Cooperating in the work of the Expedition, also, was the Museu Nacional do Brasil. A general account of the Expedition has been presented in this series by Jean Delacour[2], and the plant associations throughout the area traversed have been discussed by E. Yale Dawson[3]. These general features, therefore, will be given only brief attention in the present account, which is concerned with the entomological aspects of the Expedition.

The writer wishes to acknowledge herewith his indebtedness to those who have aided him in his work. First, to Mr. and Mrs. Maurice A. Machris of Los Angeles, California, under whose sponsorship these studies were conducted, he feels the deepest obligation and gratitude for the incentive and opportunity to investigate a much neglected area of Brazil. Without the enthusiasm and spirit of these two, the intent of the Expedition could never have been completely fulfilled. He is also indebted to Mrs. Maybell Machris Low for her generosity in contributing to the Expedition's general financial needs.

Special thanks are due Dr. José Candido M. Carvalho of the Museu Nacional do Brasil, Rio de Janeiro, and Dr. Paulo E. Vanzolini of the Departmento de Zoologia da Secretaria da Agricultura de São Paulo, Brazil, for their help and cooperation in making available the insect collections and records of their respective institutions.

To members of the Expedition, all of whom contributed materially to the entomological work, I wish to express my gratitude.

The illustrations were prepared, in part, by the Los Angeles County Museum's photographer, Lewis Athon, and the museum's artist, Dwight Phillip.

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[1] Curator of Entomology, Los Angeles County Museum.
[2] Delacour, Jean. 1957. Contributions in Science, (1): 1-12.
[3] Dawson, E. Yale. 1957. Contributions in Science, (2): 1-20.

Fig. 1. Map showing route of the Expedition in Brazil (dotted lines) and area studied (rectangle).

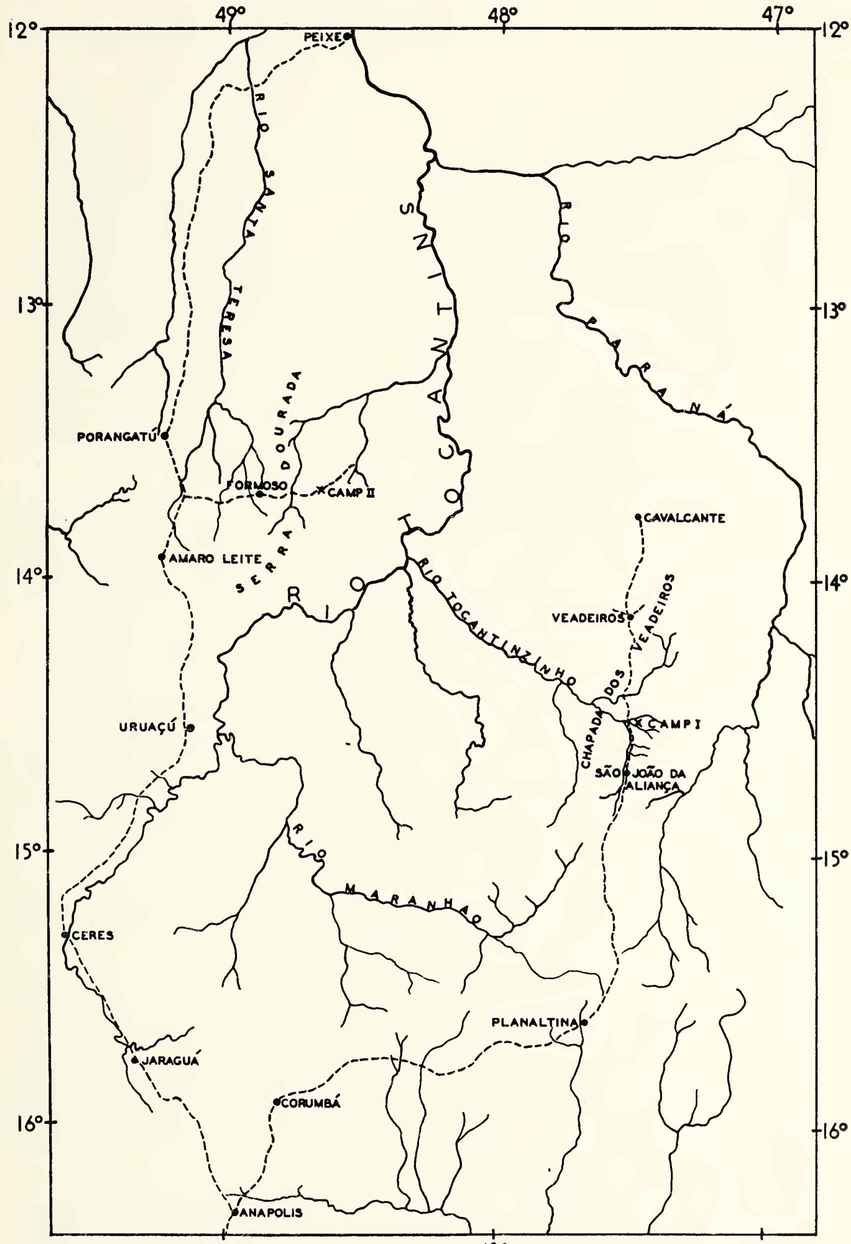


Fig. 2. Map showing detail of the area studied.

GENERAL ACCOUNT

The area selected for the Expedition lies in the state of Goiás, Brazil, along the headwaters of the Rio Tocantins, tributary to the Amazon (Fig. 1). Entomologically, the selection of this region was important for two reasons. First, this particular area of Goiás was entomologically unexplored and second, civilization had not as yet encroached this far inland. It was later discovered, however, that the impact of man on the biota was far from negligible.

A survey of the literature reveals a multitude of words concerning the insect fauna of Brazil. (Particularly significant is the work of A. da Costa Lima[4].) In spite of this great body of information, there are to be found no references for the area here involved. It is hoped, therefore, that the present series of contributions which is intended to provide a survey of a seasonal insect fauna of the Chapada dos Veadeiros and of the Serra Dourada, will find a useful and unoccupied place in Brazilian entomology.

The Expedition was in the field from March 31 to June 17, 1956. This period of time is the dry season of Goiás and was primarily chosen to facilitate overland travel. The dry season in the central highlands of Brazil, however, cannot be considered as the most favorable time of the year for general insect collecting.

The route of the Expedition covered the area from São Paulo northward 1046 kilometers to Anápolis, and thence northeastward into the Chapada dos Veadeiros for the first Base Camp. Here the party remained from April 12 to May 6. In May the Expedition returned to Anápolis and thence traveled almost directly northward to establish Base Camp II in the Serra Dourada. This camp was occupied until June 17, 1956. See figure 2.

In traveling northeastward from Anápolis one enters the rolling hills of the Planalto Centrál of Brazil and crosses the east-west divide between the Amazon Basin and the Paraná Basin. This highland region of Goiás is bounded by the Rio São Francisco on the east, the Rio Grande tributary of the Paraná on the south and the Araguaia tributary of the Tocantins on the west. Elevations range from 600 meters at Planaltina, the site of the future Brazilian capital, to 1300 meters at a point midway between Veadeiros and Cavalcante on the Chapada dos Veadeiros.

ECOLOGY. The Planalto Centrál consists of a considerable geographical area over which the environmental complex produced by climate, topography, and soil is sufficiently uniform to permit the development of characteristic types of ecologic associations. The

[4] Lima, A. da Costa. 1939-1953. Insetos do Brasil, 8 vols.

ecology of central Goiás has been very well described by Dr. E. Yale Dawson in No. 2 of this series and much of the information to follow is cited from this publication.

The highland region of Goiás is essentially a post-Cretaceous peneplain. The high permeability of the soil, which for the most part is sandy and poor, is a distinctive feature of the region and has a striking effect on the biota of the area.

The climate of central Goiás is characterized by fluctuations in daily temperature and in seasonal precipitation. Heavy rainfall is generally confined to the months of October through April (Fig. 3).

Goiás, GOIÁS	Formosa, GOIÁS
Jan. – 11.9 inches	12.0 inches
Feb. – 11.7	8.0
Mar. – 11.4	6.0
Apr. – 5.0	5.0
May – .4	.5
June – .5	.4
July – .1	.4
Aug. – .4	.5
Sept. – 1.8	2.0
Oct. – 4.8	5.0
Nov. – 8.7	8.0
Dec. – 10.2	12.0

Fig. 3. Average annual rainfall for two cities of the Planalto Centrál of Goiás, Brazil. After Delacour.

At present, almost the entire state of Goiás is occupied by a scrub forest and grass vegetation known as "*cerrado*" (Fig. 4). *Cerrado* consists of low, twisted trees, 3 to 8 m. in height, with irregular crowns, thick corky bark, and large leathery leaves which for the most part remain through the dry season. The ground cover consists of tall grass and scattered low shrubs. This vegetation type is due primarily to two factors. First, as previously stated, the *cerrado* is subject to a prolonged dry season, and secondly, the stature of the vegetation has been reduced by frequent and severe burning.

Occasionally one finds small areas that have been protected from firing, and here the vegetation has become tall and close. These areas approximate a second class forest characterized by trees 12 to 20 m. in height which become 30 per cent leafless during the dry season. The second class forest is the next most prominent vegetation type in the Goiás highlands. These forests are for the most part confined to the banks of streams and rivers.

A third vegetation type existing in the Planalto is the three-layered

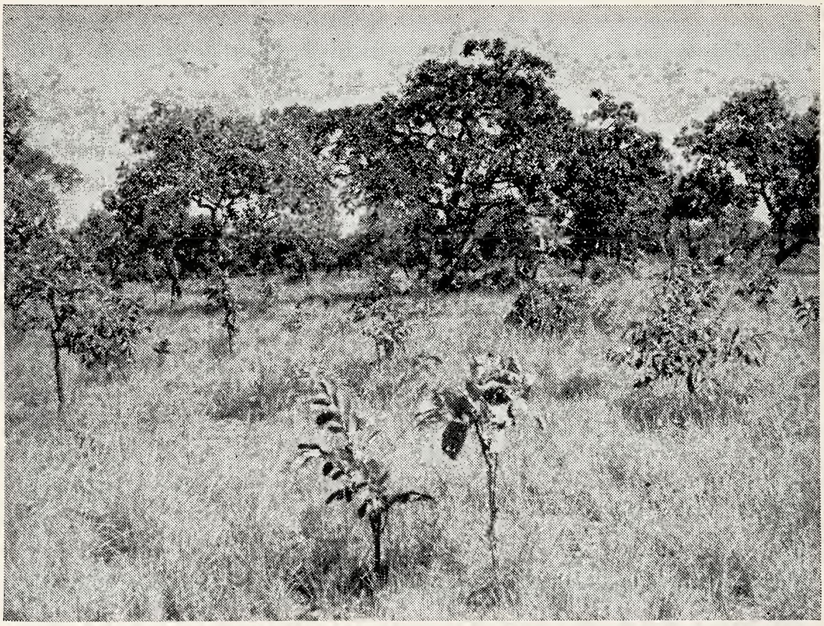


Fig. 4. *Cerrado* as seen in the vicinity of São João da Aliança, typical of the predominant vegetation of Goiás.

first class forest (Fig. 5). Here one finds a canopy of deciduous trees 20 to 30 m. in height, a second layer of more or less evergreen trees 5 to 15 m. in height and a forest floor layer of evergreen herbs and shrubs. The environmental conditions responsible for these fine forests are exceptionally favorable soil fertility, ample water and long freedom from fire. A considerable area of this vegetation type occurs in the Serra Dourada.

The well-developed *cerrado* and poor gallery forests, as well as the forest edges, supported a plentiful insect fauna. Very few insects were taken in the first or second class forests.

COLLECTING SITES. For the most part, entomological collections were made in the vicinities of the two base camps, both located on the headwaters of the Rio Tocantins.

The first base camp was established 20 kilometers north of São João da Aliança at approximately 1000 meters elevation. Vegetation consisted primarily of scrub forest and grassland dissected by numerous small streams whose margins supported forests of moderate height and density. Numerous termite mounds throughout the grasslands, however, indicated the former presence of a more dense woody vegetation (Fig. 6). Immediately east of camp was a shallow

Fig. 5. First class forest, illustrative of the luxuriant vegetation that exists in the Serra Dourada area of Goiás.

pond and marsh, as well as numerous small ox-bows left by the meandering stream known on the south bank as Jatobá and on the north bank as Pedras de Amolar. A characteristic of the Planalto in general is the occurrence of abundant shallow lakes, marshes and springs on the surface of the water-filled soil. This situation provides for a luxuriant aquatic insect fauna. Approximately 35 to 60 kilometers to the north of Base Camp I, in the vicinity of Veadeiros, a markedly different insect fauna was encountered. This was to be expected as the flora likewise differed greatly, due in part to extensive sandstone outcrops in a broken terrain of rocky hills and buttes (Fig. 7). The comparatively sparse vegetation, containing many

Fig. 6. Numerous termite mounds on the Chapada dos Veadeiros indicate the former presence of a more dense woody vegetation.

Fig. 7. A sandstone outcrop near Veadeiros supports a rich and varied insect fauna.

succulent terrestrial xerophytes, suggested, somewhat, a Sonoran desert aspect.

Temperatures ranged from a maximum of 84°F. to a minimum of 54°F. during the period of collecting at Base Camp I.

The second base camp was located in the southern Serra Dourada, 20 kilometers southeast of Formoso (Amaro Leite County) at an elevation of 800-1000 meters. The vegetation about camp consisted chiefly of well-developed *cerrado* on the hill slopes and crests with extensive second and first class forests along the streams and lowlands. Small streams and rivulets dissect this low mountainous region and in turn flow into the larger tributaries of the Rio Tocantins (Fig. 8).

During the first week in June, collections were made along the trailway between Amaro Leite and Peixe. Here, *cerrado* dominated the vegetation, with poor gallery forests following the stream beds.

Temperatures ranged from a maximum of 94°F. to a minimum of 46°F. during the period of collecting at Base Camp II.

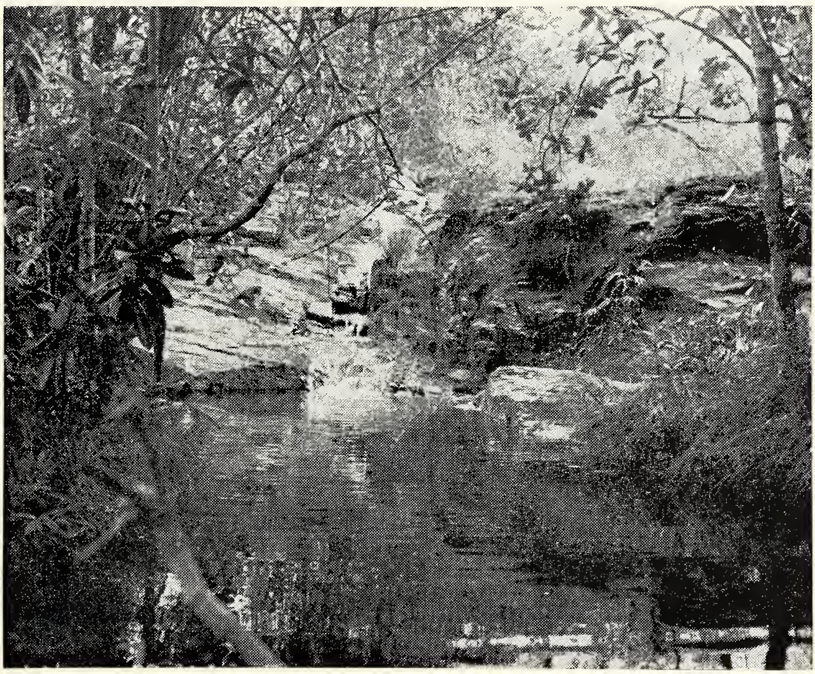


Fig. 8. A small stream near Formoso, typical of the numerous small rivulets and streams that dissect the low mountainous region of the Serra Dourada.

RESULTS. With the exception of Protura, Zoraptera, Anoplura and Strepsiptera, all insect orders are represented in the approximately 10,000 specimens taken on the Machris Brazilian Expedition. The work of identifying this material is now being accomplished with the help of a number of specialists in North and South America. As work progresses, the results will be published in subsequent issues of this serial. The following is the first of these systematic accounts.

SYSTEMATICS

NOTONECTIDAE (HEMIPTERA)

FAMILY CHARACTERISTICS. The family Notonectidæ is composed of aquatic forms differing from all other such insects, except Pleidæ and Helotrephidæ, in the habit of swimming on their backs. They are deep-bodied, flat ventrally, and convex dorsally. The abdomen possesses a prominent longitudinal mid-ventral keel, having hairs at least along its lateral margins. These, together with the hairs along the sides of the venter, cover the two longitudinal troughs to form air chambers.

GEOGRAPHICAL DISTRIBUTION. The family Notonectidæ embraces eight genera with representatives in both the Old and New World. Two genera, *Notonecta* and *Enithares*, are found in both the Eastern and the Western Hemisphere; *Neonychia* and *Paranisops* are confined to the Eastern Hemisphere. *Nychia* belongs to the Eastern Hemisphere and has its counterpart *Martarega* in the Western Hemisphere; likewise, *Anisops* is found throughout the Eastern Hemisphere and is replaced by the widely distributed *Buenoa* in the Western Hemisphere.

Of the four genera representing the Western Hemisphere, all are to be found in Brazil and three, namely *Notonecta, Martarega*, and *Buenoa*, were taken by the Machris Brazilian Expedition. Fourteen species are represented. An annotated list of these, including descriptions of three new species, follows. All records are new for Goiás, Brazil.

KEY TO THE GENERA OF NOTONECTIDÆ[5]

A. Hemelytral commissure without definite hair-lined pit at anterior end..(Subfamily Notonectinæ)

B. Intermediate femur with anteapical pointed protuberance and antennæ 4-segmented....................................(Tribe Notonectini)

[5]Truxal, F. S. 1953. University of Kansas Science Bulletin, vol. 35, p. 1366. Modified from Hungerford.

C. Anterolateral margins of prothorax not foveate *Notonecta*

CC. Anterolateral margins of prothorax foveate.........*Enithares*

BB. Intermediate femur without anteapical pointed protuberance and antennæ 3- or 4-segmented..........................(Tribe Nychini)

C. Sides of prothorax not foveate, the lateral ledge straight. Infracoxal plates bare but margined with hair. Intermediate tarsus with two well-defined segments and a very small basal one in both sexes..................................*Neonychia*

CC. Sides of prothorax foveate, the lateral ledge curving downward to embrace the fovea. Infracoxal plates covered with hair. Intermediate tarsus with one well-defined segment, except in males of *Nychia.*

D. Antennæ 3-segmented.......................... ....*Nychia*

DD. Antennæ 4-segmented............ ....*Martarega*

AA. Hemelytral commissure with definite hair-lined pit at anterior end...(Subfamily Anisopinæ)

B. Ventral abdominal keel not extending onto last abdominal segment. Male genital capsule cleft behind. Males without stridular protuberance on front tibia. Females with short gonapophyses ....*Paranisops*

BB. Ventral abdominal keel extending onto last abdominal segment. Male genital capsule closed behind. Males with stridular protuberance on front tibia. Females with long subspatulate gonapophyses.

C. Male with anterior tarsus 2-segmented.....................*Buenoa*

CC. Male with anterior tarsus 1-segmented...................*Anisops*

Genus **NOTONECTA** Linnaeus

Notonecta Linnæus, 1758, Syst. Nat., 10th Ed., p. 439.

Several species of this cosmopolitan genus inhabit Brazil, but only one is represented in the present Goiás collections.

Notonecta disturbata Hungerford

Notonecta disturbata Hungerford, 1926, Psyche, vol. XXXIII, p. 13.

Goiás: Anápolis, April 8, 1956 (Truxal); 48 km. south of Peixe, June 1, 1956 (Truxal).

Genus **MARTAREGA** White

Martarega White, 1879, Trans. Ent. Soc. London, p. 271.

This is primarily a neotropical genus. Eight of the eleven described species have been recorded from Brazil. Two species are represented in the collections of the Machris Brazilian Expedition.

Martarega membranacea White

Martarega membranacea White, 1879, Trans. Ent. Soc. London, p. 272.

Goiás: 48 km. south of Peixe, June 1, 1956 (Truxal).

Martarega uruguayensis (Berg)

Signoretiella uruguayensis Berg, 1883, An. Soc. Cient. Argentina, vol XVI, p. 122.

Martarega uruguayensis, Jaczewski, 1928, Ann. Musei Zool. Polonici, vol. VII, p. 131.

Heretofore the macropterous form of this species was unknown. Among the numerous specimens of *M. uruguayensis* taken from central Goiás, a single male macropterous form was found. As in other species, it differs markedly from the brachypterous form. The hemelytron of the macropterous specimen is distinctly divided into corium, clavus, and membrane. The color of the hemelytron is black, whereas that of the brachypterous form is testaceous. The pronotum and scutellum are more feebly developed in brachypterous forms, the pronotum being less widened posteriorly and shorter, the scutellum smaller.

Minas Gerais: Uberlândia, April 5, 1956 (Truxal). *Goiás:* 20 km. north of São João da Aliança, April 23, 1956 (Truxal); 24 km. east of Formoso, May 18-22, 1956, and June 13, 1956 (Truxal); 124 km. south of Peixe, June 2, 1956 (Truxal).

Genus **BUENOA** Kirkaldy

Buenoa Kirkaldy, 1904, Wiener Ent. Zeit., vol. XXIII, p. 120.

This genus is widespread in the New World. Fourteen of the forty species heretofore described have been recorded from Brazil. In the collections of the Machris Brazilian Expedition, a total of eleven species are here recorded. These include one species not previously reported from Brazil and three species heretofore undescribed.

Buenoa pallens (Champion)

Anisops pallens Champion, 1901, Biol. Cent. Amer., Heteroptera, vol. II, p. 374.

Buenoa pallens, Kirkaldy, 1904, Wiener Ent. Zeit., vol. XXIII, p. 121.

Goiás: 34 km. south of Amaro Leite, May 30, 1956 (Truxal).

Buenoa paranensis Jaczewski

Buenoa paranensis Jaczewski, 1928, Ann. Musei Zool. Polonici, vol. VII, p. 126.

This species, previously recorded only from the state of Paraná, was quite common in the central Goiás collections.

Goiás: 20 km. north of São João da Aliança, April 23, 1956 (Truxal); 24 km. east of Formoso, May 29, 1956 (Truxal); 34 km. south of Amaro Leite, May 30, 1956 (Truxal); 48 km. south of Peixe, June 1, 1956 (Truxal); 124 km. south of Peixe, June 2, 1956 (Truxal).

Buenoa triangularis n. sp.
(Pl. I, fig. 2)

Size: Male, length 6.30–6.75 mm., greatest body width 1.33–1.95 mm.; female, length 6.66–6.96 mm., greatest body width 1.96–2.00 mm.

Color: General facies testaceous to nigro-violaceous. Head, pronotum, thoracic venter testaceous to brown. Scutellum nigro-violaceous with apex testaceous; methoracic dorsum black. Abdomen black, except ventral keel and portions of connexivum testaceous. Some specimens entirely yellowish white to pale testaceous, except most of abdomen black. This species variable in color.

Male Structural Characteristics: As viewed from above, outline of head laterally rounded, anteriorly truncate with vertex indented at its lateral margins; greatest width of head approximately six times the anterior width of vertex and less than humeral width of pronotum; synthlipsis one third the anterior width of vertex; along median longitudinal axis, head approximately half the length of pronotum; notocephalon sulcate dorsally; tylus slightly inflated; labrum with basal width distinctly less than twice its median length and apex bluntly rounded; rostral prong (Pl. I, fig. 2b) longer than third rostral segment, with base originating laterally near proximal end of third rostral segment, and with apex sharply rounded. Pronotum with its median length less than half its humeral width; disk only faintly impressed, not carinate; lateral margins divergent; posterior margin convex, medianly concave. Scutellum large, with median length greater than that of pronotum. Fore femur (Pl. I, fig. 2a) neither wide not thickened at apex; triangular stridulatory area consisting of five to seven sclerotized ridges. Fore tibia with stridulatory comb (Pl. I, fig. 2c) consisting of eighteen to twenty-two teeth; all teeth approximately same size and thickness. Chætotaxy of male front leg as shown on Plate I. Male genital claspers normal. Spine from caudo-sinistral margin of seventh abdominal tergite tapering gradually from base to strongly acuminate apex.

Female Structural Characteristics: As viewed from above, outline of head laterally rounded, anteriorly truncate with vertex indented at its lateral margins; greatest width of head approximately six times the anterior width of vertex and less than humeral width of pronotum; synthlipsis wide, approximately half the anterior width of vertex; along median longitudinal axis, head approximately half the length of pronotum; notocephalon sulcate dorsally; tylus slightly inflated. Pronotum with its median length less than half its humeral width; disk only faintly impressed, not carinate; lateral margins divergent; posterior margin convex, medianly concave. Scutellum large, with its median length distinctly greater than that of pronotum. Female ovipositor of normal shape with teeth arranged in two longitudinal rows, one short row of approximately twelve large teeth and one long outer row of small teeth; approximately eight small, lateral, toothlike setæ near apex.

Comparative Notes: Superficially this species resembles *B. pallens* (Champion). Examination of the male, however, shows distinct differences as follows: lateral margins of the frons parallel rather than convergent toward the tylus, eyes distinctly longer, only five to seven sclerotized ridges in the femoral stridulatory area, and only eighteen to twenty-two teeth in the tibial comb.

Location of Types: Holotype male and allotype female, Veadeiros, Goiás, Brazil, April 30, 1956, F. S. Truxal, in the Museu Nacional do Brasil, Rio de Janeiro, Brazil. Paratypes as follows: In the Los Angeles County Museum, four males, ten females, Veadeiros, Goiás, Brazil, April 22 and 30, 1956, Truxal; in the Francis Huntington Snow Entomological Collections, University of Kansas, Lawrence, Kansas, one male, one female, same locality, April 22, 1956, Truxal.

Data on Distribution: Recorded from Brazil and known only from type series.

Buenoa platycnemis (Fieber)

Anisops platycnemis Fieber, 1851, Abhandl. Köngl. Böhmischen Gesells. Wiss., vol. VII, ser. 5, p. 485.

Buenoa platycnemis, Kirkaldy, 1904, Wiener Ent. Zeit., vol. XXIII, p. 134.

One finds in the literature and collections, many species masquerading under the name *Buenoa platycnemis.* This species is, for the most part, neotropical.

Goiás: 24 km. east of Formoso, May 18-29, and June 9-18, 1956 (Truxal); 48 km. south of Peixe, June 1-2, 1956 (Truxal).

Buenoa mutabilis Truxal

Buenoa mutabilis Truxal, 1953, Univ. Kansas Sci. Bull., vol. XXV, Pt. II, p. 1432.

The specimens recorded below are the first to be reported from Brazil. Heretofore, this species was known only from Haiti, Venezuela, British Guiana, Peru and Paraguay.

Minas Gerais: Uberlândia, April 5, 1956 (Truxal). *Goiás:* 20 km. north of São João da Aliança, April 23, 1956 (Truxal).

Buenoa amnigenus (White)

Anisops amnigenus White, 1879, Trans. Ent. Soc. London, p. 271.

Buenoa amnigenus, Kirkaldy, 1904, Wiener Ent. Zeit., vol. XXIII, p. 120.

This species is widespread in Brazil. Among the numerous specimens taken from Goiás, one finds considerable variation in the development of flight wings with consequent changes in the thorax and hemelytra.

Goiás: 24 km. east of Formoso, May 22-26, 1956 (Truxal); 124 km. south of Peixe, June 2, 1956 (Truxal).

Buenoa incompta Truxal

Buenoa incompta Truxal, 1953, Univ. Kansas Sci. Bull., vol. XXV, Pt. II, p. 1466.

Goiás: 20 km. north of São João da Aliança, April 23, 1956 (Truxal).

Buenoa salutis Kirkaldy

Buenoa salutis Kirkaldy, 1904, Wiener Ent. Zeit., vol. XXIII, p. 124.

This species is widespread throughout the north and central regions of South America. Macropterous forms are seldom found and only seven are recorded from the present Goiás collections. These specimens differ from the common brachypterous forms in having the head distinctly narrower than the humeral width of the pronotum; pronotum with the lateral margins more divergent; scutellum larger; hemelytra with claval sutures present and large membranes; flight wings fully developed.

Goiás: 48 km. south of Peixe, June 1, 1956 (Truxal); 124 km. south of Peixe, June 2, 1956 (Truxal).

Buenoa unguis Truxal

Buenoa unguis Truxal, 1953, Univ. Kansas Sci. Bull., vol. XXV, Pt. II, p. 1476.

This species is particularly widespread in northeastern Brazil.

Goiás: 48 km. south of Peixe, June 1, 1956 (Truxal); 124 km. south of Peixe, June 2, 1956 (Truxal).

Buenoa machrisi n. sp.
(Pl. I, fig. 1)

Size: Male, length 8.80–8.95 mm., greatest body width 2.45–2.60 mm.; female, length 8.30–8.90 mm., greatest body width 2.50–2.65 mm.

Color: General facies yellowish white to black. Head, pronotum, thoracic venter, and limbs yellowish white to pale testaceous; scutellum pale testaceous to black; metathoracic dorsum light brown to black. Abdomen black, except ventral keel and portions of the connexivum and dorsum pale testaceous. Hemelytra black with basal half of corium and most of membrane yellowish white. Some specimens entirely yellowish white to pale testaceous, except most of abdomen black. This species variable in color.

Male Structural Characteristics: As viewed from above, outline of head laterally rounded, anteriorly truncate with vertex indented at its lateral margins; greatest width of head six and one half times the anterior width of vertex and less than humeral width of pronotum; synthlipsis wide, approximately half the anterior width of vertex; along median longitudinal axis, head approximately half the length of pronotum; notocephalon wide, sulcate dorsally; tylus distinctly inflated; labrum with basal width not quite twice its median length and apex bluntly rounded; rostral prong (Pl. I, fig. 1b) short, shorter than third rostral segment, with base originating laterally near proximal end of third rostral segment, and with apex bluntly rounded. Pronotum with its median length less than half its humeral width; disk unimpressed, not carinate; lateral margins divergent; posterior margin convex, medianly concave. Scutellum large, with median length distinctly greater than that of pronotum. Fore femur (Pl. I, fig. 1a) neither wide nor greatly thickened at apex; lacking stridulatory area. Fore tibia slightly emarginate near distal end and with stridulatory comb (Pl. I, fig. 1c) consisting of fourteen to sixteen thick teeth; apical teeth wider and thicker than basal; a swollen area on inner surface of tibia at apex, densely covered with fine setæ. Tarsal claws of fore leg slightly dissimilar. Metatrochanter with oval stridulatory area on inner surface (Pl. I, fig. 1d) consisting of approximately seventeen sclerotized ridges. Chætotaxy of male front leg as shown on Plate I. Male genital claspers normal. Spine from caudo-sinistral margin of seventh abdominal tergite with apical half very narrow and apex strongly acuminate.

Female Structural Characteristics: As viewed from above, outline of head laterally rounded, anteriorly truncate with vertex indented at its lateral margins; greatest width of head six times the anterior width of vertex and distinctly less than humeral width of pronotum; synthlipsis wide, approximately half the anterior width of vertex; along median longitudinal axis, head approximately half the length of pronotum; notocephalon wide, sulcate dorsally; tylus distinctly inflated. Pronotum with its median length approximately two fifths its humeral width; disk unimpressed, not carinate; lateral margins divergent; posterior margin convex, medianly concave. Scutellum large, with median length distinctly greater than that of pronotum. Metatrochanter with oval stridulatory area on inner surface. Female ovipositor of normal shape with teeth arranged in two longitudinal rows, one short row of approximately ten large teeth and one long outer row of small teeth; approximately eight small, lateral, toothlike setae near apex.

Variation Within Species: Occasionally specimens are found with flight wings not fully developed. These specimens are pale in color with pronotum narrower and lateral margins less divergent, scutellum smaller, and hemelytral membranes smaller than the form with fully developed flight wings. Claval sutures are absent in the hemelytra of brachypterous specimens.

Comparative Notes: Superficially this species resembles *B. distincta* Truxal. Examination of the male, however, shows distinct differences as follows: fore tibia emarginate at the distal end, and the spine from the caudo-sinistral margin of the seventh abdominal tergite not sword-shaped. The male genital capsules differ greatly.

Location of Types: Holotype male and allotype female, Veadeiros, Goiás, Brazil, May 1, 1956, F. S. Truxal, in the Museu Nacional do Brasil, Rio de Janeiro, Brazil. Paratypes as follows: In the Los Angeles County Museum, twenty males, twenty-three females, Veadeiros, Goiás, Brazil, May 1, 1956, Truxal; in the Francis Huntington Snow Entomological Collections, University of Kansas, Lawrence, Kansas, three males, one female, same locality, April 22, 1956, Truxal.

Data on Distribution: Recorded from Brazil and known only from type series.

The specific name honors Mr. Maurice A. Machris, co-sponsor of the 1956 Expedition to Goiás, Brazil.

Buenoa tibialis n. sp.

(Pl. I, fig. 3)

Size: Male, length 5.00–5.45 mm., greatest body width 1.66–1.75 mm.; female 4.90–5.65 mm., greatest body width 1.70–1.85 mm.

Color: General facies sordid white to nigro-violaceous. Head, anterior portion of pronotum, thoracic venter, and limbs sordid white to testaceous. Posterior portion of pronotum and metathoracic dorsum black; scutellum black with apex testaceous. Abdomen black, except portions of connexivum and terminal segments testaceous. Hemelytra hyalin with posterior third and anterolateral areas nigro-violaceous. Some specimens entirely sordid white, except most of abdomen and posterior third of hemelytra black. This species variable in color.

Male Structural Characteristics: As viewed from above, outline of head laterally rounded, anteriorly truncate with vertex slightly indented; greatest width of head seven and one half to eight times the anterior width of vertex and less than humeral width of pronotum; synthlipsis narrow, less than half the anterior width of vertex; along median longitudinal axis, head slightly more than half the length of pronotum; notocephalon narrow, sulcate dorsally; tylus slightly inflated; labrum with basal width approximately twice its median length and apex bluntly rounded; rostral prong (Pl. I, fig. 3b) short, shorter than third rostral segment, with base originating laterally near proximal end of third rostral segment, and with apex bluntly rounded. Pronotum with its median length less than half its humeral width; disk only faintly impressed, not carinate; lateral margins divergent; posterior margin convex, medianly concave. Scutellum large, with median length distinctly greater than that of pronotum. Fore femur (Pl. I, fig. 3a) neither wide nor greatly thickened at apex; lacking stridulatory area. Fore tibia with stridulatory comb (Pl. I, fig. 3c) consisting of twenty-one to twenty-five teeth; apical teeth wider and thicker than basal. Tarsal claws of fore leg slightly dissimilar. Tibia of intermediate leg dilated medianly on outer margin. Metatrochanter with sclerotized ridges of stridulatory area indistinct. Hind femur with longitudinal row of short, stout setae on ventral surface. Chaetotaxy of male front leg as shown on Plate I. Male genital claspers normal. Spine from caudo-sinistral margin of seventh abdominal tergite with apical half very narrow and apex strongly acuminate.

Female Structural Characteristics: As viewed from above, outline of head laterally rounded, anteriorly truncate with vertex slightly indented; greatest width of head six to six and one half times the anterior width of vertex and less than humeral width of pronotum; synthlipsis narrow, approximately half the anterior width of vertex; along median longitudinal axis, head slightly more than half the length of pronotum; notocephalon narrow, sulcate dorsally; tylus slightly inflated. Pronotum with its median length approximately one third its humeral width; disk only faintly impressed, not carinate; lateral margins divergent; posterior margin convex, medianly concave. Scutellum large, with median length distinctly greater than that of pronotum. Tibia of intermediate leg slightly dilated medianly on outer margin. Metatrochanter with stridulatory area indistinct. Female ovipositor of normal shape with teeth arranged in two longitudinal rows, one short row of approximately twelve large teeth and one long outer row of small teeth; approximately fourteen small, lateral, toothlike setae near apex.

Variation Within Species: Occasionally specimens are found with flight wings not fully developed. These specimens are pale in color with pronotum distinctly narrower than that of the form with fully developed flight wings. Claval sutures and membranes are more feebly developed in the hemelytra of brachypterous specimens.

Comparative Notes: Superficially this species somewhat resembles *B. arida* Truxal. Examination of the male, however, shows distinct differences as follows: head distinctly wider in relation to the pronotum, notocephalon much narrower, and fore femur less robust and without stridulatory area.

Location of Types: Holotype male and allotype female, 24 km. east of Formoso, Goiás, Brazil, May 25, 1956, F. S. Truxal, in the Museu Nacional do Brasil, Rio de Janeiro, Brazil. Paratypes as follows: In the Los Angeles County Museum, thirty-four males, twenty-three females, 24 km. east of Formoso, Goiás, Brazil, May 23 and 25, 1956, Truxal, and two males, six females, same locality, June 9 and 18, 1956, Truxal; in the Francis Huntington Snow Entomological Collections, University of Kansas, Lawrence, Kansas, two males, two females, same locality, May 25, 1956, F. S. Truxal.

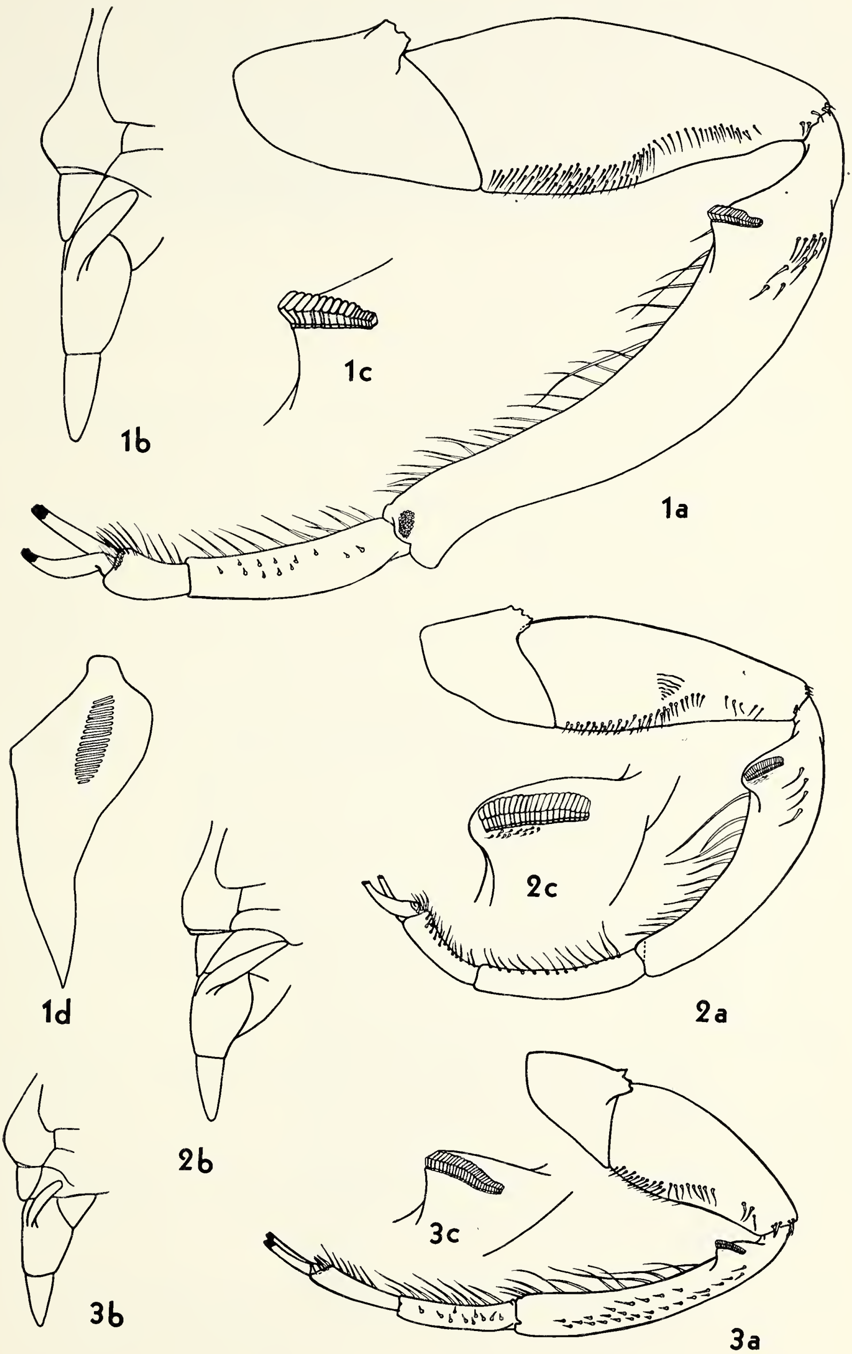
Data on Distribution: Recorded from Brazil and known only from type series.

PLATE I

Fig. 1. *Buenoa machrisi* n. sp.
1a. Inner surface view of male left fore leg.
1b. Left lateral view of male rostrum and tylus.
1c. Enlarged view of left tibial stridulatory comb.
1d. Inner surface view of metatrochanter.

Fig. 2. *Buenoa triangularis* n. sp.
2a. Inner surface view of male left fore leg.
2b. Left lateral view of male rostrum and tylus.
2c. Enlarged view of left tibial stridulatory comb.

Fig. 3. *Buenoa tibialis* n. sp.
3a. Inner surface view of male left fore leg.
3b. Left lateral view of male rostrum and tylus.
3c. Enlarged view of left tibial stridulatory comb.


1a
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LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

No. 1. The Machris Brazilian Expedition. General Account, by Jean Delacour. 11 pp., 4 figures. January 23, 1957.

No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson. 20 pp., 5 figures, 2 maps. January 24, 1957.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii*, by T. G. Yuncker. 2 pp., 1 figure. January 25, 1957.

No. 4. The Machris Brazilian Expedition. Botany: The Lichens, by Carroll W. Dodge. 2 pp. February 18, 1957.

No. 5. The Machris Brazilian Expedition. Botany: Cyanophyta, by Francis Drouet. 2 pp. February 19, 1957.

No. 6. The Machris Brazilian Expedition. Botany: A New Mint from Goiás, *Hyptis machrisae*, by Carl Epling. 4 pp., 2 figures. February 20, 1957.

No. 7. The Machris Brazilian Expedition. Botany: Phanerogamae, various smaller families, edited by E. Yale Dawson. 18 pp., 7 figures. March 7, 1957.

No. 8. Notes on Eastern Pacific Insular Marine Algae, by E. Yale Dawson. 8 pp., 4 figures. June 27, 1957.

No. 9. A New Species of Passerine Bird from the Miocene of California, by Hildegarde Howard. 16 pp., 2 figures. June 28, 1957.

No. 10. The Machris Brazilian Expedition. Botany: A New Columnar Cactus from Goiás, by E. Yale Dawson. 8 pp., 4 plates. July 15, 1957.

No. 11. The Machris Brazilian Expedition. Botany: Chlorophyta; Euglenophyta, by G. W. Prescott. 29 pp., 5 plates, 1 text figure. August 16, 1957.

No. 12. The Machris Brazilian Expedition. Entomology: General; Systematics of the Notonectidae (Hemiptera), by Fred S. Truxal. 23 pp., 1 plate, 8 text figures. August 21, 1957.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ıber 13 October 23, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamæ, Leguminosæ

By Richard S. Cowan

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and itineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Leguminosae

By Richard S. Cowan[1]

The plant collections reported upon below were obtained by E. Yale Dawson, Expedition botanist, and are cited by his field collection numbers. Detailed locality data for these may be found in his general account of the botany of the Expedition[2]. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13-May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15-June 10, 1956.

The first set of specimens is deposited in the Los Angeles County Museum. This includes isotypes of the six new species and one new variety.

The three subfamilies are arranged systematically and the genera and species are arranged alphabetically. The geographical notes are based on the available literature and the herbaria of the United States National Museum and the New York Botanical Garden.

MIMOSOIDEAE

Calliandra dysantha Benth. 14556; 14736

Calliandra macrocephala Benth. 14539 A plant best-known in Minas Gerais but extending to the states of Paraná, Matto Grosso, and Goiás.

Mimosa lasiocarpa Benth. 14253; 14369 A poorly known species of southeastern Brazil, principally Minas Gerais.

Mimosa cf. *nervosa* Bong. 14544 This collection appears to be a recognizable form of this species but material is not sufficiently abundant to make an exact identification possible.

Mimosa polycarpa Kunth 15074 Not infrequent shrub in northwestern South America, south through southern Brazil, becoming more frequent in Argentina and Paraguay.

Mimosa pteridifolia Benth. 14691 A species of southeastern Brazil, known from the states of Matto Grosso, Bahia, and Goiás. One collec-

[1]Associate Curator, Division of Phanerogams, U.S. National Herbarium, Washington, D.C.

[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Cont. Sci. (2):1-20.

tion, Gardner 4123, was known previously from the latter state.

Mimosa trijuga Benth. 14673 A southeastern Brazilian species related to *M. somnians* H. & B. ex Willd. It is very poorly known; only a single previous collection, Macedo 3495, is in the United States National Herbarium, and it also is from Goiás.

Mimosa spp. 14156; 14365; 14441; 14545; 14552; 14694; 14780; 15035 Most of these almost certainly represent known species, but some of them may possibly be undescribed. I do not feel qualified to describe any of them, since dozens of species from southeastern Brazil are known in The New York Botanical Garden Herbarium and United States National Herbarium only by photos.

CAESALPINIOIDEAE

Bauhinia candelabriformis sp. nov. **Fig. 1**

Arbuscula rigida, dense ramosa, 1.5 m. alta, ramulis pilis numerosis brevibus glanduloso-malpighiaceis; stipulae caducae; folia coriacea, profunde cordata, 1/4-1/3 bilobata, 7-nervia, petiolo 12-14 mm. longo, numerosis pilis glanduloso-malpighiaceis praeditis, foliorum lobis obtusis, plus minusve oblongis, 3.5-5 cm. longis, 3-3.5 cm. latis, supra glabris, infra venis primariis tomentellis, locis inter venas primarias pilis glanduloso-malpighiaceis ferentibus, supra venis primariis planis, infra salientibus; inflorescentiae terminales axillaresque, ca. 5-6 cm. longae, candelabriformas, dense rufo-strigulosae et pilis glanduloso-malpighiaceis praeditis, pedicellis 10-12 mm. longis; calycis lobi 4 cm. longi, lineares, intus glabri, externe dense strigulosi et pilis numerosis glanduloso-malpighiaceis; petala oblanceolato-linearia, ca. 20 mm. longa, 1 mm. lata, glabra; stamina 5-5.5 cm. longa, basaliter villosa intus; pistillum parce glanduloso-strigulosum, pilis malpighiaceis, stylo ca. 40 mm. longo; ovarium ca. 10 mm. longum, gynophoro 25 mm. longo; fructus ignotus.

A rigid, densely branched shrub, the youngest branchlets with numerous small, glandular-malpighian hairs; leaves coriaceous, 7-nerved, deeply cordate at the base and bilobed apically about 1/4 to 1/3 of the length, the lobes obtuse and oblong, 3.5-5 cm. long, 3-3.5 cm. wide, the petioles 12-14 mm. long with numerous glandular-malpighian hairs, the upper surfaces of the leaf blades glabrous, (except for glandular-malpighian hairs at the point of the attachment of the petiole), tomentellous below on the principal veins, glandular-malpighian hairs frequent in the inter-vein areas, the veins plane above, strongly salient below; inflorescences terminal and in the upper

Fig. 1. Holotype of *Bauhinia candelabriformis* Cowan.→

leaf axils, candelabriform, densely strigulose and with numerous glandular-malpighian hairs, the pedicels 10-12 mm. long; calyx lobes 4 cm. long, linear, glabrous within, externally strigulose and with glandular-malpighian hairs; hypanthium ca. 1.5 cm. long, slightly striate longitudinally, the petals glabrous, oblanceolate-linear, about 1 mm. wide near the acute apex, 20 mm. long; style 40 mm. long, the ovary 10 mm. long, strigulose with sparingly scattered glandular-malpighian hairs, the gynophore 25 mm. long, glabrous.

TYPE: *Dawson 14581* (holotype R), "Sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956."

This is closely related to *B. malacotrichoides* described below, especially in the type and distribution of pubescence; for a description of the malpighian hairs, see the discussion following that species. The name *B. candelabriformis* is given in allusion to the form of the inflorescence in this species; it differs from its near relative in having smaller leaves which are bilobed (instead of 2-parted), with fewer veins, shorter inflorescences and shorter flowers.

Bauhinia cupulata Spreng. 15036 Described from the state of Piauhy (Gardner 2529) but recently collected along the Río Orinoco in Venezuela (Wurdack & Monachino 39861).

Bauhinia elongipes sp. nov. **Fig. 2**

Arbuscula 2-2.5 m. alta, ramulis minute strigulosis; folia tenuiter coriacea, biloba 2/3-4/5, lobis obtusis ad apicem, base rotundis, 3-nerviis, oblongiusculis, 3-3.5 cm. longis, 1.5-2 cm. latis, supra glabris, infra (venis primariis tomentellis exceptis) minutissime strigulosis et glanduloso-strigulosis (pilis malpighiaceis); pedicelli 25-30 mm. longi, minute strigulosi et glanduloso-strigulosi (pilis malpighiaceis); hypanthium 11-14 mm. longum, calycis lobis 7 cm. longis, externe minute strigulosis et glanduloso-strigulosis, intus glabris; petala linearia, ca. 20 mm. longa; stigma magnum, conicum; stylus ca. 30 mm. longus, glanduloso-strigulosus; ovarium ca. 15 mm. longum, glanduloso-strigulosum, gynophoro ca. 40 mm. longo, glabro; fructus ignotus.

A shrub 2-2.5 m. tall, the young branchlets very minutely strigulose and with numerous glandular-malpighian hairs; petioles 9-15 mm. long, the leaf blades thin-coriaceous, bilobed to within 1/5 to 1/3 of the base, the lobes obtuse apically, rotund at the base, oblongish, 3-nerved, 3-3.5 cm. long, 1.5-2 cm. wide, glabrous and plane on the upper surface, the primary veins salient and tomentellous beneath, the areoles very minutely strigulose and with numerous glandular-malpighian hairs, the secondary veins prominulous; inflorescence ter-

Fig. 2. Holotype of *Bauhinia elongipes* Cowan.

minal, the flowers borne in pairs 3-4 mm. above the subtending foliaceous bracts, the axis minutely strigulose and with many glandular-malpighian hairs; pedicels 25-30 mm. long, minutely strigulose, the flower buds about 8 cm. long, pubescent as the inflorescence axis; hypanthium 11-14 mm. long, the calyx lobes 7 cm. long, glabrous within, the petals linear, glabrous, 20 mm. long; filaments 5-7 cm. long, villose basally on the inner surfaces, the anthers 10 mm. long, linear; stigma large, conical, the style slender, about 30 mm. long, glandular-strigulose (malpighian hairs), the ovary linear, 15 mm. long, strigulose with glandular-malpighian hairs, the gynophore about 40 mm. long, glabrous.

TYPE: *Dawson 15051* (holotype R), "forest and forest margin along road 22-33 km. east of Formoso, region of the southern Serra Dourada, Goiás, Brazil, May 22, 1956."

B. elongipes is closely related to *B. curvula* and *B. pulchella* but it differs from both of these in having long, slender pedicels (hence the specific epithet) and larger flowers. The leaves of the new species are much more like those of B. *curvula,* and the obvious curvature in the flower buds also seems to link them.

Bauhinia malacotrichoides sp. nov. **Fig. 3**

Arbuscula ca. 1 m. alta, ramulis juvenilibus dense puberulis, stipulis caducis; folia bifoliolata, rigido-coriacea, venosa, petiolis 8-10 mm. longis, densissime puberulis; laminae 4-5-nerviae, 7-8 cm. longae, 4.5-5.5 cm. latae, ovales, obtusae, supra glabrae, infra delapso-puberulae et pilis numerosis viscido-glandularibus malpighiaceis, supra 4-5 venis primariis planis, infra valde salientibus; inflorescentia terminalis, ca. 30 cm. longa, axe dense rufo-puberulo et glanduloso-puberulo, pedicellis 7-8 mm. longis, rufo-puberulis; flores 5 cm. longi, calycis lobis 4 cm. longis (hypanthio 1 cm. longo), externe dense appresso-puberulis et glanduloso-malpighiaceo-puberulis, intus glabris; filamenta 3-3.5 cm. longa, glabra, antheris ca. 8 mm. longis; pistillum glanduloso-malpighiaceo-puberulis, stylo 12 mm. longo; ovarium 11 mm. longum, lineare, gynophoro glabro, ca. 15 mm. longo; fructus ignotus.

A shrub about 1 m. tall with densely puberulent young branchlets; leaves coriaceous, bifoliolate, venose, the petioles 8-10 mm. long, densely rufo-puberulous and with a few small, glandular, malpighian hairs; leaflets with 4-5 veins each, 7-8 cm. long, 4.5-5.5 cm. wide, oval, obtuse, glabrous above (except densely pubescent at juncture with the petiole), puberulous below (the hairs more or less collapsed) and with numerous, small, glandular-malpighian hairs, the primary veins plane above, strongly salient beneath; inflorescence about 30

Fig. 3. Holotype of *Bauhinia malacotrichoides* Cowan.

cm. long, the axis densely puberulous with simple hairs and with small, glandular-malpighian hairs; flowers about 5 cm. long, the calyx lobes 4 cm. long, linear, glabrous within and puberulous on the outer surface, the hairs simple and glandular-malpighian; ovary and style glandular-puberulous, the hairs malpighian, the style 12 mm. long, the gynophore about 15 mm. long; fruit unknown.

TYPE: *Dawson 14293* (holotype R), "open grassy hilltop about 2½ km. northeast of the road, 21 km. north of São João da Aliança, region of the Chapada dos Veadeiros, Goiás, Brazil, April 16, 1956."

In a genus noted for extreme variation of leaf form, this species is quite striking. The leaflets are separate and so attached to the petiole as to remind one strongly of a butterfly in flight. The complete separation of the two parts of the leaf, the differences in kind and quantity of pubescence on the leaves, and the longer flowers serve to distinguish it from *B. malacotricha*. The pubescence is of two sorts: one type appears to be ordinary hairs which more or less collapse on the leaf surface (in drying?) and the other sort is a glandular-malpighian hair with very short arms. These occur in shallow depressions and give the lower surfaces of the leaflets a punctulate appearance. This type of hairs is not uncommon in the genus (at least in the Sect. Pauletia). Metcalf and Chalk in their work on the anatomy of the dicots mention "boatshaped" and glandular hairs as characteristic of many species of *Bauhinia*, but the feature seems not to be well-known.

Bauhinia recurva sp. nov. **Fig. 4**

Arbuscula 2-2.5 m. alta, ramis plus minusve quadrangularibus, in quisque faciebus unisulcatis, leviter pilosulis; folia coriacea, valde venosa, 9-nervia, 10.5 cm. longa, 6-7.5 cm. lata, biloba super medio, lobis acutis, base rotundo-truncata, supra glabra (pilosula costa excepta), infra in venis venulisque crispato-pilosula, areolis ultimis glabris, supra venis planis, infra venis venulisque salientibus; inflorescentia terminalis, pedicellis ca. 3.5 cm. longis, maturitate valde recurvis, longo-persistentibus; flores ca. 8.5 cm. longi, minute strigulosi; hypanthio 2.5 cm. longo, leviter striato; petala linearia, 1-2 mm. lata; pistillum velutinum, stylo 30-35 mm. longo; ovarium lineare, ca. 20 mm. longum, gynophoro 45 mm. longo; fructus ignotus.

An erect, loosely branched shrub 2-2.5 m. tall, the branchlets sparingly pilosulose, quadrangular, each face unisulcate; petioles terete, densely crispate-pilosulose, 14 mm. long, the leaf blades coriaceous, strongly venose, 9-nerved, 10.5 cm. long, 6-7.5 cm. wide, bilobed apically less than 1/3 of the length, the lobes acute, the base rounded-

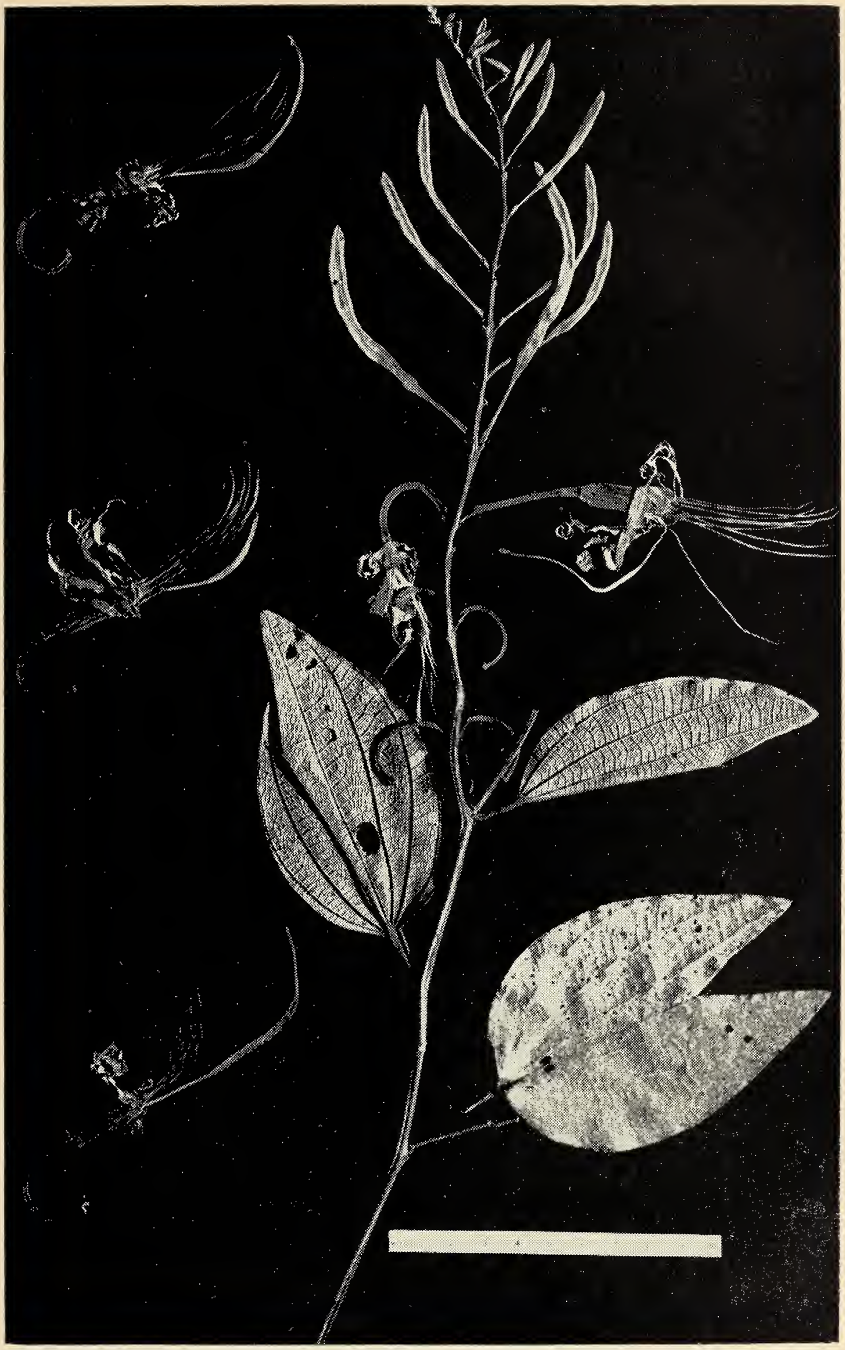


Fig. 4. Holotype of *Bauhinia recurva* Cowan.

truncate, the upper surface of the blades glabrous except for crispate-pilosulose midrib, lower surface crispate-pilosulose on the strongly salient veins and veinlets, the ultimate areoles glabrous, the veins plane above; inflorescence terminal, 25 cm. long, pilosulose and with numerous glandular-malpighian hairs, the pedicels about 3.5 cm. long, strongly recurved at anthesis, persistent; hypanthium 2.5 cm. long, slightly striate, minutely strigulose and with numerous glandular-malpighian hairs, the lobes of the calyx 6 cm. long, linear, glabrous within, pubescent as the hypanthium externally; petals linear, long-acuminate, about 40 mm. long, 1-2 mm. wide; stamens glabrous, the filaments 6 cm. long, the anthers 6 mm. long, oblong; pistil velutinous, the stigma massive, acute, the style 30-35 mm. long, the ovary linear, about 20 mm. long, the gynophore 45 mm. long; fruit unknown.

TYPE: *Dawson 14387* (holotype R), "gallery forest area along road 19-19.5 km. north of São João de Aliança, region of the Chapado dos Veadeiros, Goiás, Brazil, April 19, 1956."

The nearest relative of *B. recurva* apparently is *B. longifolia* from which it may be distinguished by its more rigid, venose leaves, larger flowers, and longer, recurved pedicels.

Cassia conferta Benth. 14161 A very distinctive shrub in Minas Gerais and less commonly in Goiás; there is an earlier collection from the latter state (Macedo 3240).

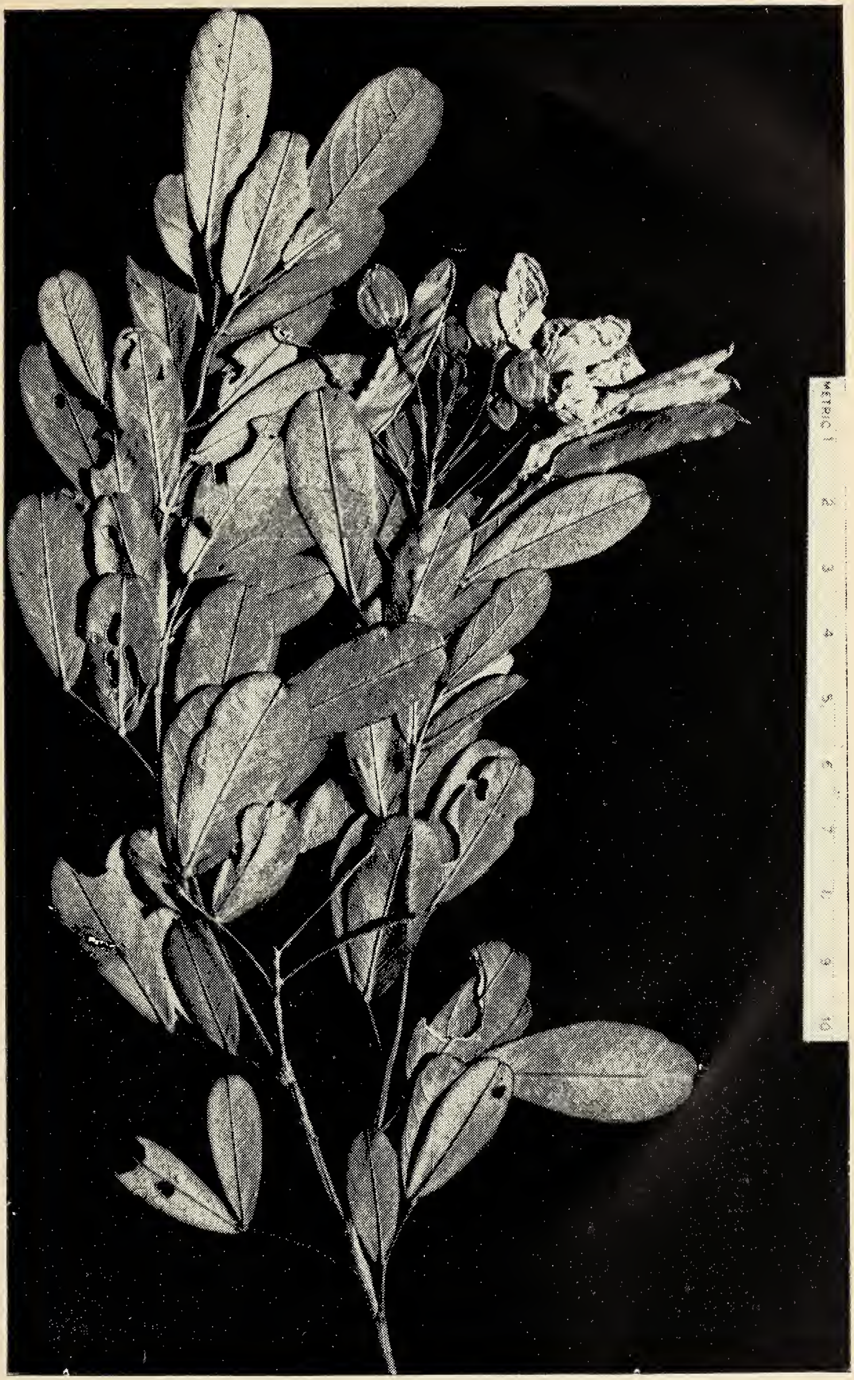
Cassia hispidula Vahl var. *fagonioides* (Vog.) Benth. 14284 This species, at least the typical form, is exceedingly widespread, occurring from Mexico and the West Indies south through Central America to Venezuela, Guianas, and Brazil. In Brazil it was known previously from Pará, Ceará, Pernambuco, Parahyba, Maranhão, and Bahia.

Cassia machrisiana sp. nov. **Fig. 5**

Arbuscula glabra, sparse ramosa, 0.5 m. alta, stipulis deciduis, foliis eglandularibus; foliola bijugata, oblanceolata vel oblongo-oblanceolata, rotundata et retusa, plerumque marginibus glanduloso-ciliolatis prope foliolorum basem, pilis rigidis, nitidis, nigris; inflorescentiae terminales, pedicellis 18-22 mm. longis; flores ca. 18 mm. longi, glabri; fructus compressus, glaber, ca. 35 mm. longus, 6-7 mm. latus, oblongus, 6-7-spermus, seminibus obliquis.

A glabrous, sparsely branched shrub 0.5 m. tall with slender branchlets, the stipules deciduous, about 1 mm. long, subulate; leaves with two pairs of subcoriaceous leaflets, the petioles 7-10 mm. long, the rachis 9-10 mm. long, terminated by a mucro about 1.5 mm. long, the lower pair of leaflets 20-25 mm. long, 8-13 mm. wide, the upper

Fig. 5. Holotype of *Cassia machrisiana* Cowan.→



pair 30-35 mm. long, 13-16 mm. wide, narrowed toward the base, obtuse, the apex rotund, retuse and mucronulate, the margin near the base with numerous stiff, shiny-black, glandular hairs, the venation prominulous on both sides; inflorescence terminal, corymbiform, about 6 cm. long, glabrous, the pedicels 18-22 mm. long, slender; perianth glabrous, the calyx yellowish, membranous, the sepals 12 mm. long, 4.5-5.5 mm. wide, elliptic, slightly concave, the blades of the petals 13-15 mm. long, 12-13 mm. wide, oval to orbicular, the claw 4-5 mm. long; stamens 10, equal, the filaments glabrous, 1-1.5 mm. long, the anthers pilosulose, oblong, 4.5-5 mm. long; pistil glabrous, the style about 10 mm. long, sigmoid, the ovary about 5 mm. long; fruits compressed laterally, oblong, glabrous, 35 mm. long, 6-7 mm. wide, the 6-7 seeds borne obliquely in the fruit.

TYPE: *Dawson 14598* (holotype R), "sandstone outcrop 7 km. south of Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956."

It is always difficult to be certain that a new species is really new in a genus such as *Cassia*, but careful checking of the literature since Bentham's treatment of the genus in Flora Brasiliensis convinces me that *Cassia machrisiana* is heretofore undescribed. It is distinctly related to *C. conferta, C. ochnacea,* and *C. punctulifera* in section Absus; with only the original description to judge by, it appears that the new species is most nearly related to *C. punctulifera* Harms, from which it differs by the lack of glandular punctations on most parts, glabrous perianth, obtuse sepals, and shorter petioles and rachis. *C. machrisiana* differs from its other near relatives by its glabrous inflorescence and thinner, retuse leaflets; its flowers are larger and the inflorescence more diffuse than those of *C. conferta.*

The species is named in honor of Mrs. Maybell Machris Low who contributed generously to the support of the botanical work of the Expedition.

Cassia mollifolia Harms 14819 A rare species which was described originally from Goiás. This collection has been identified by the description only.

Cassia multijuga Rich. 14999 Small to medium-sized tree occurring frequently through the warm zones of tropical South America as far south as Santa Catarina in Brazil.

Cassia occidentalis L. 14757 Wide-spread tropical weed.

Cassia pachyclada Harms 14721 This species is still known only from the state of Goiás and it is very rare there, if the number of collections is any indication.

Cassia dawsonii sp. nov. **Fig. 6**

Arbuscula sparse ramosa 2 m. alta, ramis ramulisque glanduloso-pilosulis et dense puberulis; stipulae deciduae, subulatae, 5-6 mm. longae, glanduloso-pilosulae et puberulae; folia linearia, deorsum curvata, petiolo 25-35 mm. longo, eglandulari, glanduloso-pilosulo et puberulo, rachibus 12-16.5 cm. longis, glanduloso-pilosulis puberulisque, facie superiore bialatis, aliis erectis; foliola 23-50-jugata, sessilia, imbricata, coriacea, apice rotundata vel obtusa, base rotundata et inaequalia, orbicularia ad late ovata, foliolis juvenilibus 3.5-5 mm. longis, 3-5.5 mm. latis, margine glandularis et ciliolatis, foliolis maturis 9-15 mm. longis, 7-10 mm. latis, margine glanduloso-dentatis, venis venulisque prominulis; inflorescentia racemosa, terminalis, 15 cm. longa, axe glanduloso-hispidulo et puberulo, bracteis persistentibus, 2.5 mm. longis, 0.5 mm. latis, lanceolatis, acutis, externe puberulis, intus glabris, pedicello 32-40 mm. longo, glanduloso-hispidulo et puberulo, bracteolis 2, subulatis, 1-1.5 mm. longis; sepala herbacea, oblongo-elliptica, acuta, 15-17 mm. longa, 5.5 mm. lata, externe glanduloso-hispidula, intus glabris; petala obcuneato-obovata, apice rotundata, 20-25 mm. longa, 15-18 mm. lata, glabra, unguiculo ca. 3 mm. longo; stamina 9, aequalia vel subaequalia, glabra, filamentis 1.5-2 mm. longis, antheris 6-8 mm. longis, glabris, duobus incisuris fissentibus; stigma simplex, stylo glabro, crasso, 14 mm. longo; ovarium 3.5 mm. longum, aureo-pilosum; fructus ignotus.

A sparsely branched shrub 2 m. tall with the branches and branchlets glandular-pilosulose and densely puberulous; stipules deciduous, subulate, 5-6 mm. long, glandular-pilose and puberulous; leaves elongate-linear, recurved, the petioles 25-35 mm. long, eglandular, glandular-pilose and puberulous, the rachis 12-16.5 cm. long, pubescent as the petiole, bialate on the upper surface with the wings erect; leaflets 23-50-jugate, sessile, imbricate, coriaceous, rotund or merely obtuse at the apex, rotund and inequilateral at the base, orbicular to broadly ovate, the young leaves 3.5-5 mm. long, 3-5.5 mm. broad, margin glandular and ciliolate, the axis glandular-hispidulous and puberulous, the bracts persistent, 2.5 mm. long, 0.5 mm. wide, lanceolate, acute, puberulous on the outer surface, glabrous within, the pedicels 32-40 mm. long, glandular-hispid and puberulous, the bracteoles 2, subulate, 1-1.5 mm. long; sepals herbaceous, oblong-elliptic, acute, 15-17 mm. long, 5.5 mm. wide, glandular-hispid externally, glabrous within; petals obcuneate-obovate, rotund apically, 20-25 mm. long, 15-18 mm. wide, glabrous, the claw about 3 mm. long; stamens 9, equal or subequal, glabrous, the filaments 1.5-2 mm. long, the anthers 6-8 mm. long, opening by two longitudinal slits; stigma simple, the style glabrous, thick, 14 mm. long, the ovary 3.5 mm. long, golden-pilose; fruit unknown.

TYPE: *Dawson 14559* (holotype R), "roadside campo sujo 21 km. north of São João da Aliança, region of the Chapada dos Veadeiros, Goiás, Brazil, April 28, 1956."

This species was first collected by Glaziou in this same locality, but only in sterile condition. He gave it a name but supplied no descrip-

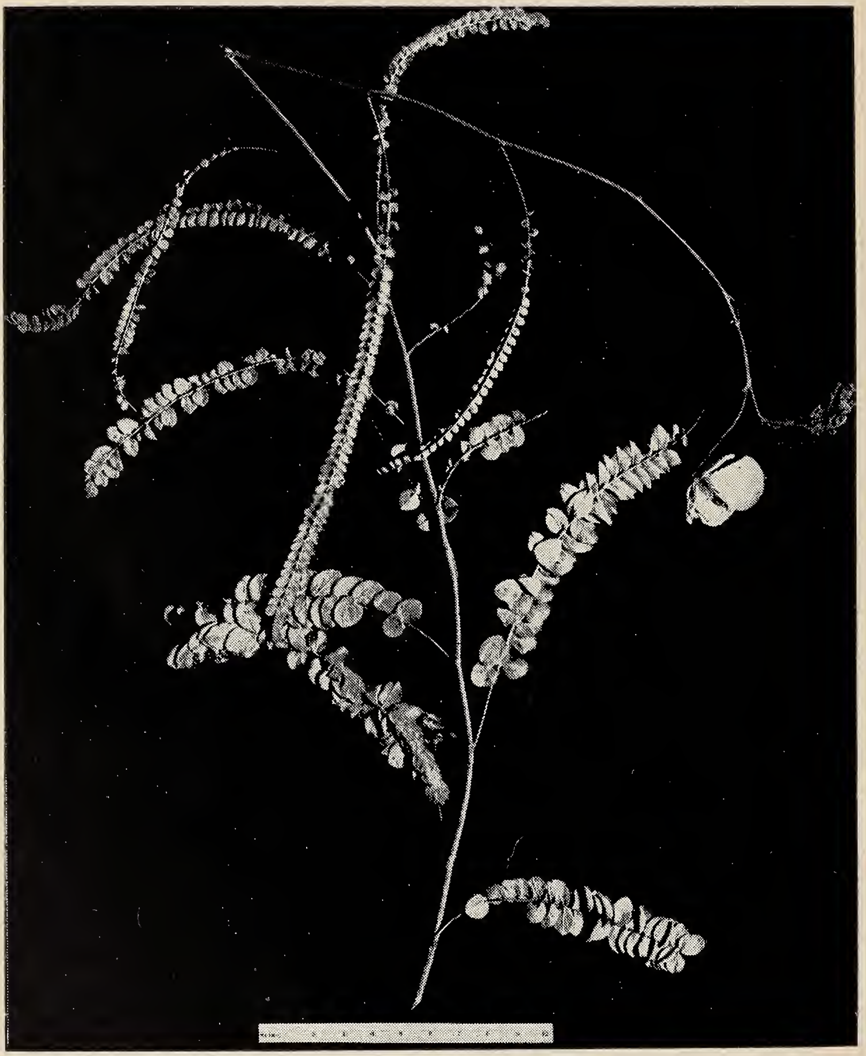


Fig. 6. Holotype of *Cassia dawsonii* Cowan.

tion; Harms (Fedde Rep. Spec. Nov. 20: 130. 1924.) published the name in an incidental note but contributed nothing that would enable one to identify the plant. A photograph of the Glaziou collection has been studied and it exactly matches this fertile material of Dawson's.

There are several other species with which this one is to be associated: *C. nummulariifolia*, *C. filicifolia*, *C. sincorana*, *C. pycnophylla*, and *C. ciliolata*. The species described here differs from all these in one or more respects involving size, shape, and/or number of leaflets, size of flowers, pubescence, etc.

Cassia rugosa Don 14157; 14264 Another poorly known species of southeastern Brasil and Paraguay. It appears to be more frequent in Minas Gerais than in Goiás.

Cassia setosa Vogel 14543 Very frequent in parts of Minas Gerais but apparently less common in São Paulo, Goiás, and Rio de Janeiro.

Cassia tagera L. 14535 Frequent mat-forming plant on dry sands or over rocks in the savannas and *llanos* of Venezuela and Colombia. It is also known from Brazil and Bolivia. R. E. Schultes has called attention to its possible utility in tropical areas for erosion control.

Cassia tetraphylla Desv. 14160; 14613 An exceedingly variable species within which Amshoff has defined several subspecific taxa, and there are probably others which also deserve recognition. It is native and rather common in the savannas and *llanos* of Venezuela, the Guianas, Colombia, and northern Brazil; it does not appear to be so frequent in south Brazil.

Cassia tora L. 14392 A tropical weed.

Cassia trichopoda Benth. 14912 An uncommon species from southern Brazil to Bolivia, Colombia, and Venezuela.

Copaifera oblongifolia Mart. ex Hayne, var. **dawsonii** var. nov. **Fig. 7**

A *C. oblongifolia* var. *comosa* plus foliolis (6-7-jugatis), sepalis glabris externe differt; a *C. oblongifolia* var. *oblongifolia* ramulis foliolisque pilosis, sepalis glabris externe differt.

Tree 3-4 m. tall; vegetative parts pilose; stipules caducous; leaves oblong in outline, the petiole 3 mm. long, the rachis 4.5-6.5 cm. long, the leaflets in 6-7 pairs, punctate, the petiolules 0.5-1 mm. long, the blades 11-22 mm. long, 5-8 mm. wide, oblong, obtuse at the base and at the apex, the latter usually slightly retuse and mucronulate; venation reticulate, the veins not obvious, the pubescence dense below, sparingly and somewhat glabrescent on the upper surface; inflorescences terminal on short lateral branchlets, sessile or subsessile, the axis pilose, 4-6.5 cm. long; flowers sessile, the calyx 3.4-4 mm. long, glabrous on the outer surface, densely suberect-villose within; stamens glabrous, 5 mm. long; margins of the ovary and the gynophore densely villose; fruit unknown.

TYPE: *Dawson 14491* (holotype R), "tree 3-4 meters tall, gallery forest margin along the stream 18 km. north of São João da Aliança, region of the Chapada dos Veadeiros, Goiás, Brazil, April 20, 1956."

The degree of relationship between this variety and the typical one is much closer than that which exists between the latter and the var. *comosa.* The glabrous outer surfaces of the sepals and the pilose leaflets serve to distinguish the new variety from the other two. There is even some similarity to *C. langsdorfii,* but it is not any of the described varieties of that species and in respect to the leaflets, at least, it is more like the type of *C. oblongifolia.*

Copaifera sp. 14445 I could not satisfactorily place this in Dwyer's monograph but I doubt that it is a new taxon.

LOTOIDEAE

Aeschynomene paniculata Willd. ex Vogel 14200

Aeschynomene paucifolia Vogel (Det. V. E. Rudd) 14822

Bowdichia virgilioides H. B. K. 14490 Very common, wide-ranging trees in or at the edge of savannas or scrub savannas in Venezuela, and Colombia, south through Brazil to Paraguay — decreasingly frequent southward.

Calopogonium caeruleum (Benth.) Sauv. 14982 Frequent twining herb in Central America, West Indies, and the tropical parts of South America.

Calopogonium velutinum (Benth.) Amsh. 15029 This very distinctive species was described on material from Bahia, but it is known as far north as Surinam, according to Amshoff. Four collections from British Guiana (de la Cruz 2592, 2937, 3620, 4406) should also be referred to this species, thereby extending its range even more.

Camptosema coriaceum (Nees & Mart.) Benth. 14450; 14681 An uncommon shrub known previously only from Minas Gerais. This is apparently the first report from Goiás.

Canavalia picta Mart. ex Benth. 15030 Very similar to *C. grandifolia* Benth. but with slightly smaller flowers and puberulous vegetative parts.

Centrosema bifidum Benth. 14919; 15045 A rare vine of southeastern Brazil; this is one of the first collections since the species was described.

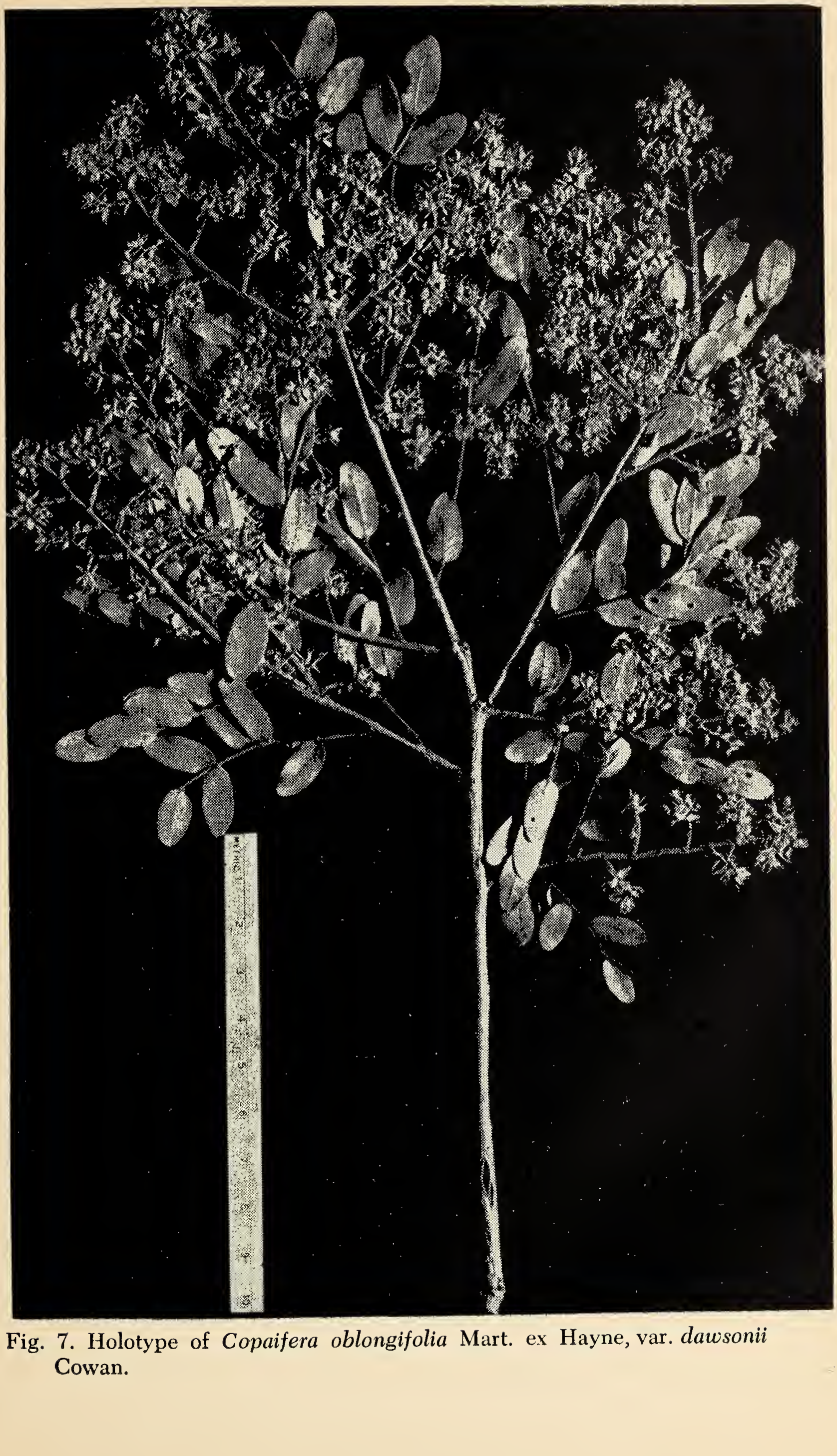


Fig. 7. Holotype of *Copaifera oblongifolia* Mart. ex Hayne, var. *dawsonii* Cowan.

Centrosema fasciculatum Benth. (ex descr. & photo) 15126 Rare vine described from Matto Grosso; this may well be the first record from Goiás.

Centrosema platycarpum Benth. 15089 Woody vine occurring rarely in southern Brazil but also known by a Spruce collection from eastern Amazonian Peru.

Centrosema pubescens Benth. 14502 Frequent vine in tropical America and introduced in Malaysia.

Centrosema sagittatum (H. &. B.) Brandg. ex Riley 14361 Frequent vine found in tropical America as far south as Patagonia and southern Brazil.

Collea crassifolia Benth. 14470. This material matches the photograph of the type quite well but it is unlike later collections cited by Bentham[3] as this species. The original material showed well-developed peduncles as does the present collection; some of the later collections cited by Bentham have short, much congested inflorescences.

Collaea martii Benth. 14582; 14658a Apparently restricted to southeastern Brazil; uncommon or rare.

Crotalaria acutiflora Benth. 14399; 14844; 15081 Originally described from Goiás but very poorly known. These collections were identified by type photo and description solely.

Crotalaria nitens H. B. K. 14500 A variable, wide-spread species.

Crotalaria pohliana Benth. 14751c Although this species was described from southern Brazil it is better known from collections made in eastern Bolivia.

Crotalaria stipularis Desv. 14921 A low plant in savannas or grasslands from Colombia, Venezuela, and the Guianas, south to Argentina.

Crotalaria unifoliolata Benth. 14150 A very distinctive species in most of the southern states of Brazil, but everywhere uncommon.

Crotalaria vespertilio Benth. 14733 Rarely collected species described from Goiás but known also by one collection from Minas Gerais.

Crotalaria sp.? 14549a This may represent a new species, related to *C. sagittalis* L., from which this collection differs primarily in leaflet shape.

Crotalaria sp.? 14372 Possibly an undescribed species; certainly not very closely related to any well-known species.

Desmodium asperum Desv. 15049 A coarse subshrub which is found frequently throughout tropical America.

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[3] Flora Brasiliensis 15 (1):151.1859.

Desmodium discolor Vog. 14366; 14435 A frequent subshrub in southern Brazil, particularly in Minas Gerais.

Desmodium leiocarpum (Spreng.) G. Don 15094 Frequent in Minas Gerais but not elsewhere. This may be the first record of the species in Goiás.

Desmodium platycarpum Benth. 14414 A poorly-known species of southern Brazil, apparently rare.

Desmodium tortuosum (Sw.) DC. 14485; 15128 Weedy herb from subtropical Florida through tropical northern South America. This collection represents a considerable southern extension of the range of the species.

Dioclea argentea Desv. 14976; 15079.

Dioclea sp. 14378; 14828; 15001

This genus so seriously needs revisionary study that many collections must presently go unnamed. Occasionally new species come to light which are sufficiently distinct to describe; some of these collections may represent undescribed species but a strong element of doubt exists in each instance.

Eriosema erythropilum Harms 14751a This determination was made solely on the basis of a type photograph and the original description, both of which seem to fit this collection very well.

Eriosema longifolium Benth. 14815 An uncommon species described from Minas Gerais but known also from Paraná and now Goiás.

Galactia glaucescens H. B. K. 15011 A wide-spread species, from Colombia and Venezuela to Ecuador and Bolivia south to southern Brazil and Paraguay.

Harpalyce brasiliana Benth. 14998; 15064 Frequent in Minas Gerais but apparently uncommon in Ceará, Piauhy, and Goiás.

Indigofera lespedezioides H. B. K. 14370 Common in Colombia and Venezuela but less frequent in Bolivia and Brazil. It occurs also in southern Mexico and the West Indies.

Machaerium aculeatum (DC.) Raddi 14471 Some forms of this species have been referred to as *M. angustifolium* Vogel, but this is treated as a synonym by several authorities. The species is known from Central America to Paraguay, east to the Guianas.

Periandra coccinea Benth. 14561; 14967 A rare species of southeastern Brazil.

Periandra densiflora Benth. 14816; 14920 An infrequent vine of Minas Gerais; these are among the very few collections from Goiás.

Periandra mediterranea (Vell.) Taub. 14448 Burkart has pointed out the necessity of adopting this name over the better-known *P. dulcis*.

It is primarily south Brazilian in distribution, known in Minas Gerais, Ceará, Paraná, Pará, Goiás, Bahia, and São Paulo.

Phaseolus appendiculatus Benth. 14904; 15018 A variable, wide-spread vine, occurring from Central America to Paraguay.

Phaseolus clitorioides Mart. 14430

Phaseolus peduncularis H. B. K. 14800 Weedy vine found from Central America and West Indies south to Paraná.

Poiretia coriifolia Vogel 14279; 14693

Pterodon polygalaeflorus Benth. 14223 This genus is very similar to *Dipteryx* (incl. *Taralea*), but there may be justification for keeping it separate, for it has a strikingly different aspect. The species referred to here is one of southeastern Brasil - Minas Gerais, Goiás, Maranhão, Matto Grosso, Piauhy.

Stylosanthes capitata Vogel 14190 Known from Venezuela to Minas Gerais in Brazil but nowhere very well-known.

Stylosanthes guianensis (Aubl.) Sw. 14405; 14437; 14880 A very wide-spread weedy plant from Central America through tropical South America to Paraguay.

Stylosanthes guianensis (Aubl.) Sw. var. *gracilis* (H.B.K.) Vogel 14813; 14862 This has been considered a distinct species by some authors but it is usually assigned varietal rank. It occurs sporadically in the same range as the typical variety.

Tephrosia leptostachys DC. 15057 Infrequent species best-known in Colombia and Venezuela but known from southern Brazil by a few collections. This is the first report from Goiás.

Zornia diphylla (L.) Pers. 14183 A weed of the tropics and sub-tropics around the world.

Zornia virgata Moric. 14564 A frequent plant in Minas Gerais but known also in São Paulo and now Goiás, less frequently.

LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

No. 1. The Machris Brazilian Expedition. General Account, by Jean Delacour. 11 pp., 4 figures. January 23, 1957.

No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson. 20 pp., 5 figures, 2 maps. January 24, 1957.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii,* by T. G. Yuncker. 2 pp., 1 figure. January 25, 1957.

No. 4. The Machris Brazilian Expedition. Botany: The Lichens, by Carroll W. Dodge. 2 pp. February 18, 1957.

No. 5. The Machris Brazilian Expedition. Botany: Cyanophyta, by Francis Drouet. 2 pp. February 19, 1957.

No. 6. The Machris Brazilian Expedition. Botany: A New Mint from Goiás, *Hyptis machrisae,* by Carl Epling. 4 pp., 2 figures. February 20, 1957.

No. 7. The Machris Brazilian Expedition. Botany: Phanerogamae, various smaller families, edited by E. Yale Dawson. 18 pp., 7 figures. March 7, 1957.

No. 8. Notes on Eastern Pacific Insular Marine Algae, by E. Yale Dawson. 8 pp., 4 figures. June 27, 1957.

No. 9. A New Species of Passerine Bird from the Miocene of California, by Hildegarde Howard. 16 pp., 2 figures. June 28, 1957.

No. 10. The Machris Brazilian Expedition. Botany: A New Columnar Cactus from Goiás, by E. Yale Dawson. 8 pp., 4 plates. July 15, 1957.

No. 11. The Machris Brazilian Expedition. Botany: Chlorophyta; Euglenophyta, by G. W. Prescott. 29 pp., 5 plates, 1 text figure. August 20, 1957.

No. 12. The Machris Brazilian Expedition. Entomology: General; Systematics of the Notonectidae (Hemiptera), by Fred S. Truxal, 23 pp., 1 plate, 8 text figures. August 21, 1957.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ıber 14 October 31, 1957

THE MACHRIS BRAZILIAN EXPEDITION

ENTOMOLOGY: Gelastocoridae (Hemiptera) from Central Goiás

By E. L. Todd[1]

The Gelastocoridae discussed in the following account were taken on an expedition sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low during the months of April through June, 1956. The field work was conducted under the direction of the Los Angeles County Museum and through the auspices of the Museu Nacional do Brasil.[2]

Gelastocorid material collected in central Goiás by members of the expedition totaled 73 specimens. Five species are represented. The collection is deposited in the Los Angeles County Museum.

Gelastocoris nebulosus (Guérin-Méneville)

Galgulus nebulosus Guérin-Méneville, Iconographie du Règne Animal de B. Cuvier, pt. 7, 1844, p. 351.

Seventy per cent of the specimens (51) were of this common, widely-distributed, South American species. Specimens were from the following localities: 67 km. N. Porangatú, June 6, 1956, A. Carvalho, 3 males; 48 km. S. Peixe, June 1, 1956, F. S. Truxal, 1 male and 6 females; 20 km. N. São João da Aliança, April 13-16, 1956, F. S. Truxal, 5 males, 8 females and 1 nymph; 24 km. E. Formoso, May 16-25, 1956, F. S. Truxal, M. and P. Machris, 9 males, 17 females and 1 nymph.

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1 Falls Church, Virginia.

2 See: THE MACHRIS BRAZILIAN EXPEDITION, Entomology: General; Systematics of the Notonectidae (Hemiptera), by Fred S. Truxal. Los Angeles County Museum Contributions in Science (12): 1-23. 1957.

Gelastocoris angulatus (Melin)

Montandonius angulatus Melin, Zoologiska Bidrag Fran Uppsala, Band 12, 1930 (prepublished 1929), p. 169, figs. 32, 33.

Six specimens collected from the following localities: 24 km. E. Formoso, May 19-26, F. S. Truxal, 1 male and 2 females; 34 km. S. Amaro Leite, May 30, 1956, F. S. Truxal, 1 female; 20 km. N. São João da Aliança, April 21, 1956, F. S. Truxal, 2 females.

Nerthra terrestris (Kevan)

Mononyx terrestris Kevan, Annals and Magazine Natural History, 11th series, vol. 14, No. 119, 1948, p. 813.

One male and one female were collected among the roots of orchids, 24 km. E. Formoso. The male was taken May 19, 1956 by F. S. Truxal and the female May 17, 1956 by A. Carvalho.

Nerthra ranina (Herrich-Schäffer)

Mononyx raninus Herrich-Schäffer, Die Wanzenartigen Insecten, vol. 9, 1853, p. 28, fig. 896.

Specimens collected in two localities as follows: 24 km. E. Formoso, May 25, 1956, F. S. Truxal, 5 males, 1 female and 3 nymphs; 20 km. N. São João da Aliança, April 16, 1956, F. S. Truxal, 1 female.

The two females are slightly aberrant in that the groove which extends from the emargination of the last visible abdominal sternite is not as long as in most females of this species.

Nerthra buenoi Todd

(Fig. 1 A-B)

University of Kansas Science Bulletin, vol. 37, pt. 1, No. 11, 1955, p. 365, fig. 82.

This species is the smallest of the known species of the family. Four specimens, 2 males and 2 females, were collected by sifting leaf mold, May 19, 1956, 24 km. E. Formoso by F. S. Truxal and A. Carvalho. Except for the type (a female), these are the only specimens of the species in collections. This fact necessitates further descriptive comment about the species.

As these two females are slightly larger than the type and as the males were previously unknown, a restatement of size is indicated.

	Type Female	Referred Specimens 2 Females		2 Males	
Length	4.2 mm.	4.6 mm.	4.1 mm.	4.2 mm.	
Width of Pronotum	2.6	3.0	2.7	2.8	
Width of Abdomen	2.7	3.0	2.7	2.8	

The abdominal sternites of the male are asymmetrical; the ninth sternite small, oval, wider than long, slightly longer than eighth sternite. Clasper (right paramere) of male small, simple, tapering to a point at apex, aedeagal furrow on median surface, not visible from a ventral view.

In addition to the characters mentioned in the original description, the sharply-pointed anterior dilation of the front femur, the absence of lateral tumescences on the last visible abdominal sternite of the female, and the smaller size, this species also differs from **N. raptoria** (Fabricius) by the absence of a short notch at the anterior end of the emargination of the last visible abdominal sternite of the female and by the absence of the aedeagal furrow on the ventral surface of the clasper of the male.

The illustrations of the male are based on the smaller of the two specimens. This specimen is designated a plesiotype and is so indicated in the Los Angeles County Museum collections.

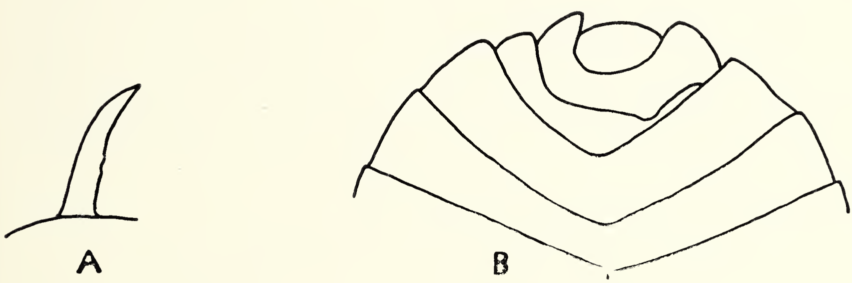

Fig. 1 *Nerthra buenoi* Todd. Plesiotype.
A. Clasper of male.
B. Terminal abdominal sternites of male.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ıber 15 October 31, 1957

MARINE ALGAE FROM THE PACIFIC COSTA RICAN GULFS

By E. Yale Dawson[1]

The marine flora of Pacific Costa Rica was virtually unknown until W. R. Taylor (1945) reported 47 species from collections made by the Allan Hancock expeditions of 1934 and 1939 to the Galapagos Islands. Apart from this report, only three other species are recorded from Costa Rica from among several other papers, namely, Grunow (1915-16), Setchell (1937), Dawson (1944, 1949 and 1953), Post (1955) and Drouet and Daily (1956). Most of the known collections came from three localities: Puerto Parker, Puerto Culebra and outer Golfo Dulce. Those from the latter area, and one from Golfo de Nicoya, are listed again in the systematic part of this paper. The other reported collections, from north to south, are:

Bahía Salinas

Enteromorpha lingulata J. Ag.
Ulva lactuca L.
Colpomenia ramosa Taylor

Puerto Parker and vicinity

Enteromorpha flexuosa (Wulfen) J. Ag.
Enteromorpha lingulata J. Ag.
Colpomenia sinuosa (Roth) Derbès & Solier (drift)
Colpomenia ramosa Taylor
Sargassum liebmannii J. Ag.
Bangia fuscopurpurea (Dillw.) Lyngb.
Acrochaetium penetrale (Drew) Taylor, prox.
Hildenbrandia prototypus Nardo
Gracilaria crockeri Dawson (dredged)

[1] Research Associate.

Gracilaria costaricensis Dawson (dredged)
Ceramium personatum Setch. & Gard., prox.
Entophysalis deusta Drouet & Daily
Lyngbya semiplena Gomont

Bahía Playa Blanca

Polysiphonia bifurcata Hollenberg (dredged)

Vicinity of Puerto Culebra

Enteromorpha lingulata J. Ag.
Rhizoclonium lubricum Setch. & Gard.
Dictyota flabellata (Collins) Setch. & Gard. (dredged)
Dictyota crenulata J. Ag.
Scinaia complanata (Collins) Cotton (dredged)
Scinaia johnstoniae Setchell (dredged)
Lithothamnium validum Foslie (dredged)
Sarcodiotheca ecuadoreana Taylor (dredged)
Gracilaria crockeri Dawson (dredged)
Gracilariopsis costaricensis Dawson (dredged)
Gracilariopsis panamensis (Taylor) Dawson (dredged)
Hypoglossum abyssicolum Taylor (dredged)
Chondria californica (Collins) Kylin (dredged)
Chondria platyclada Taylor (dredged)

Bahía Brasilito

Entophysalis deusta Drouet & Daily

Bahía Piedra de Blanca

Jania tenella var. *zacae* Dawson

Although these fifty species would seem to constitute a fair indication of the general nature of the marine flora, especially as contrasted to the almost total lack of marine algal information for all the other Central American republics as well as Pacific Colombia, the writer believed that an appreciable increase in our knowledge of the marine vegetation of the region could be obtained even during a single visit to the country. Accordingly, he accepted enthusiastically an invitation from Mr. Maurice A. Machris to go there during June of 1957 to conduct an initial survey in the Golfo de Nicoya and the Golfo Dulce. The present paper records the results of that brief exploratory trip.

In addition to the generous support provided by Mr. Machris, the writer wishes to thank several others who contributed to the success of the work by providing personal assistance or in furnishing information, namely, Mr. John McNabb, Señor Guido Contreras, Señor Hernán Sobrado, Dr. Milner B. Schaefer, Dr. Gerald V. Howard, and the staff of the United Fruit Company's office at Golfito.

COLLECTION STATIONS

Station 1: Puntarenas Peninsula, Golfo de Nicoya, June 6, 1957. Nos. 16690-16693. Except for scant *Enteromorpha* on a log buried in sand, and a bit of *Sargassum* in the beach flotsam, this shore was desolate of algae. The stones of an artificial rock dike on the polluted estuary on the north side of the peninsula yielded depauperate *Spyridia* and colonial pennate diatoms at about ½ m. above mean low tide level.

Station 2: Just inside Bahía Ballena from Punta Piedra Amarilla on the outer Peninsula de Nicoya, Golfo de Nicoya, June 7. Nos. 16694-16729, from about low water level to minus 2 m.; Nos. 16730-16751, at 1½ to 2½ m. above mean low water. This station was reached by walking around the southwest side of the bay from Tambor. The tidal amplitude is great, but rainfall is heavy and insolation intense so that almost nothing occurs at high levels except where protected by overhanging trees. Several species were obtained in such situations, but on rocks exposed to the sun Cyanophyta, (mainly *Isactis plana*) and some *Hildenbrandia* began to appear only at levels of less than two meters above low water. At the end of Punta Piedra Amarilla everything was subject to spray and surf mist at lower intertidal levels and the rocks were covered by a slippery brown cyanophyte layer. Except for a very scant growth in shallow pools and a fringe of crustose lithothamnioid in the surge zone around most of the rocks, erect algae were essentially absent from all areas above mean low water level. At depths of ½ to 2 meters a heavy *Sargassum* and *Padina* flora, with some *Dictyota* and occasionally well developed *Digenia* and *Galaxaura,* dominated a loose turf of various small species on the submerged rocks. The water was dirty from leaves and humus discharged into the bay from heavy recent rain wash.

Station 3: Rocky shore nearest Tambor on the south side of Bahía Ballena, Golfo de Nicoya, June 8. Nos. 16752-16762b. Collections were made from depths of ½ to 1 meter below mean low water. The flora was poor and the rocks covered chiefly by hydroids and bryozoans. The water was extremely opaque from plankton and debris.

Station 4: North side of Bahía Ballena, Golfo de Nicoya, within 500 meters east of Pochote, June 8. The first material (Nos. 16763-16765) came from under trees, some of them mangroves, just outside the estuary where the shade permitted growth that is otherwise restricted by the intense insolation. From there a small point extends out a short distance and Nos. 16766-16777 were collected in high seepages in the sand and in drainage pools. The principal collections (Nos. 16778-

16803a) were from a lagoon just beyond and sheltered by a natural rock breakwater formed by the next rocky point in the sequence. This lagoon is shallow, apparently not much exceeding 2 meters in depth at low water, and is bottomed by dead coral fragments. The beach sand is white from this coral material, unlike the blacker sand on the opposite side of the bay. The circulation is counter clockwise in Bahía Ballena, for the water in this lagoon was comparatively clear, and free of river debris unlike the situation on the other side where the river just above Tambor carries a great amount of silt and organic detritus into the bay and piles up driftwood in front of Tambor. The algae of this lagoon were dominated by *Padina* in scattered clumps to about 25 cm. high. All the other growth was small. An occasional clump of *Amphiroa,* a little *Liagora,* and a cover of very small species appeared on the dead coral. At the end of the natural breakwater a considerable surge occurs, as well as a small amount of surf. Under the influence of these, *Sargassum* occurs just as it did on the other side of the bay, in clumps about 25 cm. high. Quite considerable masses of *Spyridia* were on the bottom here, but other species were inconspicuous. The extreme proverty of Siphonocladales was striking. The only *Caulerpa* seen was markedly dwarfed. On such an apparently favorable bottom many other things were expected to occur, and would have been found in other parts of the tropical Pacific, but for reasons not yet fully understood were absent here.

Station 5: On a submerged rock about 50 meters off shore near Punta Voladera, Golfo Dulce, about 1 km. outside of Golfito Harbor entrance, June 13. Nos. 16804-16814. This rock is exposed somewhat less than 1 meter at low water. Except for a peculiar plant-like ctenophore bryozoan which resembles a *Laurencia* in habit and color, this rock was covered largely by a thin *Jania-Gelidium* turf of diminutive species.

Station 6: Inside and near the southeast end of Golfito Harbor, Golfo Dulce, June 13, (on rocks and mangrove, Nos. 16815-16821; on a sunken steel ship, Nos. 16822-16825). The water here was mucky, and plants were extremely scant. Tube worms and ctenophore bryozoans were dominant. Pollution was evident.

Station 7: On the mud flats at the civil town of Golfito, Golfo Dulce, June 14. Nos. 16826-16827; 16834-16835. *Spyridia* was in fairly good development on shell fragments.

Station 8: On rocks and fallen trees in the middle intertidal zone near El Atrocho, south of Golfito, Golfo Dulce, June 13. Nos. 16828-16832.

Station 9: On the legs of the light tower at the entrance to Golfito Harbor, Golfo Dulce, June 14. No. 16833. A heavy growth of a plant-like ctenophore bryozoan covered the steel legs. Several minute red algal epizoans occurred on it.

Station 10: On mud flats opposite the hospital at the Bananera Company town, inner harbor of Golfito, Golfo Dulce, June 16. Nos. 16836-16847.

Station 11: On the rocky shore of a rapid drop-off just northwest of Punta Galardo, Golfo Dulce, in 1 meter of water at low tide, June 14. Nos. 16848-16853. Although there was some surge and surf, and the bottom appeared to be favorable for abundant algal growth, almost nothing was visible except a few depauperate specimens of *Padina*.

Station 12: Bahía de los Guabos, innermost Golfo Dulce, June 15. Nos. 16854-16871. The collections were made from rocks and dead coral in 1-3 meters at low water. Visibility was about 3 meters in the calm, very warm water. The flora consisted of a continuous short turf 1-3 cm. thick. The largest plants were *Galaxaura* and *Caulerpa*, but none of these exceeded eight centimeters in height. All else was short, covered with fine silt, and of monotonously brown color. Very few living corals were visible although much of the substrate was of dead coral masses and fragments.

Station 13: On a solitary rock 200 meters off the end of Punta Galardo, Golfo Dulce, June 14. Nos. 16872-16887. This rock is subject to complete submergence at high water and to drying on top at low water. The area exposed is about 10 square meters. No growth of larger algae was observed, although considerable clumps of *Cladophoropsis* and *Amphiroa* occurred. Except for these and the conspicuous ubiquitous ctenophore bryozoan mentioned above, the rock surface was covered by a short turf mostly 1 cm. tall or less and by some thin patches of crustose algae. Articulated corallines were conspicuous but very small in size.

ECOLOGY

It may be seen from these notes and the systematic account to follow that the marine algal flora of the Costa Rican gulfs is a poor one, both in number of species and in the stature of the plants. Indeed, in the writer's experience in the tropical Pacific he has never found an area of such varied exposures and of such diversified and favorable substrates for algal attachment in which the algal population is so poorly developed. A full explanation of the reasons for this is not yet possible, but the observations to date clearly reveal several factors which are limiting. Most conspicuous among these are the exceptionally and consistently high water temperatures throughout the Golfo de Nicoya and Golfo Dulce. These high values, which for Puntarenas, Golfo de Nicoya, are outlined in Table 1, p. 26, together with the low circulation and limited to negligible surf agitation in these protected gulfs, greatly limits the availability of respiratory oxygen for the plants and probably are in large part responsible for the impoverished character of the sublittoral flora. It was notable at Bahía Ballena how the size and density of the *Sargassum* and *Padina* growths were favored by the increased exposure to agitation near Punta Piedra Amarilla.

Another restricting factor is the consistently heavy rainfall (some 280 inches annually in the Golfo Dulce) which causes reduced salinity from runoff and seepage in many inshore areas and introduces unfavorable quantities of sedimentary debris into the shore waters. This heavy and regular rainfall probably accounts for the dirth of intertidal species which, because of the tidal amplitude (to about 3 meters) and frequent exposure to drenchings with rainwater, are unable to survive above the level of mean low water. Species which might tolerate these salinity changes are further restricted by the excessive dryness, light and heat during daytime periods of exposure to intense insolation.

It remains to be seen from further explorations along the exposed, open shores of Costa Rica how rich and diversified a flora may yet be found. The abundance of rocks, islets and magnificent reefs suggest from the air that for the most part only the lesser species have been found and that a thorough survey of the outer coasts by skin diving may reveal a flora more in accord with those of other tropical Pacific areas.

SYSTEMATIC LIST

In citing specimens, the prefix "D." is given to designate the writer's field collection numbers. A complete set of these cited specimens is deposited in the herbarium of the Los Angeles County Museum. Collections by others are indicated by the full name. Those of W. R. Taylor are located in the Herbarium of the Allan Hancock Foundation and at the University of Michigan.

The literature citations are incomplete and somewhat arbitrary, but in general represent those found to be pertinent in making the determinations of these collections.

The Latin diagnoseis of new species were prepared by Dr. Hannah Croasdale.

CHLOROPHYTA

Monostroma sp. cf. *M. ecuadoreanum* Taylor 1945:40 Fig. 1.

D. 16839 agrees in size, thickness of blade, etc., with Taylor's Ecuadorean type, but does not show particularly rectangular cells in transection. The material is scant and only 1 cm. tall, so cannot be identified with certainty. Taylor's type has not previously been illustrated.

Enteromorpha lingulata J. Agardh

D. 16690. This material is apparently like that reported by Taylor (1945:39) from three Costa Rican localities outside the gulfs.

Enteromorpha compressa (L.) Grev. forma. Dawson 1956:27, fig. 1.

D. 16846 is small and not well developed. It is referred to this widespread species in *sens. lat.*

Cladophoropsis sundanensis Reinbold; Dawson 1956:30, figs. 8 a-b.

D. 16767.

Cladophoropsis gracillima Dawson 1950a: 149, figs. 12-13.

D. 16793; D. 16834. These are essentially identical with the Mexican type except that the filaments tend to be slightly larger (80-120 μ, or up to 130 μ in diameter).

Fig. 1. *Monostroma ecuadoreanum* Taylor. The type specimen, x 2.

D. 16876 is near this species, but is too large in diameter in many parts to fit well within its presently recognized circumscription. It has no fibulae, although the branching above in some parts, is struvioid. It is possibly a distinct species, but the material does not seem to warrant description at this time. It differs from *C. gracillima* not only in its greater diameter of some parts, but in the opposite branching of outermost vegetative parts.

Boodlea siamensis Reinbold; Börgesen 1913:49, fig. 34.

D. 16819 is in good agreement with Börgesen's figures of West Indian specimens. *D. 16825* may be this same, but the upper branching seems too regularly opposite for satisfactory comparison. The plant forms a well developed mat.

Struvea anastomosans (Harvey) Piccone & Grunow, ex Piccone; Egerod 1952:: 359, pl. 31, fig. 4 a-h.

D. 16799 and *D. 16813* are small and rather ill developed from turf mixtures, but their better parts seem to place them here without much question.

Willeella mexicana Dawson 1950: 151, fig. 11.

D. 16871 is represented by a single plant 2½ cm. tall, somewhat ill developed, but seemingly identical with the type which came from near Guaymas in the Gulf of California.

Cladophora prolifera (Roth) Kützing; Vickers 1908: 18, pl. 12; Taylor 1945:57.

D. 16700, D. 16751 are small plants to 2 cm. tall. *D. 16758a* is more slender and lax than *16700,* but structurally similar. *Taylor 39-108* (part) in tufts of *Galaxaura,* Golfo Dulce, 3/26/39.

Cladophora rudolphiana (Agardh) Kützing

D. 16740. Branches remote; main axes 84 μ in diameter; ultimate branches 20-30 μ in diameter; cells 5-7 diameters long.

Cladophora socialis Kützing; Dawson 1954a: 387, fig. 7e (as *Cladophora patentiramea* f. *longiarticulata*).

D. 16765 is a form with very long cells, often 10-15 (or 20-25) diameters long. Börgesen (1946: 28) has discussed this species in connection with *Cladophora patentiramea* var. *longiarticulata* Reinbold, and var. *hawaiiana* Brand, and pointed out that both are probably long-celled forms of *C. socialis* Kütz.

Bryopsis pennata Lamouroux; Egerod 1952: 370, fig. 7.

D. 16751a; D. 16758. These specimens are present in small amount but seem clearly to represent a form of this widespread tropical species.

Caulerpa racemosa var. *peltata* (Lamouroux) Eubank 1946: 421, fig. 2 r-s.

This species is well represented in the collections, but in no instance were specimens of really characteristic development seen. *D. 16809* and *D. 16856* are both small, scrubby plants; *D. 16792* is depauperate; *D. 16798* is a small, highly stoloniferous form.

Codium sp.

D. 16644, around the base of *Sargassum.*

Chlorodesmis hildebrandtii A. Gepp and Ethel Gepp 1911: 16, 137, fig. 74-75.

D. 16703; D. 16805.

Halimeda discoidea Decaisne; Egerod 1952: 398, pl. 38, fig. 19 b-d; Taylor 1945: 73.

D. 16707; D. 16801; D. 16754. These represent a small form with utricles only 35-45 μ in diameter. The plants are all short and were nowhere seen in luxuriant development. *Taylor 39-96,* in rock crevices and lower tide pools, Golfo Dulce, 3/26/39.

PHAEOPHYTA

Sphacelaria novae-hollandiae G. Sonder; Dawson 1954a; 400, fig. 14g.

D. 16865 has only a few propagulae, but these are identical with those in the writer's Viêt Nam collections cited above. The species has been reported on the Pacific Coast only from Isla Guadalupe, Mexico.

Sphacelaria furcigera Kützing; Dawson 1954a: 400, fig. 14h.

D. 16697b, D. 16699, D. 16720, D. 16786. Some of these are richly developed with abundant propagulae. They seem to be in best condition on older stipe parts of *Sargassum.*

Dictyota divaricata Lamouroux; Taylor 1928: pl. 16, fig. 6-9.

D. 16857 seems to be a form of this widespread tropical species known from several localities in southern Mexico.

Dictyota sp. cf. *D. friabilis* Setchell 1926;91, pl. 13, fig. 4-7, pl. 20, fig. 1; Dawson 1954a: 401, fig. 16a-b.

D. 16701 is a prostrate to spreading small plant from a central attachment. Its many rhizoids on the undersides and very short segments

Fig. 2. *Padina crispata* Thivy. The three small specimens are from the type collection. The larger example is from the writer's collection at Bahía Ballena, Golfo de Nicoya. Reduced x 0.7.

are noteable. It has a greenish irridescence in life. Study of many collections of small dictyotae from diverse parts of the tropical Pacific is needed to establish the specific limits of *D. friabilis* and related species. Two other collections of a different small *Dictyota* are present from the Gulf of Nicoya, *D. 16724* and *D. 16788*, representing a pinnate-proliferous small plant of unknown identity.

Dictyopteris repens (Okamura) Börgesen 1924:265, fig. 13.

D. 16697d; D. 16787a. Not previously reported from the Pacific Coast.

Pocockiella variegata (Lamouroux) Papenfuss 1943: 467, fig. 1-14.

D. 16702 and *D. 16868* are small but characteristic specimens. The former is fertile.

Padina durvillaei Bory; Setchell & Gardner 1925: pl. 93; Taylor 1945: 101.

D. 16704. The material is depauperate compared to the luxuriant specimens from Pacific Mexico. It shows a very light calcification in concentric lines on the lower surfaces. *Taylor 39-101,* infrequent in rock crevices near entrance to Golfo Dulce, 3/26/39.

Padina crispata Thivy, in Taylor 1945: 100. Fig. 2.

D. 16783; D. 16723; D. 16848 are all apparently identical with the type which, however, is not, because of its ill developed nature, characteristic of the species. It came from rocks near the entrance of Golfo Dulce, *Taylor 39-100,* 3/26/39, and was probably collected at a relatively high level where the plants are of scrubby development. The figures show the extent of development of plants in luxuriant condition at a depth of 1-2 meters below mean low water in the Gulf of Nicoya. At Bahía Ballena this species seemed to dominate considerable areas at this depth and, except for *Sargassum liebmannii,* is the species present in largest quantity of any in the Costa Rican gulfs. The dark, non-calcified upper surfaces, the chalky, rather heavily calcified lower surfaces and rather small segments are distinctive.

Padina caulescens Thivy, in Taylor 1945:99. Fig. 3.

D. 16723a has a well developed, branched, stupose stipe and thin, lightly calcified blades like this species described from Isla María Magdalena, Las Tres Marías, Mexico. The type has never been illustrated.

Chnoospora implexa Hering, ex J. Agardh; Dawson 1954a:404, fig. 20a-b.

Fig. 3. *Padina caulescens* Thivy, from the type collection, approximately natural size.

D. 16727 is a rather poor, depauperate example of this distinctive species hitherto unreported for the Pacific Coast of North America.

Sargassum liebmannii J. Agardh; Setchell 1937:130, pl. 28, fig. 1-3; Taylor 1945:119, pl. 29.

D. 16705; D. 16691; D. 16785. All of these are characteristic examples of this species which would seem to be the only one present in the Costa Rican gulfs. Taylor (1945) does not record it from Costa Rica, but his specimen 39-102 from Golfo Dulce cited under *Sargassum brandegeei* is this plant rather than the Gulf of California species. Setchell (1937) reports *S. liebmannii* from the Gulf of Nicoya as well as from two other localities to the north. Grunow (1915:398) describes *S. liebmannii* var. *nicoyana* from the Gulf of Nicoya, of which Setchell says: This "is probably an antheridial plant of quiet waters with thinner, more punctate leaves and less spinulose receptacles."

RHODOPHYTA

Goniotrichum elegans (Chauvin) Zanardini. Tanaka 1952:5, fig. 2-3, (as *Goniotrichum alsidii).*

D. 16833b.

Erythrotrichia carnea (Dillwyn) J. Agardh; Tanaka 1952:14, fig. 7A-E.

D. 16808a; D. 16833a.

Liagora valida Harvey; Taylor 1945:135.

Taylor 39-94, scarce in tide pools near the entrance to Golfo Dulce, 3/26/39. Not again collected.

Liagora ceranoides Lamouroux

D. 16782. These small, sterile plants only 2 cm. tall are best referred to the *Liagora ceranoides* complex, although with some doubt.

Galaxaura filamentosa Chou, in Taylor 1945:139; Chou 1945:39, pl. 1, fig. 1-6, pl. 6, fig. 1.

D. 16854 occurred in abundance as short, rather corymbose, spongy tufts, mostly in shaded places under cliffs in quiet water. *Taylor 39-93,* frequent on intertidal rocks on the western side of Golfo Dulce near near the entrance, 3/26/39. Also reported from Puerto Culebra.

Galaxaura ramulosa Kjellmann; Chou 1945: 44, pl. 2, fig. 3-5, pl. 7, fig. 1.

D. 16855 is represented by a single rather poor plant, but it is much like Taylor's specimen *34-505* cited and illustrated by Chou from nearby Jicarita Island, Panama.

Galaxaura stupocaula; Chou 1945: 49, pl. 5, fig. 10-12, pl. 11, fig. 1; Svedelius 1953:72, fig. 61-64; Taylor 1945:141.

D. 16698; D. 16794a, both intermixed with *Galaxaura veprecula. Taylor 39-90A; Taylor 39-91A; Taylor 39-92A,* from tide pools near the entrance of Golfo Dulce, 3/26/39.

Galaxaura veprecula; Chou 1947; 16, pl. 6, fig. 1-8, pl. 12. fig. 1; Taylor 1945:143.

D. 16696; D. 16794. The plants of both these collections were abundant and intermixed with *G. stupicaula* just as were *Taylor 39-90B, Taylor 39-91B,* and *Taylor 39-92B,* from tide pools near the entrance to Golfo Dulce, 3/26/39.

Gelidium sclerophyllum Taylor 1945:156, pl. 5, fig. 13, pl. 13, fig. 2.

Taylor 39-99, stunted, on under sides of rocks near entrance to Golfo Dulce, 3/26/39. Not again collected.

Gelidium pusillum (Stackhouse) LeJolis; Taylor 1945:152; Dawson 1944:258, pl. 42, fig. 1-6.

D. 16853; D. 16717; D. 16810. The latter two collections are of a form approaching *G. pusillum* var. *pacificum* Taylor. *D. 16821* is an extremely small form, yet with clearly evident rhizines. *Taylor 39-111* is a somewhat narrow form, abundant on rock much mixed with sand, Golfo Dulce, 3/26/39. *J. T. Howell 783, J. T. Howell 779a* and *Carroll W. Dodge n.n.* in the Herbarium of the University of California, Berkeley, are from the vicinity of Golfo de Nicoya.

Pterocladia mcnabbiana sp. nov. Fig. 4C-D.

Thalli pumili, tegetes in saxis conchisque formantes, ad 2 cm. altitudine e stolonibus ramosis subcylindricis c. 100 μ diametro constantes; stolonibus ad substratum crebro affixis, ramos erectos aut decumbentes, simplices aut parce pinnatos efficientibus, ramis partim subcylindricis ac stoloniferis, partim complanatis, c. 60-80 μ crass., ligulatis atque 0.35-0.65 mm. latis, extrema in parte, autem, in extensiones longas flagellatas subcylindricas productis. Cortex externus e strato uno cellularum minorum 3-6 μ diam., cortex internus e strato uno vel partim duobus 8-12 μ diam. constans; medulla angusta, 22-25 μ lat., rhizinas sparsas 8 vel plures per 100 μ includens; regio subcorticalis admodum sine rhizinis; tetrasporangia in ramis stichideis planis, ellipticis extrema in parte expansis producta; cystocarpi antheridiaque non visa.

Thalli dwarf, mat-forming on rocks or shells, reaching 2 cm. tall, consisting of ramified, subcylindrical stolon parts about 100 μ in diameter attached at frequent intervals to the substrate and giving rise to erect or decumbent, simple or sparingly pinnate branches, these branches in part subcylindrical, stoloniferous, and in part flattened, about 60-80 μ thick, ligulate and 0.35-0.65 mm. wide, but produced terminally into long, flagellate, subcylindrical extensions; outer cortex of 1 layer of small cells 3-6 μ in diameter; inner cortex of 1 or partially 2 layers of cells 8-12 μ in diameter; medulla narrow, 22-25 μ wide with rhizines scattered through it, sometimes as few as 8 per 100 μ, sometimes more abundant; subcortical area essentially without rhizines; tetrasporangia borne in terminally expanded, flat, elliptical, stichidial branches; cystocarps and antheridia not seen.

TYPE: *Dawson 16822,* forming small mats on the iron hull of a sunken ship, inner Golfito Bay, southwest of the civil town, Golfo Dulce, June 13, 1957.

ADDITIONAL MATERIAL: *D. 16859a, D. 16861.*

All of these collections came from extremely warm, sheltered areas of inner Golfo Dulce. They show considerable variability, but are especially marked by the dimorphism of the branches which are in part strongly flattened, and in part cylindrical and filamentous. In these respects it is reminiscent of other *Pterocladia* species such as *P. pyramidale* of Pacific Mexico and the United States. It is similar in size to both *P. parva* Dawson and *P. musciformis* Taylor, but in these the erect parts are consistently flat and lack the flagellate terminal extensions so prominent in *P. mcnabbiana.* It shows some resemblance to the stoloniferous form of *P. nana* Okamura of Japan and Formosa, but is smaller and lacks the prominent, close pinnate branching of that species. The fertile fragments of a small *Pterocladia* recognized by the writer from stomach contents of Palmyra Island fishes (Dawson, Aleem & Halstead 1955, p. 16) may be related here.

Inasmuch as cystocarps are not yet known, the position in *Pterocladia* rather than *Gelidium* must be provisional despite the evidence from vegetative parts.

The species is named for Mr. John McNabb of Los Angeles, California.

Pterocladia musciformis Taylor 1945:159. Fig. 4A.

Taylor 39-106 (TYPE), abundant on rocks much admixed with sand, associated with *Centroceras clavulatum* and *Gelidium pusillum* near the entrance of Golfo Dulce, 3/26/39. A specimen from the original collection has not heretofore been illustrated, and no new material has been found.

Gelidiopsis tenuis Setchell & Gardner 1924:749, pl. 22, fig. 2.
D. 16762; D. 16858.

Wurdemannia miniata (Lmk. & DC.) Feldmann & Hamel 1934:544, fig. 9-11.

D. 16741; D. 16749c; D. 16857a. This species is generally mixed in

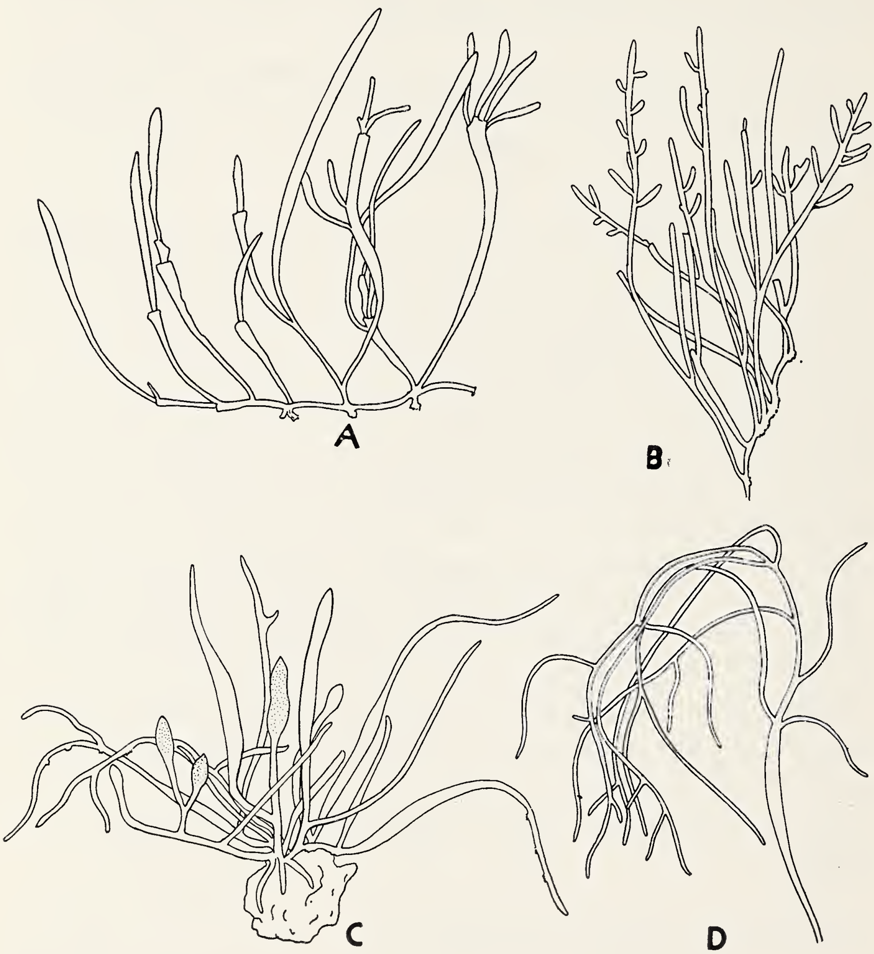

Fig. 4. A. *Pterocladia musciformis* Taylor, from the type collection, x 6.5. B. *Gelidiella machrisiana* Dawson, from the type collection, X 5. C-D. *Pterocladia mcnabbiana* Dawson, from the type collection, X 6.5.

turf with other small species. *Taylor 39-107,* below overhanging rocks near the entrance to Golfo Dulce, 3/26/39.

Gelidiella tenuissima Feldmann & Hamel

D. 16760; D. 16873?. The latter collection, growing on a chiton, seems to be almost intermediate between *G. tenuissima* and *G. myrioclada* Börgesen, but may best be referred to the former. It has tetrasporangial stichidia formed on short-stipitate branchlets. No terminal stichidia were observed.

Gelidiella machrisiana sp. nov. Fig. 4B.

Thalli penicillatim crebro fruticulosi, c. 1 cm. altitudine, e partibus repentibus cylindricis, ramos erectos efficientibus, constantes; rami erecti percurrentes compressi ad complanatos, primum simplices, deinde dimidiis in superioribus parce alterni pinnatim subdistiche breviter ramosi; ramis erectis 150-160 μ lat., 75-90 μ crass., ramis secondariis plerumque minoribus quam 1 mm. long., ad bases quasi contractis; apices subacuti, cellula apicali manifesta; transsectio structuram solidam uniformem cellularum parvarum satis isodiametricarum, cellulis extrorsus 5.5-6 μ diam., introrsus 7-8 μ diam., praebens; reproductio non visa.

Thalli densely tufted, about 1 cm. tall, consisting of subcylindrical, creeping parts giving rise to erect, compressed to flattened percurrent branches which are at first simple, then sparingly alternately, pinnately, subdistichously short-branched in their upper halves; erect branches 150-160 μ wide, 75-90 μ thick, the secondary branchlets mostly less than 1 mm. long, somewhat contracted at their bases; apices subacute, the apical cell prominent; transection showing a solid, uniform structure of small, more or less isodiametrical cells 5.5-6.0 μ in diameter toward the outside, 7-8 μ in diameter toward the center; reproduction not seen.

TYPE: *Dawson 16745,* on a shell fragment in a rock crevice about 1.5 m. above mean low water level, rocky shore on the southwest side of Bahía Ballena, Golfo de Nicoya, June 7, 1957.

The compressed to flattened percurrent, erect branches with their fairly regular alternate, distichous pinnae in the distal half are distinctive of this plant which seems amply different, despite the absence of reproductive material, from other species of *Gelidiella* heretofore described.

Caulacanthus sp. aff. *C. indicus* Weber van Bosse.

D. 16812 is sterile and poorly developed in a *Jania* turf so that it can be referred here only in doubt. The branches vary from 50 to 120 μ in diameter and, thus, tend to be somewhat larger than those of *C. indicus,* although the form and the presence of attachment discs correspond.

Hildenbrandia prototypus Nardo; Dawson 1953:95, pl. 7, fig. 4.

D. 16731; D. 16766; D. 16815; D. 16828.

Cruoriella fissurata Dawson 1953: 109, pl. 7, fig. 6, p. 24, fig. 1.

D. 16849 seems to be identical with the type from Cabeza Ballena, Baja California, Mexico. The species has been reported from as far south as Acapulco, Mexico.

Cruoriopsis mexicana Dawson 1953:99, pl. 10, fig. 11-14.

D. 16883. This material, in a mixture scraped from a rock, is tetrasporangial and is identical with the type described from Islas Los Coronados off northwesternmost Mexico. This represents the second collection of this species and a significant extension of range.

Peyssonelia conchicola Piccone & Grunow; Dawson 1953:105, pl. 11, fig. 12-13.

D. 16850 agrees with a specimen of this plant collected by the writer from Cape San Lucas, Baja California, Mexico and cited above.

Lithothamnium sp. cf. *L. heteromorphum* (Foslie) Foslie; Foslie 1929: 42, pl. 12, fig. 20.

D. 16695; D. 16778.

Lithophyllum sp. cf. *L. decipiens* (Foslie) Foslie; Mason 1953:338, pl. 40.

D. 16780.

Dermatolithon canescens (Foslie) Foslie; Dawson 1955:274.

D. 16754a; D. 16870. These are in good agreement with this species. The tetrasporangial conceptacles are 240-300 (325) μ in diameter; the hypothallus cells are 40-50 μ long. It has not previously been reported from the eastern Pacific.

Amphiroa beauvoisii Lamouroux; Hamel & Lemoine 1953: 42, pl. 5, fig. 1, 7, text fig. 7.

D. 16708 and *D. 16814* have four tiers of cells in the genicula. Their intergenicular medullas have in part exactly the pattern shown by Hamel and Lemoine, and in part 2-3 long cell-tiers alternating with 1 short. *D. 16867* has four tiers of cells in the genicula, but in the intergenicular medulla 4-5 tiers of long cells alternate with 1 short. *D. 16781* is more divergent in genicular structure with 6-7 tiers of cells, all of about the same length, but, despite this, it seems to agree with the other specimens, all of which best fall under this species.

Amphiroa taylorii Dawson 1953:138, pl. 26, fig. 1.

D. 16874 agrees well with the type from Isla Socorro, Mexico. *D. 16790* is also typical of the species in size, irregular diameter, genicula, size of conceptacles, branching habit, etc., but the presence of frequent discoid attachments between branches in the clumps were not previously noted in this species. The constrictions at the genicula are not as prominent either as in the type, and the density of the clumps is greater. Nevertheless, there are not sufficient apparent differences from *A. taylorii* to merit a separate taxonomic designation at this time. *D. 16709* seems to be a slender, lax form of this species. The genicula in the liquid preserved specimens are more prominent than in *D. 16790,* perhaps because of some decalcifying action of the formalin.

Amphiroa dimorpha Lemoine 1929:76, pl. 3, fig. 3-4, p. 4, fig. 6, text fig. 33. Taylor 1945:192, pl. 54 (as *Amphiroa polymorpha*).

Taylor 39-116B, mixed with *Amphiroa annulata* from tide pools near the entrance of Golfo Dulce, 3/26/39, has shown upon reexamination to be unlike the type of *A. polymorpha* and to be referable instead to *A. dimorpha.* The segments in part reach 2.5 mm. in width, but the material is not luxuriantly developed.

Amphiroa minutissima Taylor 1945:186, pl. 46, fig. 1.

Taylor 39-116C (TYPE), rare, littoral, Golfo Dulce, 3/26/39. Not again collected.

Amphiroa annulata Lemoine 1929:78, fig. 34, pl. 4, fig. 1; Taylor 1945: 188.

Taylor 39-116A, stunted, in tide pools near the entrance to Golfo Dulce, 3/26/39.

Amphiroa sp. cf. *A. annulata* var. *pinnata* Dawson 1953:137.

D. 16885. The unizonal genicula, size and habit are of *A. annulata,* but the suppression of dichotomous branching, the inconspicuous annulations, and short segments represent minor differences from the type of this species from the Galapagos Archipelago and seem to relate this collection more with the Mexican var. *pinnata.*

Jania tenella var. *tenella* Kützing; Dawson 1953:120, pl. 9, fig. 3.

D. 16802; D. 16787, close to this form; *D. 16875,* a slender form with ungulate tips.

Jania tenella var. *zacae* Dawson 1953:121, pl. 8, fig. 3, pl. 31, fig. 1.

D. 16718, growing on *Sargassum,* agrees well with the type from Bahía Piedra de Blanca, Costa Rica.

Jania capillacea Harvey; Dawson 1953:116, pl. 9, fig. 1.

D. 16748; D. 16757; D. 16808; D. 16852; D. 16859. These plants are common in the short turfs covering many sublittoral rocks. They are decussately branched and have segments 60-110 μ in diameter.

Jania longiarthra Dawson 1953:119, pl. 9, fig. 4, pl. 27, fig. 4.

D. 16755 compares favorably with this species known on the Pacific American coast from southern Baja California and from Sonora, Mexico.

Hypnea pannosa J. Agardh; Taylor 1945:227, pl. 71, fig. 2.

D. 16715; D. 16803.

Hypnea esperi Bory; Dawson 1954a: 436, fig. 46h-j.

D. 16762a, small amount in mixture; *D. 16787c,* tetrasporangial; *D. 16795,* tetrasporangial.

Hypnea sp.

D. 16864 is mostly of small diameter corresponding with *H. esperi,* but some main branches approach the size of *H. cervicornis* J. Ag. The habit suggests *H. cervicornis* as found by the writer in Viêt Nam on similar gravel and shell fragments.

Gracilaria crispata Setchell & Gardner 1924:753, pl. 22, fig. 7-10, pl. 44a; Dawson 1949b:26, pl. 8, fig. 4, pl. 9, fig. 4-10, pl. 10, fig. 5-7.

D. 16710 is a small fragment only, but is characteristic of this species and identical with material collected by Taylor, March 26, 1939, under number *39-105* from tide pools and friable rocks on the western side of the bay near the entrance of Golfo Dulce. The specimen was labeled "*?Rhodymenia californica* Kylin," but was not cited in publication.

?Gracilariopsis costaricensis Dawson 1949b:46, pl. 18, fig. 7-8, pl. 19, fig. 1, 2, 8.

D. 16844 is scant and sterile, so the determination is doubtful. The type of this species was dredged in Bahía Santa Elena.

Champia parvula (C. Agardh) Harvey; Dawson 1954a:443, fig. 52c.

D. 16703a, fragments only.

Antithamnion breviramosus Dawson var. *breviramosus,* Dawson 1949a: 14, fig. 28, 57.

D. 16806a.

Spyridia filamentosa (Wulfen) Harvey; Dawson 1954a:444, fig. 54i.

D. 16692 (small and poorly developed); *D. 16750; D. 16789; D. 16824; D. 16826; D. 16835.*

Pleonosporium globuliferum Levring 1941:647, fig. 19A-D.

D. 16729. This shows good agreement in size, morphology, and in the often incurved tips, but the decending rhizoids were not seen, and the plant seems to be out of its proper temperature range here. Nevertheless, the correspondence is so close that it seems best to refer this collection to the Juan Fernandez Island species.

Ceramium equisetoides Dawson 1944:320, pl. 51, fig. 1; Dawson 1950b: 128.

D. 16716b contains tetrasporangial and antheridial specimens.

Ceramium gracillimum var. *byssoideum* (Harvey) G. Mazoyer; Dawson 1954a:448, fig. 55e, f.

D. 16804c; D. 16866; D. 16756. The latter material, growing on a hydroid, contains antheridial, cystocarpic, and tetrasporangial plants. The tetrasporangia tend to be solitary and adaxial, but some range toward a whorled condition. These agree essentially with the plants treated by Dawson (1950b) as *C. masonii* Dawson and subsequently reduced. No gland cells are conspicuously evident. *D. 16759* has a stronger tendency to whorled tetrasporangia than does *D. 16756.*

Ceramium nakamurai Dawson 1954b:6. *Ceramium equisetoides* Nakamura 1950:157, fig. 1-2, non Dawson.

D. 16746 is tetrasporic and in excellent agreement with the Formosa type. The only apparent difference is the somewhat shorter nodal bands. *D. 16749b* is probably the same.

Ceramium marshallense Dawson 1957a:120, fig. 27a-b.

D. 16716a. The material is sterile but vegetatively seems to match well.

Ceramium mazatlanense Dawson 1950b:130, pl. 2, fig. 14-15.

D. 16841, tetrasporangial and cystocarpic; *D. 16843,* excellent tetrasporangial material in good agreement with this species.

Ceramium taylorii Dawson 1950b:127, pl. 2, fig. 13, pl. 4, fig. 31-33.

D. 16796 is sterile, but easily recognized as this species by its vegetative characters.

Ceramium vagabunde Dawson 1957a:121, fig. 27e; Dawson 1954b:6, pl. 4, fig. 2 (as *Ceramium* sp.).

D. 16808b, tetrasporangial plants creeping through *Jania* clumps.

Centroceras clavulatum (Agardh) Montagne; Smith 1944:328, pl. 84, fig. 5-6.

D. 16762b. This species is also mentioned by Taylor (1945:159) as occurring near the entrance of Golfo Dulce.

Cryptopleura sp.?

D. 16711 is too scant for identification, but seems to be this genus. When more material is available it should be compared with *Hymenena decumbens* Levring (1941).

Caloglossa leprieurii (Montagne) J. Agardh; Post 1943:127, fig. 3a-d.

D. 16838 seems to correspond well with *C. leprieurii* var. *hookeri* as illustrated by Post (1943:fig. 3a-d).

Dasya sp.

D. 16706a; D. 16728. These small, sterile plants, mostly under 1 cm. tall, do not seem to belong to any species previously recorded from the Pacific Coast, but are not adequate for description at this time. Their relatively coarse, corticated axes and short, spirally arranged pseudolaterals seem to relate them to *Dasya californica* Gardner, but the non-ascending character of these, their acute tips and shorter cells are different.

Heterosiphonia wurdemannii var. *laxa* Börgesen 1915-20:326, fig. 327; Dawson 1956:57, fig. 60.

D. 16697a; 16712; 16760a.

Polysiphonia mollis Hooker & Harvey; Cribb 1956:131, pl. 4, fig. 1-4, pl. 5, fig. 1-5.

D. 16716; D. 16725; D. 16749; D. 16800. This species is known in the literature as *P. snyderae* Kylin and as *P. tongatensis* Harvey.

Polysiphonia subtilissima Montagne; Tseng 1944b:70, pl. 1.

D. 16716c; D. 16721a; D. 16749a; D. 16797; D. 16869.

Digenia simplex (Wulfen) Agardh; Taylor 1945:297.

D. 16722 is luxuriantly developed; *D. 16862* is dwarfed. *Taylor 39-95*, common in tide pools near the entrance of Golfo Dulce, 3/26/39.

Lophosiphonia scopulorum (Harvey) Womersley; Cribb 1956:141. Dawson 1956:59, fig. 64; Taylor 1945:304 (as *Lophosiphonia villum*).

D. 16879, tetrasporangial. *Taylor 39-115,* forming mats attached to rocks in the deeper tide pools near the entrance to Golfo Dulce, 3/26/39.

Lophosiphonia reptabunda (Suhr) Cribb 1956:140, pl. 4, fig. 6-8.

D. 16738; D. 16739, tetrasporangial; *D. 16747; D. 16832.* These are apparently in satisfactory agreement with this species which is widely known in the literature as *Lophosiphonia obscura.*

Bostrychia simpliciuscula Harvey, ex J. Agardh; Tseng 1943:173, pl. 2, fig. 6-7.

D. 16764 is morphologically in good agreement with this species and from a characteristic habitat.

Bostrychia radicans (Montagne) Montagne.

D. 16817; D. 16818, D. 16831, tetrasporangial. These are like the photographs by Post (1955:353, pl. 15, fig. 1-2) of Nayarit, Mexico and El Salvador specimens identified as *B. radicans* f. *moniliforme.*

Bostrychia binderi Harvey; Tseng 1943:177, pl. 1, fig. 7-8; Post 1955: 359-361.

Taylor 39-98, from high cliff faces, but within reach of splash of waves, near the entrance to Golfo Dulce, 3/26/39. This was identified by Tseng in Taylor (1945:306) as *Bostrychia tenella,* but Post (1955) has reexamined the collection and called it *B. binderi.*

Herposiphonia secunda (Agardh) Ambronn; Börgesen 1930:111, fig. 45.

D. 16697c; D. 16706; D. 16721; D. 16791; D. 16803a; D. 16807; D. 16811.

Herposiphonia tenella (Agardh) Ambronn; Dawson 1954:452, fig. 59a.

D. 16726; D. 16761, both on *Padina.*

Herposiphonia subdisticha Okamura 1915, Icones III:199, pl. 146, fig. 11-18; Dawson 1944:334, pl. 49, fig. 2.

D. 16714.

?*Chondria lancifolia* Okamura 1934, Icones VII:43, pl. 323, fig. 1-10; Tseng 1945:166, pl. 2, fig. 5-7; Dawson 1957b:8.

D. 16710; D. 16713. These plants are very small, but seem well developed and very much like the Alijos Rocks, Mexico, material cited above. They are in good agreement with the species as illustrated by Tseng as a small form of *C. lancifolia,* but the size difference of both his and ours from the larger Japanese specimens is great. It is now considered probable that two different species may be involved, but more ample comparative collections are needed. The relationship of the structurally similar, but much larger sublittoral *C. platyclada* Taylor also needs clarification by additional Costa Rican collections.

Chondria repens Börgesen 1924:300, fig. 40; Dawson 1954:460, fig. 62d-e.

D. 16878 is a well developed specimen with erect, sterile parts to 1 cm. long and about 250 μ in diameter. Some tetrasporangia are present. It is somewhat more lax in sterile parts than is Börgesen's Easter Island type, but is otherwise in good agreement.

CYANOPHYTA[2]

Entophysalis conferta (Kützing) Drouet & Daily
D. 16763; D. 16768, both with *Lyngbya aestuarii.*

Calothrix crustacea Thuret
D. 16735 (with some *Hydrocoleum lyngbyaceum*); *D. 16743*

Calothrix pilosa Harvey
D. 16737

Isactis plana (Harvey) Thuret
D. 16730; D. 16733; D. 16734; D. 16872 (with *Lyngbya confervoides*)

Plectonema norvegicum Gomont
D. 16829

Symploca hydnoides Kützing
D. 16744

Hydrocoleum lyngbyaceum Kützing
D. 16735

Hydrocoleum glutinosum (Agardh) Gomont
D. 16827 (?;trichomes out of sheath); *D. 16830*

Amphithrix violacea (Kützing) Bornet & Flahault
D. 16732

Lyngbya gracilis (Meneghini) Rabenhorst
D. 16742, with *Lyngbya sordida*

[2] Determinations by Francis Drouet, and a set of specimens deposited at the Chicago Natural History Museum.

Lyngbya aestuarii (Mertens) Liebman

D. 16763; D. 16768 (both with *Entophysalis conferta*); *D. 16769* (with *Lyngbya semiplena*); *D. 16836; D. 16837.*

Lyngbya sordida (Zanardini) Gomont

D. 16742, with *Lyngbya gracilis*

Lyngbya semiplena (Agardh) J. Agardh

D. 16769, with *Lyngbya aestuarii*

Lyngbya confervoides Agardh

D. 16872, with *Isactis plana*

SUMMARY AND CONCLUSIONS

The collections here enumerated represent 108 species of which 14 are Cyanophyta, 16 Chlorophyta, 11 Phaeophyta, and 67 Rhodophyta. Apart from the Cyanophyta 51 species are of wide tropical or cosmopolitan distribution, while only six are, to this writing, known only from Costa Rica. Nineteen species, most of them of otherwise wide tropical distribution, are reported here for the first time from the Pacific Coast of North America, and 14 species previously known elsewhere along Pacific North America only from one or two collections are here given significant range extensions on this coast. Of particular significance are the following characteristics of the marine flora of the Costa Rican gulfs.

1. A generally poor diversity of species.
2. The presence of only a few species more than 2-3 cm. tall.
3. An apparent absence of marine phanerogams.
4. An extreme paucity of calcareous green algae and other members of the Siphonocladales.
5. The virtual absence of an intertidal algal flora except for Cyanophyta and members of the bostrychietum.
6. An extreme paucity of coral and of the vegetation usually associated with coral in the tropical Pacific.

TABLE 1

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1956 mean		83.2	82.4	83.6	84.2	82.5	82.9	82.8	82.1	81.8	79.3	80.9
1957 mean	81.5	81.3	82.3	83.8	85.4	85.4	85.2					
1956 max.		84.2	84.3	85.4	85.4	84.0	83.3	83.5	83.9	83.7	81.5	82.4
1957 max.	82.6	83.3	85.2	86.2	86.5	86.4	86.2					
1956 min.		82.4	79.3	81.2	82.8	81.2	80.7	81.7	80.3	79.6	77.8	79.5
1957 min.	80.2	78.2	78.8	80.2	84.2	84.1	84.4					

Surface water temperatures in Fahrenheit, Puntarenas Pier, Golfo de Nicoya. Monthly maxima and minima are taken from daily averages of eight readings from a recording thermograph at 3-hour intervals. Means are obtained by averaging these daily figures. Inasmuch as the bulb was located at a point 2 meters below mean low water, these values do not represent maxima for the immediate surface waters, especially in shoal areas such as those of Stations 6 and 12 in the Golfo Dulce where surface temperatures may commonly reach 95°F.

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Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ıber 16 October 31, 1957

A CLASSIFICATION OF THE OSCINES (AVES)

By Jean Delacour[1] *and* Charles Vaurie[2]

The classification of birds presents many uncertainties, and this is particularly true of the order Passeriformes, or Perching Birds, which includes three-fifths of the species alive at present. Among the latter, the greatest taxonomic problem is posed by the Oscines, or true Songbirds, and opinions differ very widely. In fact, scarcely any two lists recognize the same families or arrange them in the same sequence. This lack of agreement reflects the fact that most Oscines are not well differentiated morphologically from one another while many share more or less similar general habits. Important anatomical differences that could serve as clues are usually lacking and any that do exist are interpreted differently by various authors (see Mayr (1955 and 1956) whose conclusions conflict in part with those of Beecher (1953) and Tordoff (1954)). The problems inherent in a classification of the Oscines have been discussed by many authors and we need not amplify them here. We may cite, however, the paper by Mayr and Amadon (1951) which advocated one of the older arrangements but somewhat modified.

Nevertheless, among the various classifications, the one proposed by Wetmore (1934 and 1940, as well as earlier papers) has been widely accepted with certain modifications. Minor revisions were made by Wetmore in 1951. In Wetmore's classification, the Corvidae and their allies are placed near the beginning of the sequence, after the Larks, the Swallows, and the Cuckoo-Shrikes (Campephagidae). A group of families are associated with the Crows, such as the Drongos, the

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Orioles, the Cracticidae, the Birds of Paradise and the Bower-birds, forming the corvine assemblage, though it is not yet certain that these families are all closely related. An intermediate group is composed of the Waxwings and the Bulbuls (which in some anatomic features recall the Crows), the Muscicapid Flycatchers, Babblers, Thrushes and their allies, while a third group consists of the Sunbirds, Tanagers, Finches and their allies, which, in our opinion, are the most highly evolved, adapted chiefly to a diet of seeds and nectar.

Amadon, in a recent paper (1957), states that the present song birds represent "three broad levels of evolution" and he accordingly divides them into three groups in a general sequence which "from lower, to higher" follows the general lines of Wetmore's classification.

Mayr and Greenway (1956) reported on the decisions reached by an international committee appointed at the Eleventh International Ornithological Congress at Basel, to recommend "a standardized sequence of the families of Passerine birds." The decision of the committee was to place the corvine assemblage at the top rather than at the bottom of the classification. Mayr and Greenway state that in their capacity as editors of Peters' Checklist, they will follow the sequence recommended by the committee.

It is certainly to be hoped, if hardly expected, that all authors will one day adopt a standardized sequence. Whether it is the right of a committee to rule in matters of classification, is, however, open to question, but we hope, at any rate, that the group appointed at Basel will reconsider some of its decisions on the occasion of the next Congress (Helsinki, June, 1958). A satisfactory general agreement may eventually be reached, and we take this opportunity to express our opinion.

In general we follow Wetmore's composition and order of families, but have a number of modifications to present. For instance, we believe that the Campephagidae should be ranked higher than the Crows, whereas the Wood-Swallows, Shrikes and Starlings should be somewhat lower. However, in the light of our present knowledge, Wetmore's sequence, subject to some change, probably represents a fairly natural order. Of course, any arrangement is more or less arbitrary; no linear sequence can express an arrangement that is, in fact, three dimensional, We realize its shortcomings, but we believe also that no unequivocal reasons have been offered as yet to depart from it widely.

In support of this arrangement it seems that the very much greater adaptive radiation of the birds in the "third group" (which cannot be denied) is a sound argument for considering them to be the most highly evolved. Furthermore, there is some anatomical evidence that the Corvidae resemble groups which admittedly stand low on the level of classification. Wetmore has shown (1957) that there is one anatomical characteristic, namely the form of the head of the humerus, that appears to be of phylogenetic significance, and in this characteristic the Corvidae resemble some sub-Oscines, such as the Tyrannidae and their allies, and even the Piciformes, Coraciiformes, and Trogoniformes. A complicated form of the head of the humerus, similar to that seen in the Finches, also appears among non-passerine birds such as the Gulls. Dr. Hildegarde Howard has pointed out to us that the fossil record suggests that in the Gulls this represents an evolutionary advancement, for ancestral larids lacked this complicated form of the humeral head. She also has called our attention to the similarity of the manubrial area of the sternum in the Corvidae and such sub-oscine birds as the Pittidae, Tyrannidae and Cotingidae. The chief reason why the members of the corvine assemblage are regarded by some authorities as the most highly evolved is their alleged ability to learn, and the complex behavior of some of their species. The elaborate courtship of the Birds of Paradise and Bower Birds is also mentioned. However, as Wetmore remarks, a "belief in superior mental reactions" in the Crows, may be "more an anthropomorphic interpretation than one supported by scientific fact." But, granting that the Corvidae are capable of more complex behavior than the smaller song birds, it must be admitted that the Parrots also are capable of such "intelligent" behavior and that elaborate courtship habits are shown by other non-passerine birds, (Humming-Birds, Pheasants, Ducks, etc.) or sub-Oscines (Manakins). We question, therefore, that these considerations should be given preeminent weight in a classification of the song birds since they have appeared in various groups as a result of parallel evolution.

We recognize the following families and subfamilies, placing them in the three groups recommended by Amadon. We do not infer, however, that other families should not be divided into subfamilies, and we think particularly of the Laniidae and Prionopidae. In a linear sequence there is some unavoidable juxtaposition of families which have little relationship. We, therefore, call the reader's attention to this fact by separating with a line the families, or group of families, that are not closely allied to those immediately above and below.

We express our appreciation to Drs. Dean Amadon, Hildegarde

Howard, and Alexander Wetmore for discussing with us a number of problems.

SYSTEMATIC LIST

GROUP 1

Alaudidae

———————

Hirundinidae

———————

Motacillidae ([3])

———————

Prionopidae
Vangidae
Artamidae
Cracticidae
Laniidae
Oriolidae
Dicruridae
Grallinidae
Callaeidae

———————

Sturnidae

———————

Corvidae
Paradisaeidae
    Paradisaeinae
    Ptilonorhynchinae

GROUP 2

Bombycillidae
    Dulinae
    Ptilogonatinae
    Hypocoliinae
    Bombycillinae
Campephagidae
Pycnonotidae
Irenidae

———————

Cinclidae
Troglodytidae
Mimidae

———————

Prunellidae

———————

([3]) This family is placed next to the Larks in many lists. It is dubious, however, that the Pipits and Wagtails are closely related to the Larks, and Amadon places them as the first family in his group 3.

Muscicapidae
- Pachycephalinae
- Sylviinae
- Polioptilinae
- Malurinae
- Rhipidurinae
- Monarchinae
- Muscicapinae
- Turdinae
- Timaliinae (including *Chamaea*, *Paradoxornis* and their allies)

Aegithalidae

Paridae
- Parinae
- Sittinae
- Tichodromainae

Certhiidae

Salpornidae
- Salpornitinae
- Neosittinae
- Daphoenosittinae
- Hyposittinae

GROUP 3

Remizidae

Dicaeidae

Nectariniidae

Zosteropidae

Meliphagidae

———————

Ploceidae
- Bubalornithinae
- Ploceinae
- Viduinae
- Estrildinae

Fringillidae
- Fringillinae
- Carduelinae

Emberizidae [4]
- Emberizinae
- Pyrrhuloxiinae
- Thraupinae
- Parulinae

Vireonidae

Drepaniidae

Icteridae

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[4] *Tersina* seems to belong in this group and is treated sometimes as a subfamily or a full family. *Catamblyrhynchus* belongs in this group also and is likewise treated as a subfamily or a family. The so-called Coerebidae are believed to be a polyphyletic group, see Beecher (1951), composed of species related either to the Tanagers or to the Wood Warblers.

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LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

No. 1. The Machris Brazilian Expedition. General Account, by Jean Delacour. 11 pp., 4 figures. January 23, 1957.

No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson. 20 pp., 5 figures, 2 maps. January 24, 1957.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii*, by T. G. Yuncker. 2 pp., 1 figure. January 25, 1957.

No. 4. The Machris Brazilian Expedition. Botany: The Lichens, by Carroll W. Dodge. 2 pp. February 18, 1957.

No. 5. The Machris Brazilian Expedition. Botany: Cyanophyta, by Francis Drouet. 2 pp. February 19, 1957.

No. 6. The Machris Brazilian Expedition. Botany: A New Mint from Goiás, *Hyptis machrisae*, by Carl Epling. 4 pp., 2 figures. February 20, 1957.

No. 7. The Machris Brazilian Expedition. Botany: Phanerogamae, various smaller families, edited by E. Yale Dawson. 18 pp., 7 figures. March 7, 1957.

No. 8. Notes on Eastern Pacific Insular Marine Algae, by E. Yale Dawson. 8 pp., 4 figures. June 27, 1957.

No. 9. A New Species of Passerine Bird from the Miocene of California, by Hildegarde Howard. 16 pp., 2 figures. June 28, 1957.

No. 10. The Machris Brazilian Expedition. Botany: A New Columnar Cactus from Goiás, by E. Yale Dawson. 8 pp., 4 plates. July 15, 1957.

No. 11. The Machris Brazilian Expedition. Botany: Chlorophyta; Euglenophyta, by G. W. Prescott. 29 pp., 5 plates, 1 text figure. August 20, 1957.

No. 12. The Machris Brazilian Expedition. Entomology: General; Systematics of the Notonectidae (Hemiptera), by Fred S. Truxal. 23 pp., 1 plate, 8 text figures. August 21, 1957.

No. 13. The Machris Brazilian Expedition. Botany: Phanerogamae, Leguminosae, by Richard S. Cowan. 24 pp., 7 figures. October 23, 1957.

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No. 15. Marine Algae of the Pacific Costa Rican Gulfs, by E. Yale Dawson. 28 pp., 4 figures. October 31, 1957.

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Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ıber 17 December 23, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Bromeliaceae and other smaller families

By LYMAN B. SMITH[1]

The plant collections reported upon below were obtained by E. Yale Dawson, Expedition botanist, and are cited by his field collection numbers. Detailed locality data for these may be found in his general account of the botany of the Expedition[2]. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13–May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15–June 10, 1956.

The first set of specimens is deposited in the Los Angeles County Museum, except holotypes of the two new species which are in the Museu Nacional do Brasil in Rio de Janeiro.

Inasmuch as the author is a specialist in only one of the families treated, namely the Bromeliaceae, references are given to the works used in making determinations in the others.

BROMELIACEAE

Bromelia karatas L. 14994

Bromelia villosa Mez 15109 Fig. 1.

Heretofore this highly ornamental species has been known by fragmentary dried material alone. It is hoped that the accompanying figure will arouse interest in its cultivation. The type of this species was collected by Glaziou between "Sitio de Bacarão" and "Areias," neither

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[2] Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2):1-20.

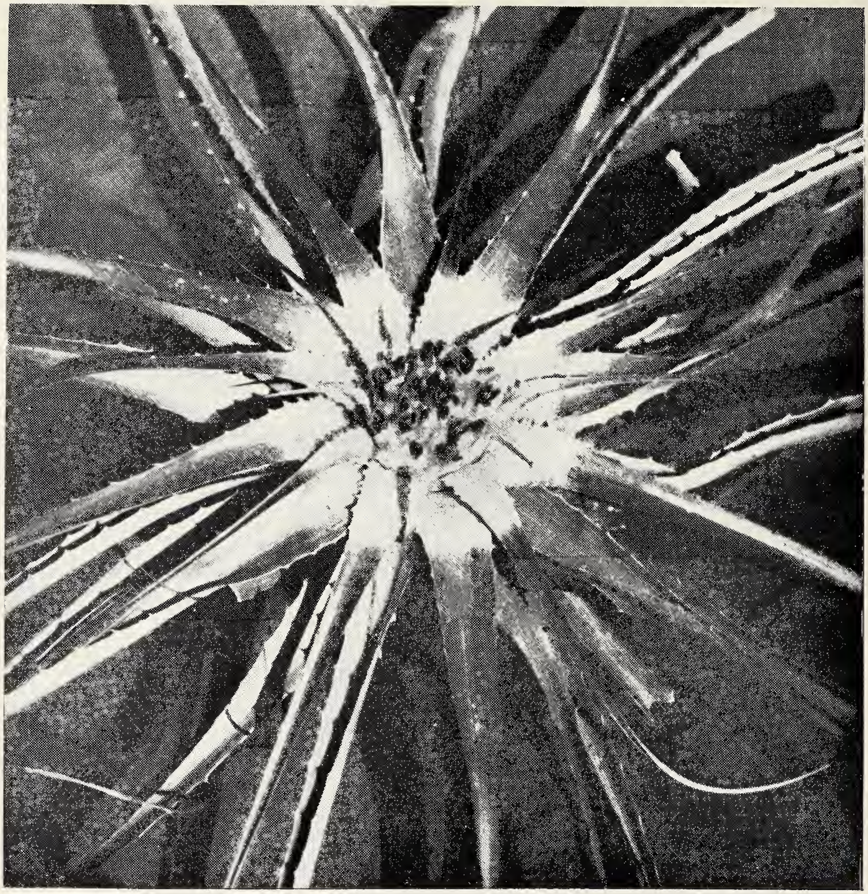

Fig. 1. *Bromelia villosa* Mez. A flowering specimen collected near Uruaçú, Goiás, May 25, 1956. Photo by M. A. Machris.

locality being identifiable, but in all probability situated in southern Goiás in the same region as that covered by the Machris Expedition.

Dyckia dawsonii L. B. Smith, sp. nov. Fig. 2-4.

A *D. niederleinii* Mez, cui affinis, laminis foliorum angustissimis quam longitudine spinarum angustioribus, petalis minoribus ecarinatis differt.

Fruiting plant about 7 dm high; leaves to 22 cm long, the sheaths suborbicular, over 2 cm in diameter, glabrous, stramineous, lustrous, the blades linear, 7 mm wide at base, covered on both sides with cinereous appressed scales, laxly serrate with slender curved mostly subopposite spines 5-7 mm long; scape 4 mm in diameter, glabrous; scape-bracts broadly ovate with a linear blade, thin, entire, all but the lowest much shorter than the internodes; inflorescence simple, lax, 25-30 cm long, glabrous; floral bracts suborbicular, apiculate, 4 mm long, thin, erose; pedicels stoutly obconic, 3 mm long; sepals broadly elliptic, obtuse, 5-6 mm long, thin, ecarinate; petals 9 mm long, ecarinate, the blade broadly obovate, yellow; stamens exserted, the filaments connate for 2 mm above the 1 mm tube with the petals; stigmas subsessile.

Fig. 2. *Dyckia dawsonii* sp. nov. Herbarium material prepared from a plant collected at the type locality by A. L. Carvalho and flowered in Rio de Janeiro in November 1956.

Fig. 3. *Dyckia dawsonii* sp. nov. A group of plants growing at the type locality in the Serra Dourada, Goiás, June 1, 1956. Photo by A. L. Carvalho.

Fig. 4. *Dyckia dawsonii* sp. nov. A plant from the type collection cultivated in Santa Monica, California.

Type: Museu Nacional do Brasil, Rio de Janeiro, collected on rocks in an outcrop along a cerrado canyon 20 km east of Formoso, region of the southern Serra Dourada at W. Long. 48° 50′, S. Lat. 13° 45′, Goiás, Brazil, June 10, 1956, by E. Yale Dawson (No. 15236). Isotypes in the United States National Herbarium and in the Los Angeles County Museum. The original collection was in very old fruit, but was cultivated by A. L. Carvalho and flowered in Rio de Janeiro in November 1956. The description is drawn from both collections.

The technical floral characters of *Dyckia dawsonii* place it next to *D. niederleinii,* to which it bears little resemblance otherwise. Its leaves alone distinguish *Dyckia dawsonii* from all other species in the genus, but are strikingly similar to those of *Encholirium bradeanum* L. B.

Fig. 5. *Dyckia machrisiana* sp. nov. The type specimen.

Smith. The latter, however, has a relatively long cylindrical pedicel which quickly distinguishes it from *Dyckia dawsonii* even in fruit.

Dyckia machrisiana L. B. Smith, sp. nov. Fig. 5.

A *D. tuberosa* (Vell.) Mez, cui affinis, laminis foliorum utrinque albido-lepidotis, laminis petalorum atris differt.

Flowering plant 8 dm high; leaves rosulate, 25 cm long, the sheaths suborbicular, 3 cm in diameter, glabrous, the blades linear-triangular, 15 mm wide, covered on both sides with white subappressed scales, laxly serrulate with acicular teeth 1 mm long; scape 4 mm in diameter, sparsely pale-lepidote; scape-bracts broadly ovate, thin, abruptly contracted into a linear-triangular apex, all but the lowest several times shorter than the internodes; inflorescence simple, lax, sparsely pale-lepidote; rhachis slender, flexuous; floral bracts broadly ovate, acuminate, to 6 mm long; flowers spreading or divergent; pedicels cylindric, stout, 2-4 mm long; sepals ovate, obtuse, 7 mm long, ecarinate, rather fleshy; petals 10 mm long, the blades elliptic, ecarinate, dark blackish orange externally (! Dawson); stamens included, the filaments free above the short common tube with the petals; stigmas subsessile.

Type: Museu Nacional do Brasil, Rio de Janeiro, collected in open grassland and marginal cerrado 20 km north of São João da Aliança, region of the Chapada dos Veadeiros at W. Long. 47° 30′, Lat. 14° 30′, Goiás, Brazil, April 14, 1956, by E. Yale Dawson (No. 14153a). Photo no. 4836 in U. S. National Herbarium.

Dyckia minarum Mez 14153; 14803

Dyckia racemosa Baker 14494

This collection from the vicinity of São João da Aliança is the first since the type which was made by Gardner at Arraias in April 1840. The two localities are not far apart.

Tillandsia streptocarpa Baker 14587

ALISMACEÆ

Echinodorus paniculatus Micheli 15168

Sagittaria rhombifolia Cham. 15164

References: *Echinodorus:* N. C. Fassett, Rhodora 57: 133-156, 174-188, 202-212. 1955. *Sagittaria:* C. Bogin, Mem. N. Y. Bot. Gard. 9: 179-233. 1955.

ARALIACEÆ

Dendropanax cuneatum (DC.) Dcne. & Planch. 14890

Didymopanax macrocarpum Seem. 14267

References: E. Marchal, Fl. Brasiliensis 11, pt. 1: 229-258. 1878 (as Hederaceæ). *Dendropanax:* Rehder & Merrill, Journ. Arnold Arboretum 18: 228. 1937.

BORAGINACEÆ

Cordia calocephala Cham. 14749

Cordia superba Cham. 14996

Heliotropium indicum L. 14905

Heliotropium salicoides Cham. 14196

References: *Cordia:* I. M. Johnston, Contrib. Gray Herb. 92: 5-65. 1930. *Heliotropium:* I. M. Johnston, Contrib. Gray Herb. 81: 3-73. 1928.

BURMANNIACEÆ

Burmannia capitata (Walt.) Mart. 14632

Burmannia flava Mart. 14886a

Reference: F. P. Jonker, Monograph of the Burmanniaceae 1-279. 1938.

COMBRETACEÆ

Combretum fruticosum (Loefl.) Stuntz 15191

Reference: A. W. Exell, Journ. Linn. Soc. 55: 103-141. 1953.

LOGANIACEÆ

Spigelia scabra Cham. & Schlecht. 15125

Reference: A. Progel, F1. Brasiliensis 6, pt. 1: 249-300. 1868.

PRIMULACEÆ

Anagallis pumila Sw. 14793; 14885

Reference: F. Pax & R. Knuth, Pflanzenreich IV. Fam. 237: 1-386. 1905.

STYRACACEÆ

Styrax ferrugineus Nees & Mart. var. *grandifolius* Perk. 15076; 15234.

Reference: J. Perkins, Pflanzenreich IV. Fam. 241: 1-111. 1907.

TILIACEÆ

Luehea speciosa Willd. 15046

Triumfetta abutiloides St.-Hil. 14376; 14732

Triumfetta althæoides Lam. 15129

References: *Luehea:* C. Schumann, F1. Brasiliensis 12, pt. 3: 117-200. 1886. *Triumfetta:* Ko Ko Lay, Ann Missouri Bot. Gard. 37: 315-395. 1950.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ber 18 December 23, 1957

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Musci

By Howard Crum

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and itineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Musci

By Howard Crum[1]

In the spring of 1956 Dr. E. Yale Dawson collected 31 species of mosses in the State of Goiás, central Brazil, in three general localities, as follows: 1. The region of the Chapada dos Veadeiros, in grassland (with gallery forests along the streams) at an altitude of about 3500 ft.; collections were made 19-20 km. north of São João da Aliança and also 14 km. south and 4 km. north of Veadeiros (April 13 to May 7). 2. The southern Serra Dourada, a region of dense forest interspersed with open scrub forest and scant grassland, 17-25 km. east of Formoso, at an elevation of about 3000 ft. (May 12 to June 15). 3. A gallery forest along a stream 143½ km. south-southwest of Peixe, on the road to Porangatú. Species are grouped together by localities in the following list. Information on each numbered collection, as well as general ecological information, can be found in the second paper in the series on "The Machris Brazilian Expedition."

A full set of specimens, including a duplicate type of the one new species, is deposited in the Los Angeles County Museum, with a representative set of duplicates in the National Museum of Canada.

1. Region of the Chapada dos Veadeiros

Sphagnum erythrocalyx Hampe. 14669

Fissidens garberi Lesq. & James. 14311; 14341a; 14346 *p. p.* (with *Sematophyllum caespitosum*)

Ochrobryum gardnerianum (C. M.) Mitt. 14344 These plants resemble a slender *Leucobryum* with leaves bearing propagula near their tips. Dr. A. LeRoy Andrews recently sent me a very similar specimen from Mexico, as a first record for that country and a northern range extension for the genus. The apparently wide disjunction of the species makes one wonder whether specimens from Guatemala, Costa Rica and Colombia which have been referred in the literature to *O. obtusifolium* (C. M.) Mitt. are specifically distinct from *O. gardnerianum.*

Octoblepharum albidum Hedw. 14308

Syrrhopodon incompletus Schwaegr. 14513

Syrrhopodon prolifer Schwaegr. 14315

[1] National Museum of Canada, Ottawa.

Calymperes richardii C. M. 14352 *p. p.* (with *Erythrodontium squarrosum*)

Trichostomum weisioides C. M. *(det. ex char.)* 14349 *p. p.* (with *Mittenothamnium diminutivum);* 14416; 14421 (All were found to be dioicous.)

Funaria calvescens Schwaegr. 14324; 14461

Bryum truncorum Brid. 14409

Macromitrium punctatum (Hook. & Grev.) Brid. 14743c

Macromitrium stellulatum (Hook. & Grev.) Brid. 14806

Schlotheimia rugifolia (Hook.) Schwaegr. 14408

Rhacopilum tomentosum (Hedw.) Brid. 14326; 14459 *p. p.* (with *Helicodontium tenuirostre);* 14462 *p. p.* (with *H. tenuirostre)*

Leucodontopsis geniculata (Mitt.) Crum & Steere. 14318

Jaegerina scariosa (Lor.) Arzeni. 14310; 14319; 14326 *p. p.* (with *Rhacopilum tomentosum*); 14341 *p. p.* (with *Sematophyllum caespitosum)* These plants have markedly squarrose leaves, with the costa exceedingly variable even on the same stems, always slender, frequently extending ½ - ¾ the length of the leaf, but sometimes short and double. The leaves may vary on a single stem from entire to very finely serrulate nearly all around. The leaf cells are porose throughout, and filiform propagula of the typical sort are frequent in leaf axils. The meager specimen of *Jaegerinopsis ulei* (C. M.) Broth. (presumably part of the Brazilian type) at the New York Botanical Garden is completely similar to these plants except that the leaves are erect-spreading. A sizable series of specimens, mostly from Mitten's herbarium at New York, has proved to my satisfaction that the angle of leaf divergence is highly variable and not a character of genetic significance. Mitten's concept of *Pterobryum brasiliense* obviously included *Jaegerinopsis ulei* and *Jaegerina scariosa.* Although generally credited as the basionyn for *Jaegerinopsis brasiliensis* (Mitt.) Broth., *Pterobryum brasiliense* was intended by Mitten only as a generic transfer for *Antitrichia brasiliensis* Hornsch. Brotherus (in *Die natürlichen Pflanzenfamilien)* called Mitten's concept of *A. brasiliensis* into question and pointed out that a specimen named by Hampe *(Glaziou* 6397) is a *Squamidium.* I have confirmed Brotherus' statement; I find Glaziou's specimen to be a species related to *S. nigricans* (Hook.) Broth. There is, of course, no apparent reason to favor Hampe's concept over Mitten's. The doubt should be resolved by study of Hornschuh's original specimen, which I have been unable to find; the original description is singularly uninformative.

Helicodontium tenuirostre Schwaegr. 14346 *p. p.* (with *Semato-*

phyllum caespitosum); 14347; 14459; 14461 *p. p.* (with *Funaria calvescens);* 14462 The type collections of this species and also of *H. chlarazii* (Duby) Par. were recently studied. The latter has been characterized in the literature as having a smooth seta and, questionably, a monoicous inflorescence. I found the seta often somewhat roughened and the inflorescence autoicous.

Isopterygium brachyneuron (C. M.) Mitt. 14327 These plants (which are autoicous) compare reasonably well with the original collections by Pabst and Gardiner.

Isopterygium lonchopelmatum (C. M.) Broth. *(det. ex char.)* 14745

Taxiphyllum machrisianum sp. nov. Fig. 1-4

Planta tenella, luteo-virens, nitida, depressa. Caulis repens, irreg-

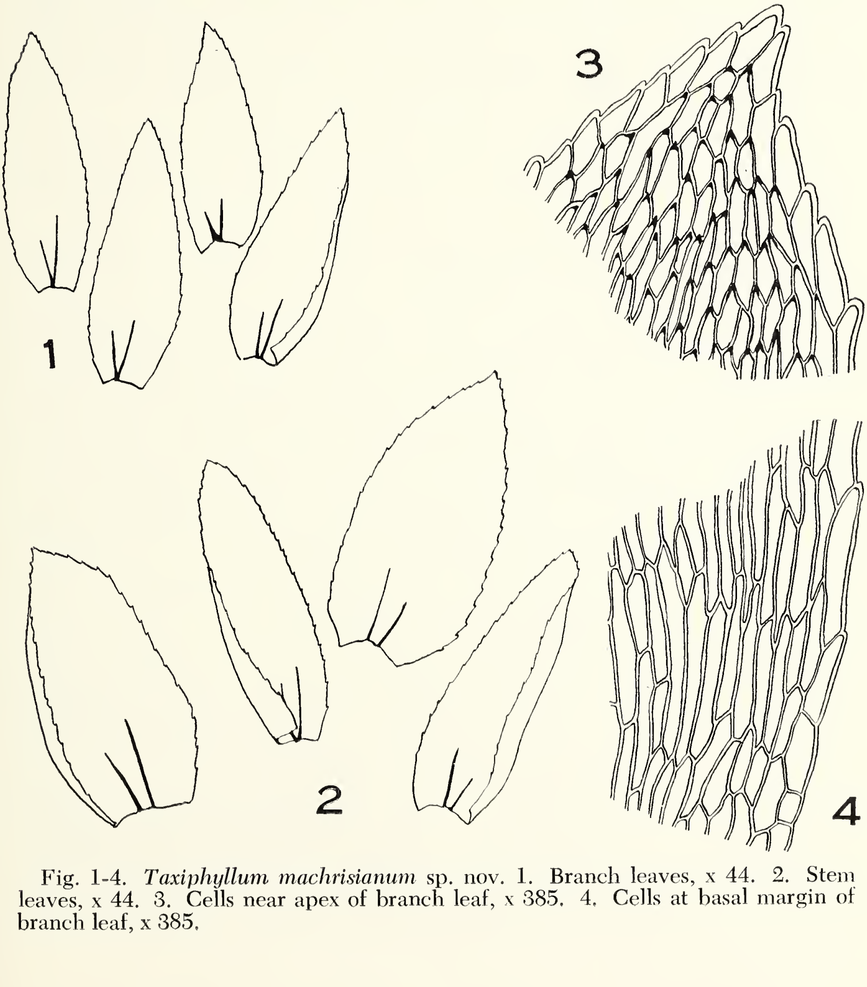

Fig. 1-4. *Taxiphyllum machrisianum* sp. nov. 1. Branch leaves, x 44. 2. Stem leaves, x 44. 3. Cells near apex of branch leaf, x 385. 4. Cells at basal margin of branch leaf, x 385.

ulariter ramosus; rami prostrati, breves, inaequali, plus minus plani. Folia ramulina erecto-patens, subcomplanata, 0.59-0.86 mm. longa, ovata vel oblongo-ovata, acuta, marginibus erectis, serrulatis, nervis duobus, inaequalis, cellulis flexuoso-linearibus, dorso papillis parvis sed distinctis prominentibus. Folia caulis similis sed major, 0.86-1.12 mm. longa. Caetera ignota.

Plants slender, yellow-green, glossy, in low, flat, intricate mats. Stems creeping, freely but irregularly branched; branches unequal, up to 6 mm. long, 1-1.5 mm. wide (with leaves), spreading horizontally, slightly flattened. Branch leaves erect-spreading, somewhat complanate, 0.59-0.86 mm. long, moderately concave, ovate or oblong-ovate, acute; margins erect, serrulate nearly to the base; costae two, one somewhat the longer and extending 1/5 - 1/4 up the leaf; cells linear-flexuose, in the upper third of the leaf mostly about 40 - 56 by 5 μ, their distal ends projecting as a small but distinct papilla on the dorsal side, a few apical cells shorter, alar cells scarcely differentiated. Stem leaves very similar but somewhat larger, 0.86-1.12 mm. long.

TYPE: *Dawson* 14743a (holotype R), 14743b, along streambed 4 km. north of Veadeiros, Chapada dos Veadeiros, Goiás, Brazil, April 30, 1956.

This species is named in honor of Mr. and Mrs. Maurice A. Machris, co-sponsors of the Brazilian Expedition.

The gross aspect of the plants is reminiscent of a *Taxithelium,* but the leaf shape and papillosity are even more strongly suggestive of *Mittenothamnium.* The nature of branching and the close conformity of stem and branch leaves, as well as the nature of the papillae, seem to indicate a relationship to *Taxiphyllum.* (It should be noted, however, that no paraphyllia were found on either stems or branches; the presence of paraphyllia, at least a few of them, is characteristic of many species of *Taxiphyllum.*) Although *T. scalpellifolium* (C. M.) Broth., with its differentiated stem leaves is probably not closely allied to this species (and perhaps is misplaced in this genus), it bears some resemblance to *T. machrisianum.* The latter differs, as follows: The leaves are less concave and less crowded, and they are erect-spreading at an angle of about 45° (rather than widely spreading) and only slightly complanate. The cell ends project as distinct papillae at the back of the leaves, rather than slightly or not at all.

Stereophyllum obtusum Mitt. 14460 This specimen, determined from descriptions in the literature, was submitted to Mr. Edwin B. Bartram, who wrote: "This agrees well with material I have from Brazil. In referring to this species Grout [in his revision in *The*

Bryologist 48: 60-70. 1945] mentions an occasional tooth on the apical margins. Your material, and mine too, show the apical margins quite strongly toothed."

Erythrodontium squarrosum (C. M.) Par. 14339a; 14346 *p. p.* (with *Sematophyllum caespitosum);* 14352; 14805

Sematophyllum caespitosum (Hedw.) Mitt. 14314; 14325 *p. p.* (with *Isopterygium* sp.); 14327 *p. p.* (with *I. brachyneuron);* 14341; 14342; 14351; 14357; 14410.

Sematophyllum galipense (C. M.) Mitt. 14309; 14312

Potamium vulpinum (Mont.) Mitt. 14339

Mittenothamnium diminutivum (Hampe) Britt. 14316 *p. p.* (with *Trichostomum weisioides);* 14421 *p. p.* (with *T. weisioides);* 14348; 14349; 14460 *p. p.* (with *Stereophyllum obtusum);* 14417; 14419

Mittenothamnium elegantulum (Hook.) Card. 14514 This species has been greatly misunderstood by most bryologists working with tropical American mosses. The material at the New York Botanical Garden includes many specimens of *M. diminutivum* and its near relatives, several species in the *M. reptans* complex and even a few misnamed specimens of *Ctenidium malacodes.* I have not seen the type, but Mitten's concept of the species was almost surely correct, and his concept can be clearly seen from the abundance of material in his herbarium now kept at New York. Although they grow in low mats, the plants are not so clearly flattened as in *M. diminutivum,* and the branches are not at all or only slightly flattened. The leaves are accordingly not notably complanate; they are usually crowded and loosely erect or somewhat widely spreading, or on the stems often nearly squarrose; they are rather soft and ovate-acuminate. I have seen many specimens from Brazil, one from Bolivia *(Williams* 2055) and one from Mexico *(Purpus* 4274), and it is very likely that the species is widely distributed in other parts of tropical America.

2. Southern Serra Dourada

Syrrhopodon incompletus Schwaegr. 14965
Trichostomum weisioides C. M. *(det. ex char.)* 14852a
Hyophila tortula (Schwaegr.) Hampe. 15201
Funaria calvescens Schwaegr. 14969
Bryum truncorum Brid. 14855
Rhacopilum tomentosum (Hedw.) Brid. 14942
Pireella pohlii (Schwaegr.) Card. 14966
Sematophyllum galipense (C. M.) Mitt. 14851; 14854

Isopterygium lonchopelmatum (C. M.) Broth. *(det. ex char.)* 14888

3. On road to Porangatú, SSW. of Peixe

Syrrhopodon ligulatus Mont. 15194 *p. p.* (with *Callicostella apophysata)*

Callicostella apophysata (Hampe) Jaeg. *(det. ex char.)* 15194 The plants are autoicous, and the setae are subscabrous.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

er 19 January 29, 1958

A NEW RACE OF THE POCKET GOPHER *Geomys bursarius* FROM MISSOURI

By Charles A. McLaughlin[1]

During the preparation of a study of the taxonomy and zoogeography of *Geomys* of the central United States, it has become increasingly evident that the pocket gophers found in that part of eastern Missouri lying south of the Missouri River do not fit into our current knowledge of the races. Particular interest in this problem was kindled when specimens listed by C. H. Merriam (North Amer. Fauna, No. 8, 1895) from this area were examined and found to differ from the known races of *Geomys bursarius*. Additional specimens were collected from the state of Missouri south of the Missouri River. Critical examination of these new specimens, plus those already available, indicates that this area apparently supports a population of pocket gophers distinct from any described race. For this new race the following name is proposed:

Geomys bursarius missouriensis new subspecies

Type.—Female, adult, skin with skeleton, no. 9736, Museum of Natural History, University of Illinois; from 2 mi. north of Manchester, St. Louis County, Missouri, obtained April 10, 1955, by Charles A. McLaughlin, orig. no. 675. Measurements of type: total length, 235 mm.; tail length, 61 mm.; hind foot length, 29 mm.; basilar length of skull, 38.1 mm.; mastoidal breadth of skull, 23.2 mm.; zygomatic breadth, 26.0 mm.; fronto-palatal depth of skull, 15.7 mm.

Range.—Eastern Missouri south of the Missouri River and north of the Meramek River above the flood level in the river bottoms in St. Louis County. Formerly south into the Ozark Mountains in the vicinity of Hunter, Carter County, and Williamsville, Wayne County.

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1 Associate Curator of Ornithology and Mammalogy, Los Angeles County Museum.

Diagnosis.—Size medium; color of upper parts Cinnamon-Brown[2] to Russet, darkening in mid-dorsal region to give the appearance of a dark dorsal stripe; space between extensions of premaxillaries posterior to nasals, narrow.

Description.—Color. Dorsal region between Cinnamon-Brown and Russet, darkening in mid-dorsal region to between Bone Brown and Clove Brown, admixed with darker hairs, giving the appearance of a dark dorsal stripe as found in *Geomys bursarius dutcheri,* this stripe absent or very faint in some individuals. Some individuals tending toward melanism. Sides lightening to Tawny, continuing in most specimens onto and across the ventral surface, in some lighter, to a buffy white. Fore and hind feet white. Distal ½ to ⅔ of tail white. One specimen out of 29 examined from St. Louis area melanistic, dorsal region being considerably darker than Mummy Brown, approaching black, with Cinnamon-Brown extending onto belly, and only distal ⅓ of tail white.

Size medium. Average of 4 adult males and 20 adult females, respectively: total length, 278.8 mm. and 244.4 mm.; tail length, 80.8 mm. and 71.7 mm.; hind foot, 32 mm. and 29.8 mm.

Skull. Females: nasal bones somewhat constricted in the middle to give them a slight, but conspicuous, hourglass shape; sagittal crest absent; palatine canals open ventrally for their entire length, appearing as continuous grooves; occiput nearly vertical when skull laid on its dorsal surface; posterior extensions of premaxillaries with convex medial borders, frequently touching each other at midline behind nasals. Males similar to females but more robust and with low sagittal crests developing with age. Size medium. Average measurements of 5 adult males and 17 adult females (or fewer as indicated in parentheses), respectively: basilar length, 46.98 mm. (4) and 38.55 mm. (14); mastoidal breadth, 28.28 mm. and 24.57 mm. (16); fronto-palatal depth, 18.74 mm. and 16.35 mm.; zygomatic breadth, 32.55 mm. (4) and 26.64 mm.; nasal length, 20.54 mm., and 16.02 mm. (14).

Comparisons.—From *Geomys bursarius majusculus, G. bursarius missouriensis* differs as follows: size smaller, total length averaging 279 mm. for males and 245 mm. for females rather than 287 mm. and 259 mm. as in *G. b. majusculus* from Douglas County, Kansas; dorsal coloration darker; nasals with constriction in the center rather than with straight or evenly curving sides; medial borders of premaxillaries

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2 All capitalized names for colors are those found in R. Ridgway's Color Standards and Nomenclature, Washington, D. C., 1912.

posterior to the nasals convex, frequently touching or considerably constricting the intervening space.

From *Geomys bursarius illinoensis, G. b. missouriensis* differs as follows: size smaller (*G. b. illinoensis* similar in size to *G. b. majusculus*); coloration brown rather than dark gray or black; palatine canals open rather than partially closed over ventrally; inner margins of posterior extensions of premaxillaries convex rather than straight sided.

From *Geomys bursarius dutcheri, G. b. missouriensis* differs as follows: size larger, total length averaging as above as compared with 235 mm. and 213 mm. for *G. b. dutcheri;* dorsal exposure of jugal greater rather than less than breadth of rostrum ventral to openings of infraorbital foramina; sides of zygomatic arches diverging anteriorly rather than being roughly parallel; color more reddish and less yellowish.

Remarks.—The pocket gophers in Missouri represent a zoogeographical enigma. Although large expanses of that state have soil texture and vegetation which seem well suited for habitation by pocket gophers, records have been very rare. The Ozark region, with some of the most unlikely terrain in the state, has in the past supported a sizeable population of these animals. C. H. Merriam (North Amer. Fauna, No. 8, 1895, p. 123) reported 12 specimens taken from near Hunter and Williamsville, Missouri. These specimens were collected by Mr. Dutcher of the U. S. Biological Survey in 1894 and were accompanied by excellent field notes.

Dutcher was explicit in that he found all the animals ". . . within 50 yards of the tracks" of the Frisco Railroad which ran between Hunter and Williamsville, but three separate attempts by the author to locate pocket gophers in the precise area described proved fruitless. In the middle 1930's these tracks were removed and all that remains is a dirt rut road running along the old right-of-way. The author traveled this road through much of its distance without discovering the slightest indication of pocket gophers. Local farmers, owning or working farms along the right-of-way and in the adjoining river bottoms, were questioned and none was found who even knew of the animals. If any part of the original population remains it is quite well hidden.

Various other localities throughout southeastern Missouri, where pocket gophers were supposed to have occurred, were examined by Dutcher, Preble and A. H. Howell of the U. S. Biological Survey, all without success. The author personally traveled through many areas which seemed excellent for supporting gophers in Franklin, Jefferson, St. Genevieve, Perry, Cape Girardeau and Washington counties without sighting the slightest evidence of these rodents. A check of Lincoln, Montgomery, St. Charles and Warren counties, north of the Missouri River proved unsuccessful. The only pocket gophers noted were in St. Louis County above the flood plains of the Missouri and Meramek rivers. Here they are quite common in the rolling meadows of the western and southern suburbs of St. Louis.

The population of *G. b. missouriensis* is separated geographically from other populations of *G. bursarius* by a wide hiatus on the north, west and south. Only on the east does it approach the radically different *Geomys bursarius illinoensis,* which occupies the opposite bank of the Mississippi River in Madison and St. Clair counties, Illinois. The Mississippi River is an absolute barrier to the distribution of pocket gophers at this point, so there is no area of intergradation between neighboring races.

Specimens examined.—41 specimens, all from Missouri: *St. Louis County*: vicinity of St. Louis, 29 (22, Univ. Illinois; 4, U. S. Nat. Mus.; 1, Univ. Missouri). *Wayne County*: Williamsville, 8 (U. S. Nat. Mus.). *Carter County*: Hunter, 4 (U. S. Nat. Mus.).

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CONTRIBUTIONS IN SCIENCE

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FURTHER BIRD REMAINS FROM THE SAN DIEGO PLIOCENE

By Loye Miller and Robert I. Bowman

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

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FURTHER BIRD REMAINS FROM THE SAN DIEGO PLIOCENE

By Loye Miller[1] and Robert I. Bowman[2]

The final presswork on a paper by the senior author (1956) concerning San Diego Pliocene birds had not been accomplished before a further assemblage of material from the same formation came to hand. Part of this material (14 specimens) came from Mr. Joseph Arndt and was deposited in the University of California Museum of Palaeontology, referred to below as U.C.M.P. A larger number of specimens was sent from the Los Angeles County Museum by its Chief Curator of Science, Dr. Hildegarde Howard, with the request to include them in our study. This loaned material will be referred to as L.A.M. Our thanks are extended to Dr. Howard and Mr. Arndt for their much appreciated courtesies. We are further indebted to Dr. Howard for helpful suggestions during the course of our labors.

Specimens assigned to the genus *Mancalla* are not included in this study because no significant additions to our knowledge of that genus have developed since it was reported upon by Miller and Howard (1949). Most of the other specimens are assignable to species recorded by Howard (1949), Brodkorb (1953), or Miller (1956), but it has appeared advisable to describe three species as new to science. The new material relating to previously known species is discussed here because of the additional light it throws upon the forms that were but sparsely represented heretofore.

There is, of course, no anatomical association of skeletal elements in the matrix. Hence the assignment of a bone to a species based upon a type that represents a different element has to be supported by one or more of three factors: first, their occurrence in a fairly restricted geologic formation; second, their relative size as compared with the nearest previously known form; and third, the degree of morphologic divergence from that form. It is freely confessed that there are weaknesses in such procedure and that a large element of personal judgment is involved, but we have endeavored to be conservative in such assignments.

For a discussion of age, matrix, and the ecologic picture of the San Diego Pliocene the reader is referred to the papers by Miller and Howard (1949), Howard (1949), and Miller (1956).

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GAVIIFORMES

Gaviidae. Loons.

Gavia howardae Brodkorb. Specimens of loon from the San Diego beds were tentatively referred by Howard (1949:186-188) to Wetmore's Pliocene species, *Gavia concinna* from Monterey County, California. A later study of all the known Pliocene loons by Brodkorb (1953) led to his establishment of the species *Gavia howardae* for part of the San Diego material (3 humeri), and the definite assignment of the remainder (upper and lower mandibles, cranium, and additional humeri) to *Gavia concinna.* Since then Miller (1956:617) has assigned an incomplete tibiotarsus to *G. howardae* and an incomplete humerus to *G. concinna.*

On the basis of the humerus, Brodkorb states that *Gavia howardae* is slightly smaller than *Gavia arctica pacifica* or *G. stellata,* whereas *Gavia concinna* exceeds in size these two Recent species. We now have at hand a well-preserved specimen of the distal condyles of the tibiotarsus of a loon (L.A.M. no. 2314) which, on the basis of small size, we assign to the species *G. howardae.* The fossil differs from *G. a. pacifica* as follows: the condyles, though only slightly worn, are each thinner in the transverse diameter, giving the impression that they must have articulated with smaller tarsal cotylae that were separated by a relatively broad intercotylar tuberosity; the supratendinal bridge is more nearly at right angles to the shaft, is more nearly uniform in width, and the proximal opening of the tendinal canal is almost perfectly circular; the distal orifice of this canal is more slit-like (Fig. 1).

No further material representing the loons has come to light.

COLYMBIFORMES

Colymbidae. Grebes.

Colymbus parvus Shufeldt. A total of 45 bones (38 L.A.M. and 7 U.C.M.P.) representing nine skeletal elements, forms the basis of this review. These include the following: femur 4, tibiotarsus 9, tarsometatarsus 15, humerus 7, radius 2, ulna 3, carpometacarpus 3, scapula 1, and coracoid 1. Three of these elements, namely the femur (L.A.M. nos. 2189, 2203, 2569; U.C.M.P. no. 45881), radius (L.A.M. no. 2563; U.C.M.P. no. 45893), and scapula (L.A.M. no. 2523) heretofore have been unknown for *Colymbus parvus.* These bones are not lacking in diagnostic features that unquestionably ally them with *Colymbus.* Nevertheless, they are smaller than *C. grisigena,* yet larger than *C. auritus,* thus bearing the same size relationship to these species as do the other known elements of *C. parvus.*

The excellent preservation of several of the bones permits the taking of certain measurements (see Table I).

TABLE I

Measurements of bones of *Colymbus parvus,* in millimeters

FEMUR

(All dimensions are maximum, except as indicated)

	Length	Breadth proximal end	Breadth distal end	Breadth across fibular & external condyles	Depth external condyle	Minimum diameter of shaft
L.A.M. 2189	42.15	12.00	12.60	5.57	9.10	4.70
L.A.M. 2203	....	....	....	5.57	......	......
L.A.M. 2569	....	11.45	....	......	......	......
U.C.M.P. 45881	....	....	12.00	......	......	......

RADIUS

	Minimum diameter of shaft	Maximum diameter of shaft
U.C.M.P. 45893	2.00	4.20

SCAPULA

	Length of head from anterior tip of furcular articulation to posterior edge of glenoid facet
L.A.M. 2523	8.35

CORACOID

	Maximum length on lateral edge	Maximum length on medial edge	Breadth of base from sternocoracoidal process to int. distal angle	Maximum antero-posterior diameter brachial tuberosity	Minimum diameter of shaft
U.C.M.P. 45873	40.70	38.40	12.70	6.70	3.35

Colymbus parvus has been carried back in time from Pleistocene (Shufeldt, 1913), through upper Pliocene (Wetmore, 1937), to lower middle Pliocene (Howard, 1949). Its known geographic distribution is from southern Oregon to southern California. Only in San Diego do we find it in deposits of salt water origin. Furthermore, in comparison with numbers of associated bird species, it reaches maximum abundance in the San Diego formation. It is perhaps significant that among 2500 bird bones from the Pleistocene of Oregon, there are only 11 bones of this grebe, whereas among 500-600 bones from the San Diego Pliocene, there have now been determined no less than 58 of this species. The species is unrecorded from the Pleistocene of California.

The presence of a small grebe in the Pliocene formation of San Diego was first reported by Howard (1949:185) who described, but left unnamed, the femur (L.A.M. no. 2118) and the tibiotarsus (L.A.M. no. 2129) "of a grebe smaller than *Colymbus parvus*." Also, the senior author (Miller, 1956:617) noted "some imperfect bones of a small grebe" from the same formation although the particular elements were not designated. Additional material is now available, and it is evident that a new species of grebe should be named. It is, therefore, described as follows:

Colymbus subparvus, new species. Fig. 5

Type. — L.A.M. no. 2568, a right femur lacking proximal end and small areas of distal end. L.A.M. loc. 1080, Washington Blvd. freeway, south of University Ave., San Diego; Pliocene. Collected by T. Downs, 1952.

Diagnosis. — Distal end approximately the same size as in *Podilymbus podiceps* (Mus. Vert. Zool. no. 118985) and from 8 to 13 per cent narrower than in *Colymbus parvus* (see Table II). Profile of rotular grove (frontal aspect) with much more steeply inclined lateral wall than in *C. parvus*. Remainder of description as in Howard (1949:185) for specimen L.A.M. no. 2118: "fibular condyle deeper, and junction of its proximal border with the external intermuscular line more anterior in position; . . . less constriction of shaft internally, above internal condyle." See Fig. 5.

Paratype. — L.A.M. no. 2118, left femur, lacking proximal end and adjacent shaft, with condyles heavily eroded. L.A.M. loc. no. 1071, Curlew St. near Ostego Drive, San Diego; Pliocene. Collected by G. P. Kanakoff, 1947.

Referred material. — L.A.M. no. 2129, proximal head of left tibiotarsus with approximately 15 mm. of adjacent shaft; lacking all of internal and most of external cnemial crest, with edges heavily eroded. L.A.M. loc. no. 1080; collected by G. P. Kanakoff, 1947. L.A.M. no. 2354, left coracoid, complete except for minor areas which are eroded. L.A.M. loc. no. 1079, canyon east of Balboa Park, San Diego. Collected by Clifford Kennell, 1950.

The tibiotarsus is closest to *Colymbus* in degree of distal extension of the external cnemial crest along the anterior surface of the shaft. Its size is approximately as in *Podilymbus podiceps*. It also resembles this species in the "flare of the external crest" (Howard, loc. cit.), but otherwise shows a distinctive configuration. Although the coracoid gives a superficial appearance of immaturity, due to heavy erosion, details of muscle scars are so clearly defined that we may assume the bone came from an adult or nearly adult bird. It is referred to *Colymbus* on the basis of general configuration and to *C. subparvus* on the basis of size.

Grebe, species undetermined. A well preserved distal half of a very small, grebe femur (L.A.M. no. 2605) resembles that of *C. subparvus* in the steeply inclined lateral wall of the rotular groove seen in frontal aspect. In distal breadth, however, it measures only 8.0 mm. (28 per cent smaller than the type of *C. subparvus*). Compared with Recent grebes, the bone is remarkably similar in size to a specimen of *C. occidentalis* (M.V.Z. no. 125154) from Peru, hence smaller than in *C. auritus*. Other characters, however, are in general similar to those displayed by specimens of Recent Eared Grebes.

Although femur L.A.M. no. 2605 appears to be distinct from specimens of this element known for other fossil or Recent grebes, we prefer to refrain from establishing a new species on the basis of this single bone.

TABLE II

Measurements of bones of *Colymbus subparvus*, in millimeters
(Per cent smaller than *C. parvus* shown in parentheses)

FEMUR*

	Maximum breadth distal end	Breadth across fibular and external condyles	Maximum depth external condyle	Minimum diameter of shaft
L.A.M. 2568	11.0 (8-13)	4.9 (12)	7.7 (15)	4.2 (11)
L.A.M. 2118	......	5.0 (10)	......	4.1 (13)

TIBIOTARSUS

	Minimum diameter of shaft approx. 15 mm. from base of proximal head
L.A.M. 2129	3.4 (23 +)**

CORACOID*

	Maximum length on lateral edge	Maximum anteroposterior diameter of brachial tuberosity	Minimum diameter of shaft
L.A.M. 2354	37.70 (7)	5.90 (12)	3.15 (6)

*For comparable measurements of *C. parvus*, see Table I.
**This percentage may be inaccurate (too small) as the comparable measurement on *C. parvus* (tibiotarsus U.C.M.P. no. 45876) of 4.4 mm. may be influenced by erosion of the bone.

PROCELLARIIFORMES

Procellariidae. Shearwaters.

Puffinus kanakoffi Howard. This species was described (Howard, 1949:187) as a "small shearwater similar in size to *Puffinus opisthomelas*" but with certain osteologic characters that distinguish it from that species. The tarsometatarsus, humerus, and femur, were discussed. Miller (1956:617) added a few items concerning the humerus, stating that a specimen in the U.C.M.P. collection was shorter but actually heavier in shaft and condyles than in Recent *P. opisthomelas.*

We now have before us parts of nine fossil humeri (7 L.A.M. and 2 U.C.M.P.), three tarsometatarsi (1 L.A.M., 2 U.C.M.P.) and a vertebra (U.C.M.P.) that we consider to be of the one species, *P. kanakoffi.* The lengths are not accurately measurable on all of the specimens of humeri and tarsometatarsi but they appear not to vary too greatly for inclusion in one species. There is an appreciable variation in width of shaft in the humeri that we would ascribe to age of the individual, since one specimen strongly suggests an immature bird. The following measurements were taken on complete or nearly complete specimens: humerus, L.A.M. no. 2516, length 85.0 mm.; U.C.M.P. no. 45896, length 91.2 mm., greatest breadth across distal condyles, 11.4 mm.; tarsometatarsus, L.A.M. no. 2572, length 45.5 mm., breadth of distal end 6.3 mm.

While we may not be able to add appreciably to the osteologic picture of *P. kanakoffi,* we may perhaps sharpen the focus on the ecologic picture. Miller and Howard (1949) visualized the San Diego accumulation as that of a tidal flat with small islets fairly nearby, thus furnishing for *Mancalla* a loafing and sunning ground with insular breeding sites close at hand. The fairly abundant remains of the Kanakoff Shearwater (a total of 27 specimens now recorded), would tend to accentuate this impression. Though shearwaters today do not congregate on sand bars to rest, they are highly gregarious birds both during the nesting season and the remainder of the year. Epidemics or other adverse factors often cause great mortality, and on occasion their bodies are cast up on the sands in great numbers. The islets that afforded nesting grounds for *Mancalla* might likewise have accommodated the shearwaters or even the aberrant barn owl, *Lechusa stirtoni,* if rocky cliffs were exposed in places.

PELECANIFORMES

Sulidae. Boobies.

The only sulid previously reported from the Pliocene of the west coast is *Miosula recentior* Howard (1949:190) from the San Diego deposits. A large tibiotarsus and a small ulna were assigned as type and cotype respectively and a fragment of a small humerus tentatively referred. The three specimens were not associated in the matrix. The assignment was rationalized on the basis that *Miosula* (Miller, 1925: 115) was described as a form with stout legs and weakened wings, thus suggesting a modification toward the cormorants, with greater swimming power than is possessed by *Sula*.

We now find in the San Diego formation the distal third of a sulid humerus and a femur which is complete except for the inner condyle. The humerus is larger than in *Sula sula websteri* or *S. leucogaster brewsteri,* though smaller than in *Morus bassanus.* It is distinguished from the genus *Miosula,* as represented by *Miosula media* Miller from the Lompoc Miocene, by lesser curvature of the shaft. In general characters it resembles the humerus as found in the genus *Sula.* The femur is smaller than that of *Sula dactylatra,* but exceeds that of *Sula sula* in about the same proportion as does the humerus. It is far too small, however, to have articulated with the gigantic tibiotarsus of *Miosula recentior,* described by Howard (1949:190) as "larger than in any living member of the family." The humerus and femur, therefore, are believed to represent a species new to science.

Sula humeralis, new species. Fig. 2

Type. — U.C.M.P. no. 45889, distal third of right humerus, practically unworn and apparently representing a fully mature bird. San Diego; Pliocene. Collected by Joseph Arndt.

Diagnosis. — Shaft heavy and less curved than in *Miosula*; ectepicondyle and entepicondyle less prolonged up the shaft than in living sulids but both epicondyles broadened; ulnar condyle relatively large; internal tricipital groove relatively shallow as compared with *Sula leucogaster.* See Fig. 2.

Detailed description. — The type humerus is larger than available specimens of either *Sula sula websteri* or *S. leucogaster brewsteri,* but markedly smaller than *Morus bassanus,* and with characters more closely related to *Sula.* Characters of the palmar aspect ally it with *S. leucogaster* rather than with *S. dactylatra* or *S. sula*; the impression of brachialis anticus is defined distally by a transverse ridge as in *S. leucogaster* (this ridge is lacking or only faintly indicated in *S. dactylatra, S. sula,* and *Morus bassanus)*; distal to this ridge, the brachial depression is almost triangular in outline with (1) its broad base lying transversely under the overhang of the internal (ulnar) condyle, (2) its external side defined by a ridge extending obliquely inward from the external condyle, and (3) its internal side defined by the entepicondylar prominence. This triangle is not as nearly perfect in any living species of sulid examined but is approached in S. *leucogaster* and is remote from S. *dactylatra.* The area is more depressed than in *Morus bassanus.* The interior border of the brachialis depression forms a pronounced ridge broadening distally into a fairly heavy mass of bone; this broadened area is less in S. *leucogaster* and S. *sula* and least in S. *nebouxi.* The entepicondylar area is less pronounced than in any available living sulid; the area is most prominent in S. *sula* and is intermediate in S. *nebouxi* and S. *leucogaster.* The ligamental attachments at the entepicondyle and ectepicondyle are shorter and broader than in living sulids, except S. *dactylatra.*

When the bone is viewed from the distal end in line with the axis of the shaft, the ulnar condyle is relatively larger in comparison to the radial condyle than in S. *sula,* S. *nebouxi,* or S. *leucogaster,* but the mesial ridge defining the tricipital groove is less developed; the external tricipital groove, therefore, appears to lie more toward the sagittal line and less toward the lateral border; the outer ridge of the tricipital groove is well developed. The shaft is heavy, its diameter relative to the expanded articular end is greater than in specimens of living species at hand, approaching S. *nebouxi* most nearly. The curvature of the shaft is similar to living species of *Sula* and is straighter than in *Miosula.*

Measurements of type. — Maximum width across distal end, 19.8 mm.; minimum diameter of shaft, 8.0 mm.; ratio of shaft to distal end, .40.

Referred material. — L.A.M. no. 2522, femur complete except for inner condyle. L.A.M. loc. 1128, Washington St. between 1400 block and Highway 395, San Diego; Pliocene; collected by Clifford Kennell, 1954. An eroded fragment of sulid coracoid, L.A.M. no. 2521, may possibly represent this species; locality, collector and date as for the femur.

In the femur, the fracture that deprived us of the inner condyle involved also the contour between the condyles and the popliteal area. So far as preserved, its characters are as follows: it is longer than in *Sula sula websteri,* but the shaft is more slender and the contours are more rugged. The effect is of a strongly activated bone despite its slenderness. Recent sulids examined give the impression of weakness in the femur. Measurements: length along external side, 58.2 mm.; minimum breadth of shaft, 5.5 mm.; breadth of proximal end, 13.2 mm.

Discussion. — *Sula humeralis* is distinguishable from fossil sulids of other California localities as follows: from *Morus vagabundus* Wetmore, *Morus lompocana* Miller, and *Morus reyana* Howard, it is distinguished by the fact that its characters are distinctly those of *Sula* rather than *Morus*. From *Sula stocktoni* Miller it is distinguished by smaller size, and from *Sula willetti* by markedly larger size. Compared with *S. willetti*, also, the femur of *Sula humeralis* is not only longer, but its distal end is more expanded.

With the establishing of this second sulid species from the San Diego formation, the femur of which is markedly smaller and more slender than could be expected for articulation with the tibiotarsus that forms the type of *Miosula recentior*, it seems proper to raise the question of the allocation of the ulna that forms the cotype of the latter species.

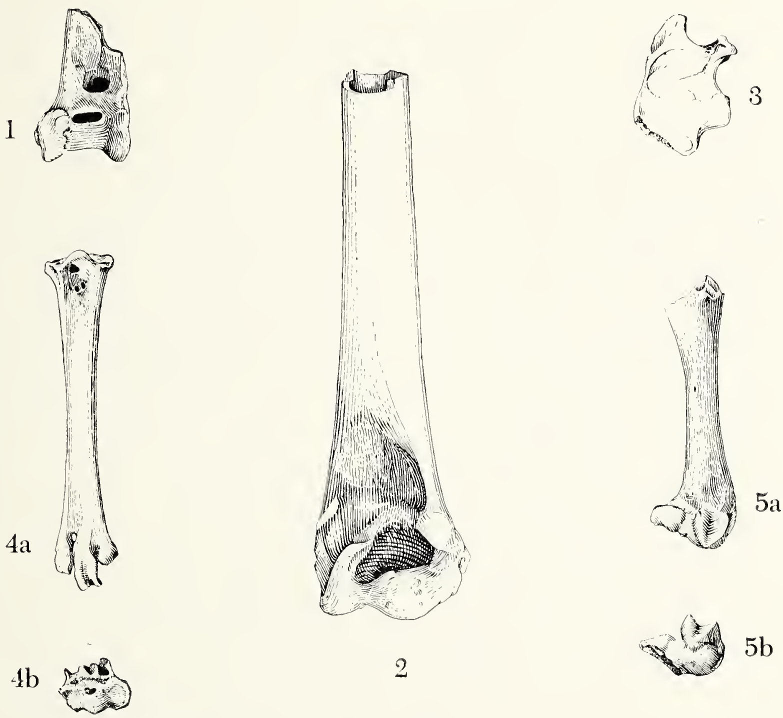

Fig. 1. *Gavia howardae*. Tibiotarsal condyles, L.A.M. no. 2314. Natural size. Fig. 2. *Sula humeralis*, new species. Type specimen. Distal end of humerus, U.C.M.P. no. 45889. Natural size. Fig. 3. *Phalacrocorax kennelli*. Head of tibiotarsus, L.A.M. no. 2566. Natural size. Fig. 4. *Ptychoramphus tenuis*, new species. Type specimen. Tarsometatarsus, U.C.M.P. no. 45662. *a*. Anterior face. x 2. *b*. Proximal end. x 2. Fig. 5. *Colymbus subparvus*, new species. Type specimen. Femur, L.A.M. no. 2568. *a*. Anterior face. Natural size. *b*. Distal end. Natural size. All drawings by Gene M. Christman.

Unfortunately there is no anatomical association in the specimens from the San Diego Pliocene. The sulid species from the Lompoc and Lomita Miocene deposits of California are based on articulated skeletons that show the size ratios of various segments in the skeleton. Although this is not the case for the San Diego fossils, the relative size of the sulid humerus, ulna, and femur, as compared with living species, supports the conclusion that they could all represent one form. The large tibiotarsus of *Miosula recentior* appears to stand apart. After weighing the problem carefully, therefore, we recommend that the ulna (L.A.M. no. 2112) be reclassified as *Sula humeralis*.

PHALACROCORACIDAE. CORMORANTS.

Phalacrocorax kennelli Howard. For the present study we have additional cormorant material representing the tibiotarsus (L.A.M. no. 2566), femur (L.A.M. no. 2528), ulna (L.A.M. no. 2529), and coracoid (L.A.M. no. 2282) all of which harmonize fairly well with Howard's (1949:188) concept of the species, namely, a small cormorant intermediate in size between *Phalacrocorax auritus* and *P. pelagicus*.

L.A.M. no. 2566 is a complete right tibiotarsus in almost as perfect condition as a well-preserved Recent bone. Only the varied dark coloring makes it slightly less easy to study. The total length (100 mm. to the proximal articular surface) is just equal to that of a specimen of a male *P. pelagicus* from Alaska; the fossil is, however, definitely stouter and more curved towards the median plane. The curvature is perhaps correlated with the fact that the outer condyle is less extended distally, i.e. it is raised above the level of the inner condyle. The notch between the condyles is shallower and more open. When viewed from the side, the contours of both the condyles form a more nearly circular arc and are more evenly curved in outline. The fibular crest is less developed along the area of contact proximally as well as at the distal point of fusion of fibula, tibia, and proximal tarsals. When the bone is viewed from the proximal end, the pattern is quite different from that seen in *P. pelagicus* (Fig. 3). The outer cnemial crest is much less developed, whereas the inner crest is powerful and is bent over towards the external side leaving a narrower notch between crests. The condition is somewhat similar to that seen in *P. auritus*, though different in detail. The external articular surface is broader and rounder and less extended to a point on the external contour. The notch between this contour and the external crest is much more enclosed. We have not seen these characters displayed in any other cormorant examined.

The femur is complete and almost perfect in preservation of details.

In size it is slightly less than a male *P. pelagicus,* but the size difference between Recent specimens of *P. pelagicus* and *P. auritus* is so slight as to fall within the range of a single species. The fossil femur measures 55.5 mm. and is larger than a specimen of female *P. auritus* at hand. Slight osteological differences that appear in comparing the fossil with one Recent specimen fall to the ground when a series of Recent birds is studied. In fact, we find no stable character in the femur that sets the Pliocene bird apart from the Recent smaller cormorants of the California coast.

The ulna measures 141.0 mm. in length and is markedly smaller than available specimens of *P. auritus,* but larger than those of *P. pelagicus.*

The coracoid is represented only by a fragment of the upper end which is devoid of diagnostic characters.

CHARADRIIFORMES

ALCIDAE. MURRELETS AND AUKLETS.

Brachyramphus pliocenus Howard. In the senior author's general paper (1956:618) dealing with the San Diegan fauna, a tarsometatarsus (U.C.M.P. no. 45662) was tentatively assigned to this species. The question was raised, however, as to the generic assignment, as the tarsometatarsus seemed more closely to resemble *Ptychoramphus.* Neither the type humerus nor the cotype ulna of *B. pliocenus* was available for study. Another complete ulna (L.A.M. no. 2573) has now come to hand. It is definitely different from *Ptychoramphus aleuticus* and appears to conform to the characters described for the cotype of *Brachyramphus pliocenus* (Howard, 1949:192) although there is a size difference amounting to more than 10 per cent in length. This discrepancy is not greater, however, than is found to exist in a series of bones of *Pinguinis impennis* from the mounds on Funk Island. We, therefore, see no reason for doubt in assigning these two ulnae to the same species.

The tarsometatarsus in the U.C.M.P. collection is not separable on osteologic characters from *Ptychoramphus,* though it is shorter and more slender than in *P. aleuticus.* It is, however, longer than in *Brachyramphus marmoratus.* Compared with *P. aleuticus,* Recent *B. marmoratus* has considerably shorter leg bones, although the humeri are longer and the ulnae of the two species are of about equal length. *B. marmoratus* has, in fact, a surprisingly weak foot as compared with *P. aleuticus.* The length of the tarsometatarsus in *B. marmoratus* is approximately 45 per cent of that of the ulna, whereas in *P. aleuticus,* it is approximately 65 per cent.

If we were to allocate the fossil tarsometatarsus with the humeri and ulnae now assigned to *Brachyramphus pliocenus* we would find the species incongruous in either *Brachyramphus* or *Ptychoramphus* as known today. The characters of the wing bones and their relative size bespeak the genus *Brachyramphus,* whereas the characters of the tarsometatarsus are those of *Ptychoramphus.* The ratio of the length of the tarsus relative to length of either ulna now assigned to *B. pliocenus* would be slightly less than in *Ptychoramphus* but far greater than in *Brachyramphus.* We prefer, therefore, to recognize the presence of two genera of small alcids in the San Diego formation, the one represented by wing elements and the other by a single perfect tarsometatarsus. The latter specimen we assign to the genus *Ptychoramphus* and erect for it a species category that is new (see below). Hence, the suggestion offered by the senior author (Miller, 1956:618) regarding the generic reassignment of *Brachyramphus pliocenus* is no longer valid.

Ptychoramphus tenuis, new species. Fig. 4

Type. — U.C.M.P. no. 45662, a perfect right tarsometatarsus; San Diego; Pliocene. Collected by Joseph Arndt.

Diagnosis. — Tarsometatarsus similar to that of *Ptychoramphus aleuticus* (Pallas), but shorter and more slender, and inner condyle more distinct and set off more gradually from middle condyle. See Fig. 4.

Measurements of the type. — Length 21.7 mm.; breadth of proximal end 4.4 mm.; breadth of distal end 4.— mm.; minimum mediolateral diameter of shaft 1.9 mm.; minimum anteroposterior diameter of shaft 1.6 mm.; ratio of minimum mediolateral diameter of shaft to length of tarsometatarsus 8.7 per cent.

Discussion. — The character of the inner condyle of the tarsometatarsus is suggestive of that of *Sterna,* but the bone as a whole is clearly that of an alcid. The shape of the head and excavation of the anterior surface of the shaft closely resemble the contours of *P. aleuticus.* The pattern of the hypotarsal ridges also is most nearly like that of *Ptychoramphus* and is widely different from *Brachyramphus.* There are four well-developed hypotarsal ridges of which the inner one is the strongest. In the Recent *P. aleuticus* there is an enclosed channel or tunnel between this inner ridge and the one next to it; unfortunately it is not quite certain whether or not this channel was enclosed in the fossil, although there is strong indication that it was. This enclosed channel is present in both *Synthliboramphus* and *Aethia,* but the pattern of the ridges is otherwise quite divergent.

SUMMARY

Seventy-three determinable bird bones, and numerous fragments from the San Diego Pliocene have been examined in this study, although *Mancalla,* the most abundant San Diegan form, was not treated further here. Ten species are discussed, of which three, namely, *Sula humeralis, Colymbus subparvus,* and *Ptychoramphus tenuis,* are new to science, and new light is thrown on the others. *Colymbus parvus* was found to be second only to *Mancalla* in point of numbers.

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Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ber 21 April 21, 1958

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: PHANEROGAMAE,

EUPHORBIACEAE, LENTIBULARIACEAE, RUBIACEAE

BY JULIAN A. STEYERMARK

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and itineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: PHANEROGAMAE,

EUPHORBIACEAE, LENTIBULARIACEAE, RUBIACEAE

By JULIAN A. STEYERMARK[1]

The following account continues the reporting of the plant collections obtained by Expedition botanist, E. Yale Dawson. The specimens are cited by his field collection numbers for which detailed locality data have been provided in the general account of the botany of the Expedition[2]. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13-May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15-June 10, 1956.

The first set of specimens, including isotypes of the seven new species and one new form are deposited in the Los Angeles County Museum.

EUPHORBIACEAE

Caperonia stenophylla M. Arg. 15143 Previously known only from Minas Gerais (Lagoa Santa, *Warming* 1545). The capsules were unknown at the time of the original description. The following description is based upon the present collection: capsula tricocca, 3 mm. alta 6-7 mm. lata tuberculata; seminibus subglobosis fuscis 2.5 mm. diametro foveolato-punctatis.

Cnidoscolus cnicodendron Griseb. 15092 *Jatropha vitifolia* Mill. var. *genuina* M. Arg.; Pax, (1910, p. 88). Pax divides *J. vitifolia* into several varieties of presently doubtful status. As shown by McVaugh (1944, p 471), the correct name for this taxon is *Cnidoscolus cnicodendron* Griseb. The var. *genuina* (=var. *cnicodendron)* has been known previously from Goiás.

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[1]Curator of the Phanerogamic Herbarium, Chicago Natural History Museum, Chicago 5, Illinois.
[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2):1-20.

Croton angustifrons M. Arg. 14194 Previously known only from Minas Gerais.

Croton douradensis sp. nov. Figs. 1, 2

Stipules subulate, 2-4 mm. long, moderately appressed-pubescent with simple hairs; leaves petiolate, the petioles 6-25 mm. long, rather densely stellate-pubescent; leaf blades undivided or deeply 2-3-lobate, 4-5 cm. long, 2-4.5 cm. wide, lateral lobes smaller and narrower than the intermediate ones, 1-3 cm. long, 0.7-1.7 cm. wide, crenate, moderately appressed-pubescent above with simple hairs, gray green below with short stellate pubescence; racemes terminal, slender, 12-17 cm. long; rachis rather densely canescent; pistillate flowers: calyx lobes 6, unequal, one larger, the others elliptical-ovate, acute, 2.5-4 mm. long, 0.6-1.5 mm. wide, hispidulous on both sides; petals 5, erect, lanceolate, acute, 2 mm. long, 0.7-0.8 mm. wide, sparsely or moderately pubescent on both sides with ascending hairs; glands of the petals 20, minute, suborbicular, 4 at the base of each petal; styles 3, flabellately 8-divided from the middle; ovary pilose; staminate flowers: pedicels 5-7 mm. long; staminate receptacle densely pilose; calyx deeply 5-parted, divisions elliptical-oblong, obtusish, 2 mm. long, 1 mm. wide, pilose on both sides; petals 5, obtuse, 2 mm. long, 1 mm. wide; stamens 12-15; filaments glabrous.

Caules videntur saltem 0.5-metralis, superne herbacei; caulibus teretibus pilis stellatis moderatim juvenalibus densiuscule vestitis; stipulis subulato-linearibus 2-4 mm. longis pilis simplicibus moderatim adpresso-pubescentibus; foliis petiolatis, petiolis 6-25 mm. longis pilis stellatis plerumque densiuscule vestitis; laminis membranaceis indivisis vel profunde 2-3-lobatis, si indivisis ovatis cuspidato-acuminatis 4-5 cm. longis 2-4.5 cm. latis, si divisis laciniis lateralibus intermedia minoribus brevioribus angustioribusque, lobis lateralibus oblongo-lanceolatis 1-3 cm. longis 0.7-1.7 cm. latis, lobo intermedio vel lobo majore elliptico-ovato vel obovato 4.5-6 cm. longo 2.5-4 cm. lato, crenatis supra pilis simplicibus ad 0.8 mm. longis moderatim adpresso-pubescentibus subtus cinereo-viridibus indumento brevi stellari molli vestitis; racemis terminalibus gracilibus elongatis 12-17 cm. longis micranthis floribundis non comosis, i. e. bracteis flores masculos haud vel non excedentibus, inferne mixto-bisexualibus; rhachi angulosa densiuscule canescenti; bracteis triangulari-lanceolatis vel subulatis ad 2 mm. longis; floribus foemineis: calycis foeminei laciniis 6 inaequalibus, uno majore, elliptico-ovatis acutis 2.5-4 mm. longis 0.6-1.5 mm. latis utrinque hispidulis; petalis 5 erectis lanceolatis acutis cucullatis 2 mm. longis

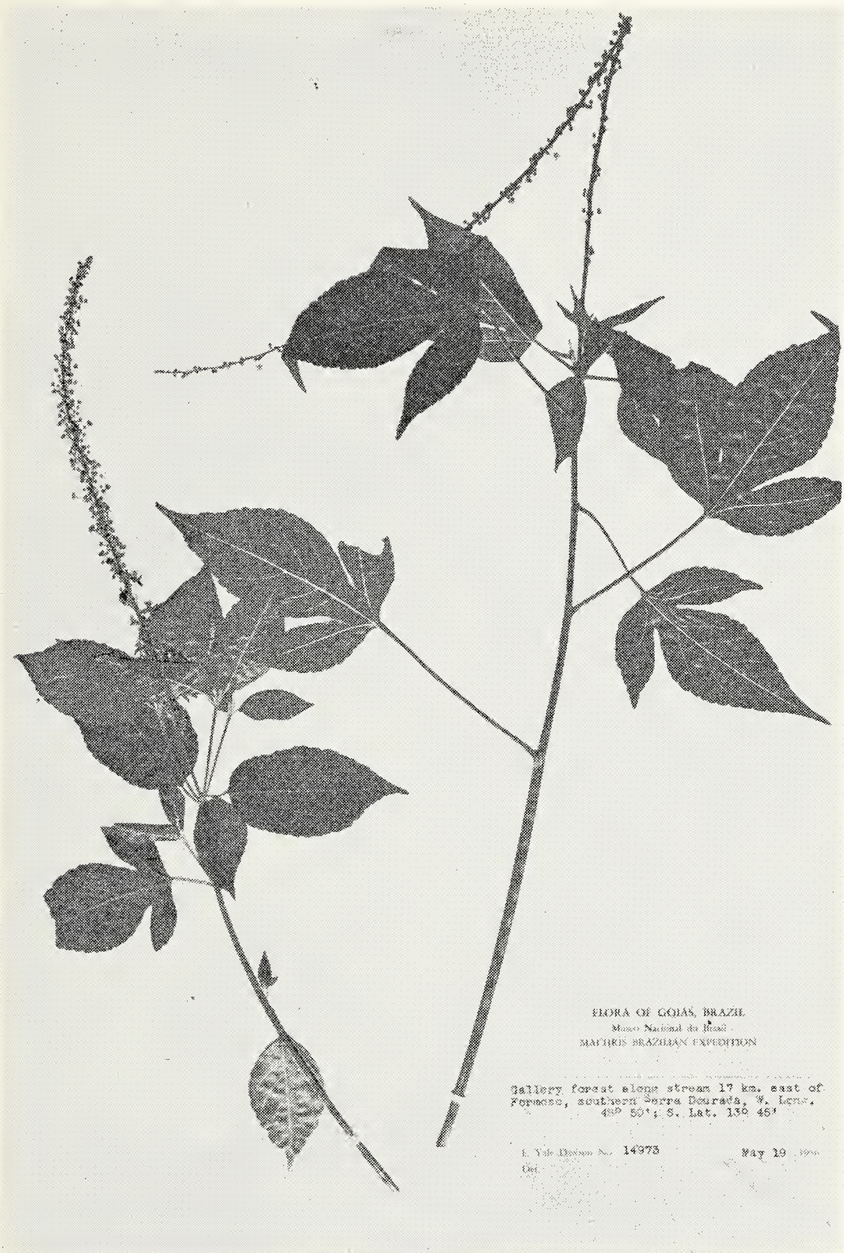

Fig. 1. *Croton douradensis* sp. nov. The holotype specimen, x 0.38

0.7-0.8 mm. latis, marginibus incurvatis, utrinque pilis adscendentibus parce vel moderatim vestitis; petalorum glandulis 20 minutis suborbicularibus, 4 basi intus cuiusque petali; stylis tribus e medio flabellatim 8-divisis, ramis 2.6-3 mm. longis 0.5 mm. diam. canescentibus, cruribus tenuibus 2.7-2.8 mm. longis pilis adscendentibus hispidulis; ovario piloso; floribus masculis; pedicellis 5-7 mm. longis basin versus angustatis stellato-pubescentibus; receptaculo masculo dense piloso; calyce profunde 5-partito, laciniis (sepalis) elliptico-oblongis obtusiusculis 2mm. longis 1mm. latis scariosis utrinque pilosis inferne remote ciliatis; petalis 5 membranaceo-scariosis obtusis 2 mm. longis 1 mm. latis; staminibus 12-15, filamentis glabris; capsulis ignotis.

TYPE: *Dawson* 14973 (holotype R, isotypes F, LAM), collected in gallery forest along stream 17 km. east of Formoso, region of the

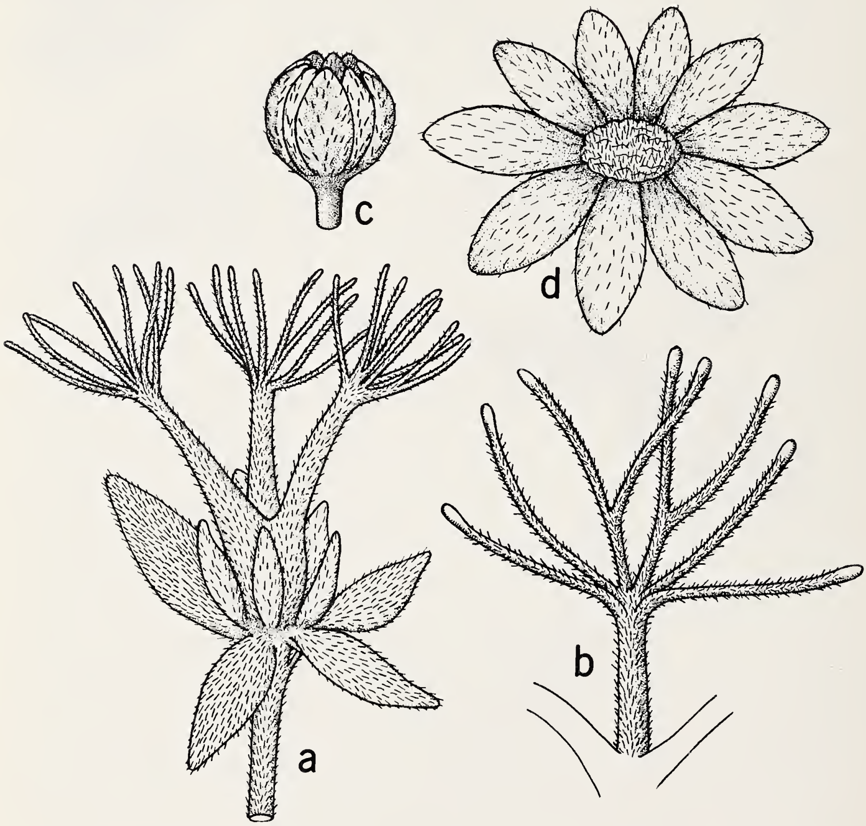

Fig. 2. *Croton douradensis* sp. nov. a. Pistillate flower, x 6.6; b. one of the style arms with branches, x 8; c. staminate flower in bud, x 6.6; d. staminate flower opened, showing receptacle, x 10. All drawn from holotype.

southern Serra Dourada at W. Long. 48° 40′, S. Lat. 13° 40′, Goiás, Brazil, May 19, 1956.

This species, at first, might appear to be related to such species of section *Astraea* Baill. as *C. gardneri* M. Arg., but that section has glabrous staminate receptacles, and a 5-parted pistillate calyx. It may perhaps better be considered an anomalous member of section *Decalobium* M. Arg., which includes species having a pubescent staminate receptacle and pistillate flowers sometimes with an unequally 6-10-parted calyx. The present species is marked by the combination of dimorphous leaves, some simple, others 2-3-lobed, pubescent staminate receptacle, glabrous filaments, unequally 6-parted pistillate calyx with one division larger than the other five, 5 pistillate petals with 4 glands at the base of each petal, and 8-cleft divisions of each of the three styles.

Croton gracilipes Baill. 15030a The present collection has somewhat larger leaves than most collections examined, but agrees in all other essential characters of the species. The species has hitherto been known in Brazil from Minas Gerais and Matto Grosso, and from Paraguay.

Croton inaequilobus sp. nov. Figs. 3, 4

Leaves petiolate, petioles 3-6 mm. long; leaf blades ovate or ovate-oblong, obtuse, rounded at base, 1.5-3.5 cm. long, 1-2.5 cm. wide, irregularly simply or doubly crenate, stellate-pubescent above, densely stellate-tomentose below with whitish interrupted tomentum; racemes densely-flowered; pistillate flowers: calyx unequally 5-parted, one segment inconspicuous, narrowly lanceolate, acutish, 2-3 mm. long, 0.7-0.8 mm. wide, glabrous within, 3 lobes obovate-rounded, 4-4.5 mm. long, 3.5 mm. wide, entire, stellate-pubescent on both sides, a fifth segment larger, obovate, 5 mm. long, 3.5 mm. wide, entire, stellate-pubescent on both sides; styles 3, once divided, shortly dichotomously bifid; ovary obpyriform; staminate flowers: pedicels 1.5 mm. long; calyx deeply 5-parted, segments ovate, obtuse, 1.5-2 mm. long, 1.1-1.2 mm. wide, glabrous within, densely stellate-pubescent without; petals 5, spatulate-obovate, obtuse, 1.75 mm. long, 1 mm. wide, pilose on both sides; receptacle pilose; stamens 11; filaments glabrous.

Fruticulus saltem 2.5-4 dm. altus, ramis teretibus inferne fuscis vel nigrescentibus superne cum petiolis et inflorescentiis et pagina inferiore foliorum tomento stellari velutino ex argillaceo albicante densissime tectis; stipulis sub indumento fere omnino occultis; foliis petiolatis, petiolis 3-6 mm. longis; laminis subcoriaceis supra cano-viridibus subtus argillaceo-albescentibus ovatis vel ovato-oblongis obtusis vel obtusiusculis basi rotundatis 1.5-3.5 cm. longis, 1-2.5 cm. latis plus mi-

Fig. 3. *Croton inaequilobus* sp. nov. The holotype specimen, x 0.4.

nusve irregulariter simpliciter vel duplicato-crenatis penninerviis vel abbreviato-palmatinerviis, nervis lateralibus utroque 3-4 subtus paullo prominulis supra pilis stellatis brevibus dense vestitis, subtus indumento dense stellato-tomentoso magis albicante non interrupte obtectis; basi eglandulosis vel 1 vel 2, glandulis disciformibus; racemis evolutis densifloris 1.5-1.7 cm. longis, bracteis setaceis acuminatis extus dense stellato-tomentosis intus glabris 2.5-3.5 mm. longis 0.5 mm. latis; floribus foemineis: calyce inaequaliter 5-partito, una lacinia fere obsoleta anguste lanceolata acutiuscula 2-3 mm. longa 0.7-0.8 mm. lata intus glabra, tribus laciniis obovatis rotundatis 4-4.5 mm. longis 3.5 mm. latis integris utrinque stellato-pubescentibus, una lacinia majore obovata rotundata 5 mm. longa 3.5 mm. lata integra utrinque stellato-pubescenti; stylis 3 semel breviter dichotome bifidis, ramis 0.5 mm. longis cruribus 1.5 mm. longis stellato-pubescentibus praeter apices papillosos; ovario obpyriformi 4-5 mm. longo 3.5-4 mm. lato dense stellato-pubescenti; floribus masculis: pedicellis 1.5 mm. longis stellato-

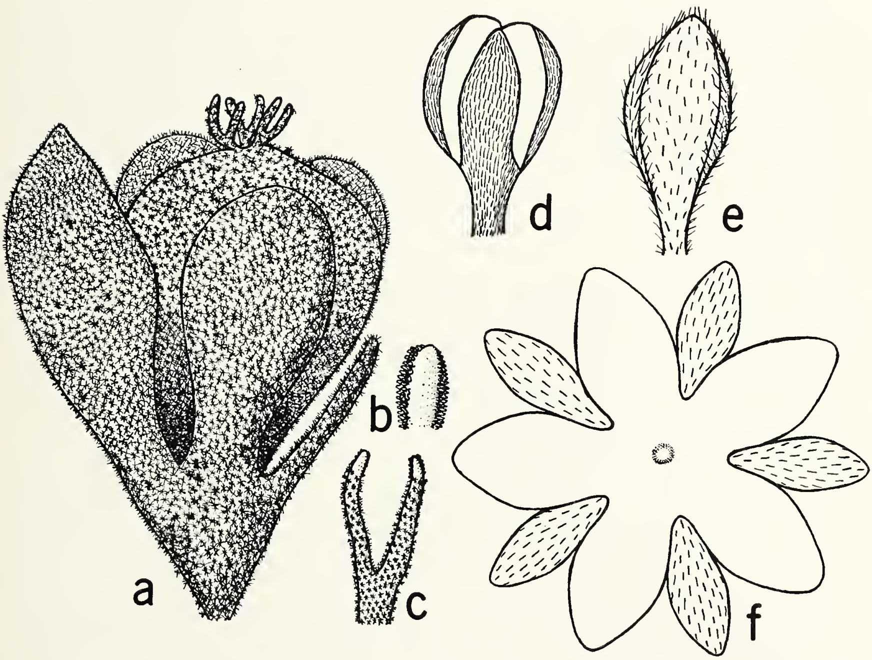

Fig. 4. *Croton inaequilobus* sp. nov. a. Pistillate flower, x 9; b. papillate margins of style tips, x 26; c. style branches, x 26; d. stamen, x 22.5; e. staminate flower in bud, x 11; f. staminate flower expanded, view from below, x 11.

pubescentibus; calyce profunde 5-partito, laciniis ovatis obtusis 1.5-2 mm. longis 1.1-1.2 mm. latis extus dense stellato-pubescentibus intus glabris; petalis 5 spatulato-obovatis obtusis 1.75 mm. longis 1 mm. latis marginibus involutis utrinque pilosis; receptaculo piloso; staminibus 11; antheris 0.9 mm. longis 0.8 mm. latis, filamentis glabris 2.5-2.6 mm. longis; capsulis stellato-tomentosis immaturis.

TYPE: *Dawson* 14685 (holotype R, isotypes F, LAM), collected in sandstone rocky area on west bank of stream and above, 14 km. south of Veadeiros, region of the Chapada dos Veadeiros at W. Long, 47° 30′, S. Lat. 14° 20′, Goiás, Brazil, April 25, 1956.

This is a very well-marked species, peculiarly characterized by the pistillate flowers having unequal, broadly rounded, obovate, subfoliaceous calyx lobes, and by the leaf blades having either one or two very small disk-shaped glands at their bases, or lacking glands entirely. It seems most closely related to *C. goyazensis* M. Arg. and *C. luzianus* M. Arg.

Croton urucurana Baill. 15093 A fairly widespread, somewhat variable species, distributed through much of Brazil, Paraguay, Argentina, and Bolivia. The species varies in the degree of indument on the lower surface of the leaf blades. The filaments in the present collection and in others studied are glabrous, and not "pilosis" as described and figured by Mueller Argoviensis (1873, p. 111, pl. 22). The stamens in the present collection are 13, instead of 17 as stated in Flora Brasiliensis.

Dalechampia caperonioides Baill. 14231; 14560 A species limited to southern Brazil, with several described varieties, whose relative merits are uncertain. Some of the leaves in *Dawson* 14231 measure up to 38 mm. broad, others only 18 mm. broad. The var. *rhomboidalis* M. Arg., to which most of the present collections may be relegated, has been collected previously in Goiás and Minas Gerais.

Euphorbia coecorum Mart. 14182; 14455; 14584 Previously known from Goiás, as well as from Bahia, Minas Gerais, São Paulo, and Matto Grosso. Also known from Paraguay and Bolivia.

Euphorbia hirta L. 14395 A weedy and widely distributed species, occurring from Florida and the West Indies to Mexico, Central America, and South America.

Euphorbia hyssopifolia L. 14394 A widely distributed species, occurring from the southern United States and the West Indies to Mexico, Central America, and temperate South America.

Euphorbia machrisiae sp. nov. Figs. 5, 6

Stems erect or ascending, 12-14 cm. tall, pilose with spreading hairs to 0.7 mm. long; leaves opposite, short-petiolate, petioles 1-1.5 mm. long, pilose; lamina broadly ovate or suborbicular-oval, obtuse or rounded at the apex, strongly obliquely inequilateral at base, entire with thickened margins, 4-10 mm. long, 3-7 mm. wide, pubescent throughout with hairs 0.5-0.7 mm. long; stipules broadly deltoid, 0.6 mm. long, 0.6 mm. wide, lacerate in upper half with 3-5 lanceolate to deltoid, acute to acuminate lobes, the apex with short, erect, white, crowded hairs; cyathia solitary, terminal or in the uppermost axils; peduncles 1-1.5 mm. long, glabrous; involucre deeply campanulate, 0.5-0.7 mm. long, pubescent within, glabrous without; lobes lanceolate, entire, acute or acuminate, 0.5 mm. long, 0.2 mm. wide, fimbriate, densely pubescent within; glands 4, transversely oblong, 0.4-0.5 mm. long, 0.3-0.4 mm. wide, glabrous, verruculose; staminate flowers 18-21; ovary pilose; styles glabrous, 0.5 mm. long, bifid above; capsule pilose, 2.2-2.5 mm. long.

Radix annua; caulibus erectis vel adscendentibus 12-14 cm. altis inferne simplicibus superne ramosis gracilibus 0.8-1 mm. diam. pilosis, pilis crispis ad 0.7 mm. longis; internodiis inferioribus mediisque 8-17 mm. longis, nodis tumidis dense pubescentibus; foliis oppositis brevi-petiolatis, petiolis vinaceis 1-1.5 mm. longis pilosis, laminis firme membranaceis supra olivaceo-viridibus subtus pallido-griseo-viridibus late ovatis vel suborbiculari-ovalibus apice obtusis vel rotundatis basi valde oblique inaequilateralibus integris marginibus incrassatis 4-10 mm. longis 3-7 mm. latis omnino pubescentibus pilis plerumque 0.5-0.7 mm. longis, costa media subtus prominente, venulis subtus prominulis creberrime irregulariter reticulatis; stipulis vinaceis late deltoideis ad 0.6 mm. longis basi ad 0.6 mm. latis, dimidia parte superiore lacerata in lacinias 3-5 lanceolatas vel deltoideas acutas vel acuminatas fissa, glabris praeter margines ciliatos pilos erectos albos rigidos instructos; cyathiis solitariis terminalibus vel in axillas foliorum supremorum; pedunculis vinaceis angulatis 1-1.5 mm. longis glabris; involucris profunde campanulatis obtuse angulatis 0.5-0.7 mm. altis 1.2 mm. diam. intus pubescentibus extus glabris; lobis lanceolatis integris acutis vel acuminatis 0.5 mm. longis 0.2 mm. latis fimbriatis intus dense pubescentibus glandulis excedentibus autem quam appendicibus brevioribus glandulis 4 ochroleucis transverse oblongis 0.4-0.5 mm. longis 0.3-0.4 mm. latis glabris verruculosis; floribus masculis 18-21; androphoris glabris 0.7-1.2 mm. longis; gynophoriis exsertis reflexis glabris; ovario trilobato piloso; stylis glabris 0.5 mm. longis superne bifidis, cruribus paullo dilatatis; capsulis pilosis 2.2-2.5 mm. longis; seminibus (immaturis) vinaceis quadrangulari-oblongis 1.2 mm. longis 1 mm. latis, latere convexo paullo 3-4-sulcato.

TYPE: *Dawson* 14594 (holotype R, isotypes F, LAM), collected on sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos

Fig. 5. *Euphorbia machrisiae* sp. nov. The holotype specimen, x 1.0.

Veadeiros at W. Long. 47° 30′, S. Lat. 14° 15′, Goiás, Brazil, April 24, 1956.

This species appears most closely related to *E. peruviana* Wheeler, from which it differs in the shorter styles, glabrous outer surface of involucre, long-pilose stems and leaf surfaces, more strongly inequilaterally based leaf-blades, shorter petioles, and more conspicuous stipules, which are deltoid instead of linear.

The species is named in honor of Mrs. Paquita Machris.

Mabea longifolia (Britton) Pax & K. Hoffm. 15041 This species has been known in Brazil hitherto from Matto Grosso. It is also found in Bolivia.

Mabea sp. 15104 In the absense of staminate flowers, the identity of this specimen is uncertain.

Manihot violacea (Pohl emend.) M. Arg. 15083 This species is known only from Goiás and Minas Gerais. Pax (1910, pp. 29-30) recognizes several varieties, which, however, at present, cannot be readily distinguished.

Manihot sp. 14149 In the absence of pistillate flowers, the identification of this collection must await future exploration.

Phyllanthus dawsonii sp. nov. Figs. 7, 8

Phyllanthus ericoides Glaziou, 1913, p. 613 (*nomen*); not *P. ericoides* Torrey, 1858, p. 193.

Dwarf ligneous plant, 3-4 dm. tall; stems glabrous; stipules subulate, 0.5 mm. long; leaves sessile, erect, spirally arranged, linear-lanceolate, acuminate, 5-7 mm. long, 1-1.25 mm. wide, glabrous; flowers monoecious, mostly solitary; staminate flowers: petals 5, subequal, elliptical-

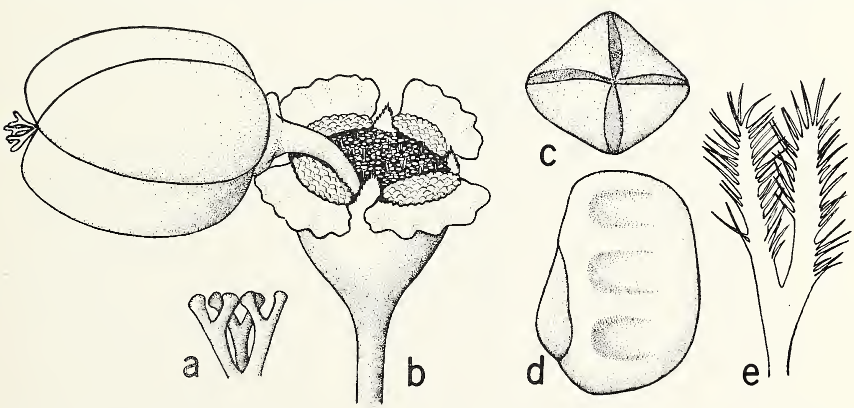

Fig. 6. *Euphorbia machrisiae* sp. nov. a. Styles and branches, x 30; b. pistillate flower, x 18; c. seed, end view, x 18; d. seed, lateral view, x 18; e. bracteole, x 36.

Fig. 7. *Phyllanthus dawsonii* sp. nov. The holotype specimen, x 0.5.

oblong, rounded at apex, 2 mm. long, 1.3-1.4 mm. wide; stamens 3, anthers orbicular, adnate to the apex of the staminal column; filaments monadelphous into a glabrous, erect column 0.8-1 mm. long; pistillate flowers: calyx 6-parted, divisions oblong, obtuse, 3-3.2 mm. long, 1.5 mm. wide, connate 0.75 mm. at the base; styles 3, bilobed above; stylar column 0.5-1 mm. long; seeds acutely trigonous, 2 mm. long, 1.5 mm. wide, prominently reticulate throughout.

Fruticulus 3-4 dm. altus; ramis ramulisque subteretibus 1-1.5 mm. diam. glabris erectis elongatis; internodiis saltem superioribus mediisque 1-2 mm. longis; stipulis rubescentibus subulatis 0.5 mm. longis; foliis pallido-viridibus sessilibus erectis rigidis subcoriaceis spiraliter dispositis lineari-lanceolatis acuminatis acriter cuspidatis basi obtusis 5-7 mm. longis 1-1.25 mm. latis glabris marginibus incrassatis subinvolutis, costa media tantum prominente nervis lateralibus nullis; floribus monoicis plerumque solitariis; pedicellis masculis anthesi 0.5 mm. longis; floribus masculis: petalis 5 subaequalibus elliptico-oblongis apice rotundatis 2 mm. longis 1.3-1.4 mm. latis; staminibus 3, antheris

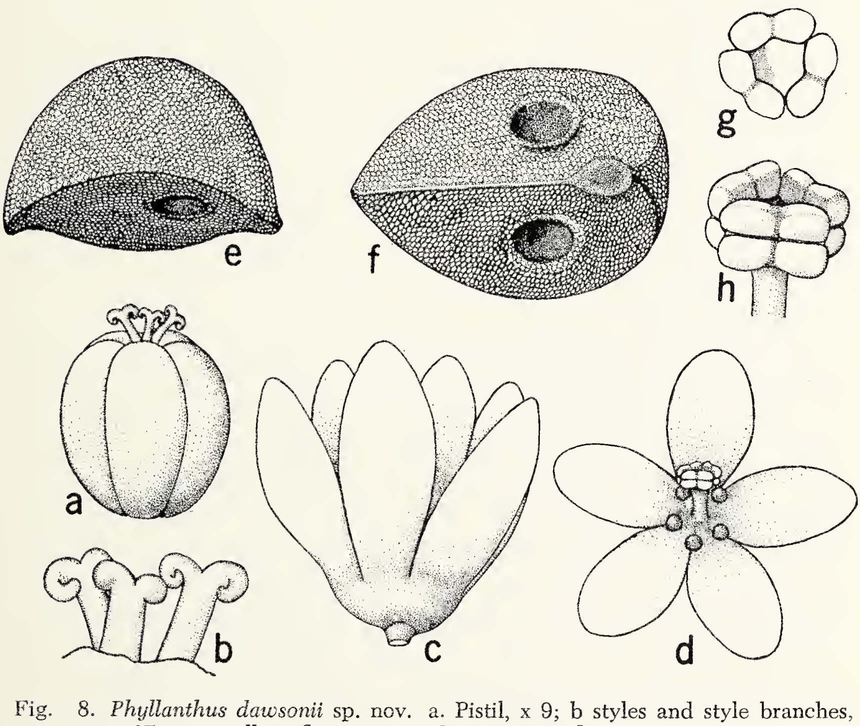

Fig. 8. *Phyllanthus dawsonii* sp. nov. a. Pistil, x 9; b styles and style branches, x 27; c. pistillate flower, x 6; d. staminate flower, x 9; e. seed, x 21; f. seed, x 21; g. stamens attached to column, lateral view, x 27; h. stamens and column, from above, x 27.

orbicularibus bilobatis transverse birimosis 0.5 mm. altis 0.5 mm. latis ad apicem columnae adnatis; filamentis in columnan monadelphis, columna erecta glabra 0.8-1 mm. longa; glandulis florum masculorum 5 liberis orbicularibus cum petalis alternis; floribus foemineis: calyce 6-partito, laciniis inferne 0.75 mm. connatis oblongis obtusis 3-3.2 mm. longis 1.5 mm. latis; stylis 3 semel dichotome divisis superne bilobatis, columna stylari 0.5-1 mm. longa 0.2 mm. diam., cruribus recurvatis; ovario 2.5 mm. alto 3 mm. diam.; seminibus fuscis acute trigonis 2 mm. longis 1.5 mm. latis sub lente per omnes partes prominente reticulatis.

Type: *Dawson* 14776 (holotype R, isotypes F, LAM), collected in wet spring area from among rocks on gentle slope 10 km. from Veadeiros on Cavalcante road, region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 00′, Goiás, Brazil, May 1, 1956.

PARATYPES: *Dawson* 14593a (F, LAM), sandstone outcrop 7 km. south of Veadeiros, region of Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 15′, Goiás, April 24, 1956; *Glaziou* 22095 (B, BR, F, K, P), Serra da Baliza, dans le campo, Goyaz, Jan.-March.; *Glaziou* 22093, same locality (B, BR, K, P).

This very distinct species, with its ericoid spirally arranged foliage, has never been described, Glaziou having only named it *P. ericoides* with the brief comment "Frutescent, fl. blanchâtres." The collection of *Dawson* 14776, in the most satisfactory state of preservation, I have designated as holotype.

Phyllanthus lathyroides H.B.K. 14752; 15121 A polymorphic taxon of broad distribution, occurring from Mexico to South America. The present collection has three filaments, which are free and 0.5-1 mm. long, and staminate sepals 1.2-1.5 mm. long.

Phyllanthus orbiculatus L. C. Rich. 14488 A widespread South American species, distributed from the Guianas, Trinidad, Venezuela, and Colombia, southward to Brazil, Paraguay, Bolivia, and Peru. It has been collected previously from Goiás.

Phyllanthus perpusillus Baill. 15140 This species has hitherto been known only from Minas Gerais. Although Mueller Argoviensis (Flora Brasiliensis 11 (2): 55-56. 1873) describes the leaves as "lanceolatis acutis" in the general description of the species, and as "lanceolato-ellipticus, acutus vel subacutus" in the detailed section of the specific description, they are to be characterized as more nearly narrowly elliptic and obtuse or obtusish, instead of acute or acutish. This is borne out by a comparison of Dawson's collections with a photograph and fragment of the *Pohl* 2677 specimen preserved in the herbarium of the Chicago Natural History Museum.

Phyllanthus websterianus sp. nov. Figs. 9, 10

Lateral branches elongate, divaricately spreading, 7-10 cm. long, 11-15-phyllous; internodes 1-1.5 cm. long; stipules triangular-lanceolate, subulate-acuminate, 0.8-1.5 mm. long; leaves petiolate, petioles 1.5-2.5 mm. long, glabrous: lamina glaucescent below, suborbicular or broadly oval, rounded-obtuse at base and apex, 6-15 mm. long, 5-12 mm. wide; flowers monoecious, mostly 3-4-fasciculate; staminate flowers: calyx 6-parted, divisions connate at base, 3 outer ones shorter, ovate, acute, 1-1.2 mm. long, 0.5-0.6 mm. wide, 3 inner ones ovate, obtuse, 1.5-1.7 mm. long, 1-2 mm. wide; stamens 3, anthers oblong, coherent at the apex, vertically dehiscent, somewhat inclined, 0.9 mm. long; filaments monadelphous into a column 0.8-0.9 mm. long; glands of the staminate flowers connate, 6-angled, undulate, rugose above; pistillate flowers: sepals 6, the outer ones ovate, obtuse or acute, 1.5 mm. long, 0.8-1 mm. wide, the 3 inner ones lanceolate, obtusish, 1 mm. long, 0.2-0.3 mm. wide; styles 3, dichotomously divided; seeds acutely trigonous, 1.2 mm. long, transversely striolate.

Fruticulus saltem 4 dm. altus; ramis ramulisque atrovinaceis subteretibus glabris, ramis 1.5-2 mm. diam., ramulis lateralibus elongatis divaricate patentibus tenuibus 7-10 cm. longis 0.5 mm. diam., 11-15-phyllis; internodiis 1-1.5 cm. longis; stipulis vinaceis triangulari-lanceolatis apice nigrescentibus subulato-acuminatis basi subauriculatis 0.8-1.5 mm. longis, margine scariosis; foliis petiolatis, petiolis gracilibus 1.5-2.5 mm. longis glabris; laminis firme membranaceis supra ut videtur olivaceo-viridibus subtus glaucescentibus suborbicularibus vel late ovalibus utrinque rotundato-obtusis apice minute mucronulatis 6-15 mm. longis 5-12 mm. latis, costis secundariis utrinque 5-6 omnino glabris; floribus monoicis plerumque 3-4-fasciculatis mediocriter pedicellatis; pedicellis masculis anthesi 3-3.8 mm. longis glabris; pedicellis foemineis anthesi 3.5-4 mm. longis; floribus masculis: calyce 6-partito, laciniis inferne connatis, 3 exterioribus brevioribus ovatis acutis 1-1.2 mm. longis 0.5-0.6 mm. latis, 3 interioribus ovatis obtusis 1.5-1.7 mm. longis 1.2 mm. latis marginibus involutis; staminibus 3, antheris late oblongis apicibus cohaerentibus verticaliter birimosis paullo inclinatis 0.9 mm. longis; filamentis in columnam monadelphis, columna 0.8-0.9 mm. longa; glandulis florum masculorum connatis 6-gonis undulatis supra rugulosis; floribus foemineis: sepalis 6, juvenalibus adscendentibus vel erectis vetustioribus patentibus vel descendentibus, 3 exterioribus ovatis obtusis vel acutis 1.5 mm. longis 0.8-1 mm. latis, 3 interioribus lanceolatis obtusiusculis 1 mm. longis 0.2-0.3 mm. latis; stylis 3 semel dichotome divisis inferne connatis, columna stylari 0.5-2.5 mm.

Fig. 9. *Phyllanthus websterianus* sp. nov. The holotype specimen, x 0.38.

longa 0.2-0.5 mm. diam., cruribus 0.2-0.5 mm. longis emarginatis; disco hypogyno urceolari integro 0.3 mm. alto; ovario 0.8 mm. longo; seminibus acute trigonis 1.2 mm. longis sub lente secus lineas longitrorsas transverse striolatis.

TYPE: *Dawson* 14918 (holotype R, isotypes F, G, LAM), collected on banks and margins of small stream running through hilly cerrado 20 km. east of Formoso, region of the southern Serra Dourado at W. Long. 48° 40', S. Lat. 13° 40', Goiás, Brazil, May 17, 1956.

PARATYPE: *Glaziou* 22090 (F, G), Paranauá, dans le campo, Goyaz, March-April, 1898.

I am indebted to Dr. Grady L. Webster for his verification of my conclusion that Dr. Dawson's collection no. 14918 represents an undescribed species. It is with great pleasure that I dedicate this very distinct species to Dr. Webster, whose recent monographic studies on the West Indian species of *Phyllanthus* show careful and precise work in this difficult group of Euphorbiaceae.

Dawson's collection is conspecific with *Glaziou* 22090, identified as *P. amoenus* M. Arg. While habitually similar, *P. websterianus* differs

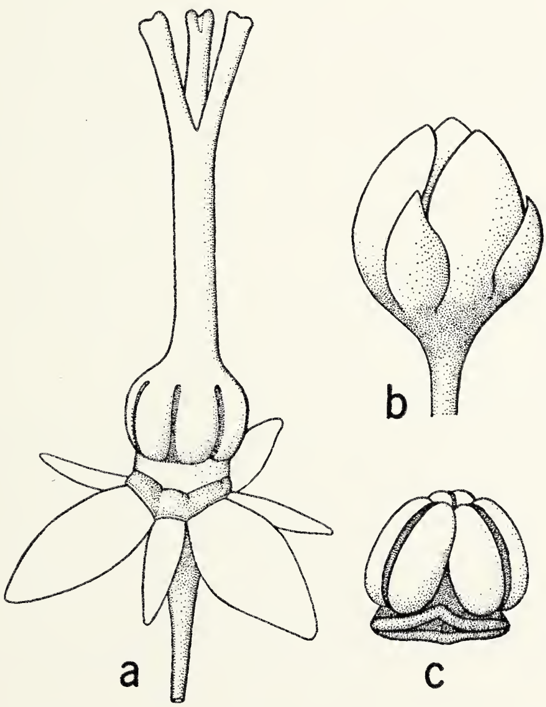

Fig. 10. *Phyllanthus websterianus* sp. nov. a. Pistillate flower, x 14; b. staminate flower, x 14; c. stamens in natural position, x 14.

from *P. amoenus* in the connate filaments, vertically dehiscent anthers, monoecious flowers and fewer leaves of the branchlets.

Sebastiania bidentata (Mart.) Pax 14540 This species is limited to southern Brazil. Several varieties have been recognized by Pax (1912, pp. 113-114). The present collection may be referred to *S. bidentata* var. *scoparia* (Mart.) M. Arg., hitherto known from Goiás, Minas Gerais, and Matto Grosso.

Sebastiana hispida (Mart.) Pax 14842; 14907 This species is an exceedingly polymorphic one, ranging from Brazil to Paraguay, Bolivia, and Argentina. *Dawson* 14907 may be referred to *S. hispida* var. *laeta* M. Arg., and *Dawson* 14842, a more narrow-leaved variation, to var. *occidentalis* M. Arg., as treated by Pax (1912, pp. 105-113). However, the taxonomic status of the numerous varieties, which he places under *S. hispida*, is quite uncertain at the present time.

Tragia pohlii M. Arg. 15122 This is a rare species, known only from Goiás, where it was collected by Pohl (1742, 350). At first, it was believed that Dawson's collection might represent a distinct species, as the racemes showed no glandular hairs intermixed with the hispid pubescence. However, an examination of isotype material (*Pohl* 1742) likewise reveals that most, if not all, of the racemes are without glandularity. Accordingly, the original description should be emended as follows: "racemi axillares vel terminales, ramis plerumque dense hispidulis, interdum glanduligeris (apud M. Arg., Pax et cetera)."

LENTIBULARIACEAE

Utricularia cornuta Michx. 14792 This collection has the long spurs characteristic of *U. cornuta* var. *cornuta.* This long-spurred variation is found in South America in the Guianas, Venezuela, and Brazil, but has not previously been found in Goiás.

Utricularia dawsonii sp. nov. Figs. 11, 12

Plant 9-15 cm. high; radical leaves few, entire, spatulate-ligulate, rounded at the apex, short-petiolate, 3.5-4 mm. long; cauline scales few, broadly ovate, 0.6-0.8 mm. long, entire, basifixed; bracts 3-lobate, 1 mm. long, 1 mm. wide, median lobe ovate, acutish, lateral lobes ovate-lanceolate, acutish; flowers 1-2, pedicels 7-8 mm. long; upper calyx lobe oblong-ovate, rounded at apex, 2 mm. long, 1.5 mm. wide, entire; lower calyx lobe broadly oblong-ovate, rounded at apex, 1.8 mm. long, 1.5 mm. wide; corolla purple, 14-20 mm. long, upper lip broadly ovate, obtuse, 6 mm. long, 5 mm. wide; lower lip deeply 3-lobed, median lobe rhomboid-oblong, rounded at apex, 5 mm. long, 2.5 mm. wide, lateral lobes rhomboid-oblong, 5 mm. long, 3.5 mm. wide, obliquely rounded at apex; spur subhorizontal, cylindrical-conic, acutish, 11 mm. long, 1.5 mm. wide.

Herba 9-15 cm. alta; foliis radicalibus paucis integris spatulato-lingulatis apice rotundatis brevipetiolatis 3.5-4 mm. longis; scapo tenui squamoso glabro; squamis paucis distantibus late ovatis obtusiusculis apicem versus constrictis 0.6-0.8 mm. longis integris basifixis; bracteis trilobatis 1 mm. longis 1 mm. latis, lobo medio ovato acutiusculo, lobis lateralibus ovato-lanceolatis acutiusculis; floribus 1-2, pedicellis 7-8 mm. longis; calycis lobo superiore late oblongo-ovato

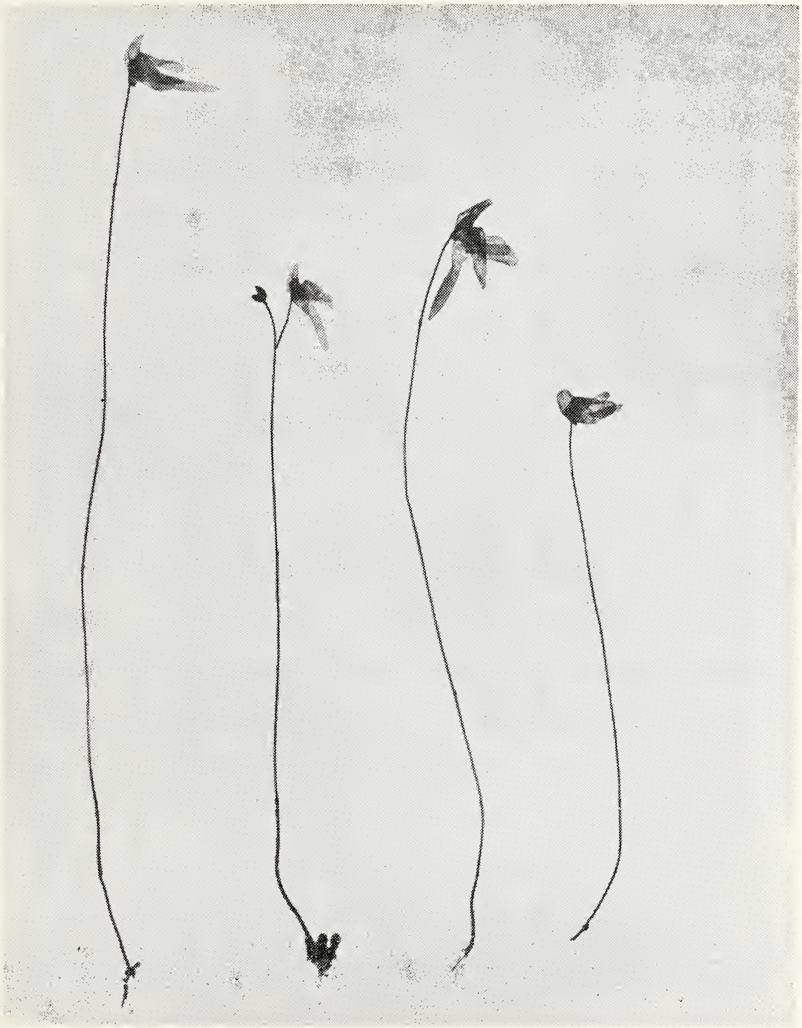

Fig. 11. *Utricularia dawsonii* sp. nov. Four plants from the type collection, x 1.0. The two center specimens are deposited as holotype.

apice rotundato 2 mm. longo 1.5 mm. lato integro valde naviculaeformi, lobo inferiore late oblongo-ovato apice rotundato 1.8 mm. longo 1.5 mm. lato integro marginibus incurvatis; corolla ut videtur violacea 14-20 mm. longa, labio superiore lato ovato apice obtuso 6 mm. longo 5 mm. lato integro; labio inferiore profunde trilobato, lobo medio rhomboideo-oblongo apice rotundato 5 mm. longo 2.5 mm. lato supra medium sensim angustato, lobis lateralibus rhomboideo-oblongis nonnihil apice oblique rotundatis 5 mm. longis 3.5 mm. latis, a summo palato minute papillato prominente; calcare subhorizontali subrecto cylindrico-conico acutiusculo 11 mm. longo 1.5 mm. lato basi 3.5 mm. lato.

TYPE: *Dawson* 14770 (holotype R, isotypes F, LAM), collected in wet, spring area among some rocks on gentle slope 10 km. from Veadeiros on Cavalcante road, region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 00′, Goiás, Brazil, May 1, 1956.

This species is related to *U. tridentata* Sylven, *U. bicolor* St. Hil., and *U. lindmanii* Sylven. It differs from *U. tridentata* in the more

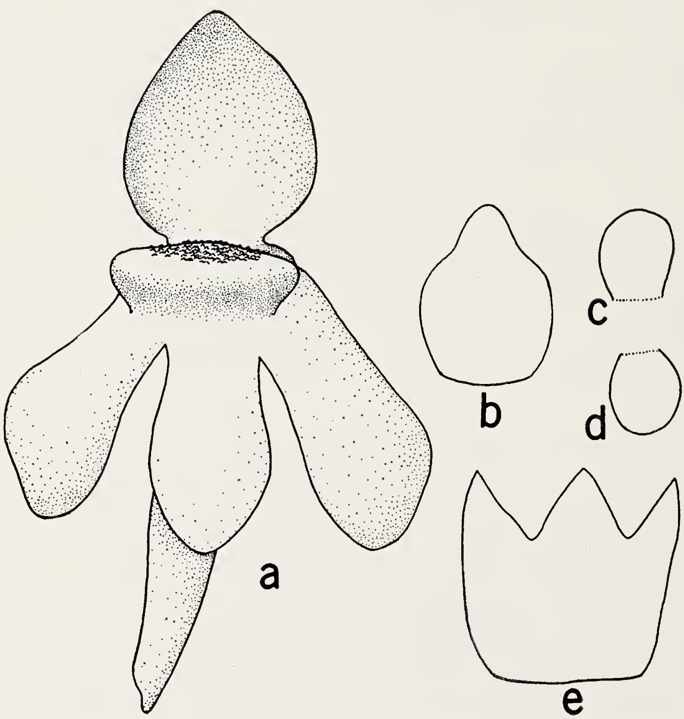

Fig. 12. *Utricularia dawsonii* sp. nov. a. Corolla, x 4.9; b. cauline scale, x 24.5; c. upper calyx lobe, x 5.6; d. lower calyx lobe, x 5.6; e. bract, x 28.

deeply lobed lower corolla lip, the broader upper corolla lip, and the narrower, smaller basal leaves. From *U. bicolor* it differs in the one- or two-flowered, instead of three to many-flowered scapes, the non-flexuous rachis, and the entire lower calyx lobe. From *U. lindmanii* it differs chiefly in the entire, not erose lower calyx lobe and the longer upper corolla lip.

Utricularia hydrocarpa Vahl 15142 This species has been known hitherto in Brazil from Minas Gerais. Otherwise, it is known from French Guiana, whence originated the type.

Utricularia laciniata St. Hil. 14784 This species has been known previously only from its original station, "Serra do Ibitipoca", in Brazil, where it was collected by St. Hilaire. The present collection agrees with the original description in having some of the cauline scales "ciliato-multipartitae" (Saint Hilaire et Girard 1839, p. 157), mostly 1-flowered scapes, lower lobe of the calyx somewhat bifid, corolla "dilutè violacea, palato lutea", spur somewhat shorter than the lower corolla lip, which is obscurely 3-lobed. The original description refers to the spur as "puberulum." The spurs in the present collection are papillate, perhaps thereby presenting a minutely puberulent aspect, but are not truly puberulous or puberulent.

This species was validly published in 1839. *Utricularia laciniata* Martius, ex Benjamin (1847, p. 251), a later homonym, is synonymous with *U. longeciliata* DC. For a discussion of the taxonomy of the latter species, see Steyermark (1953, p. 540).

Utricularia subulata L. forma *cleistogama* (Gray) Fern. 14479 The small-flowered form occurs throughout the range of this species.

RUBIACEAE

Borreria angustifolia Cham. & Schl. 14276; 14537 Known previously in Brazil from São Paulo and Minas Gerais. Also known from Paraguay.

Borreria capitata (R. & P.) DC. 14171; 14195 (in part) A widely distributed species of South America.

Borreria centranthoides Cham. &. Schl. 14133 This species is common in Argentina, Paraguay, and Uruguay, and extends north into southeastern Brazil to Minas Gerais and Goiás. A previous Goiás collection is *Gardner* 3785.

Borreria ocymoides (Burm.) DC. 14195 (in part) A species widely distributed from Mexico into South America. Previously known from Goiás.

Borreria poaya DC. var. *nervosa* Schumann 14820 This variety, in which the stems, leaves, and calyces are prominently pubescent, has been found previously in Goiás. *Borreria poaya* var. *poaya*, together with its other varieties, is known from Minas Gerais, Goiás, and São Paulo.

Many specimens labeled as *Diodia gymnocephala* (DC.) Schumann, and also distributed under an unpublished specific epithet of *Diodia* by Standley should be referred to *Borreria poaya* var. *nervosa* and other varieties of *B. poaya.*

Borreria suaveolens Mey. 14832 A widely distributed and variable species of tropical Mexico, Central and South America.

Coccocypselum aureum Cham. & Schl. 14473 This species has been known previously from Bahia and Minas Gerais.

Declieuxia dasyphylla K. Schumann ex Glaziou, emend. Steyermark.

Declieuxia dasyphylla K. Schumann ex Glaziou, 1909, p. 359 (nomen).

Dwarf ligneous plant, 1-1.7 dm. tall; stems erect, simple, glabrous; stipules decurrent, mostly hirtellous, 1-1.2 mm. long, subulate; leaves crowded, erect to ascending, subcoriaceous, pale green below, sessile, elliptic-oblong, obtuse at base and apex, 1.5-3 mm. long. 0.6-1.7 cm. wide, glabrous except minutely hispidulous-ciliolate toward the base, the margins revolute, lateral nerves obscure, veins obsolete; inflorescence terminal, cymose-paniculate; peduncles glabrous; flowers many, sessile; bracts conspicuous, foliaceous, exceeding the calyx, linear-ligulate, obtuse, 3-4.5 mm. long, glabrous; hypanthium glabrous; sepals minute, linear, obtuse, 0.7-0.8 mm. long, 0.1-0.2 mm. wide; corolla 7.5 mm. long, tube 5 mm. long, glabrous without, pilose within, lobes ovate, obtuse, 2.25 mm. long, 1.5 mm. wide; anthers oblong; filaments free.

Fruticulus 1-1.7 dm. altus, caulibus e caudice lignoso pluribus erectis vulgo vel plerumque simplicibus glabris striato-angulatis; internodiis foliis brevioribus; stipulis e basi late dilatatis subulatis 1-1.2 mm. longis rigidis erectis plerumque hirtellis decurrentibus; foliis creberrimis erectis vel erecto-adscendentibus subcoriaceis subtus pallido-viridibus sessilibus elliptico-oblongis utrinque obtusis 1.5-3 cm. longis 0.6-1.7 cm. latis glabris praeter basin versus minutissime hispidulo-ciliolatos, marginibus revolutis, penninerviis, nervis lateralibus obscuris utroque 3-4, venis obsoletis, costa media subtus prominente; inflorescentiis terminalibus cymoso-paniculatis 1-3 cm. altis 2-4 cm. latis, pedunculis glabris, floribus pluribus sessilibus plus minusve secundis, bracteis conspicuis foliaceis calycem superantibus lineari-ligulatis obtusiusculis 3-4.5 mm. longis 0.5-0.6 mm. latis glabris; hypanthio glabro latiore quam longo in anthesi 1.25 mm. alto 1.6 mm. lato, sepalis minutis linearibus obtusis 0.7-0.8 mm. longis 0.1-0.2 mm. latis; corolla 7.5 mm. longa, tubo

5 mm. longo sursum paullo sensim dilatato basi ipsa 1.25 mm. lato superne 2.5 mm. lato extus glabro intus piloso; lobis ovatis obtusis 2.25 mm. longis 1.5 mm. latis apice marginibus cucullato-incrassatis glabris; antheris oblongis 1 mm. longis 0.3-0.4 mm. latis; filamentis 1.8-1.9 mm. longis liberis; stigmatibus anguste oblongis 1 mm. longis papillosis; fructus coccis valde compressis 2.2 mm. longis 1.5 mm. latis.

TYPE: *Glaziou* 21502 (holotype F, isotypes B, BR, F, K, P) "entre Rio Tocantins et Os Porcos, Goyaz, Brazil, Janvier-Fevrier."

PARATYPE: *Dawson* 14163 (F, LAM), open grassland and cerrado border 20 km. north of São João da Aliança, region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 30′, Goiás, April 13, 1956 (as to specimen with glabrous bracts and peduncles).

The species indicated as new in Glaziou's "Plantae Brasiliae centralis a Glaziou lectae" published in various fascicles (Bull. Soc. Bot. Fr. Mem. 3 a- 3 g: 1-661. 1905-1912) have been treated by a number of botanists as a catalogue of names or *nomina nuda* (Harms, 1924, p. 123; Cowan, 1957, pp. 16-17). In the present instance (K. Schumann ex Glaziou, 1909, p. 359), the only words, "Frutescent, fl. blanches" used in the publication of *Declieuxia dasyphylla* are insufficient for identification. Many botanists might construe such brevity as insufficiently detailed to constitute a description, and would therefore consider it a *nomen nudum.* Other botanists, however, might be inclined to accept such names as valid, arguing that a description can involve the mention of but a single word.

In order to assure the perpetuation of Schumann's name and to eliminate any future doubts as to its usage, I have provided the above detailed description of this species. This has seemed prudent, because 1) the name is widely distributed in herbaria, and 2) by various botanists might be construed as already validly published, although inadequately described.

Of the two sheets of *Declieuxia dasyphylla* preserved in the herbarium of Chicago Natural History Museum, one bears a leafy stem with an inflorescence, originally part of a specimen sent from the herbarium of the Muséum National d'Histoire Naturelle at Paris. The other sheet consists of a fragment and photograph of a specimen from the herbarium of the Botanical Garden of the Botanisches Museum at Berlin-Dahlem. I have indicated the latter sheet (fragment and photo from the Berlin-Dahlem herbarium) as the actual holotype. Both specimens have glabrous bracts and peduncles.

One of the specimens collected by Dawson has the bracts and peduncles glabrous, as in the material examined of *Glaziou* 21502, and designated by me as holotypic and isotypic. The other Dawson specimen has the bracts and peduncles minutely hispidulous-ciliolate. As this character differs from typical *D. dasyphylla* as seen in the holotype, isotype, and paratype at the Chicago Natural History Museum herbarium, I am designating it as follows:

Declieuxia dasyphylla f. **ciliolata** f. nov.

Peduncles and bracts minutely hispidulous-ciliolate.

A *f. dasyphylla* pedunculis bracteisque minute hispidulo-ciliolatis differt.

TYPE: *Dawson* 14163a (holotype R, isotypes F, LAM), open grassland and cerrado border 20 km. north of São João da Aliança, region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 30′, Goiás, Brazil, April 13, 1956 (as to specimen with hispidulous-ciliolate bracts and peduncles).

Declieuxia fruticosa (Willd.) Kuntze 14993 A widespread species of Colombia, Venezuela, Brazil, and Paraguay.

Declieuxia fruticosa (Willd.) Kuntze 14265 This collection represents the extreme pubescent variation found in the species, which is synonymous with *D. chiococcoides* H.B.K. Mueller Argoviensis (1881, pp. 441-445) described a number of varieties of *D. chiococcoides*, varying in leaf shape, pubescence of stems and leaves, and glabrity or pubescence of fruits. Until the variations of this group have been carefully restudied, it is not possible at present to assign a given varietal name to the present collection. Because of its lance-elliptical leaves, acute at the base, and pubescent fruits, the present collection would fall somewhere between *D. chiococcoides* var. *puberula* and var. *guyanensis* (= *D. fruticosa* var. *guyanensis* [M. Arg.] Standl.).

Declieuxia oenanthoides M. Arg. var. *stenophylla* M. Arg. 14725 The variety has been known previously from Goiás, Minas Gerais, and São Paulo. The species is a Brazilian one, limited to the few states mentioned above.

Diodia angustata sp. nov. Figs. 13, 14

Stems ascending, cinereous-hispidulous with crowded subfasciculate hairs up to 1.5 mm. long; middle internodes 3.5-5 cm. long; leaves subcoriaceous, narrowly lanceolate or linear-lanceolate, sessile, 2.5-6 cm. long, 2-8 cm. wide, acuminate, margins entire, strongly revolute, mostly glabrous except sometimes with a few, short, rigid hairs near the base, lateral nerves 4-5 on each side, prominent below; stipular sheaths 3-4 mm. long, densely hirtellous with the larger setae 3-7 mm. long; inflorescences mostly terminal, sometimes axillary, few-flowered; flowers

Fig. 13. *Diodia angustata* sp. nov. The holotype specimen, x 1.0.

3-5; bracts prominent, broadly lanceolate, 5-7 mm. long; calyx 4-fid, 8-9.5 mm. long, lobes equal, lanceolate, 4.5-6 mm. long, 0.8-1 mm. wide; hypanthium turbinate, 4 mm. long, hispidulous without; corolla infundibuliform, 9-9.5 mm. long, tube 4.5-5 mm. long, hirsute within at the base, lobes 4, oblong-ovate, acute, 4.5 mm. long, 2.5 mm. wide, hirsute without, glabrous within; stamens 4, shorter than the corolla lobes; filaments glabrous, 3 mm. long; stigma capitate-globose, subbilobate.

Herbacea perennis basi lignescente caulibus adscendentibus superne parce ramosis saltem ad 2 dm. longis 1-2 mm. diam. cinereo-hispidulis pilis subfasciculatis confertis ad 1.5 mm. longis praeditis post delapsum praesertim inferne epidermidis cortice fusco obtectis; ramis alternis vel oppositis inaequilongis; internodiis mediis 3.5-5 cm. longis; foliis subcoriaceis angustate lanceolatis vel lineari-lanceolatis sessilibus 2.5-6 cm. longis 2-8 mm. latis acuminatis mucronatis basin versus valde angustatis marginibus valde revolutis integris utrinque plerumque glabris interdum basin versus utroque pilis brevibus rigidis praeditis, nervis lateralibus valde adscendentibus utroque 4-5 supra valde sulcatis subtus prominentibus; vaginis stipularibus 3-4 mm. longis dense hirtellis, setis plurimis majoribus 3-7 mm. longis ciliatis instructis; inflorescentiis plerumque terminalibus interdum axillaribus paucifloris, floribus 3-5; bracteis prominentibus late lanceolatis 5-7 mm. longis setoso-mucronatis hispidulis; calyce 8-9.5 mm. longo 4-fido, lobis aequilongis lanceolatis 4.5-6 mm. longis 0.8-1 mm. latis hypanthio longioribus acuminatis apice setoso-mucronatis, setis 0.5 mm. longis, extus intusque hispidulis; hypanthio turbinato 4 mm. longo apice 3.5 mm. lato extus hispidulo; corolla infundibuliformi 9-9.5 mm. longa, tubo 4.5-5 mm. longo basi intus hirsuto, lobis 4 oblongo-ovatis acutis 4.5 mm. longis 2.5 mm. latis extus hirsutulis intus glabris; staminibus 4 lobis corollae brevioribus, antheris oblongis 2.5 mm. longis 0.8 mm. latis; filamentis glabris 3 mm. longis 0.5 mm. latis; stylo glabro 8 mm. longo; stigmate capitato-globoso subbilobato 0.5 mm. diam.; seminibus ignotis.

TYPE: *Dawson* 14672 (holotype R, isotypes F, LAM, US), collected on grassy hillslope near canyon bottom in sandstone area 14 km. south of Veadeiros, region of the Chapada dos Veadeiros at W. Long. 47° 30′, S. Lat. 14° 15′, Goiás, Brazil, April 24, 1956.

This species appears to be most closely related to *D. radula* Cham. & Schl., from which it differs in the narrower and more nearly glabrous leaves, mostly terminal inflorescences, prominent bracts, hairs on the stem in close tufts or fascicles, and the longer calyx lobes.

I am indebted to Dr. Lyman B. Smith, Curator, Division of Phane-

rogams, United States National Museum, for his courtesy in comparing this collection with critical material in the herbarium of that institution, and for his discriminating comments.

Diodia teres Walt. 14193 A widespread species, extending from tropical America northward to the United States.

Guettarda viburnoides Cham. & Schl. 14432 This species has been collected previously from Goiás, as well as from Minas Gerais, Bahia, São Paulo, Rio de Janeiro, Maranhão, Paraná, Matto Grosso, and Ceará, and in Paraguay.

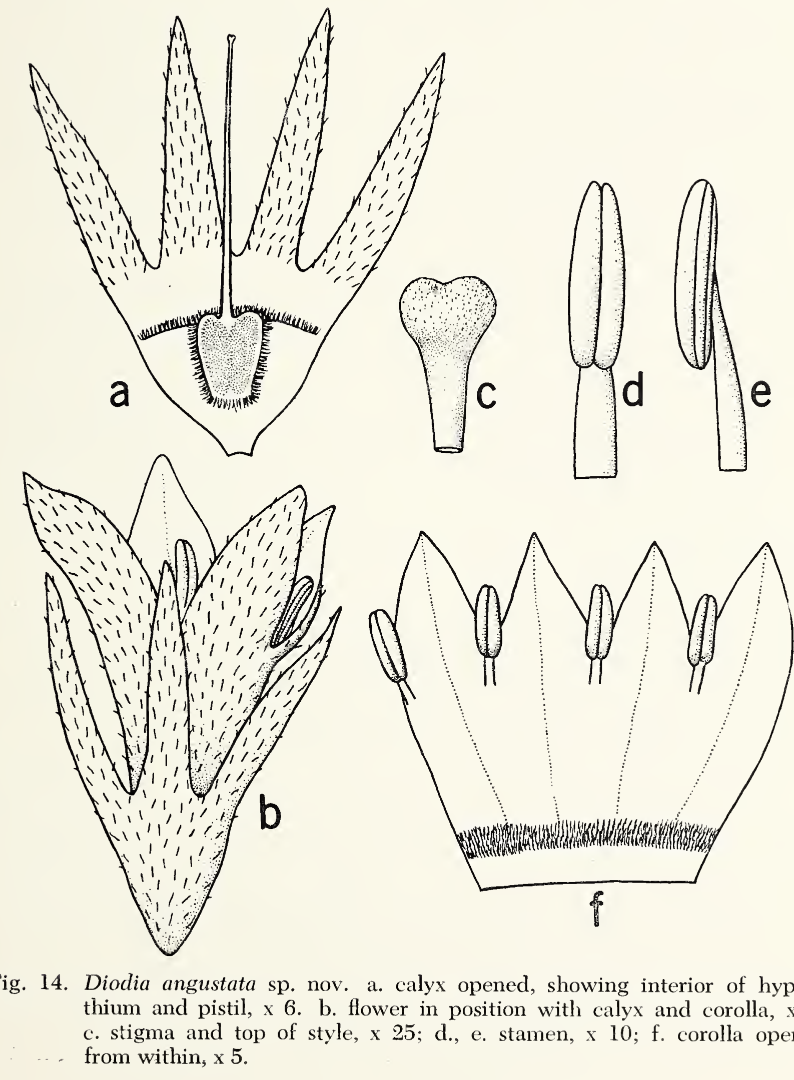

Fig. 14. *Diodia angustata* sp. nov. a. calyx opened, showing interior of hypanthium and pistil, x 6. b. flower in position with calyx and corolla, x 5; c. stigma and top of style, x 25; d., e. stamen, x 10; f. corolla opened from within, x 5.

Manettia cordifolia Mart. 15043; 15075 A widely distributed species occurring from Peru to Argentina.

Mitracarpus recurvatus Standley 14583 Previously known only from the holotype collection (*Glaziou* 21511 from "Goyaz (?)" in Kew Herb.), the present collection is the first good flowering material known. The original material, Standley noted (1931, p. 385), is in a condition "so far past flowering that it is difficult to determine satisfactorily the characters of the inflorescence." For this reason, the following discrepancies may be stated as occurring between the measurements given in the original description and those taken from the Dawson collection: the sepals (calyx lobes) in *Dawson* 14583 are 2.5 mm. instead of 1-1.5 mm. long; the corolla tube in *Dawson* 14583 measures 3-4 mm. instead of "fere" 2 mm. long; the corolla lobes of the *Dawson* collection are 1.5 mm. instead of 0.7 mm. long and are elliptic-oblong. These floral differences are, doubtless, based upon the more poorly preserved state of the flowers in the holotype collection.

Palicourea rigida H. B. K. 15054 A widely distributed species in South America, previously know from Goiás.

Psychotria barbiflora DC. 14569 A fairly widely distributed species in Brazil. Also known from British Guiana, Venezuela, and Colombia.

Psychotria formosa Cham. & Schl. 14753 A Brazilian species, previously known from Goiás. Also known from Pará and Minas Gerais. It is said to be economically important because of its toxicity to cattle.

Psychotria trichophora M. Arg. 14472 This species is known only from Goiás. The original collection (*Pohl* 2053) was taken along the Rio Maranhâo.

Psychotria xanthophylla M. Arg. 14151 A Brazilian species known from Goiás, Minas Gerais, and São Paulo.

Psyllocarpus laricoides Mart. & Zucc. 14619 This species is common in Minas Gerais. This is the first record from Goiás. It has also been collected in Brazil in Bahia and Rio de Janeiro.

Relbunium noxium (St. Hil.) K. Schum. 14249 The holotype was collected in Minas Gerais. This is the first record from Goiás. The species is distributed from Peru and Bolivia to Brazil and Uruguay.

Tocoyena formosa Schumann 14191 A fairly widely distributed species in Brazil; also ranging north to British Guiana and Surinam, and south and west to Paraguay and Bolivia.

Ucriana longifolia Spreng. 14843 A monotypic genus, previously known from Goiás. It is confined to a sector of Brazil from Maranhâo south to Rio de Janeiro and west to Matto Grosso.

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No. 1. The Machris Brazilian Expedition. General Account, by Jean Delacour. 11 pp., 4 figures. January 23, 1957.

No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson. 20 pp., 5 figures, 2 maps. January 24, 1957.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii*, by T. G. Yuncker. 2 pp., 1 figure. January 25, 1957.

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No. 20. Further Bird Remains from the San Diego Pliocene, by Loye Miller and Robert I. Bowman. 15 pp., 5 figures. March 6, 1958.

No. 21. The Machris Brazilian Expedition. Botany: Phanerogamae, Euphorbiaceae, Lentibulariaceae, Rubiaceae, by Julian A. Steyermark, 31 pp., 14 figures. April 21, 1958.

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

ber 22 April 21, 1958

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Gramineae

By Jason R. Swallen[1]

The present paper continues the reports of the plants collected by E. Yale Dawson on the recent expedition to Goiás, Brazil, sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. Seventy-two collections of grasses were obtained, among which were five new species. The rest of the collections represent, for the most part, well known, rather wide-spread species. For convenience, the arrangement is alphabetical rather than taxonomic.

Specimens bearing field numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13-May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15-June 10, 1956. For more detailed locality data see Number 2 of this series.

The first set of specimens is in the Los Angeles County Museum. A second set, nearly complete, is deposited in the U. S. National Herbarium. Holotypes will be deposited in the Museu Nacional, Rio de Janeiro, with the exception of that of *Ichnanthus goiasensis* which was collected at an earlier date by Agnes Chase and is part of the collections of the U. S. National Museum.

Andropogon acuminatus sp. nov. **Fig. 1**

Perennis; culmi caespitosi, 1-1.3 m. alti, glabri, in parte superiore ramosi; vaginae internodiis breviores, teretes, glabrae; ligula membranacea, truncata, 0.5-1 mm. longa; laminae lineares, usque ad 26 cm. longae, 3-4 mm. latae, glabrae, apice acuminatae; racemi 10-20, solitarii,

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stricti, 8-12 cm. longi, parte inferiore in vagina inclusa, pedunculo 1-2 cm. longo; rachis glabra, basi pilis longis praedita; pedicellus sterilis margine uno longiciliatus; spicula sessilis 6 mm. longa, acuminata, minute bifida, ecarinata, apice plana, marginibus pilis albis 3-4 mm. longis praedita; gluma secunda compressa, carinata, acuminata, marginibus hyalinis, in parte inferiore minute ciliata; lemma fertile 4 mm. longum, acuminatum, hyalinum, marginibus in parte inferiore minute ciliatis; arista super basim ⅓ inserta, 2 cm. longa, geniculata, infra geniculum tortilis; spicula pedicellata 4.5-5 mm. longa, acuminata, scabra, arista recta, gracili, 5-7 mm. longa, scabra.

Perennial; culms tufted, erect, 1-1.3 m. tall, glabrous, branching in the upper half; sheaths shorter than the internodes, rounded, glabrous; ligule membranaceous, truncate, 0.5-1 mm. long; blades linear, as much as 26 cm. long, 3-4 mm. wide, glabrous, the tip acuminate; racemes 10-20, solitary, strict, 8-12 cm. long, partly enclosed in the narrow sheath, the peduncle 1-2 cm. long; rachis joints glabrous on the back and margins, bearded at the base, gradually enlarged to the summit; sterile pedicel similar to the rachis joint but conspicuously long-ciliate on one side; sessile spikelet 6 mm. long, acuminate or minutely bifid, the back rounded, flattened toward the narrow tip, the margins conspicuously covered with white hairs 3-4 mm. long; second glume laterally compressed, keeled, acuminate, the hyaline margins minutely ciliate in the lower half; fertile lemma 4 mm. long, acuminate, hyaline, the margins finely ciliate in the lower half, bearing a geniculate awn 2 cm. long inserted ⅓ above the base, the lower segment tightly twisted, brown, about 7 mm. long, the terminal segment slender, scabrous, straight, loosely spiral or twisted; pedicellate spikelet 4.5-5 mm. long, erect, acuminate, scabrous, with a slender, erect, loosely twisted scabrous awn 5-7 mm. long.

TYPE: *Dawson* 14604, collected on sandstone outcrop, 7 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956.

Andropogon hirtiflorus (Nees) Kunth 14143; 14841
Andropogon microstachyus Desv. 14140
Andropogon tener (Nees) Kunth 14187a
Aristida capillacea Lam. 14478; 15196
Aristida circinalis Lindm. 14606
Aristida implexa Trin. 14145
Aristida recurvata H.B.K. 14137; 14147
Axonopus brasiliensis (Spreng.) Kuhlm. 14772
Axonopus chrysoblepharis (Lag.) Chase 14202

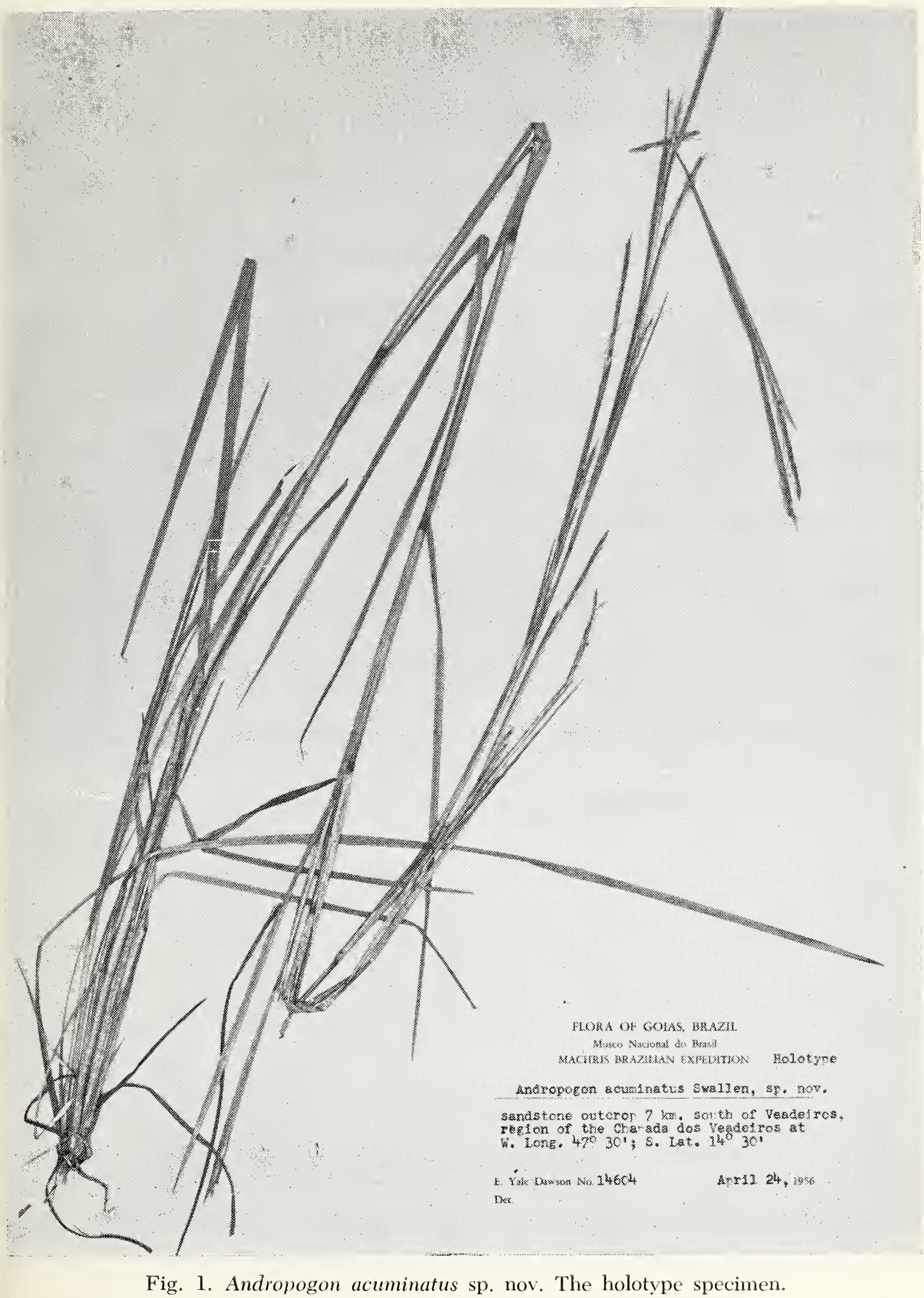

Fig. 1. *Andropogon acuminatus* sp. nov. The holotype specimen.

Cenchrus brownii Roem. & Schult. 15123
Ctenium chapadense (Trin.) Doell 14220
Ctenium cirrosum (Nees) Kunth 14139; 14216
Diectomis fastigiatus (Swartz) H.B.K. 14487; 15173
Digitaria horizontalis Willd. 15096
Echinolaena inflexa (Poir.) Chase 14138
Eleusine indica (L.) Gaertn. 15171
Eragrostis compacta Steud. 14178; 14186
Eragrostis rufescens Schrad. 15170
Eriochloa distachya H.B.K. 14256
Gymnopogon foliosus (Willd.) Nees 14628
Gymnopogon spicatus (Spreng.) Kuntze 14144; 14548
Hyparrhenia bracteata (Humb. & Bonpl.) Stapf 14234
Hyparrhenia rufa (Nees) Stapf 14814; 15095; 15198

Ichnanthus amplifolius sp. nov. **Fig. 2**

Perennis (?); culmi erecti plus minusve ramosi, plus quam 1 m. alti; vaginae condensatae, glabrae vel summam versus plus minusve ciliatae; ligula membranacea, 0.5 mm. longa; laminae usque ad 26 cm. longae, 4.5 cm. latae, acuminatae, basi subcordatae, scaberulae, marginibus scabrae, basi plus minusve ciliatae; paniculae usque ad 30 cm. longae, ramis 10-16 cm. longis, superioribus gradatim brevioribus, ramulis brevibus adscendentibus vel patentibus; spiculae 3.6-4mm. longae, brevipedicellatae, appressae, glabrae; gluma prima acuminata, 3-nervia, lemmate sterili paulo longior vel brevior; gluma secunda plerumque lemmate sterili longior, acuta vel subacuminata, 5-nervia; lemma sterile flosculo paulo longior, cucullatum; palea lemma aequans; flosculus 3 mm. longus, 0.7 mm. latus, acutus, pallidus, cicatricibus 0.6-0.7 mm. longis.

Perennial (?); culms probably erect, more or less branching, more than 1 m. tall; sheaths crowded (at least toward the summit of the culm and the ends of the branches), glabrous or somewhat ciliate near the summit; ligule membranaceous, not ciliate, 0.5 mm. long; blades as much as 26 cm. long, 4.5 cm. wide, acuminate, narrowed toward the rounded subcordate base, scaberulous, the margins finely scabrous, more or less ciliate at the base; panicles as much as 30 cm. long, the branches stiffly ascending, mostly 10-16 cm. long, gradually shorter toward the summit, with short, stiffly ascending or spreading branchlets; spikelets 3.6-4 mm. long, short-pedicellate, appressed on the branchlets, glabrous; first glume acuminate, 3-nerved, a little longer or shorter than the sterile lemma, the tip awn-like; second glume usually longer than the sterile lemma, acute or subacuminate, 5-nerved; sterile lemma longer than the fruit, 5-nerved, cucullate, enclosing a

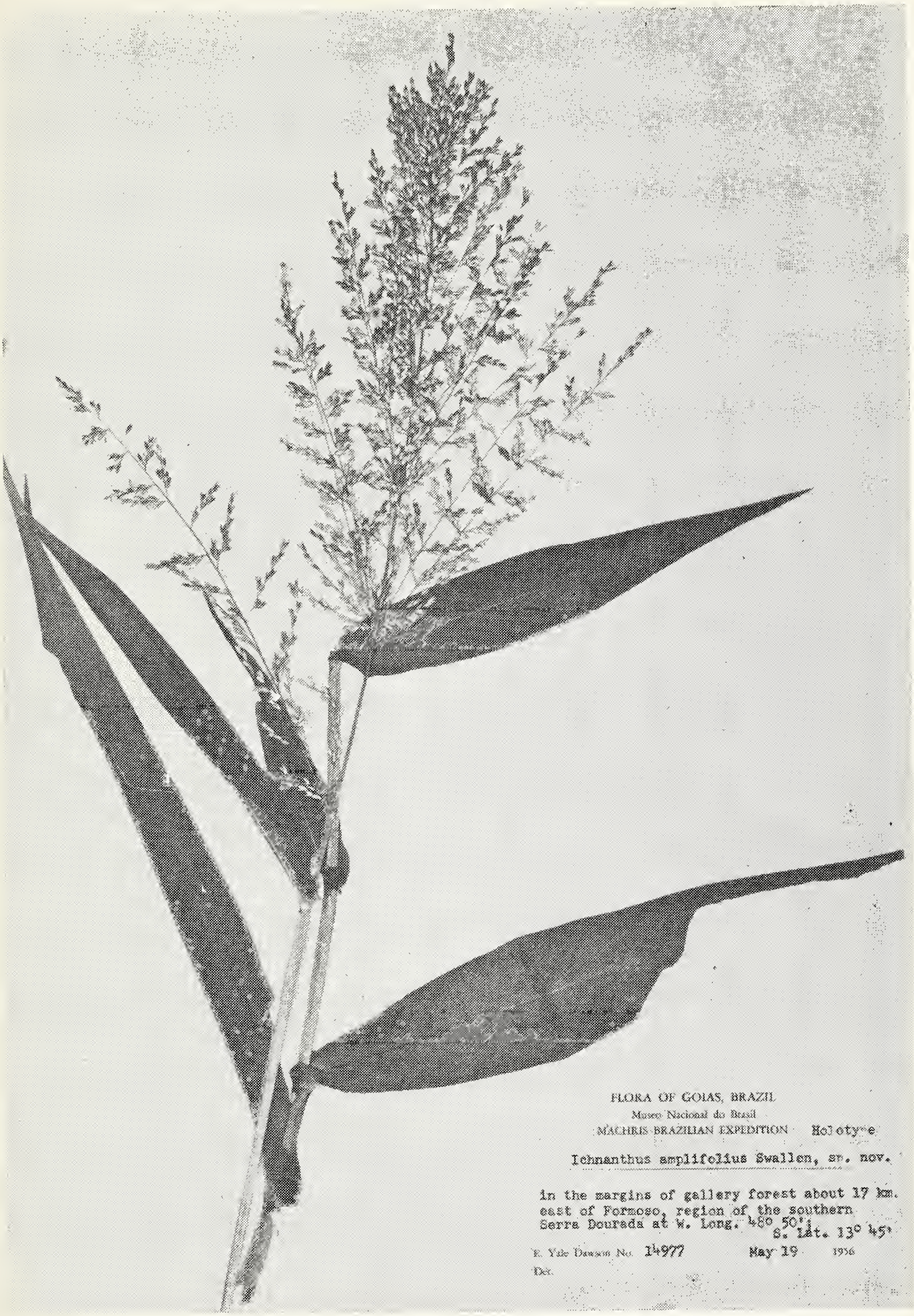

Fig. 2. *Ichnanthus amplifolius* sp. nov. The holotype specimen.

palea as long as the lemma, and a well developed staminate flower; fertile floret 3 mm. long, 0.7 mm. wide, acute, straw-colored, the prominent scars 0.6-0.7 mm. long.

TYPE: *Dawson* 14977, collected in gallery forest along stream, 17 km. east of Formoso, region of the southern Serra Dourada, Goiás, Brazil, May 19, 1956.

Also collected on banks and margins of small stream running through hilly cerrado, 20 km. east of Formoso, *Dawson* 14867; and forest along road, 13 km. east of Formoso, *Dawson* 15133.

Ichnanthus demazianus Hack. 14591

Ichnanthus goiasensis sp. nov. **Fig. 3**

Perennis; culmi elongati, ramosi, pilosi vel villosi, internodiis numerosis brevibus; vaginae pilosae vel villosae, superiores condensatae; laminae lanceolatae vel ovato-lanceolatae, subcordatae, 3.5-8 cm. longae, pubescentes vel pilosae, marginibus scabrae; panicula ca. 6 cm. longa, ramis dense floriferis, adscendentibus vel patentibus, inferioribus 2-3 cm. longis, basi dense pilosis; spiculae 3.4-3.6 mm. longae, appressae; gluma prima lemma sterile plus minusve aequans, 3-nervia, marginibus pilosa; gluma secunda lemmate sterili paulo longior, 5-nervia, subacuminata, apice scabra et interdum pilosa; lemma sterile acutum, 5-nervium, glabrum; flosculus 2.4 mm. longus, anguste ellipticus, acutus, pallidus, glaber, lucidus, cicatricibus 0.6-0.8 mm. longis.

Perennial; culms elongate, arching, rather freely branching, softly pilose or villous, with numerous relatively short internodes; sheaths pilose or villous, those of the main culm and lower part of the branches much shorter than the internodes, becoming crowded toward the end of the branches; blades lanceolate or ovate-lanceolate, subcordate. 3.5-8 cm. long, pubescent or pilose on both surfaces, the margins very scabrous; inflorescence about 6 cm. long, usually partly enclosed in the sheath, the densely flowered branches ascending to spreading, the lower ones 2-3 cm. long, densely pilose at the base; spikelets 3.4-3.6 mm. long, paired, unequally pedicellate, appressed on two sides of the narrow rachis; first glume about as long as the sterile lemma including the scabrous awn-like tip, 3-nerved, irregularly pilose on the margins; second glume a little longer than the sterile lemma, 5-nerved, subacuminate, the tip scabrous and sometimes sparsely pilose; sterile lemma acute, 5-nerved, glabrous; fertile floret 2.4 mm. long, narrowly elliptic, acute, pale, smooth and shining, the prominent scars 0.6-0.8 mm. long.

TYPE: *Agnes Chase* 11578, collected in wood border, Goiandira, Goiás, Brazil, 820-825 meters altitude, March 26-27, 1930.

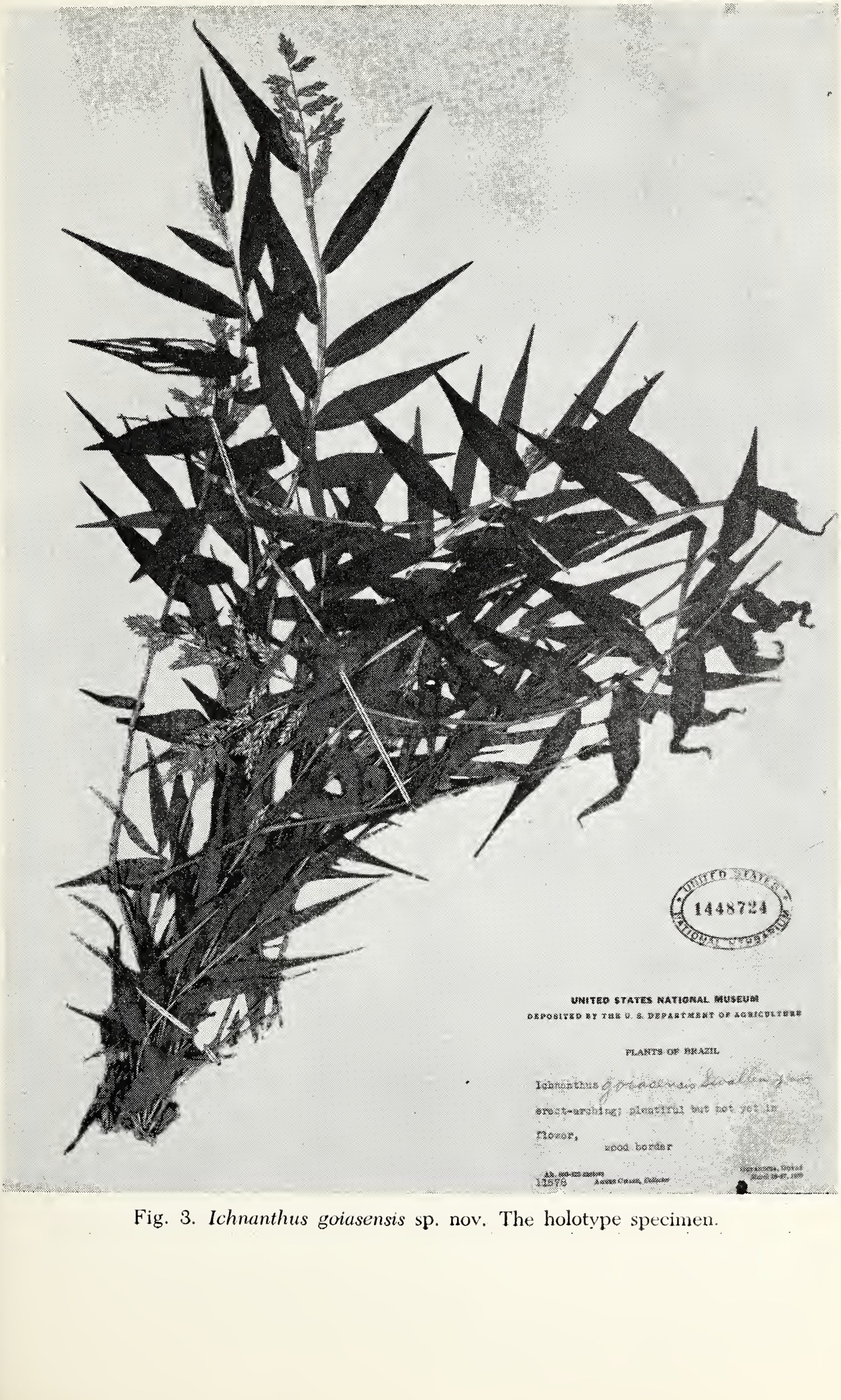

Fig. 3. *Ichnanthus goiasensis* sp. nov. The holotype specimen.

A second collection of this species was obtained along shaded dry creek in hilly cerrado area, 23 km. north of São João da Aliança, region of the Chapada dos Veadeiros, Goiás, Brazil, *Dawson* 14272.

Ichnanthus pallens (Swartz) Munro 14390
Lasiacis ligulata Hitchc. & Chase 15027a
Leptochloa virgata (L.) Beauv. 15174
Melinis minutiflora Beauv. 14563; 15033
Olyra latifolia L. 14510
Oplismenus hirtellus (L.) Beauv. 14504
Panicum campestre Nees 14442
Panicum carannasense Mez 14667; 14789
Panicum cervicatum Chase 14554a

Panicum chapadense sp. nov. **Fig. 4**

Perenne adscendens; culmi 110 cm. alti, basi bulbosi; vaginae glabrae, inferiores internodiis longiores, superiores elongatae internodiis breviores; ligula ciliata, ca. 1 mm. longa; laminae inferiores usque ad 17 cm. longae, 2.4 cm. latae, sursum gradatim minores, subcordatae, acuminatae, dense pubescentes vel subglabrae, marginibus basim versus ciliatae; inflorescentia 10-19 cm. longa, 2.5-4 cm. lata, densa, ramis numerosis adscendentibus vel patentibus usque ad 2.5 cm. longis; rachis angusta, basi plerumque pubescens vel pilosa; spiculae 2.2-2.4 mm. longae, secundae, breviter pedicellatae; gluma spicula ½ brevior, acuta, 3-nervia, scabra; gluma secunda et lemma sterile aequalia vel subaequalia, acuta, 5-nervia, minute scabra, lemma marginibus crinitum, gluma marginibus pilis paucis; flosculus stipitatus, 1.3-1.4 mm. longus, anguste ellipticus, acutus, pallidus, glaber, lucidus.

Ascending perennial; culms 110 cm. long, the base bulbose; sheaths glabrous, the lower ones longer than the internodes, the upper ones much shorter than the somewhat elongate internodes; ligule ciliate, about 1 mm. long; lower blades as much as 17 cm. long, 2.4 cm. wide, progressively smaller upward, subcordate, acuminate, rather densely pubescent on both surfaces or nearly glabrous, the margins ciliate toward the base; inflorescence 10-19 cm. long, 2.5-4 cm. wide, dense, with numerous ascending to spreading crowded racemes as much as 2.5 cm. long, these becoming shorter and more crowded upward; rachis narrow, usually densely pubescent or pilose at the base; spikelets 2.2-2.4 mm. long, secund on one side of the rachis, somewhat laterally compressed, the pedicels less than one-half as long as the spikelets; first glume a little more than half as long as the spikelet, acute, 3-nerved, scabrous; second glume and sterile lemma equal or subequal, acute, minutely scabrous, 5-nerved, or the glume sometimes 3-nerved,

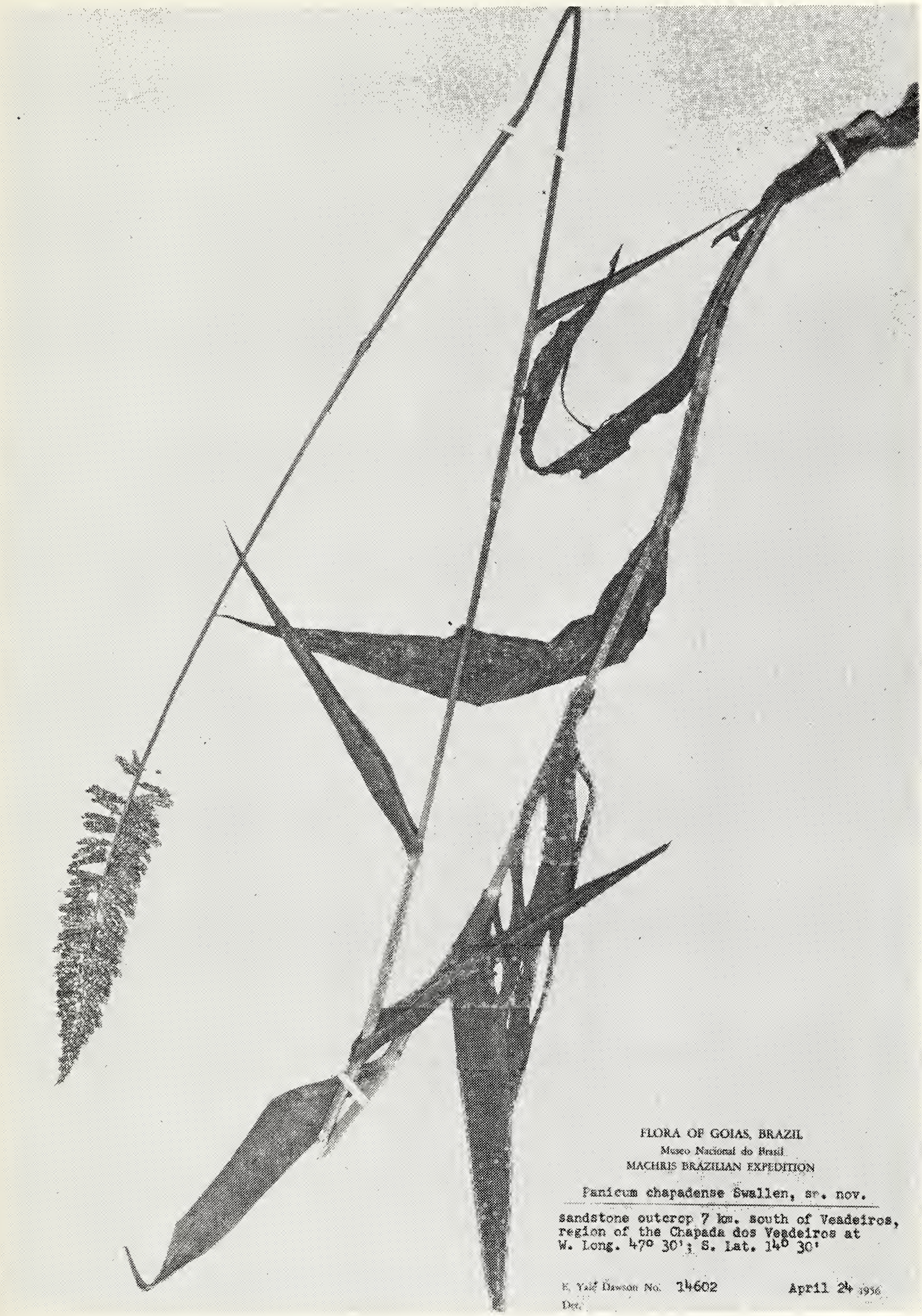

Fig. 4. *Panicum chapadense* sp. nov. The holotype specimen.

the lemma conspicuously ciliate-fringed, with a well developed palea, the glume sometimes with a few hairs on the margins; fruit stipitate, 1.3-1.4 mm. long, narrowly elliptic, acute, pale, smooth and shining.

TYPE: *Dawson* 14602, collected on sandstone outcrop, 7 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956.

This species belongs to the Laxa group of *Panicum*, but differs from all other species in the conspicuously fringed sterile lemma and the bulbose base of the culm.

Panicum machrisiana sp. nov. **Fig. 5**

Annuum; culmi gracillimi, erecti vel patentes, ramosissimi, 9-12 cm. longi, glabri; vaginae plerumque internodiis multo breviores, superiores glabrae vel sparse pilosae; ligula hyalina, ca. 1 mm. longa; laminae 8-16 mm. longae, 1-4 mm. latae, acutae, glabrae; paniculae 1.5-2.5 cm. longae, ramis filiformibus, reflexis, flexuosis, spiculis 1-3 longipedicel-

Fig. 5. *Panicum machrisiana* sp. nov. The holotype specimen, x 1.

latis; spiculae 1.4-1.5 mm. longae, acutissimae, sparse papilloso-pilosae; gluma prima angusta, hyalina, enervia, spicula ½ brevior; gluma secunda et lemma sterile subaequalia, acutissima, 5-nervia; flosculus 1.1-1.2 mm. longus, tenuis, albus, glaber, lucidus.

Annual; culms very slender, erect or spreading, freely branching, 9-12 cm. long, glabrous; sheaths usually much shorter than the internodes, the lower ascending pilose, the upper glabrous or with a few hairs; ligule thin, about 1 mm. long; blades 8-16 mm. long, 1-4 mm. wide, acute, glabrous; panicles 1.5-2.5 cm. long, the filiform branches reflexed, flexuous, bearing one to three long-pedicellate spikelets, the pedicels filiform, reflexed; spikelets 1.4 mm. long, sharply pointed, sparsely papillose-pilose; first glume very narrow, hyaline, nerveless, a little less than half as long as the spikelet; second glume and sterile lemma subequal, very acute, 5-nerved; fertile floret 1.5 mm. long, relatively thin, white, smooth and shining.

TYPE: *Dawson* 14679, collected on sandstone rocky area, on west bank of stream, 14 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 25, 1956.

This distinctive species is related to *Panicum pandum* Swallen, having the same habit and spikelet shape. The latter differs, however, in having stiffer panicle branches, pilose foliage, the first glume 1-nerved, and a larger, dark colored, minutely pubescent fruit.

Panicum macranthum Trin. 14554
Panicum parvifolium Lam. 14788
Panicum pilosum Swartz 14389
Panicum pseudisachne Mez 14629
Paspalum carinatum Humb. & Bonpl. 14154
Paspalum geminiflorum Steud. 14135
Paspalum scalare Trin. 14678
Paspalum stellatum Humb. & Bonpl. 14142; 14215
Paspalum strigosum Doell 14388
Paspalum rectum Nees 14879
Paspalum trachycoleon Steud. 14863
Pennisetum setosum (L.) Rich. 15172
Raddiella nana (Doell) Swallen 14956
Setaria tenacissima Schrad. 14916
Sorghastrum stipoides (H.B.K.) Nash 14239
Thrasya petrosa (Trin.) Chase 14141; 14185; 14840
Trachypogon mollis Nees 14136
Trichachne insularis (L.) Nees 15100
Tristachya chrysothrix Nees 14605

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ber 23 June 25, 1958

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: PHANEROGAMAE

ALSTROEMERIACEAE AND OTHER FAMILIES

BY LYMAN B. SMITH AND COLLABORATORS

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and itineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Alstroemeriaceae and other families

By LYMAN B. SMITH[1] AND COLLABORATORS

The plant collections reported upon below were obtained by E. Yale Dawson, Expedition Botanist, and are cited by his field collection numbers. Detailed locality data for these may be found in his general account of the botany of the Expedition[2]. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13-May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15-June 10, 1956.

The families are arranged alphabetically. The treatments are by L. B. Smith unless otherwise indicated.

The first set of specimens, including isotypes of the three new species, is deposited in the Los Angeles County Museum.

ALSTROEMERIACEAE
(Amaryllidaceae – Tribe Alstroemerieae)

Alstroemeria brasiliensis Spreng. 14204; 14818 A species of Minas Gerais and Goiás. The present material shows great variation in the bracts and rays of the umbel and casts grave doubt on their value in making distinctions between species.

Reference: A. Schenk, Fl. Brasiliensis 3, pt. 1: 171-180. 1855.

BOMBACACEAE

Bombax marginatum (St.-Hil.) K. Schum. 14495; 15235 The flowers of number 15235 attain 16 cm. in length but such large size is probably not significant in this variable species.

Reference: K. Schumann, Fl. Brasiliensis 12, pt. 3: 201-250. 1886.

CAMPANULACEAE (Lobelioideae)
det. by Rogers McVaugh, University Herbarium
University of Michigan, Ann Arbor, Michigan

Centropogon cornutus (L.) Druce 14532 Central America and the Lesser Antilles to Bolivia and Brazil.

Siphocampylus corymbiferus Pohl 14571 Bolivia, central Brazil.

[1]Curator, Division of Phanerogams, U.S. National Museum, Smithsonian Institution, Washington, D.C.

[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2): 1-20.

COMMELINACEAE

Commelina virginica L. 14666 Common in tropical and subtropical America.

Floscopa glabrata (Kunth) Hassk. 14959; 15132 Widely distributed in Brazil and Paraguay.

? *Phaeosphaerion persicariifolium* (DC.) C. B. Clarke 14972 The lack of fruit in the specimen makes determination uncertain. Vegetative characters vary greatly but seem to indicate this widespread species of the American tropics. I am following Woodson (Ann. Missouri Bot. Gard. 29: 150. 1942) in using *Phaeosphaerion* instead of *Athyrocarpus*.

Reference: C. B. Clarke in DC. Monogr. Phan. 3: 113-324. 1881.

CONVOLVULACEAE

Evolvulus lagopodioides Meissn. 14797 A species of Minas Gerais and Goiás.

Ipomoea alba L. (*Calonictyon album* House) 15008 Pantropical.

Ipomoea hederifolia L. (*Quamoclit coccinea hederifolia* House) 14975 Tropical and subtropical America.

Ipomoea martii Meissn. 14978 Pernambuco, Minas Gerais and Goiás.

Ipomoea tubata Nees 14377 Venezuela, Brazil.

Merremia cissoides (Lam.) Hallier 14505 Tropical and subtropical America.

Merremia tomentosa (Choisy) Hallier (*Batatas tomentosa* Choisy; *Ipomoea tomentosa* Pohl ex Meissn.) 14155 Central and eastern Brazil.

Note: Determinations were made in this family largely by comparison with material in the United States National Herbarium annotated by the late Dr. Carlos A. O'Donell, who had large revisions under preparation at his untimely end.

References: C. F. Meissner, Fl. Brasiliensis 7: 199-370. 1869. *Evolvulus*: S. J. van Ooststroom, A Monograph of the Genus Evolvulus 1-267. 1934. *Merremia*: C. A. O'Donell, Lilloa 6: 467-554. 1941.

LILIACEAE

Herreria glaziovii H. Lecomte 14995 Heretofore this species was known from the type, *Glaziou* 14354, and one other specimen, both without locality data. We now find that it is native in southern Goiás, a region in which Glaziou collected extensively.

Reference: K. Krause, Nat. Pflanzenfamilien, ed. 2, 15a: 276. 1930.

MARANTACEAE

Monotagma plurispicatum (Koern.) K. Schum. 14895 Tropical South America especially the Amazon Basin.

Reference: K. Schumann, Pflanzenreich IV. Fam. 48: 1-184. 1902.

SCROPHULARIACEAE

Bacopa monierioides (Cham.) Robinson (*B. ranaria* (Benth.) Chodat & Hassler). 15150 This species ranges from Amazonas to Minas Gerais and Paraguay but judging from collections, is of rather infrequent occurrence.

Buchnera palustris (Aubl.) Spreng. 14646; 14795 Tropical South America.

Buchnera virgata H. B. K. 14609 Colombia, Venezuela, Guiana, Brazil.

Esterhazya macrodonta Cham. & Schlecht. 14614 Minas Gerais, São Paulo. Apparently a new record for Goiás.

Esterhazya splendida Mikan 14217; 15060 No attempt is made to assign a form name here, because the variation of the leaves can be so great on a single plant. The species is widespread in central Brazil from Bahia to Matto Grosso and São Paulo.

Lindernia barrosorum L. B. Smith, sp. nov. Figs. 1, 2

Ab omnibus speciebus brasiliensibus facie subaquatica, caulibus tumidis, staminum anteriorum dimidia parte fertili differt.

Plant subaquatic, glabrous; stems simple or branched, at least 4 dm. long, 4 mm. in diameter, tumid, prostrate and rooting at the nodes, the internodes 5-25 mm. long; leaves sessile, entire, very variable, those toward the base of the stem linear, acuminate, 18 mm. long, 2 mm. wide, those near the apex elliptic with a broad base of attachment, acute, 8 mm. long, 4 mm. wide; inflorescence laxly racemose; bracteal leaves distinctly reduced; pedicels filiform, 15-25 mm. long, erect at anthesis, deflexed in fruit; sepals free, unequal, the posterior linear, 2.5 mm. long, the anterior lanceolate, 3 mm. long; corolla 15 mm. long, pale blue, the posterior lip short, bifid, the anterior lip of 3 large suborbicular lobes with dark blue markings at base; posterior stamens fertile, anterior stamens branched, the erect branch sterile and capitate, the horizontal branch fertile; stigma 2-lobed; capsule (immature) slenderly ellipsoid, 7 mm. long; seeds deeply pitted.

TYPE: Museu Nacional do Brazil, Rio de Janeiro, collected in flowing rivulet 35 km. southwest of Peixe on the Peixe-Porangatú road, Goiás, Brazil, June 2, 1956, by E. Yale Dawson (No. 15158). Isotypes in the

Fig. 1. *Lindernia barrosorum* sp. nov. The holotype specimen.

United States National Herbarium, the Los Angeles County Museum, and the Jardim Botânico do Rio de Janeiro.

The specific name is in honor of Dr. Liberato Joaquim Barroso and Dra. Graziela Maciel Barroso whose scholarly treatment of the Brazilian Scrophulariaceae greatly facilitated the identification of the collections listed here.

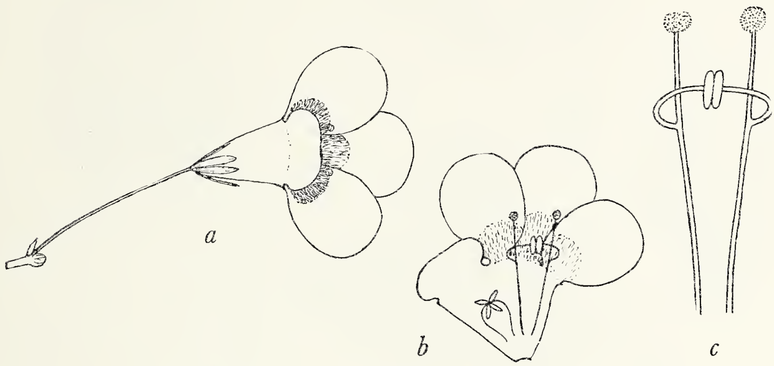

Fig. 2. *Lindernia barrosorum* sp. nov. a. Flower x 2; b. dissected corolla x 2; c. anterior stamens x 5.

Scoparia dulcis L. 14438; 14988; 15155 A pantropical weed.

SOLANACEAE

det. by C. V. Morton, Division of Ferns, U. S. National Museum, Smithsonian Institution, Washington, D.C.

Solanum crinitum Lam. 14283 French Guiana, Brazil. Probably includes *S. jubatum* Willd. and *S. cyananthum* Dunal.

Solanum nigrum L. var. *americanum* Miller 14391 General in tropical America.

Solanum tenellum Bitter 14938 Brazil. This is probably no more than a variety of *S. nigrum*.

STERCULIACEAE

Byttneria dawsonii L. B. Smith, sp. nov. Figs. 3, 4

A *B. benensis* Britton, cui affinis, pilis stellatis subappressis minutissimis, dentibus foliorum erectis haud patentibus, pedicellis paulo supra medium distincte articulatis differt.

Vine, unarmed; indument of younger parts minute, stellate, white, subappressed; stems slightly flexuous, slender; stipules deciduous, lanceolate, 1.5 mm. long, red-brown; petioles slender, to 45 mm. long; leaves broadly ovate or elliptic-ovate, abruptly acuminate, deeply

Fig. 3. *Byttneria dawsonii* sp. nov. An isotype specimen.

cordate at base, 10.5 cm. long, 6 cm. wide, green, soon essentially glabrous, the nerves prominent on both sides, the gland basal on the midnerve beneath; inflorescence on short lateral branches, subumbellate, about 10-flowered, the peduncle 8 mm. long; bracts like the stipules, deciduous; pedicels slender, 7 mm. long, articulate slightly above the middle; calyx 6 mm. long, the lobes lanceolate, acuminate, 4.5 mm. long, 1-nerved, pale green; petals spatulate, cucullate, 2 mm. long, whitish, the slenderly cylindric ligule 2.5 mm. long, pubescent toward base; stamen tube 0.5 mm. long, staminodes bidentate; ovary subglobose, coarsely echinate.

TYPE: Museu Nacional do Brasil, Rio de Janeiro, collected by roadside along openly vegetated stream 23 km. east of Formoso, region of the southern Serra Dourada at W. Long. 48° 50′; S. Lat. 13° 45′, Goiás, Brazil, May 21, 1956, by E. Yale Dawson (No. 15042). Isotypes in the United States National Herbarium and the Los Angeles County Museum.

Curiously enough *Byttneria dawsonii* is widely different from all Brazilian species and bears its closest resemblance to *B. benensis* of Bolivia. The combination of prominent veins on both sides of the leaf and leaves that are ovate and cordate make it quite impossible to relate it to anything in the "Flora Brasiliensis."

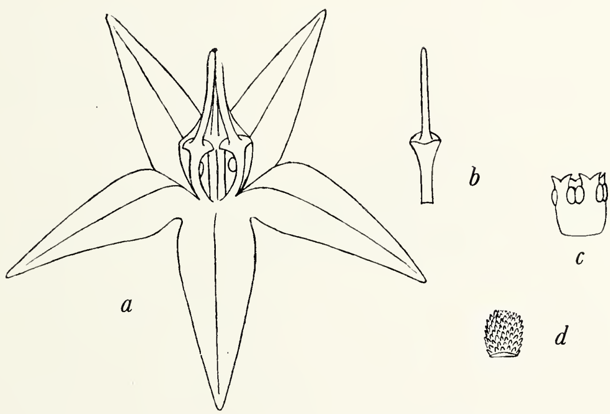

Fig. 4. *Byttneria dawsonii* sp. nov. a. Flower x 5; b. petal, ventral side x 5; c. androecium x 5; d. ovary x 5.

Byttneria melastomifolia St.-Hil. 14817 Endemic in Goiás.
Helicteres guazumifolia H. B. K. 15182 Tropical America.
Helicteres macropetala St.-Hil. 14997 Rio de Janeiro (?), Minas Gerais, Goiás.

Helicteres sacarolha St.-Hil. 14214; 14914 São Paulo, Minas Gerais, Goiás.

Waltheria americana L. 14197 Tropical and subtropical.

Waltheria ferruginea St.-Hil. 14368; 15037 Piauí, Bahia, Minas Gerais. Apparently the first record for Goiás.

Waltheria machrisiana L. B. Smith, sp. nov. Figs. 5, 6

A *W. viscosissima* St.-Hil., cui affinis, inflorescentiae ramis graciliori-bus, inferioribus folia multo superantibus, petiolis brevibus, glandulis calycis stipitatis, alibi sessilibus minutissimis differt.

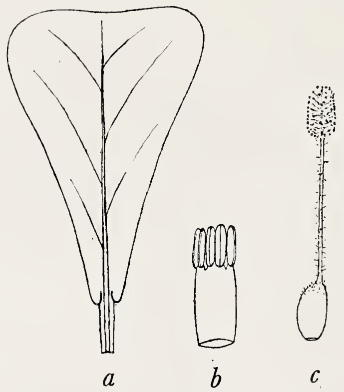

Fig. 6. *Waltheria machrisiana* sp. nov. a. Petal x 5; b. androecium x 5; c. pistil x 5.

Shrub, except for the flowers vestite with a mixture of fine white non-glandular hairs and minute sessile nearly colorless glands; stems straight or slightly flexuous, very slender; stipules linear-lanceolate, acuminate, subfalcate, 4 mm. long; petioles slender, those of the upper leaves 3 mm. long; leaves ovate or lance-ovate, acuminate, broadly rounded and shallowly cordate at base, to 9.5 cm. long and 5 cm. wide, thin, crenate-serrate, green above, whitish green beneath; inflorescences terminal with foliaceous bracts, very laxly paniculate with the flowers in small dense clusters at the ends of the branches, the lowest branches spreading, much longer than their foliaceous subtending bracts; pro-phyllae unequal, linear, acuminate; flowers sessile; calyx 4 mm. long, the lobes linear, acuminate; petals 8 mm. long, bright yellow when dry, the claws linear, the blades broad, spreading; stamen tube about 1 mm. long in the presumably longistylous flower, anthers oblong, 1 mm. long; pistil 7 mm. long, white-pilose.

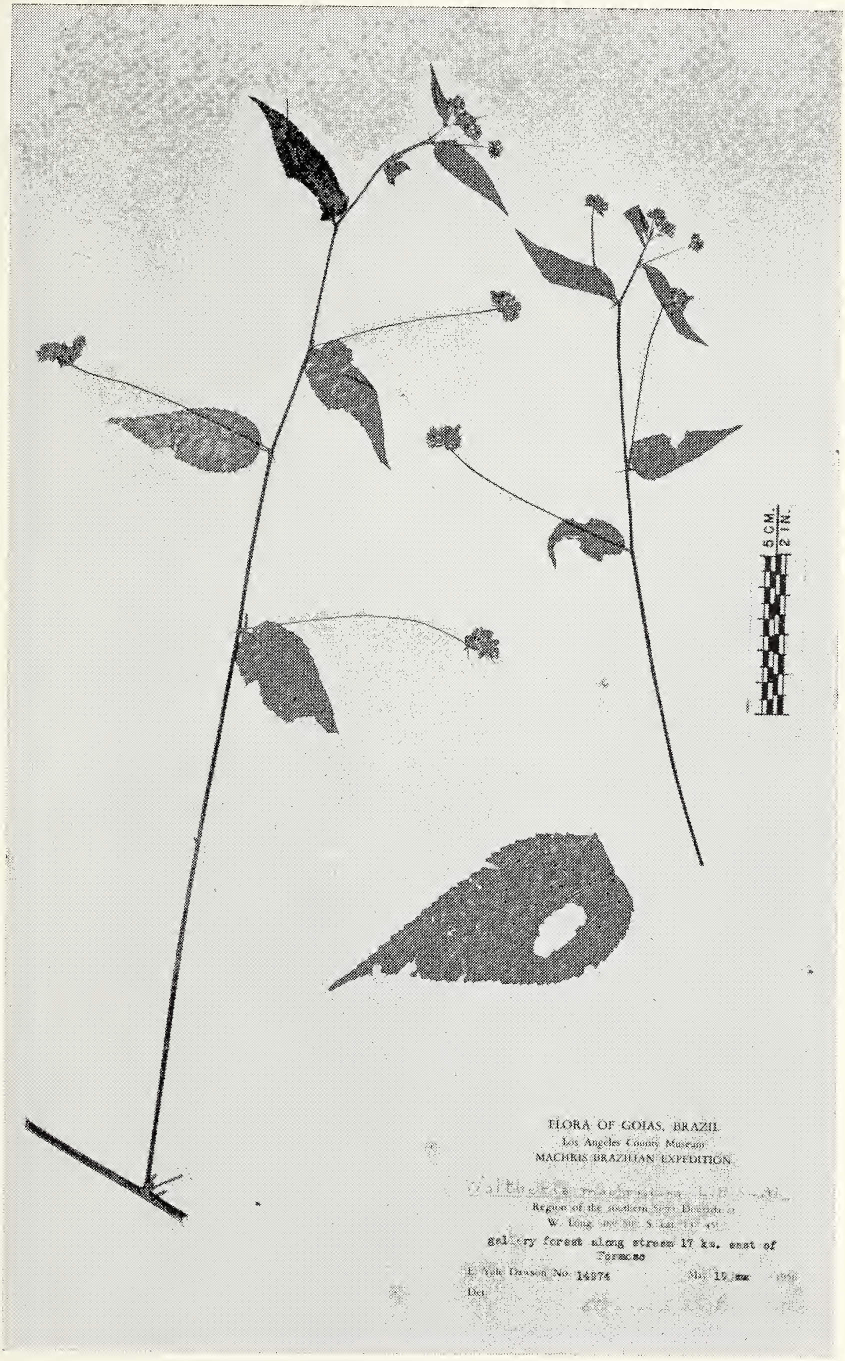

Fig. 5. *Waltheria machrisiana* sp. nov. An isotype specimen.

TYPE: Museu Nacional do Brasil, Rio de Janeiro, collected in gallery forest along stream 17 km. east of Formoso, region of the southern Serra Dourada at W. Long. 48° 50'; S. Lat. 13° 45', Goiás, Brazil, May 19, 1956, by E. Yale Dawson (No. 14974). Isotypes in the United States National Museum and the Los Angeles County Museum.

Melochia

det. by Aaron Goldberg, Animal Parasite Laboratory
U. S. Department of Agriculture, Beltsville, Maryland.

Melochia pyramidata L. 15098 Pantropical weedy shrub.

Melochia villosa (Mill.) Fawcett & Rendle (*M. hirsuta* Cav.) 14247 Tropical America.

Reference: K. Schumann, Fl. Brasiliensis 12, pt. 3: 1-114. 1886.

VITACEAE

Cissus erosa L. C. Rich. 15078 Tropical America.

Cissus scabricaulis (Baker) Planch. 14677 Minas Gerais, Goiás.

References: J. G. Baker, Fl. Brasiliensis 14, pt. 2: 197-220. 1871. J. E. Planchon in DC. Monogr. Phan. 5: 305-637. 1887.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ber 24 June 25, 1958

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Fungi

By G. W. Martin
and Collaborators

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

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THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Fungi

By G. W. Martin[1] and Collaborators

This report continues the accounting of specimens obtained during 1956 in the Serra Dourada and on the Chapada dos Veadeiros of Goiás, Brazil, by Expedition botanist E. Yale Dawson. Detailed locality data are given in the second paper of this series.[2] Of the 43 specimens of fungi received, all but two or three were in condition for at least tentative determination. In addition, cultures were made from the debris accompanying a number of the collections. As might be expected, numerous colonies of *Aspergillus* and *Penicillium* appeared in such plates, but no attempt was made to determine them, particularly since there was no assurance that they might not have been introduced in handling the specimens during and after shipment. Also, as is usual in material of this sort, *Trichoderma viride* appeared in a large number of plates. A few species, however, seemed clearly to be derived from the collections, with little chance that they represented contaminants. These are included below.

Specimens representing particular groups were sent for determination to various specialists whose names are indicated below wherever the material was not determined by the writer. Others advised on certain difficult species, and Dr. William Bridge Cooke has described the single *Phlebia* included as new. To all these persons grateful acknowledgment is extended.

PHYCOMYCETES

Mucorales

? *Mucor hiemalis* Wehmer

The mold referred to this species appeared on a number of plates sprinkled with debris from different collections. Two such isolates were sent to Dr. C. W. Hesseltine who identified them as belonging to the *Micor hiemalis* group.

[1]Professor of Botany, Emeritus, State University of Iowa, Iowa City, Iowa.

[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2):1-20.

ASCOMYCETES

Pyrenomycetes

Acrospermum compressum Tode ex Fr. 15106

Determined by Dr. J. H. Miller, who noted that this species usually occurs on dead plant parts. In the present collections the fungus was conspicuously abundant on the leaves of a living plant in a roadside cerrado area 20 km. east of Formoso in the southern Serra Dourada.

Cordyceps denterigena Berk. & Br. 14945 On a fly. Determined by Dr. E. B. Mains.

Cordyceps unilateralis (Tul.) Sacc. 14946 On an ant. Determined by Dr. E. B. Mains.

? *Daldinia eschscholzii* (Ehrenb.) Rehm. 14990 Determined by Dr. J. H. Miller. "Too badly damaged to be determinable with certainty."

Gelasinospora cerealis Dowding Isolated from 15106. Determined by Dr. R. F. Cain (GWM 8911).

BASIDIOMYCETES

Auriculariaceae

Auricularia fusco-succinea (Mont.) Farl. 15134
Auricularia polytricha (Mont.) Sacc. 15097

Thelephoraceae

All determined by Dr. Paul L. Lentz.

Hymenochaete sallei Berk. & Curt. 14517
Stereum ostrya (Blume & Nees ex Fr.) Fr. 14567
Stereum papyrinum Mont. 14536

Clavariaceae

Clavicorona pyxidata (Fr.) Doty 14463 Commonly referred to as *Clavaria pyxidata* Fr.

Meruliaceae

Phlebia faviformis W. B. Cooke sp. nov. Fig. 1

Dimidiata, supra pallida, tomentosa, zonata; hymenio rubro-fusco, subgelatinoso, merulioidi, interne hymenochaetoidi; trichodermato amplo; hyphis septatis, non nodoso-septatis; sporis non visis.

Pileus dimidiate, with small portion appressed to the substratum; surface whitish-grey, hymenium dark red-brown in older portions, fading to white at margin; dimidiate portion up to 1.5 cm wide and 4 cm long, with a well-developed trichoderm arranged in concentric zones, up to 0.2 mm thick, tough; tissues arranged much as in *Stereum;* older portions of pileus formed of densely interwoven yellowish hyphae more or less loosely interwoven toward the surface producing the trichoderm hyphae; hyphae pale yellowish, 3.5-5.5μ in diameter, the tissue, when compacted, appearing brown, yellow to nearly white when loosely arranged; brown amorphous granules present in context near older portions of surface layers of hyphae; toward the hymenium, hyphae less densely interwoven, giving rise to the compact subhymenium formed of dendroid branching hyphae 2.5-3μ in diameter; clamps not seen, but in the subhymenium these, if present, are obscured by the tightly compact irregular branching; all hyphae branching, septate, without clamps; subhymenial hyphae becoming arranged in parallel position perpendicular to the context and giving rise to the compact hymenium; hymenium appearing as a palisade of hypha-like cells which may be septate; terminal cell of each hypha-like member of the palisade appearing to be a basidial initial, hyaline, less thick-walled, appearing to become elongated at maturity, at first 25-36 x 3-4μ, swelling slightly in expanding and becoming 4-4.5μ in diameter, reaching beyond the hymenium and occasionally producing four protrusions which appear to be sterigmatic initials; in cross section, hymenial tissues appearing like the honey-comb type characteristic of the Hymenochaetaceae; no mature basidia nor spores seen; no sterile organs present in hymenium or subhymenium; hymenium covering phlebioid folds radiating out from central attachment positions and subsidiary centers.

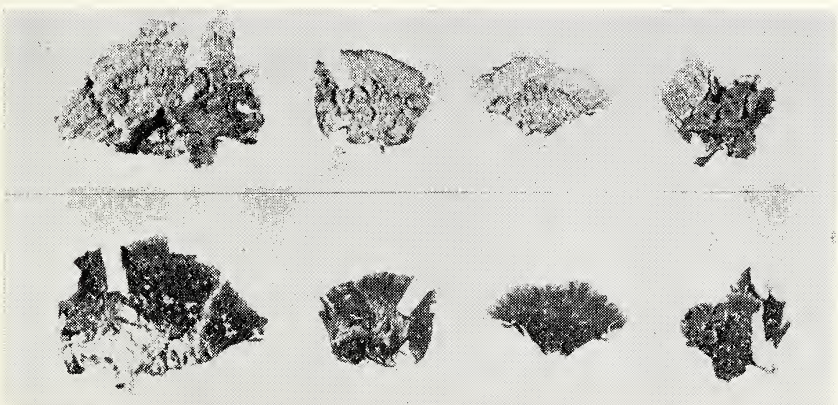

Fig. 1. *Phlebia faviformis* W. B. Cooke. Four specimens from the type collection, x 1. The upper row shows the superior surfaces, and the lower row the under surfaces.

The specimen is unusual in that the basidia are honey-comb-like in the sense of Cunningham; the tissues are like those of *Stereum,* and the hymenium covers folds such as are found in the genus to which it is assigned. The context and hymenial tissues exclude it from the genus *Punctularia (Phaeophlebia).*

TYPE: *Dawson* 14700 (holotype R; isotype LAM), collected on bridge timbers, 21 km. N. of São João da Aliança, region of the Chapada dos Veadeiros, Goiás, Brazil, at W. Long. 47° 30′, S. Lat. 14° 30′.

POLYPORACEAE

Determined by Mr. John A. Stevenson except as indicated.

Favolus brasiliensis Fr. 15022

Favolus fimbriatus Speg. 15108 Possibly not distinct from *F. brasiliensis.*

Fomes fastuosus (Lév.) Cke. 15088 On a forest tree.

Fomes marmoratus (Berk. & Curt.) Cke. 15199

Fomes perlevis Lloyd 14991 This is perhaps closer to *F. demidoffii* (Lév.) Sacc. & Syd., but that species is of temperate climates and occurs on coniferous wood.

Fomes ribis (Schum. ex Fr.) Gill. 14568 Determined by J. L. Lowe as "the thin tropical form."

Ganoderma sessile Murr. 14516a

Xerotus erubescens (Berk.) Singer comb. nov. 14517a

Daedalis erubescens Berk. Notice on some Fungi collected by C. Darwin, Esq., during the Expedition of H. M. Ship Beagle, Ann. Mag. Nat. Hist. 4:292. 1840. Saccardo (Syll. Fung. 5:645. 1887) transferred it to Lenzites and referred that genus and *Xerotus* to the agarics. Singer (Lilloa 22:735, 744 [1949] 1951) gave valid reasons for regarding both genera, despite the superficial gill-like configuration of the hymenium, as more nearly related to the polypores.

Polyporus caryophyllus Cke. 14958

Polyporus conchoides (Mont.) Lloyd 15019

Polyporus gayanus Lév. 14896 Determined by Dr. & Mme. O. Fidalgo.

Polyporus leonotus Kalchbr. 15103 *Trametes viellata* Torrend is the same.

Polyporus pinsitus Fr. 14699

Polyporus sanguineus L. ex Fr. 14557; 15031; 14690 On a fallen palm leaf.

Polystictus brasiliensis Lloyd 14321; 14702 A manuscript name of Lloyd's, not validly published. Possibly a *Trametes.*

Trametes richenii Rick 14698 A nomen nudum?
Trametes rigida Berk. & Mont. 14696; 14943
Trametes fumoso-avellanea Romell 15127

AGARICACEAE

Panus crinitus (L. ex Fr.) Singer 14328 Determined by Dr. Rolf Singer.

Pleurotus ostreatus (Jacq. ex Fr.) Kummer 14697; 14570

Determined by Dr. Rolf Singer with the comment, "or very close." The specimens were not in good condition, but 14570 appears to be the typical small tropical form of *P. ostreatus.*

Schizophyllum radiatum Fr. 14701 Regarded by many as merely the tropical phase of *S. commune* Fr.

Schizophyllum umbrinum Berk. 15195 On base of old palm leaf.

GASTEROMYCETES

Podaxis pistillare (Pers.) Desv. 14802 On a termite mound.

If regarded as a modified agaric, which, in my opinion, it is, the correct name is *Podaxon pistillaris* Fr.

FUNGI IMPERFECTI

Myrothecium verrucaria [A. & S.] Ditmar ex. Fr. Isolated from No. 15097 (GWM 8918).

Spicaria griseola Sacc. Isolated from No. 14991 (GWM 8926).

Trichoderma viride Fr. This appeared in nearly all cultures.

LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

No. 1. The Machris Brazilian Expedition. General Account, by Jean Delacour.

No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii,* by T. G. Yuncker.

No. 4. The Machris Brazilian Expedition. Botany: The Lichens, by Carroll W. Dodge.

No. 5. The Machris Brazilian Expedition. Botany: Cyanophyta, by Francis Drouet.

No. 6. The Machris Brazilian Expedition. Botany: A New Mint from Goiás, *Hyptis machrisae,* by Carl Epling.

No. 7. The Machris Brazilian Expedition. Botany: Phanerogamae, various smaller families, edited by E. Yale Dawson.

No. 8. Notes on Eastern Pacific Insular Marine Algae, by E. Yale Dawson.

No. 9. A New Species of Passerine Bird from the Miocene of California, by Hildegarde Howard.

No. 10. The Machris Brazilian Expedition. Botany: A New Columnar Cactus from Goiás, by E. Yale Dawson.

No. 11. The Machris Brazilian Expedition. Botany: Chlorophyta; Euglenophyta, by G. W. Prescott.

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No. 13. The Machris Brazilian Expedition. Botany: Phanerogamae, Leguminosae, by Richard S. Cowan.

No. 14. The Machris Brazilian Expedition. Entomology: Gelastrocoridae (Hemiptera), by E. L. Todd.

No. 15. Marine Algae of the Pacific Costa Rican Gulfs, by E. Yale Dawson.

No. 16. A Classification of the Oscines (Aves), by Jean Delacour and Charles Vaurie.

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No. 18. The Machris Brazilian Expedition. Botany: Musci, by Howard Crum.

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No. 21. The Machris Brazilian Expedition. Botany: Phanerogamae, Euphorbiaceae, Lentibulariaceae, Rubiaceae, by Julian A. Steyermark.

No. 22. The Machris Brazilian Expedition. Botany: Gramineae, by Jason R. Swallen.

No. 23. The Machris Brazilian Expedition. Botany. Phanerogamae, Alstroemeriaceae and other families, by Lyman B. Smith and collaborators.

No. 24. The Machris Brazilian Expedition. Botany: Fungi, by G. W. Martin and collaborators.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ıber 25 August 15, 1958

MIOCENE SULIDS of SOUTHERN CALIFORNIA

By Hildegarde Howard

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

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MIOCENE SULIDS OF SOUTHERN CALIFORNIA

By Hildegarde Howard

Sixteen species of fossil birds of the family Sulidae are now on record. Of these, five occur in three Middle Miocene localities of southern California, as follows:

Lompoc, Santa Barbara County (Miller, 1925)
Sula willetti Miller
Morus lompocana (Miller)
Miosula media Miller

Sharktooth Hill, Kern County (Wetmore, 1930)
Morus vagabundus Wetmore

Lomita, Los Angeles County (Miller, 1935)
Sula stocktoni Miller

Since Miller's latest Miocene record (1935), a second representative of the family has been found in the Lomita deposits, and sulid specimens have been discovered at two new localities in Los Angeles County, one in the San Fernando Valley, the other in El Sereno. These new occurrences are here recorded.

San Fernando Valley

Two specimens of fossil Sulidae have been recovered from a site on Ventura Blvd., near Whitsett Avenue, in Studio City. The first of these was given to this museum in May, 1954, by Howard Vein. This is a single bone, which the young student brought to the Museum still embedded in the shale matrix. Upon preparation, it was found to be a partial humerus (right) of a small sulid. Except for some fragmentation at the ends, the internal side of the element is preserved; the deltoid crest, external tuberosity, distal condyles (except the entepicondyle) and external contour of the shaft are missing; the proximal contour of the head is incomplete. The pneumatic fossa and internal contour of the bicipital crest are preserved, albeit with some apparent distortion. The length of the specimen, lacking the complete contour of the head and the internal distal condyle, is 145 mm. The length of the humerus in the type of *Sula willetti* is recorded (Miller, 1925, p. 114) as 156 mm. In view of the fact that precise measurements are impossible on either specimen (in all Lompoc fossils the bone had completely disintegrated leaving only the impression), the size of the single humerus suggested allocation with *S. willetti*. However, in the hope that further material might be obtained, allocation was withheld.

A second specimen from the San Fernando Valley locality was brought to the Museum in December, 1957, by Michael and Terry Pohl, of Studio City, California. The boys had collected the fossil two years before. This specimen, consisting of wing bones, sternum and furcula, occurs in two slabs of diatomaceous shale, and is represented by mineralized and greatly fragmented bone, as well as impressions.

The ulnar side of the right humerus is exposed on one slab, and by preparation the region of the pneumatic fossa has been revealed. The contour of this area shows marked resemblance to the specimen recovered in 1954 from the same locality, and I have no hesitation in contending that the two specimens represent separate individuals of the same species.

Description of the specimen on the slabs is complicated by the fact that the humerus and ulna of the left side are shorter than those of the right, and the shaft of the left humerus appears more curved. The right and left carpometacarpi, on the other hand, agree in length. As they are lying in place adjacent to the two ulnae, it is strongly suggested that the right and left wing bones represent the same individual. It is important, however, to determine which bones may be considered normal for the species. The humeri are in slightly different positions in the matrix; the right is tipped slightly toward the internal side, the left is lying with the ulnar surface straight down on one slab. This latter (left humerus) may be slightly warped. The ulnae do not appear to differ in their positions in the slab, but the left one is overlain by the left coracoid and scapula, and is broken where the bones cross; telescoping may have occurred at this point. There is nothing to suggest any abnormality in length or shape of the right humerus and ulna, and as the exposed proximal area of the humerus of this side so closely resembles the humerus collected in 1954, it is considered likely that the bones of the right side represent normalcy.

There are sufficient skeletal parts represented on these slabs to afford satisfactory comparison with the type of *Sula willetti,* and on the basis of a number of characters the two show specific distinction. Comparison with other Tertiary sulids also shows differences, to be pointed out below, that mark the Pohl skeleton as a species new to science.

Sula pohli, new species

(Figs. 1-2)

Type.—L.A. Co. Mus. no. 2674. Bones of right and left wing and wing girdle (proximal end of ulnar side of right humerus exposed by preparation), sternum and furcula exposed on slab of diatomaceous shale. Collected, 1955, by Michael and Terry Pohl for whom the species is named.

Locality and Age.—L.A. Co. Mus. Vert. Paleon. loc. no. 1229, Ventura Blvd. between Whitsett Ave. and Coldwater Canyon Road, Studio City, California; Middle Miocene.

Diagnosis.—Ulna longer than humerus; humerus with distal contour relatively straight, bicipital crest deeply indented in outer contour, pneumatic fossa narrowly triangular, and ulnar surface near proximal end angular and sloping from median line towards bicipital and pectoral crests; coracoid relatively short from sternocoracoidal process to head; sternum with short, deep carina.

Cotype.—Pohl Mus. no. PV 68, reverse of type slab with same skeletal elements present; left coracoid exposed by preparation.

Referred material.—L.A. Co. Mus. no. 2532, single right humerus recovered by Howard R. Vein, 1954, from type locality.

Comparisons with Recent sulids.—Similar to *Sula* as contrasted with *Morus* as follows: ulna noticeably longer than humerus; coracoid relatively narrow and short from procoracoid to head; humerus angular between pectoral and bicipital crests on ulnar surface near proximal end. Distinguished from available specimens of Recent *Sula leucogaster, S. dactylatra, S. nebouxi,* and *S. sula* as follows: humerus with outer contour of bicipital crest more markedly indented below median crest, pneumatic fossa narrower and more angular, ligamental furrow (palmar side as seen in referred specimen no. 2532) broader and more deeply incised, condyles and epicondyles of more nearly equal distal development, giving distal contour a straight, square appearance; sternum with carina shorter and deeper, closest to *Sula sula websteri;* coracoid longer relative to length of sternum and humerus, and its posterior sternal facet (as seen in left coracoid on reverse slab) relatively deeper.

Comparisons with fossil sulids.—Of the sixteen fossil sulids heretofore known, four are represented by partial skeletal impressions in shale; the others are known only from disassociated, usually incomplete single elements. Comparisons are difficult to make; the single elements reveal characters in some detail, whereas the skeletal impressions show proportions, but very little detail. However, by use of Recent species as a means of cross reference, it has been possible to determine that the new species is indeed distinct from those previously described.

Basing the possible size range of *Sula pohli* on specimens of Recent *Sula leucogaster brewsteri* in the collections of the Los Angeles County Museum (see Tables I and III), seven of the other fossil species exceed

Fig. 1. *Sula pohli,* new species. Type specimen. Approx. x ½.

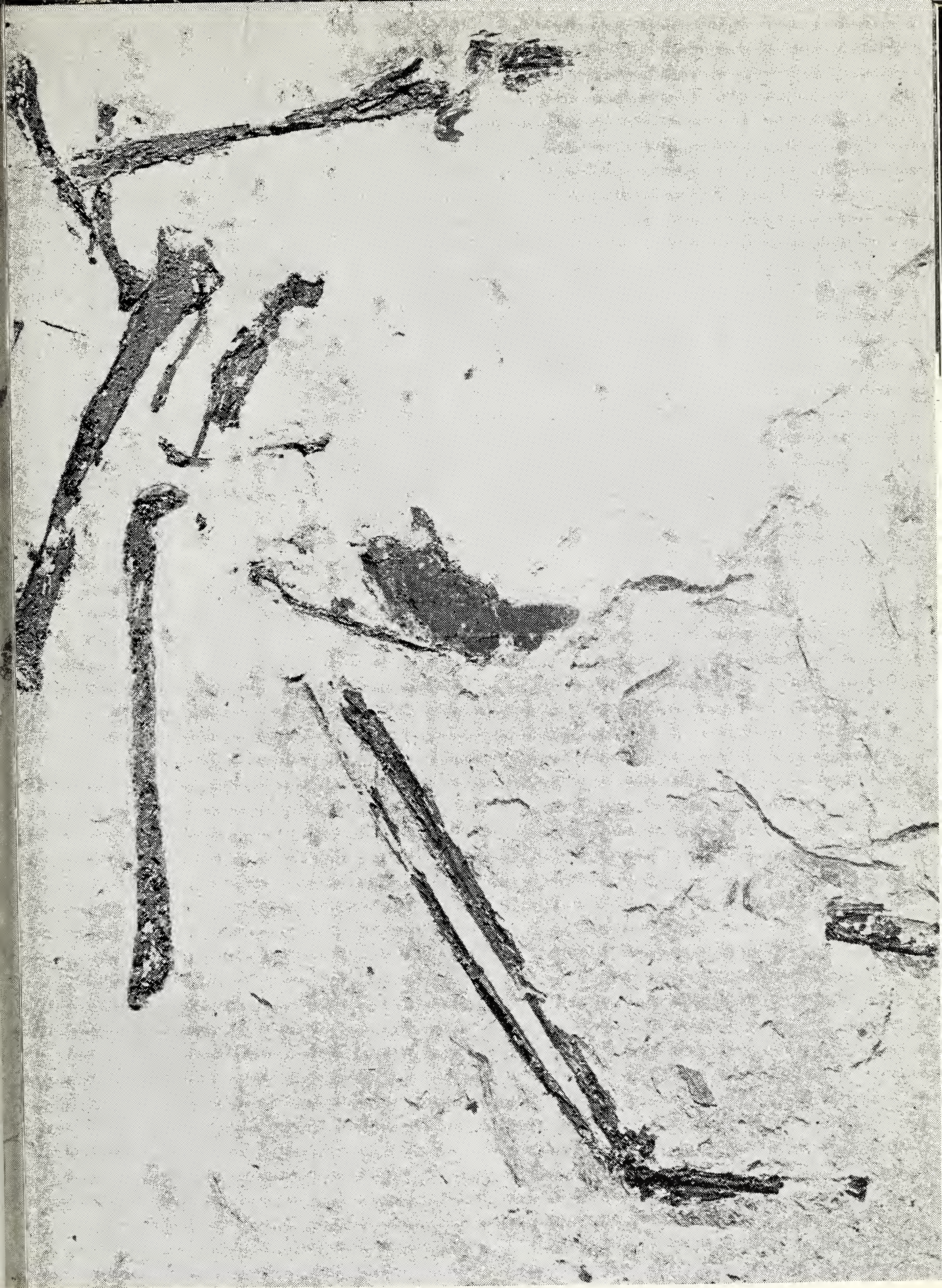

Fig. 2. *Sula pohli*, new species. Cotype (reverse of type). Approx. x ½.

in size the maximum that could be expected for *S. pohli.* These are, *Sula stocktoni* Miller, *Morus lompocana* (Miller) and *Miosula media* Miller from the California Miocene; *Miosula recentior* Howard from the California Pliocene; *Morus reyanus* Howard from the California Pleistocene; and *Sula arvernensis* Milne-Edwards and *Sula ronzoni* (Gervais) from the European Oligocene. On the other hand, *Sula pygmaea* Milne-Edwards from the European Miocene is smaller than *S. pohli.* The new species could be included in the size range of any of the remaining eight species. It is, however, distinguishable in each case on the basis of other characters, as outlined below.

Compared with the California Miocene *Sula willetti* Miller, (1925) known from practically complete skeletal impressions, the coracoid is actually, as well as relatively, longer, and the distance from procoracoid to head of coracoid is shorter as observed in comparison with a reverse cast of the type of *S. willetti* (see Table II); the ulna is longer relative to humerus (see Table I). The longer ulna is characteristic of all specimens of Recent *Sula* at hand, but, with the exception of *S. pohli,* the other (four) Miocene sulids, in which proportions of wing skeleton can be observed, have a short ulna as found in Recent *Morus.*

Compared with *Sula avita* Wetmore (1938) of the Miocene of Maryland, known from the distal end of humerus (type) and the carpometacarpus (referred), the process of metacarpal I of the carpometacarpus is straighter and is situated farther from the proximal trochlea. In these characters *S. pohli* is closer than *S. avita* to Recent specimens of *Sula.* It should be noted that Wetmore (op.cit., p. 25) erected a separate subgenus for *Sula* (*Microsula*) *avita* on the basis of still other characters.

Compared with *Sula guano* Brodkorb (1955) and *Morus peninsularis* Brodkorb (1955) from the Florida Miocene, described from coracoids, the coracoid is narrower both across the head and at the level of the scapular facet, and relatively shorter from the procoracoid to the head. *S. pohli* resembles Recent *Sula* in these proportions, whereas the Florida species agree more closely with *Morus* (see Table II).

Compared with *Sula phosphata* Brodkorb (1955), also from the Florida Miocene, and described from an incomplete coracoid, the internal sternal facet of the coracoid is longer although all other measurements of the element are less.

Compared with *Morus loxostylus* (Cope) of the Miocene of Maryland and New Jersey, known from two coracoids (the type and a referred specimen) and the distal end of a humerus (referred), the posterior sternal articulation of the coracoid is evenly rounded, rather

TABLE I

Measurements (in millimeters) of Wing Elements of Sulids

	Sula pohli Right	Sula pohli Left	S. willetti Type	Sula l. brewsteri L.A.M. no. 1349	Sula l. brewsteri L.A.M. no. 1352
Humerus					
Length	150.5	145.0	156.0	147.2	166.0
Breadth prox. end	22.1	22.1	———	20.0	24.0
Breadth dist. end	17.3	17.9	———	15.5	18.2
Ulna					
Length (greatest)	170.0	148.5	147.0	159.0	177.0
Carpometacarpus					
Length	69.3	69.3	70.0	70.5	77.3
Phalanges of Manus					
Length D2, P1	32.5	———	37.0	32.4	37.3
Length D2, P2	31.5*ap.*	———	23.0	32.3	37.1

TABLE II

Measurements (in millimeters) and Proportions (in per cent) of Sulid Coracoids

	S. pohli	S. willetti	S. guano[1]	M. peninsularis[1]	Average ratios, living sulids[2] Morus	Average ratios, living sulids[2] Sula
a. Length along axial border	55.0	45.0	50.0	54.0-55.6		
b. Breadth of head	11.4		13.4	14.2		
c. Breadth at scapular facet	13.7		14.7	17.0-17.7		
d. Height from head to procoracoid	19.1*ap.*	17.0*ap.*	21.0	25.0-25.1		
Ratio of b to a	20.7		26.8	25.5-26.3	26.7	22.9
Ratio of c to a	24.8		29.4	30.5-32.7	30.8	26.1
Ratio of d to a	34.7	37.7*ap.*	42.0	45.0-46.4	42.9	38.6

1Ratios calculated from measurements given by Brodkorb (1955, p. 13, Table 4).
2From Howard, 1936, p. 213.

TABLE III

Measurements (in millimeters) and Proportions (in per cent) of Sulid Sterna

	Sula pohli	Sula websteri L.A.M. no. 1339	Sula l. brewsteri L.A.M. no. 1349	Sula l. brewsteri L.A.M. no. 1352
a. Greatest length, carina to xiphius	94.3	110.0	95.0	114.0
b. Sternocoracoidal process to xiphius	57.0	63.3	51.0	62.3
c. Sternocoracoidal process to anterior edge of manubrium	26.0	32.0	27.0	32.0
d. Depth of carina through manubrium	28.7	33.5	26.0	31.1
Ratio of c to b	45.6*	50.7	52.9	51.3
Ratio of d to a	30.4	30.4	27.3	27.2
Ratio of d to c	110.4	104.9	96.3	97.1

*The minimum ratio among Recent specimens available is found in **Sula nebouxi** (43.8 per cent).

than wide at the median end and contracting abruptly to one-half the width as described for *Morus loxostylus* (Cope, 1871, p. 236). Both coracoid and humerus of *M. loxostylus* are said to be characteristic of the genus *Morus* (Wetmore, 1926, p. 466), whereas other skeletal characters of *S. pohli* relate the new species to *Sula.*

Also on the basis of generic allocation, *S. pohli* is distinguished from *Morus vagabundus* Wetmore of the California Miocene. The latter species is described from a distal end of a humerus, and the characters noted are not visible in the specimen of *S. pohli.* Wetmore (1930, pp. 90-91), however, states that *M. vagabundus* resembles *M. loxostylus* and is clearly of the genus *Morus.* It is significant to note that in this original description of *M. vagabundus,* size is noted as the sole distinction from *M. loxostylus* (breadth of distal end, *M. vagabundus,* 18.3 mm.; *M. loxostylus,* 21.1 mm.). In view of the size range now noted for the living *S. leucogaster brewsteri* (Table I), it is possible that the relationship between *M. vagabundus* and *M. loxostylus* should be reviewed.

Compared with the type of *Sula humeralis* Miller and Bowman (1958) from the California Pliocene (a distal half of a humerus), the entepicondyle is more prominent laterally and more extended proximally, but the condyles are less developed, so that the distal contour is straighter.

Lomita

Shortly after Miller's description of *Sula stocktoni* (1935) from the Lomita diatomite, the superintendent of the dacelite company at that site presented him with another, smaller specimen of sulid in two slabs of diatomaceous shale. Miller tentatively identified the skeleton as *Sula willetti* but did not record the specimen. At his suggestion it is included in this report.

The specimen is number 2543 in the collections of the University of California at Los Angeles. A partial skeleton is represented on the two slabs, by obverse and reverse impressions, as follows: sternum; right and left tibiotarsi and tarsometatarsi with some pedal phalanges; and right humerus, ulna, partial radius, and carpometacarpus. The left humerus and scapula are incompletely impressed. There is no bone remaining in the impressions.

Until the discovery of *Sula pohli* in the San Fernando Valley, there would have been little doubt that the Lomita specimen could be referred to *Sula willetti.* Its general size and proportions appear to agree with the specimens from Lompoc on which the description of *S. willetti* was based. Only one measurement is strikingly different as compared with the type of *S. willetti*, namely the length of the hind toe. This toe is shown to be only 34 per cent of the length of the tarsometatarsus in the type (Miller, 1925, p. 114), whereas in the Lomita specimen it is over 50 per cent of the tarsal length. In the referred specimen of *S. willetti* figured by Miller (op. cit., pl. 8) the hind toe appears to be longer than in the type, and the proportion to the tarsometatarsus is close to that of the Lomita specimen.

The discovery of *Sula pohli* introduces an element of doubt regarding the assignment of the Lomita skeleton to *Sula willetti.* Unfortunately the leg and foot elements are not present in the type of *Sula pohli,* and the important characters of coracoid and proportions of ulnar to humeral length that distinguish this species from *Sula willetti* cannot be accurately ascertained in the Lomita specimen. The coracoid is lacking; the ulna is broken, with the proximal quarter offset and possibly extended; the humerus is crushed and distorted. A latex cast made from the impression of the humerus shows the bone to be lying with the ulnar face of the proximal end impressed, but so twisted midway down the shaft that the external surface is impressed at the distal end. The proximal end is abnormally bent over, and there is a suggestion, also, that the shaft of the bone may be shortened where it is crushed and twisted. Therefore, although the measurements of the impressions of humerus and ulna show the ulna to be longer than the humerus, as in *S. pohli,* it is doubtful that these measurements are accurate. Two other characters of the Lomita skeleton can be compared with *S. pohli* and seem to distinguish it from that species, namely a greater length of the sternum and a more smoothly rounded contour of the ulnar face of the shaft of the humerus below the proximal head. The size of the sternum in proportion to the rest of the skeleton appears to be close to that noted in the referred specimen of *S. willetti* from Lompoc (Miller, op. cit., plate 8), but it is impossible to determine accurately the detail on the latter specimen. Details of the contour of the proximal end of the humerus are not available for *S. willetti.*

Although it is important to record the occurrence of this small sulid at the Lomita locality, it seems wise, in view of the several uncertainties involved in its identification, to refer it only tentatively at this time — to *Sula willetti.*

EL SERENO

A very large, almost complete humerus was given to the Museum in April, 1954, by Eugene Robkin and Harry Ralph Wilbur of El Sereno. The boys found the bone embedded in a chunk of matrix that had fallen from a Miocene shale embankment on Round Drive near Chester Street, El Sereno.

The specimen (fig. 3) is strongly compressed laterally through the upper portion, and there is a marked longitudinal ridge external to the pneumatic fossa on the ulnar surface. The very heavy head extends proximally beyond the internal tuberosity. In part these characters may be distortions due to crushing, but the condition cannot be entirely abnormal. Compared with *Sula* and *Morus*, the large, extended head and the marked compression below the external tuberosity are so notably different that allocation to the sulids was at first questioned. However, the shape of the pneumatic fossa and the internal tuberosity, as well as the contour of the bicipital crest are sulid in character though markedly heavier than in *Morus bassanus*, the largest of the living sulids. The length of the specimen, lacking the distal end, is 222 mm. Another 25-30 mm. should be allowed for the distal contour, giving an estimated total length of 247-252 mm.

Compared with other Miocene sulids, the El Sereno bone unquestionably exceeds in size all but *Morus lompocana* (Miller) from Lompoc and *Sula stocktoni* Miller from Lomita. From the former it is, however, distinguished by the shape of the proximal end. The proximal contours of the humerus of *M. lompocana* are well preserved in a reverse cast of the type and show the element to be quite typical of *Morus*, with a broad, smooth ulnar surface external to the pneumatic fossa and a broad, low head. A cast of the type of *Sula stocktoni* is also at hand for comparison. Although the proximal contours of the humerus are not so well preserved as in the specimen of *M. lompocana*, a marked longitudinal ridge is evident external to the pneumatic fossa, as in the El Sereno humerus, and the head appears to extend considerably beyond the internal tuberosity, and to differ from living sulids in this respect in the same manner noted in the single humerus. Because of these structural similarities, as well as close agreement in size, the new humerus is assigned to *S. stocktoni*.

In view of the distinctive characters of the humerus, as above noted, combined with other characteristics of the skeleton remarked by Miller (1935, pp. 75-78), a new genus is hereby designated for this species, with characters defined as follows:

Paleosula, new genus

Type.—Paleosula stocktoni (Miller)

Diagnosis.—Humerus very large, both actually, and relatively with respect to length of ulna; proximal end massive, with head extended proximally beyond internal tuberosity; shaft laterally compressed below

Fig. 3. *Paleosula stocktoni* (Miller). Referred humerus from El Sereno, L.A. Co. Mus. no. 2533. Approx. x 0.8.

Note: In the photograph, the shape of the distal end of the broken shaft resembles the outline of condyles which, however, are not present.

head on external side, with strong longitudinal ridge on ulnar surface external to pneumatic fossa. Manubrium of sternum with less forward thrust than in either *Sula* or*Morus*. Distance from procoracoid to head of coracoid relatively greater than in *Sula* or *Morus*.

The characters of the proximal portion of the humerus (prominence of the head and compression of the shaft below it, externally), while distinctly different from those of *Sula* or *Morus*, are approached in *Miosula* (as observed in reverse cast of type of *Miosula media*). The latter genus might be said to be intermediate in these respects between *Sula* and *Morus* on one hand and *Paleosula* on the other. *Miosula* also appears to be intermediate between *Morus* and *Paleosula* in the matter of relative length of ulna to humerus. Due to the fact that the best preserved humerus in the type of *P. stocktoni* is broken and overlain by other bones, the exact length cannot accurately be determined. The maximum measurement of the element, lying in place, is given (Miller, 1935, p. 78, Table I) as 264 mm. In calculating the ratio of length of ulna to humerus, a lesser humeral length (presumably of the impression actually present) is used, showing that even at the minimum estimate, the humerus is far longer in proportion to the ulna, than in any living sulid. The reasoning presented (op. cit., pp. 76-77) for believing that the maximum figure is essentially accurate, is, however, sound. Therefore, the ratio of ulna to humerus should be closer to 66 per cent rather than 75 per cent as given in Miller's Table I. The ratio in *Miosula* is given as 77 per cent, in *Morus* 87-89 per cent.

The proportionate forward thrust of the manubrium of the sternum relative to the length of the lateral border is found to be only 36.4 per cent in the type of *Paleosula stocktoni* on the basis of the measurements given by Miller (op. cit., p. 78, Table I), although in the text (op. cit., p. 76) this ratio is given as 41 per cent. Even this latter figure, however, is less than that of any specimen of *Sula* or *Morus* examined (see "Ratio of c to b," Table III above).

Miller describes the coracoid of *P. stocktoni* as proportionately longer from procoracoid to head than that of *Morus bassanus*. As noted in Table II above, the coracoid of *Morus*, in turn, is longer in this region than is that of *Sula*.

SUMMARY AND CONCLUSIONS

As a result of new discoveries of specimens of fossil sulids in Miocene deposits of Los Angeles County, a new species, *Sula pohli*, is described, and a new genus, *Paleosula*, is established to contain the species formerly known as *Sula stocktoni* Miller. A new locality record is noted for the latter form. A tentative identification of *Sula willetti* from the Lomita deposits marks the first record of this species outside its type locality of Lompoc, and the second sulid species to be recorded from the Lomita locality.

Sula pohli is the first of the California Miocene species in which the character of short humerus - long ulna, typical of present-day *Sula* as contrasted with *Morus,* has been clearly observed. *Sula willetti* has been maintained in the genus *Sula* in spite of its longer humerus because of other characters of the skeleton (see Wetmore, 1930, p. 91).

Paleosula is the second extinct genus of sulids to be established in the fossil record.

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IN SCIENCE

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No. 2. The Machris Brazilian Expedition. Botany: General, by E. Yale Dawson.

No. 3. The Machris Brazilian Expedition. Botany: A New Dodder from Goiás, *Cuscuta burrellii,* by T. G. Yuncker.

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No. 22. The Machris Brazilian Expedition. Botany: Gramineae, by Jason R. Swallen.

No. 23. The Machris Brazilian Expedition. Botany. Phanerogamae, Alstroemeriaceae and other families, by Lyman B. Smith and collaborators.

No. 24 The Machris Brazilian Expedition. Botany: Fungi, by G. W. Martin and collaborators.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ıber 26 August 15, 1958

THE MACHRIS BRAZILIAN EXPEDITION[1]

BOTANY: Hepaticae

By MARGARET FULFORD[2]

The Hepaticae listed below were collected by Expedition Botanist E. Yale Dawson in the vicinity of the two principal camps in central Goiás at the end of the rainy season of 1956. He has presented detailed locality data, according to his field collection numbers which are here cited with each determination, in paper number 2 of this series.[3] Briefly, however, numbers 14311 through 14807 came from the Chapada dos Veadeiros, April 17-May 3, and 14848 through 15213 from the vicinity of the Serra Dourada, May 5-June 3. The first set of specimens is deposited in the Herbarium of the Los Angeles County Museum. Some duplicates are in the private collection of the writer.

Leafy Forms

Bryopteris filicina (Sw.) Nees 14734
Euosmolejeunea clausa (Nees & Mont.) Evans 14856
Frullania brasiliensis Raddi 14743 p.p.
Frullania riojaneirensis (Raddi) Spr. 14340
Frullania squarrosa (R. Bl. & N.) Num. 14317 p.p.; 14807
Heteroscyphus amphibolius (Nees) Schiffner 14311b, c, d
Lejeunea flava (Sw.) Nees 14311
Lophocolea coadunata (Sw.) Nees 14311 p.p.; 14313 p.p.
Lophocolea sp. 15183
Lopholejeunea muelleriana (G.) Schiffner 14320?; 14327b; 14422

[1]This expedition from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museo Nacional do Brasil.

[2]Department of Biological Sciences, University of Cincinnati, Cincinnati 21, Ohio.

[3]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci (2):1-20.

Lopholejeunea sp. 14320
Mastigolejeunea auriculata (Wils. & Hook.) Spr. 14316b; 14807 p.p.
Microlejeunea sp. 14322 The specimens are sterile.
Microlepidozia verrucosa (Stephani) comb. nov. (*Lepidozia verrucosa* Stephani, Hedwigia 24:167. Tab IV. 1885) 14311 p.p.; 14315a
Odontoschisma falcifolium Steph. 14311 p.p.
Odontoschisma glaziovii Steph. 14315a p.p.; 14420
Plagiochila aliena G. 14317 p.p.; 14320a p.p.; 14343; 14422 p.p.
Plagiochila sp. 14316b p.p.
Porella sp. (probably *P. swartziana* (Web.) Ldbg.) 14320 p.p.
Prionolejeunea sp. 14852; 14857; 14858; 14894 p.p. The plants are sterile.
Psiloclada brasiliensis Steph. 14654 This species is known from only a few collections in South America.
Radula andicola Steph. 14350
Radula sp. (probably *R. arsenii* Steph.[4]) 14317; 14418
Radula korthalsii Steph.[4] 14323; 14346b
Radula sp. 14807 p.p.; 14934
Stylolejeunea pililoba (Spr.) Evans 14316b p.p.

Thalloid Forms

Anthoceros sp. 14747 Spores not mature.
Fossombronia sp. 14411 (♀); 15179; 15184
Riccardia sp. 14654 p.p.; 14853
Riccia sp. (probably) 15184 p.p.
Symphyogyna brasiliensis Nees 14654 p.p.; 14894

[4]Determination by Dr. H. Castle, Yale University.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

mber 27 January 19, 1959

MARINE ALGAE FROM THE 1958 CRUISE OF THE STELLA POLARIS IN THE GULF OF CALIFORNIA

By E. Yale Dawson

os Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

MARINE ALGAE FROM THE 1958 CRUISE OF THE STELLA POLARIS TO THE GULF OF CALIFORNIA[1]

By E. Yale Dawson[2]

Our recorded knowledge of the marine flora of the Gulf of California is based largely upon the paper of Setchell and Gardner (1924) and those of the writer (Dawson 1944, 1949b, 1953, 1954). Incidental accounts of a number of species have appeared in various papers by Hariot, Howe, and by Dawson. There have remained to date, however, many areas, especially in the southern Gulf of California, in which few or no collections have been made, and any description of the major components of the sublittoral flora at any localities in that region have been notably lacking. This has been due to the fact that virtually all collections prior to the present were made by dredge or by shore collecting at low tide where only exposed areas would be examined. Furthermore, most of these were made during late winter months when, in the southern Gulf, the flora is in poor development.

The collections reported upon here were made possible through the kindness and collaboration of Mr. and Mrs. John McNabb and Mr. and Mrs. Maurice A. Machris, who invited the writer, then Curator of Botany at the Los Angeles County Museum, to accompany them on a two-weeks cruise in April, 1958. Mr. McNabb directed the movements of the M/V Stella Polaris in accord with the best interests of the botanical studies, such that it was possible on almost every day of the cruise, from April 15 to 29, to anchor in a different and suitable locality from which we could engage in shallow water diving, with face plate and snorkle, to observe and collect the representatives of the flora. Inasmuch as the cruise moved regularly northward from La Paz to Isla San Pedro Nolasco off Guaymas, Sonora, it was possible to observe a geographic progression in the development of the flora from the impoverished algal region around Isla Espíritu Santo to the relatively richly vegetated region in the vicinity of Guaymas, Sonora.

The following brief field observations, accordingly, are arranged from south to north. In each case the inclusive collection numbers from the writer's series are given as a means of designating the collections cited elsewhere in the text. A bare listing of the various species obtained at each station is given as an aid to future comparative floristic work in the region.

The collections are deposited in the herbarium of the Los Angeles County Museum.

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[1] Contribution from the Beaudette Foundation for Biological Research, Solvang, California. This study was aided in part by a National Science Foundation grant, G5848.

[2] Research Director, Beaudette Foundation, and Research Associate, Los Angeles County Museum.

GENERAL FIELD DATA

Lagoon between Isla Espíritu Santo and Isla Partida. April 16. Numbers 18969 to 18975.

The shallow inshore area in depths of 1 to 5 feet was completely dominated by large mats of *Caulerpa*. There was no *Sargassum* present, and no red algae of any significance were evident.

Caulerpa sertularioides, C. racemosa v. *turbinata, Halimeda discoidea, Enteromorpha compressa. Ernodesmis verticillata Hydrocoleum glutinosum.*

Entrance to west side of channel between Isla Espíritu Santo and Isla Partida. April 17. Numbers 18930 to 18948.

This area consists of rocks a few hundred feet off shore awash at mid-tide. The flora was completely different from that of the lagoon, but was in general exceedingly scant. There was scant and very short *Sargassum*, a fair growth of *Amphiroa*, some *Jania*, and a few dwarfish specimens of other species in cracks of the rocks. Almost no *Padina* occurred and indeed there was nothing of a conspicuous nature.

Hypnea nidulans, Codium sp. (prostrate), *Prionitis abbreviata* forms. *Ahnfeltia svensonii, Colpomenia sinuosa* v. *tuberculata, Gracilaria pachydermatica. Gelidium johnstonii, Corallina pinnatifolia* v. *digitata. Chlorodesmis hildebrandtii, Pocockiella variegata, Caulerpa sertularioides, C. racemosa* v. *turbinata. C. racemosa* v. *peltata, Heterosiphonia wurdemannii* v. *laxa. Falkenbergia* stage of *Asparagopsis taxiformis, Ceramium paniculatum, Taenioma perpusillum, Callithamnion paschale, Polysiphonia simplex. Spirulina subsalsa. Symploca hydnoides. Phormidium hormoides. Lyngbya aestuarii, L. majuscula.*

East side of Isla Partida. April 28. Numbers 18587 to 18598.

The flora here in depths of 1 to 4 feet was even more impoverished than on the west side. Only a few dwarfish plants of few species occurred, and there was nothing of a conspicuous nature present.

Codium sp. (prostrate), juvenile *Sargassum, Padina crispata?, Neomeris annulata. Centroceras clavulatum, Jania capillacea, Amphiroa annulata, Herposiphonia spinosa, Gracilaria pachydermatica?, Gelidiella hancockii. Falkenbergia* stage of *Asparagopsis taxiformis, Amphiroa dimorpha, Symploca hydnoides.*

Isla San Francisco. April 18. Numbers 18976 to 18988.

In depths of 2 to 7 feet on the southwest side of the island (on the north side of the anchorage inshore) a very poor flora appeared, consisting of only a few species with the exception of *Codium*, which occurred as the only conspicuous large plant. At a depth of 10 feet on the southwest side of the anchorage, collections by Mrs. Paquita Machris (numbers 18961 to 18963) indicated the dominance of *Asparagopsis, Galaxaura* and *Dictyota*.

Codium sp. (clumping), *Rhodymenia hancockii?, Jania longiarthra, Chnoospora implexa, Gelidiopsis tenuis, Polysiphonia mollis, Dasya* sp., *Cladophora utriculosa, Chlorodesmis hildebrandtii, Pocockiella variegata, Caulerpa racemosa* v. *peltata, Geppella decussata* sp. nov., *Sphacelaria furcigera, Peysonnelia rubra* v. *orientalis.*

Punta San Evaristo. April 19. Numbers 18949 to 18960.

Inshore on the southwest side in more or less protected places there was dominant *Sargassum* and *Chnoospora* on the bottom. On the south side near the entrance in a surfy area, *Liagora* was dominant on the bottom with some *Padina*, and more or less common *Colpomenia* and *Hydroclathrus* mixed in. The prostrate *Codium* formed large patches 1 to 3 feet in extent on the lower, under, or vertical surfaces of rather smooth rocks in depths of 1 to 3 feet. Young material of two species of *Sargassum* was noted together with some scrappy *Padina durvillaei.*

Liagora farinosa, Laurencia obtusiuscula, Padina crispata?, Dictyota sp., *Ulva lactuca, Codium* sp. (prostrate), *Sargassum sinicola, Colpomenia sinuosa* v. *tuberculata* (not collected), *Hydroclathrus clathratus, Chnoospora implexa, Padina caulescens? Lyngbya majuscula, Calothrix crustacea, Hydrocoleum glutinosum.*

Isla San Diego. April 19. Numbers 18913 to 18929.

Along the south end of the island near the prolonged reef, the bottom consisted of rich *Liagora* beds and fine big clumps of *Asparagopsis* on either side. Farther north along the inside shore, the cover was mainly of *Amphiroa* with some of the grass green *Laurencia obtusiuscula* close in. Observations were in depths of 1 to 6 feet.

Laurencia obtusiuscula, Liagora farinosa, Codium sp. *Asparagopsis taxiformis, Dictyota crenulata, Chondria* sp., *Amphiroa drouetii, Jania longiarthra, Chondria californica, Amphiroa annulata, Dictyota divaricata, Padina mexicana, Hypnea nidifica?, Liagora magniinvolucra, Sphacelaria tribuloides, Ectocarpus mitchellae, Pocockiella variegata.*

Bahía Agua Verde. April 20. Numbers 18877 to 18912.

Observations in depths of 1 to 6 feet along the inner margin of the lagoon on the south side of the bay showed an abundance of *Chnoospora, Hydroclathus, Rosenvingia* and *Laurencia*, and a general bottom cover of *Amphiroa*. A little way out, at the inner sea stack, *Amphiroa* was the general cover to depths of 1 to 6 feet, after which much *Padina* covered the bottom to 20 feet or more. *Halimeda* occurred in patches. *Dictyota* was present only as solitary individuals. *Sargassum* was spotty and mostly short, but some plants in 10 to 15 foot depths appeared to reach a height of 3 feet or more. There was no evidence of *Liagora* or *Asparagopsis.*

Sargassum horridum, Chnoospora implexa, Gracilaria crispata, Padina caulescens, Hydroclathrus clathratus, Laurencia obtusiuscula, Rosenvingea intricata, Codium sp. (clumping), *Codium* sp. (prostrate), *Amphiroa subcylindrica, Gracilaria pachydermatica, Gracilaria subsecundata, Amphiroa drouetii, Corallina pinnatifolia* v. *digitata, Hypnea esperi, Colpomenia sinuosa, Jania longiarthra, Prionitis abbreviata, Bryopsis pennata, Laurencia papillosa* v. *pacifica, Herposiphonia tenella, Ceramium gracillimum* v. *byssoideum, Herposiphonia subdisticha, Halimeda discoidea, Rhodymenia hancockii, Ceramium sinicola* v. *interruptum, Dictyota divaricata, Ulva dactylifera?, Amphiroa dimorpha, Galaxaura arborea, Hypnea nidulans, Jania decussato-dichotoma, Gelidium johnstonii, Valoniopsis pachynema, Gelidium pusillum.*

El Solitario Rock, off Bahía Agua Verde. April 20. Numbers 18834 to 18876.

A rather varied and well developed flora occurred here, in depths of 2 to 5 feet, including a turf consisting of a number of small species of *Laurencia, Chondria, Ceramium* and *Amphiroa*, etc. *Gracilaria pachydermatica* occurred in cracks in the rocks, but the most conspicuous rock cover of larger plants consisted of *Asparagopsis*, and to a lesser extent, of *Sargassum.*

Saragassum sinicola, Derbesia hollenbergii, juvenile *Sargassum, Ceramium zacae, Gracilaria pachydermatica, Gelidium johnstonii, Chondria californica* with *Jantinella verrucaeformis, Polysiphonia concinna, Codium* sp. (clumping), *Laurencia obtusiuscula, Dictyota divaricata, Colpomenia sinuosa* v. *tuberculata, Laurencia obtusiuscula* v. *laxa?, Asparagopsis taxiformis, Amphiroa dimorpha, Amphiroa zonata, Prionitis abbreviata, Corallina pinnatifolia* v. *digitata, Laurencia papillosa* v. *pacifica, Grateloupia howei, Gracilaria* sp., *Hypnea nidifica, Hypnea johnstonii, Ectocarpus mitchellae, Chondria dasyphylla, Digenia simplex, Ceramium sinicola, Ceramium caudatum, Ceramium procumbens, Bryopsis muscosa, Centroceras clavulatum, Laurencia hancockii, Herposiphonia subdisticha, Galaxaura arborea, Laurencia sinicola, Dasya sinicola, Schizoseris pygmaea, Ceramium taylorii, Amphiroa annulata.*

Isla Monserrate. April 21. Numbers 18794 to 18822.

Collections were made along the northwest end of the island at a small rocky outcrop extending into the sand at depths of 4 to 5 feet. The general cover was of *Amphiroa* and epiphytic *Ceramium*. There was little *Codium, Asparagopsis* and *Digenia*, scant *Padina*, and no evidence of *Sargassum.*

Amphiroa subcylindrica, A. zonata, Codium sp. (clumping), *Halimeda discoidea, Asparagopsis taxiformis, Digenia simplex, Gracilaria pachydermatica, Polysiphonia mollis, Padina crispata?, Callithamnion paschale, Caulerpa racemosa* v. *turbinata, C. sertularioides, Chnoospora implexa, Ceramium gracillimum* v. *byssoideum, Dasya pedicellata?, Peysonnelia rubra* v. *orientalis, Ceramium fimbriatum, Dasya sinicola, Gracilaria crispata?, Chondria californica, Enteromorpha compressa,* *Lithophyllum trichotomum?, Jania longiarthra, Amphiroa annulata, Hypnea nidifica, Amphiroa drouetii, Champia parvula, Lyngbya majuscula.*

Puerto Escondido. April 22. Numbers 18770 to 18793.

Collections were made along the outer cliffs at the entrance to Puerto Escondido opposite Isla Danzante and Isla Carmén in depths from 1 to 5 feet. *Sargassum* was conspicuous in some places, but the algae in general were rather sparse. *Gelidium* was frequent, and short plants of *Ceramium* and other small species formed a prominent turf. The corallines were notably scant. No *Asparagopsis, Liagora* or *Caulerpa* occurred. In depths of 20 feet or more, the bottom exhibited dominant *Padina durvillaei.*

Gracilaria pachydermatica, Sargassum macdougalii, Chnoospora implexa, Laurencia papillosa v. *pacifica, Dictyota divaricata?, Gelidium johnstonii, Gracilaria spinigera, Prionitis abbreviata* v., *Codium* sp. (prostrate), *Codium* sp. (erect), *Ceramium caudatum, Hypnea* sp., *Centroceras clavulatum, Polysiphonia mollis, Ceramium procumbens, Lophosiphonia scopulorum, Bryopsis muscosa, Amphiroa dimorpha, Amphiroa franciscana* f.?, *Jania decussato-dichotoma, Jania capillacea, Chaetomorpha bangioides, Gelidium pusillum.*

Puerto Escondido. April 22. Numbers 18751 to 18769.

Collections were made from the protected outer bay outside of the port proper. Here *Sargassum* occurred more or less densely in depths of 6 to 8 feet. The other conspicuous large species were mainly *Caulerpa sertularioides, Padina durvillaei* and large plants of *Codium amplivesiculatum.* There were few corallinaceae. *Neomeris* was frequent and conspicuous on well-lighted stones at 4 to 6 foot depths.

Caulerpa sertularioides, Padina durvillaei, Codium amplivesiculatum, Sargassum sinicola, Hypnea nidifica, Hydroclathrus clathratus, Graciliaria ramisecunda, Nemacystus brandegeei, Gracilaria crispata, Rhizoclonium kochianum, Griffithsia tenuis, Amphiroa subcylindrica, Laurencia obtusiuscula, Ceramium fimbriatum, Polysiphonia mollis, Amphiroa zonata, Ceramium caudatum, Hormothamnion enteromorphoides, Lyngbya majuscula.

Puerto Escondido proper (inner harbor). April 22. Numbers 18823a to 18833.

Collections from a rather mucky bottom in depths of 1 to 4 feet showed a flora of rather few species dominated by *Enteromorpha clathrata, Polysiphonia and Lithophyllum ? trichotomum. Gelidiopsis tenuis* and *Caulerpa sertularioides* were frequent.

Hydroclathrus clathratus, Gelidiopsis tenuis, Caulerpa sertularioides, Enteromorpha clathrata, Polysiphonia mollis, Gracilariopsis sp., *Bryopsis muscosa?, Lithophyllum trichotomum?, Amphiroa taylorii.*

Puerto Ballandra, Isla Carmén. April 3. Numbers 18600 to 18626.

The inner part of the bay has a bottom cover mainly of *Polysiphonia* with scattered *Codium, Laurencia,* etc. at about + 0.5 feet. These are mixed with varying amounts of *Amphiroa.* Farther out, at the entrance to the bay, in depths of less than 6 feet on either side, *Amphiroa* and *Jania* are much stronger. Some *Halimeda* occurs and rather short *Sargassum* and *Hypnea. Gelidium johnstonii* becomes prominent in clefts and under overhanging rocks where the currents are strong.

Halimeda discoidea, Bryopsis pennata, Colpomenia sinuosa, Laurencia obtusiuscula, Chnoospora implexa, Pterocladia pyramidale?, Potysiphonia mollis, Ceramium gracillimum v. *byssoideum, Gracilaria textorii, Prionitis abbreviata, Ulva lactuca?, Amphiroa dimorpha, Amphiroa subcylindrica, Amphiroa zonata, Jania decussato-dichotoma, Jania longiarthra, Gelidium johnstonii, Sphacelaria hancockii, Laurencia papillosa* v. *pacifica, Griffithsia tenuis, Dictyota divaricata, Padina durvillaei, Laurencia hancockii, Herposiphonia secunda, Lithophyllum trichotomum?, Hydrocoleum comoides.*

Isla Cholla, off the north end of Isla Carmén. April 3. Numbers 18654 to 18695.

An amazing bottom of dominant *Halimeda, Codium* and *Sargassum* occurred here in depths of from 1 to 6 feet. The smaller turf-forming plants consisted largely of *Caulerpa* and *Ceramium,* and there were rather limited amounts of *Amphiroa.* Some good patches of luxuriant *Asparagopsis* occurred. The *Codium* grew in great, broad cushions, and *Halimeda* occupied whole acreages. In some places one could observe nothing but a spreading lawn of *Halimeda.* The *Sargassum* plants, where they occurred in reasonable abundance, were mostly short and apparently young.

At high levels of + 1.5 to 2.5 feet (numbers 18746 to 18749) a remarkable association of *Dermonema frappieri, Ahnfeltia svensonii, Laurencia hancockii* and *Hildenbrandia* occurred.

Sargassum horridum, Asparagopsis taxiformis, Padina durvillaei, Derbesia hollenbergii, Rhodymenia californica, Gracilaria crispata, Gracilaria ramisecunda, Halimeda discoidea, Caulerpa vanbosseae, Corallina pinnatifolia v. *digitata, Herposiphonia subdisticha, Polysiphonia mollis, Chondria californica, Griffithsia tenuis, Centroceras clavulatum, Dictyopteris repens, Herposiphonia secunda, Antithamnion breviramosus, Schizoseris pygmaea, Peysonnelia rubra* v. *orientalis, Codium* sp. (clumping), *Dasya* sp., *Amphiroa zonata, Amphiroa dimorpha, Laurencia obtusiuscula, Prionitis abbreviata, Ernodesmis verticillata, Dictyota* sp., *Hypnea nidulans, Gelidiopsis tenuis, Jania decussato-dichotoma, Laurencia papillosa* v. *pacifica, Lithophyllum trichotomum?, Laurencia sinicola, Chnoospora minima, Bryopsis muscosa.*

Punta Pulpito. April 23.

Although no collections were made, *Sargassum* was observed to occur in heavy beds along the immediate shore, and large masses were breaking loose to float southward.

Isla Ildefonso. April 24. Numbers 18696 to 18730 (from depths of 1 to 5 feet); numbers 18731 to 18745 (from levels of + 1 foot or more).

This shore consists of solid, rough lava subject to heavy surf. *Porphyra* occurred to as much as 10 feet above mean low water level. No sand was present at all. The general bottom cover was of *Sargassum* with a heavy and dense mixture of many other things in good development, such as *Gracilaria, Botryocladia, Ulva, Dictyota, Dictyopteris*, much epiphytic *Ceramium, Polysiphonia, Chondria*, etc. Some *Asparagopsis* occurred and there was much *Codium* at levels of + 1 foot in shaded places along lava cliffs in estuarine breaks in the lava. Otherwise, the *Codium* occurred generally down to about -1 foot.

On exposed rocks at high levels in this locality (+ 1 foot or more), there was a good development of a flora adapted to desiccation. The surge, surf and spray are sufficiently continuous to keep this area wet except for relatively short times. Nevertheless, at the time of my collecting at low tide, the exposed material was severely dried. The *Porphyra* was practically crisp, as was much of the *Dermonema*, these being at the highest levels or at least exposed to the more severe drying.

Sargassum sinicola, Polysiphonia johnstonii, Botryocladia uvarioides, Gracilaria spinigera, Caulerpa vanbosseae, Ulva lactuca?, Pachydictyon coriaceum, Centroceras clavulatum, Amphiroa dimorpha v. *digitata* v. nov., *Amphiroa magdalenensis, Asparagopsis taxiformis, Dictyopteris zonarioides, Laurencia obtusiuscula* v. *laxa*?, *Laurencia papillosa* v. *pacifica, Hypnea cervicornis?, Gracilaria pachydermatica, Griffithsia tenuis, Dictyota divaricata, Herposiphonia subdisticha, Gracilaria textorii, Carpopeltis stella-polaris* sp. nov., *Jania tenella* v. *zacae*?, *Padina durvillaei, Cladophoropsis robusta, Grateloupia versicolor, Chondria californica, Branchioglossum woodii, Laurencia sinicola, Codium* sp. (clumping), *Codium* sp. (prostrate), *Ceramium procumbens, Ceramium taylorii, Ceramium sinicola, Dasya sinicola.*

High levels: *Codium* sp. (clumping), *Griffithsia tenuis, Ceramium taylorii, Pterocladia pyramidale, Chaetomorpha antennina, Porphyra hollenbergii, Dermonema frappieri, Polysiphonia simplex, Laurencia hancockii, Centroceras clavulatum, Gracilaria pachydermatica, Herposiphona tenella?, Prionitis* sp., *Chondria californica.*

Bahía Concepción, along the east shore between 5 and 8 miles from the entrance.

No collections were made here, but beds of *Sargassum* were observed in immediate inshore water in depths of 6 to 8 feet extending along much of this shore. The plants for the most part rose nearly to the surface, and large rafts were aggregating from detached plants, and drifting south.

Isla Tortuga. April 25. Numbers 18627 to 18653.

Collections were made along the shore of lava cobbles in depths of 0.5 to 5 feet. The bottom consisted of a mixed cover of *Codium, Caulerpa, Laurencia*, and *Amphiroa*. Some *Dictyopteris, Asparagopsis* and *Dictyota* occurred, but there was little *Sargassum* and *Padina*.

Codium sp. (clumping), *Padina durvillaei, Gracilaria pachydermatica, Sargassum sinicola, Caulerpa vanbosseae, Asparagopsis taxiformis, Galaxaura fastigiata, Gracilaria spinigera, Digenia simplex, Dictyota flabellata, Gelidiopsis variabilis, Bryopsis muscosa, Ulva lactuca, Polysiphonia concinna, Gloioderma conjuncta* comb. nov., *Laurencia obtusiuscula, Laurencia papillosa* v. *pacifica, Griffithsia tenuis, Centroceras clavulatum, Amphiroa magdalenensis, Chondria californica, Prionitis abbreviata* f., *Amphiroa dimorpha, Dictyota divaricata, Gigartina intermedia, Amphiroa zonata, Ceramium procumbens.*

Isla San Pedro Nolasco. April 25. Numbers 18545 to 18585.

At the single small landing place a remarkable algal community was encountered in a small invagination of the cliffs. Many small species, such as *Cladophoropsis, Rhodoglossum, Prionitis, Ceramium, Griffithsia, Dasya*, etc., occurred on the cliffs, some of which are deeply shaded. On the deep bottom grew a heavy *Padina* cover with great *Sargassum* plants standing up 20 feet or more and rising to the surface. Some fine, almost pure beds of *Spatoglossum* were found. In other places *Botryoglossum* was present in rich patches together with scattered *Grateloupia*. Closer inshore, although this is only a matter of a few yards because of the rather steeply inclined bottom, *Ulva* and *Centroceras* were conspicuous. This whole area is subject to constant surge of varying intensity.

Padina durvillaei, Codium sp. (clumping), *Sargassum brandegeei, Gracilaria textorii, Dictyopteris zonarioides, Gracilaria crispata, Dictyota flabellata, Grateloupia prolongata, Rhodoglossum hancockii, Dasya sinicola, Cladophoropsis robusta, Griffithsia tenuis, Prionitis abbreviata* v. *guaymasensis, Gigartina tepida, Hypnea esperi?, Gelidiopsis variabilis, Dictyota divaricata, Hypnea nidulans, Peysonnelia rubra* v. *orientalis, Derbesia hollenbergii?, Amphiroa subcylindrica, Schizoseris pygmaea, Callithamnion paschale, Ceramium sinicola, Ulva lactuca, Spatoglossum schroederi?, Botryocladia uvarioides, Gymnogongrus johnstonii, Sargassum sinicola, Laurencia obtusiuscula* v. *laxa?, Chondria decipiens?, Ceramium paniculatum, Hypnea johnstonii, Heteroderma gibbsii?, Antithamnion breviramosus.*

FLORISTIC LIST

CHLOROPHYTA

Enteromorpha clathrata (Roth) J. Ag. 18828; 18826

Not previously known in the Gulf of California, this species has been reported from Isla Clarión, Mexico, by Setchell and Gardner as *E.*

plumosa. Bliding (1944) has shown that *E. plumosa* Kütz. should be relegated to synonymy under *E. clathrata*.

Enteromorpha compressa (L.) Grev. 18816; 18972

Ulva lactuca L. 18571; 18639; 18954; 18610 This latter collection is a densely headed, doubtfully referred form producing more or less hemispherical tufts.

Ulva sp. 18701 This is probably a form of *U. angusta*, although it may possibly be a thin, deeply lobed variety of *U. lactuca*. Two specimens are present, one contradicting the other with regard to external form.

Ulva sp. cf. *U. dactylifera* Setch. & Gard. 18901 The cells are vertically elongated even near the margins, but distinctive characters of the blades are not evident.

Ernodesmis verticillata (Kütz) Børg. 18974; 18683

Cladophoropsis ? robusta Setch. & Gard. 18555; 18720 Fig. 3A

Examination and comparison of the present materials with the type of *Willeella mexicana* Dawson in connection with comments on *Willeella ordinata* Børg. and *W. mexicana* by Papenfuss and Egerod (1957:83) have led to the conclusion that the materials treated as *Willeella* from Mexico are more fully developed, amply branched examples of the plant named *Cladophoropsis robusta* Setchell and Gardner (1924, p. 714, pl. 13, fig. 16). The type of the latter was an immature plant in which the characteristic distichous branching of well-developed specimens had not yet come into evidence.

Despite the comments of Papenfuss and Egerod suggesting identity of *Willeella mexicana* and *W. ordinata* (although they had not seen material of the former) a further comparison of the present specimens with the illustrated account of *W. ordinata* by Børgesen (1930) points to a number of more clear-cut distinctions then were fully indicated earlier. Younger plants, and some older ones too, show little branching. The axes are rigid, erect and coarse with few septations. Mature material develops regular distichous branches which are at first markedly strict in position, standing parallel to and nearly touching the sides of the bearing axis. These branches almost invariably arise in pairs, and have consistently delayed septation somewhat suggestive of *Struvea*. In *Willeella ordinata* the branches are not strict, but usually spreading, are acute rather than blunt, and commonly arise in groups of 4 to 6 at a node. Irregular secondary branches often arise from lower parts of the primary axes, both in apparently younger plants with little or no distichous branching, as well as older ones with well-developed distichous branching. These arise by the cutting off of a lens-like cell which develops much as in *Valoniopsis pachynema*, a feature which, despite the distichous branching, suggests that our plant may be more nearly related to *Valoniopsis* than to *Willeella*. The septation in the formation of these irregular lower branches, and in some of the primary axial parts of the plants as well, appear to be the result of segregative division. Such division is not found among the Anadyomenaceae to which *Willeella* is now generally recognized to belong (Papenfuss and Egerod, 1957:83).

The plants which correspond to *Cladophoropsis robusta* are often quite richly developed and provided with more or less frequent lower branchlets or lens-shaped incipient branchlets before the distichous branching of mature plants takes place. This is true of the type material and is now seen in number 18720 and in other earlier collections from Cabo Arco, near Guaymas, Sonora, in which densely tufted plants to 4 cm. tall bear only occasional, or scarcely any, paired branches. This feature, the apparent segregative division, and the distichous branching which is not characteristic of *Cladophoropsis*, suggest relationships apart from that genus and probably closer to *Valoniopsis*. More study of ample material is needed to clarify the position of this interesting plant, but it is manifestly clear that it is not identical with *Willeella ordinata*.

Taylor's number 34-588A from Isla Isabel, Nayarit, has been examined again and found to agree better with *Valoniopsis pachynema* than with *Cladophoropsis robusta*.

Valoniopsis pachynema (Mart.) Børg. 18907 This is characteristic material of this species (see Isaac 1957, fig. 6-7, pl. 28).

Rhizoclonium kochianum Kütz. 18760 This agrees with Hamel's concept (1930-32). He does not consider the differences of *R. kerneri* to be specific and treats that plant as a variant of *R. kochianum*. Taylor (1945:55) has reported a plant much like the present from Isla Clarión under the name *R. kerneri*.

Chaetomorpha antennina (Bory) Kütz. 18735

Chaetomorpha bangioides Daws. 18792 This is identical with the type from Isla Patos in the northern Gulf of California. It represents the second known occurrence of this distinctive species and a southward extension of range.

Chaetomorpha linum (Müller) Kütz. 18599

Cladophora albida (Huds.) Kütz. 18823b, on a parrot fish beak, Bahía Agua Verde, April 20.

Cladophora utriculosa Kütz. 18983 This agrees with the treatment by Hamel (1929). The species is reported as common in southern Japan, but has not heretofore been reported from Mexico.

Bryopsis pennata Lamx. 18601 Although there is some irregularity in the branching of this specimen to the extent of showing a tendency to be polystichous or secund, as in similar material studied by Egerod (1952) from Hawaii, most branch tips show a clearly distichous arrangement as in *B. pennata*. The material is reasonably well developed although the branching is largely confined to the branch tips. This recalls *B. pennatula* J. Agardh, described from southern Pacific Mexico and since reported by Taylor (1945) from White Friars Islands, Guerrero,

Fig. 1. *Spatoglossum* sp. cf. *S. schroederi*

Mexico, and from the Galapagos Archipelago. In the present material, the distichous branchlets are confined to the upper 2-3 mm. of the axes much as in Taylor's material, but are shorter and smaller, like *B. pennatula* figured by Kützing (1856, Tab. Phyc. vol. 6, pl. 76, fig. 2). Considering the dwarfish character of some other of the Liebmann specimens described by J. Agardh from San Agustin, Mexico, such as *Hypnea pannosa, Grateloupia versicolor,* etc., it seems probable that the type of *B. pennatula* may have come from a surfy, high habitat in which the production of the lateral branchlets was particularly disfavored by the environment. Such reduction of the lateral branchlets is observable in various *Bryopsis* species, and there does not appear to be any clear-cut distinction between Agardh's plant and *B. pennata* Lamx. as currently understood.

The plants called *B. plumosa* var. *pennata* (Lamx.) Børg by Dawson (1944:212) are probably luxuriantly developed, richly branched examples of this same species.

Bryopsis muscosa Lamx. 18638; 18694; 18788; 18866; 18830; 18894 Most of these are scrubby and ill-developed with very irregular multifarious branching, commonly in part secund. In some the laterals are mainly confined to branch tips and are not very abundant, or there may be many axes with almost no laterals.

Derbesia hollenbergii Taylor 18670 This material is abundantly fertile and the zoosporangia are consistently pyriform or turbinate. *D. hollenbergii* was described from the Galapagos Archipelago and was recently reported from South Africa. Our material has filaments 60-80 μ in diameter and sporangia to 130 μ in diameter, more like the South African material in size than either the type of *D. hollenbergii* or of *D. turbinata* Howe and Hoyt. 18657; 18682; 18835, scantily fertile, but with the turbinate sporangia.

Derbesia sp. 18580, sterile; 18567, sterile; 18582 These are all probably, but uncertainly, referable to *D. hollenbergii.*

Caulerpa racemosa var. *peltata* (Lamx.) Eubank 18986; 18944b

Caulerpa racemosa var. *turbinata* (J. Ag.) Eubank 18804; 18944a; 18970

Caulerpa sertularioides (Gmelin) Howe 18805; 18825; 18944; 18969; 18751, a new northward record in the Gulf of California.

Caulerpa vanbosseae Setch. & Gard. 18631; 18662; 18700

Chlorodesmis hildebrandtii A. Gepp & Ethel Gepp 18941; 18984 This material is short, but shows all the characters of this species, especially the internodal constrictions not present in *C. mexicana.* This is a new record for Pacific Mexico.

Geppella decussata sp. nov. Fig. 7 A

Thalli minuti, 2-3 mm. alt., monosiphoni, e parte superiore dichotome ramosa e stipite elongato, ex adhaesione basali prostrata oriente, constantes; stipes 1.0-1.5 mm. long., ca. 40 μ diam. maxime viridis, supra

Fig. 2. *Nemacystus brandegeei.* Part of a large plant from Puerto Escondido (18758). Natural size.

dichotome decussate ramosus, primis furcis duabus vel tribus, intervallis 80-150 μ, deinde intervallis 250-400μ, ad dichotomias paululum constrictus, ad segmenta ultima ca. 25 μ diam. gradatim reductus; apices obtusi rotundatique; chromatophori longi, ellipticique, ca. 1.75-4.0 μ.

Thalli minute, 2-3 mm. tall, monosiphonous, consisting of a dichotomously branched upper part from an elongated stipe part arising from a prostrate basal attachment; stipe 1.0 to 1.5 mm. long, about 40 μ in diameter, densely green pigmented, dichotomously, decussately branched above, the first two or three forkings at intervals of 80-150 μ, then at intervals of 250-400 μ, very slightly constricted at the dichotomies, gradually reduced in diameter to the ultimate segments which are about 25 μ in diameter; apices blunt, rounded; chromatophores long elliptical, about 1.75-by 4.0 μ in dimensions.

TYPE: Dawson 18987, with *Sphacelaria* scraped from rocks on the southwest side of Isla San Francisco, April 18, 1958. (LAM)

In reporting on the marine algae of the southern Marshall Islands the writer (Dawson 1956:39, fig. 27) recorded and illustrated a small green alga from Arno Atoll as *Geppella mortensenii* Børgesen. That plant, now deposited in the Bishop Museum, Honolulu, showed a somewhat decussate, non-flabellate branching and also lacked the annular attachments between branches characteristic of Børgesen's Mauritius specimens of *G. mortensenii*. Its size, general structure and appearance were such that it was referred in the absence of other comparative material to the Indian Ocean species. Now we find a plant in the southern Gulf of California which is quite clearly the same as the Arno Atoll specimens, although more laxly branched above, but more clearly distinct from the Indian Ocean plant in its lax, decussate, non-flabellate branching as well as in the lack of attachment discs. Accordingly, the Mexican plant is described as a second representative of this curious codiaceous genus and the Marshall Islands material referred to it.

Codium spp. A number of collections of this interesting genus were made and submitted to Dr. P. C. Silva for determination. He, however, indicated that the problems with Mexican codiums are so numerous and difficult that he prefers to treat them only monographically as a large geographic unit. This he proposes to do in the near future. Accordingly, the material from the present collections will be cited only with brief discussion.

With the exception of collections at Puerto Escondido of large plants identical in habit and utricle characters with *Codium amplivesiculatum* Setch. & Gard. (18753), the *Codium* collections consisted of two distinctive types. One of these, represented by 18587, 18725, 18779, 18911, 18932, 18956 is a thin, prostrate species which was observed at nearly all of the southern localities visited to as far north as Puerto Escondido. In some localities it formed extensive patches to a meter broad, while in

Fig. 3. A. *Cladophoropsis robusta.* Part of a collection from Isla San Pedro Nolasco (18555) showing the congested habit and lack of well-developed distichous branches throughout most of the clumps. B. *Dasya sinicola.* A specimen from Isla San Pedro Nolasco. C. *Ahnfeltia svensonii.* Dwarfish material from Isla Cholla, off Isla Carmén (18747). All natural size.

others the plants were only a few cm. across. This suggests the plant reported by Taylor (1945) as *Codium setchellii* Gard., prox. from Panama, but clearly has nothing to do with that California species.

The other group of collections represented by 18546, 18627, 18675, 18727, 18731, 18784, 18796, 18843, 18884, 18915, 18965, 18976, is of a more or less densely clumping form mostly 5-10 cm. high, seemingly of the *Codium simulans* Setch. & Gard. complex. These were found at nearly every locality from Isla San Francisco to Isla San Pedro Nolasco. They sometimes, as at Isla Cholla, occurred as dominant members of the bottom community between low water level and depths of 6 to 10 feet. At Isla Ildefonso, dense, spongy fringes of these plants occurred in shaded places to above the + 1 foot tide level.

Neomeris annulata Dickie 18590

Halimeda discoidea Dec'ne 18600; 18661; 18797; 18898; 18971

PHAEOPHYTA

Ectocarpus sp. aff. *E. mitchellae* Harv. 18859; 18928

Sphacelaria furcigera Kütz. 18823, on a parrot fish beak, Bahía Agua Verde, April 20.

Sphacelaria hancockii Daws. 18617, with abundant propagulae

Sphacelaria tribuloides Menegh. 18927, a new record in the Gulf of California. A few propagulae of *S. furcigera* are also present.

Pachydictyon coriaceum (Holmes) Okam. 18702, a narrow, slight form

Dictyota crenulata J. Ag. 18917 This is a new extension northward into the Gulf of California.

Dictyota dichotoma (Huds.) Lams. 18586, covered with abundant, deciduous, vegetative propagulae; 18964, a narrow form.

Dictyota divaricata Lamx. 18561; 18620; 18650; 18713; 18845; 18923; 18900; 18963; 18967; 18775, referred with doubt

Dictyota flabellata (Collins) Setch. & Gard. 18551; 18636

Dictyota sp. 18685 This is apparently distinct from any known Pacific Mexican species, but the affinities with exotic species are not clear.

Dictyopteris repens (Okam.) Børg. 18671 This material is characteristic of the species as known from several other tropical Pacific areas and represents a new record for Pacific Mexico.

Dictyopteris zonarioides Farlow 18549; 18707

Padina caulescens Thivy 18880 has the branched, stupose stipe, the light calcification and regular, closely spaced hair lines of this species, which has not heretofore been reported as far north as the Gulf of California. Number 18960 is similar, but is referred with some doubt.

Padina sp. cf. *P. crispata* Thivy 18951 is the best developed of three examples and shows general agreement with this species from the Tres Marías Islands and from Costa Rica. The blades are twolayered in outer parts and six-layered below. 18802, not well developed; 18598, poorly developed.

Padina durvillaei Bory 18545; 18621, poor and young; 18628; 18656; 18718 seems to show very slight calcification in some places; 18752; 18842

Padina mexicana Daws. 18924 This is the third locality for this species known hitherto from La Paz and from Isla Tiburón.

Spatoglossum sp. aff. *S. schroederi* (Mert.) J. Ag. 18572 (Fig. 1) The presence of marginal teeth and protuberances, as well as the relatively narrow blades, places this plant nearest to *S. schroederi*. A similar collection in size and branching, but with less regularly or conspicuously toothed or modified margins, is Dawson 9987 (AHFH) from near Punta Malarrimo, Bahía Vizcaino, Baja California. *S. schroederi* is reported from Chile. Specimens from Hawaii have been seen and noted that agree superficially with specimens of *S. schroederi* from the West Indies.

Pocockiella variegata (Lamx.) Papenf. 18942; 18929; 18985 These represent new records for the Gulf of California.

Nemacystus brandegeei (Setch. & Gard.) Kylin 18758 (Fig. 2) This is large, luxuriant material, lax, long, skein-like and entangled, observed to reach a meter or more in length.

Colpomenia sinuosa (Roth) Derbès & Solier 18861; 18891

Colpomenia sinuosa var. *tuberculata* (Saund.) Setch. & Gard. 18846; 18935

Hydroclathrus clathratus (C. Ag.) Howe 18756; 18823a; 18881; 18958

Rosenvingea intricata (J. Ag.) Børg. 18883

Chnoospora implexa Hering, ex J. Ag. 18604; 18773; 18806; dwarfish; 18878; 18959; 18979; 18692

Sargassum brandegeei Setch. & Gard. 18547

Sargassum horridum Setch. & Gard. 18654, immature material, but spiny and with muricate branches. The holdfast is a small, irregular discoid or conical attachment 6-8 mm. in diameter. 18877

Sargassum macdougalii Daws. 18771, somewhat immature, but the lower "leaves" and holdfast in agreement with this species.

Sargassum sinicola Setch. & Gard. 18575; 18630; 18696; 18754; 18834; 18957

Sargassum sp. 18588, juvenile specimens resembling *S. patens* Ag.; 18966

RHODOPHYTA

Porphyra hollenbergii Daws. 18736, carposporic plants only

Dermonema frappieri (Mont. & Millard.) Børg. 18737; 18746 These represent new records from the Gulf of California.

Galaxaura arborea Kjellm. 18870; 18903

Galaxaura veprecula Kjellm. 18962, richly developed material

Galaxaura fastigiata Dec'ne 18633

Liagora farinosa Lamx. 18914; 18949 This species has not been reported from the Gulf of California.

Liagora magniinvolucra Daws. 18926 A single male and a mature cystocarpic plant are present, the latter more slender and less mucilaginous than the former, but otherwise like it. This is a new record for the Gulf north of Cabo Pulmo.

Asparagopsis taxiformis (Delile) Collins & Hervey 18655; 18632; 18706; 18798; 18848; 18916; 18961; 18597, *Falkenbergia* generation; 18945, *Falkenbergia* generation

Gelidium johnstonii Setch. & Gard. 18616; 18776; 18839; 18938, slender and dwarfish but tetrasporic; 18906

Gelidium pusillum (Stackh.) Le Jolis forms 18793, tetrasporangial; 18912

Pterocladia pyramidale (Gard.) Daws. 18605; 18734 These are almost unquestionably the *Gelidium decompositum* of Setchell and Gardner which has not been found in fertile condition. The known occurrence now of *Pterocladia pyramidale* at several tropical and near tropical localities such as Alijos Rocks, Isla Clarión, Galapagos Archipalego, etc., also suggests strongly the identity of this species with the Gulf of California plants known as *Gelidium decompositum.*

Gelidiella hancockii Daws. 18596 This agrees with the type in size and habit but is more strict. The erect axes are almost all simple and attenuate whereas most specimens to date have shown some irregularity of branching and less strict erect parts.

Gelidiopsis tenuis Setch. & Gard. 18687; 18824; 18980

Gelidiopsis variabilis (Grev.) Schmitz 18560 These have compressed branches and axes and occasional opposite branches that were at first misleading; 18637

Hildenbrandia prototypus Nardo 18749

Peysonnelia rubra var. *orientalis* Weber v. Bosse 18674; 18810; 18988

Lithophyllum ? trichotomum (Heydr.) Lemoine? 18626; 18690; 18817; 18832

cf. *Heteroderma gibbsii* (Fosl. & Setch.) Foslie 18584

Corallina pinnatifolia var. digitata Daws. 18663; 18852; 18889; 18939

Amphiroa annulata Lemoine 18591, in a turf of *Jania capillacea* and *Centroceras clavulatum;* 18593; 18876, near var. *pinnata* Daws., mixed with dwarfish *A. zonata;* 18922; 18598; 18611; 18649, an atypical, narrow, proliferous form with upper segments very much and consistently unlike the lower; 18678

Amphiroa dimorpha Lemoine 18789; 18849; 18902

Amphiroa dimorpha var. **digitiforme** var. nov. Fig. 4

Forma speciei similis, segmentis inferioribus latis, autem, irregulariter lobatis atque digitate divisis, segmentis superioribus ad segmenta ultima subcylindrica 400 μ diam. successive reductis.

Like the species but the lower, broad segments irregularly lobed and digitately divided, and the upper segments successively reduced to ultimate ones, in part subcylindrical and only 400 μ in diameter.

TYPE: Dawson 18684, at a depth of about 5 feet, Isla Cholla, off Isla Carmén, April 23, 1958. (LAM)

ADDITIONAL MATERIAL: Dawson 18704, Isla Ildefonso, April 24, 1958.

The fact that this stikingly atypical form has appeared several times (specimens approaching the present ones have been examined in the Hancock Foundation, Los Angeles) has indicated that a distinct entity of at least varietal rank should be recognized. At best the varied forms of *Amphiroa dimorpha,* as, indeed, other species of this difficult genus, cannot easily be described in precise terms. The figures best show the range of variation in lower segment size and form that may be found in this taxon.

Amphiroa drouetti Daws. 18821, genicular calcification not as complete as in some examples; 18888 This is very tall material, to 6 cm, but in good agreement with the original material in diameter, forking, calcification of genicular regions, etc. The lower genicula on this large material show clearly, but the upper show little except by cracks in the calcification. 18908, luxuriant, rather strongly compressed below and larger in diameter than some; 18919

Amphiroa magdalenensis Daws. 18646; 18705 These extend the range northward into the Gulf of California.

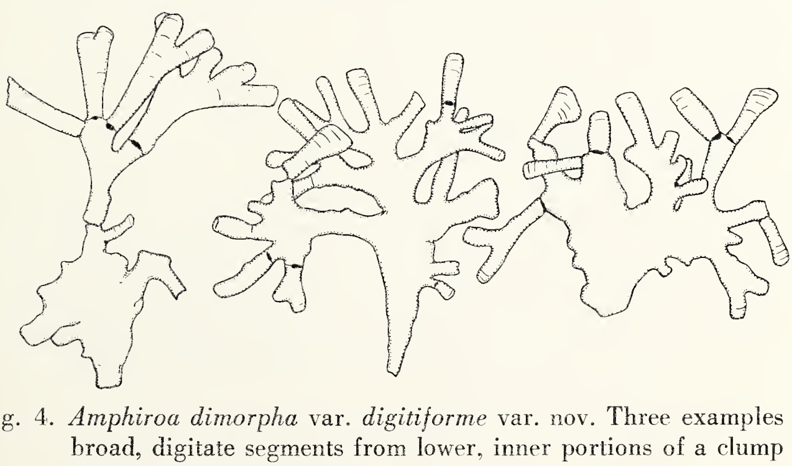


Fig. 4. *Amphiroa dimorpha* var. *digitiforme* var. nov. Three examples of broad, digitate segments from lower, inner portions of a clump of the type collection, × 3.

Amphiroa subcylindrica Daws. 18612; 18763; 18794; 18885

Amphiroa taylorii Daws 18833 This collection is in good agreement with this species, but is more regularly dichotomously branched than the type and not so crooked. The two-tiered genicula, the diameter of the cylindrical branches and the constricted genicula are distinctive. The species has not previously been reported in the Gulf of California proper.

Amphiroa zonata Yendo 18613; 18652; 18677, 18768; 18795, large material 8 cm. tall; 18850, an atypical form

Amphiroa sp. (cf. forms of *A. franciscana* Taylor) 18790 This is difficult to assign. Some lower segments are quite broad, but many are as narrow as 200 μ or less.

Jania capillacea Harv. 18591a, with *Centroceras clavulatum* and *Amphiroa annulata*

Jania decussato-dichotoma (Yendo) Yendo 18614; 18688; 18791, with *Jania capillacea;* 18905, richly developed and typical

Jania longiarthra Daws. 18615; 18818, with *Amphiroa annulata;* 18892, rather slender, decussate and somewhat divaricate, but in otherwise satisfactory agreement; 18909; 18920; 18978, luxuriant material nearly 3 cm. tall.

Jania tenella Kütz. 18729, in a *Hypnea-Laurencia-Jania* turf mixture

Jania tenella aff. var. *zacae* Daws. 18717

Grateloupia howei Setch. & Gard. 18854 This collection shows a variegation in some parts suggestive of that in *G. versicolor.* This is a new southern record, but depauperate material of this species is known from Mazatlán.

Grateloupia prolongata J. Ag. 18552

Grateloupia versicolor (J. Ag.) J. Ag. 18721 This is a dichotomously branched, abundantly tetrasporic collection without pinnae or proliferations of any kind. It extends the species range northward into the Gulf of California.

Carpopeltis stella-polaris sp. nov. Fig. 9 B

Thalli erecti, 3-4 cm. alt., e fasce axium dichotomorum e systemate parvo rhizomatum subteretium ramosorum stolones breves nonnullos ferentium oriente constantes; laminae erectae ramosae quaternae vel quinae e caudicibus brevibus (2 mm. alt.) super systema rhizomaticum interdum orientes, laminae a basi anguste cuneatae, uno in plano intervallis 5-11 mm. dichotome ramosae, angustae planaeque, 0.5-1.5 mm. latae, ca. 150 μ crassae, segmentis terminalibus plerumque quasi attenuatis aut obtuso-lanceolatis, non expansis; sori tetrasporangiales indefiniti, elongati, in partibus laminarum terminalibus plerumque per dichotomiam ultimam extensi, quasi totas laminas utroque in latere nisi margines occupantes; tetrasporangia ca. 32 μ long., cruciata, in cortice

Fig. 5. *Gracilaria spinigera.* A specimen from Isla Ildefonso (18699). Natural size.

ca. 40 μ crass. propter nematheciam mutato producta; reproductio sexualis non visa.

Thalli erect, 3-4 cm. tall, dull red in color, consisting of a group of dichotomous axes arising from a small system of subterete, branched rhizomes bearing some short stolons; erect branched blades sometimes arising in groups of 4-5 from short (2 mm. tall) stumps above the rhizome system, narrowly cuneate from the base, dichotomously branched in one plane at intervals of 5-11 mm., narrow, flat, 1.0-1.5 mm. wide, about 150 μ thick, the terminal segments usually somewhat attenuated or blunt-lanceolate, not expanded; transection of sterile mid-parts showing a medulla of moderately densely packed filamentous cells essentially longitudinally arranged, mostly 3-4 μ in diameter, a subcortex of about 2 layers of smaller, more or less rectangular cells somewhat anticlinally elongated, about 5-6 μ long, 3.5-5 μ wide; tetrasporangial sori indefinite, elongated, in terminal blade parts, usually running back through the last dichotomy, occupying essentially the whole of both sides of the blades except the margins; tetrasporangia about 32 μ long, cruciate, borne in a nemathecially modified cortex about 40 μ thick in which the sterile cortex and subcortex of 4-5 layers of cells is somewhat augmented to about 6, but anticlinal elongation and further division of the outer layers reducing the lateral diameters of the ultimate layers to about 2.5 μ; sexual reproduction not seen.

TYPE: Dawson 18716, at a depth of about 5 feet, Isla Ildefonso, Gulf of California. (LAM)

This species closely resembles *Rhodymenia californica* or *R. attenuata* in form, but is quickly separated by observation of the filamentous structure. The nemathecial tetrasporangia together with the filamentous structure and flat, dichotomous branches seem clearly to place the plant in the genus *Carpopeltis* as understood by Kylin, 1956[3]. Two other species are reported in the northeastern Pacific. *Carpopeltis bushiae* (Farl.) Kylin is a broader, thicker species with proportionally short upper segments, and branching from a definite cylindrical stipe. Its range is from southern California to Punta Abreojos, Baja California. *Carpopeltis clarionensis* (Setch. & Gard.) comb. nov. (*Polyopes clarionensis* Setchell & Gardner 1937, p. 91, pl. 4, fig. 9, pl. 6, fig. 17, pl. 23, fig. 45) is a species with subdichtomous ligulate blades from a rigid, cylindrical branched lower portion. It is reported from Isla Clarión and from Oahu, Hawaii. Our present species is distinct from both of these in stipe and branching characters, although seemingly nearest *C. bushiae* and

[3] Kylin (1956) has limited his recognition of *Polyopes* to the single Australian species *P. constrictus* (Turn.) J. Ag. He has transferred *Polyopes bushiae* Farl. and *P. sinicola* Setch. & Gard. to *Carpopeltis*. The latter plant has been shown by the writer (1954) to have nothing to do with *Polyopes*, but to represent a specimen of *Ishige foliacea*.

possibly derived from it. Some resemblances are seen to the Japanese species *Carpopeltis affinis* (Harv.) Okam., but there appear to be ample differences in habit and habitat.

Prionitis abbreviata Setch. & Gard. 18609; 18933, an extremely reduced, almost branchless form from near the margin of its range; 18936, the same, but with branches. Other variations of this species not well assignable to var. *guaymasensis* are 18648, 18681, 18851, 18893.

Prionitis abbreviata var. *guaymasensis* (Daws.) comb. nov. (*Prionitis guaymasensis* Dawson 1944, p. 283, pl. 60, fig. 1-2) 18557 represents an atypical form of this plant with decompound, attenuate, acute branches. 18778 is a narrow form not quite equivalent to this variety.

Hypnea sp. cf. *H. cervicornis* J. Ag. 18710

Hypnea esperi Bory 18890, typical material adhering loosely to sand and gravel, and identical with specimens collected by the writer in Viét Nam. 18559 is possibly a rather large form of this species.

Hypnea johnstonii Setch. & Gard. 18581; 18858

Hypnea nidulans Setch. 18562, 18566 and 18930 are sufficiently coarse, loosely branched and reddish in color to be placed with certainty under this widely distributed tropical species. Numbers 18686, 18904 and 18925 are similar, but for the most part somewhat smaller, and have led to a further comparison of the type specimens of *Hypnea nidulans* Setch. and *H. pannosa* J. Ag. with various collections of caespitose hypneas in the tropical Pacific. This seems to bring out the following point: The type of *Hypnea pannosa* seems to be depauperate material taken from high rock pockets in which the plants were fertile but somewhat dwarfishly developed. These are most nearly like material from a similar high surfy habitat collected by Taylor on Islas Secas, Panama, and recognized by him as this species. Taylor also placed under *H. pannosa* several coarser, better developed plants which correspond with plants more generally known as *H. nidulans* Setch.

The writer in 1944 (p. 291) compared *H. pannosa* and *H. nidulans* on the basis of type fragments of the former in the herbarium of the University of California. Subsequently, examination of the type material in Herb. Agardh has revealed somewhat more of the characteristics of this collection and shows that the small, caespitose material of Dawson's number 722 referred to *H. pannosa* in 1944 may not be this plant, but perhaps a still more delicate species with saddle-shaped nemathecia. The habit, although somewhat more lax, is very much the same, and it looks simply like a smaller edition of *H. pannosa*.

Hypnea nidifica auct. 18755; 18819; 18857 These correspond with the species interpreted as *Hypnea nidifica* J. Ag. in the Gulf of California (Dawson 1944), but the identity of Agardh's species from Hawaii is confused because the type collection consists of a mixture of two species, one saxicolous and one epiphytic, which have been recognized as distinct when observed in nature in Hawaii.

Gracilaria crispata Setch. & Gard. 18550; 18659; 18759, an extremely attenuated bay form?; 18814, probably young, dwarfish; 18879, richly developed

Gracilaria pachydermatica Setch. & Gard. 18629; 18711; 18741; 18772, antheridial; 18770; 18800; 18838; 18886; 18937, a dwarfed form; 18595, doubtful

Gracilaria ramisecunda Daws. 18660; 18757, sterile

Gracilaria spinigera Daws. 18634; 18699 (Fig. 4); 18777

Gracilaria subsecundata Setch. & Gard. 18887

Gracilaria textorii (Suring.) J. Ag. 18548 The discovery of male plants of *G. textorii* in Japan has enabled Ohmi (1955) to make critical comparisons with the writer's material of *G. vivesii* Howe from the Gulf of California with the result that the writer's suspicions of the identity of the two (Dawson 1949a) have been substantiated. This is small, narrow, apparently immature material. 18608, poorly developed

Gracilaria sp. 18715, probably a very narrow, young form of *G. textorii*; 18829, sterile

Gymnogongrus johnstonii (Setch. & Gard.) Daws. 18574, cystocarpic material identical with the type illustration; 18583 (Fig. 6 A)

Ahnfeltia svensonii Taylor 18747 (Fig. 3 C) This material is very small for the species, but a comparison with a wide range of large and dwarfish examples from the Galapagos Archipelago shows that our material is essentially indistinguishable from some of the smaller topotype examples of *A. svensonii* from Charles Island, Galapagos. The distinctly compressed segments and approximate branches are characteristic; 18934, juvenile material with the flattening of axes scarcely yet apparent.

Rhodoglossum hancockii Daws. 18553

Gigartina intermedia Suring. 18651 These plants are so remarkably like Suringar's species that this identification seems almost unquestionably correct despite the fact that the species has not heretofore been reported from the eastern Pacific. It is well known in Japan, Amoy, China, and was recently reported from Viêt Nam.

Gigartina tepida Hollenb. 18558

Gloioderma conjuncta (Setch. & Gard.) comb. nov. (*Estebania conjuncta* Setchell & Gardner 1924, p. 783, pl. 25, fig. 35, 36, pl. 85, 86) 18641

Setchell and Gardner provisionally placed their genus *Estebania* in the Grateloupiaceae because of "general structure, the absence of an apical cell and the cruciate tetraspores." Their description of the "general structure" consisted largely of an account of the "center of the fronds packed with fine, densely intertwined, much branched filaments, surrounded on all sides by 1-2 layers of large ovoid cells merging outwardly into smaller cells."

An examination of the development of these branched filaments in the medulla, between and even within the large, vacuolate medullary cells, has shown that they occur as the result of secondary growth and intrusion in older thallus parts. Young areas of the thallus have only the large medullary cells without such filaments. This structure is characteris-

Fig. 6. A. *Gymnogongrus johnstonii.* A specimen from Isla San Pedro Nolasco (18574). Natural size. B. *Callithamnion paschale.* Mature, fertile material from Isla Monserrate (18803). Natural size.

tic of *Gloioderma*, and the account and illustrations of Sparling (1957), when compared with our present material of *Estebania*, conclusively call for union of the latter with *Gloioderma*, despite the fact that frequent collection of this species in abundance at a number of northern Gulf of California stations has failed to reveal any sexually reproductive plants.

Rhodymenia californica Kylin 18658 The size, thin segments and especially the non-nemathecial manner of the tetrasporangia production seem to substantiate this determination which represents a new Gulf of California record.

Rhodymenia hancockii Daws. 18899 (Fig. 9 A) This ample material permits expansion of the description drawn from the fragmentary type specimen. The holdfast, heretofore not known, is discoid and without stolons. The stipe is prominent and the blades over 400 μ thick. The narrower blades of the present material probably reflect the shallower habitat. The type came from about 40 meters depth. Specimens under 18977 also have branched stipes and discoid holdfasts without stolons, but are referred here with some doubt.

Botryocladia uvarioides Daws. 18573; 18698 (Fig. 8) The gland cells are 11-12 μ in diameter and arranged as described.

Champia parvula (Ag.) Harv. 18821a, small, epiphytic examples

Callithamnion paschale Børgesen (Fig. 6 B) Examination of Børgesen's (1924) well-illustrated account of this plant in the light of three new collections of the species described some years ago as *C. veleroae* Dawson (1944:312) has revealed such similarity, not only in vegetative characters, but in all the reproductive phases, that it is considered necessary to reduce the name of the Gulf of California plant and to recognize a wide distribution for *C. paschale* in both the southern and northern hemispheres in the Pacific. It was heretofore presumed to be an endemic at remote Easter Island. All reproductive phases are present in number 18803, antheridial in 18948b, and tetrasporangial in 18569, in which there is some tendency to irregular rather than strictly dichotomous branching.

Antithamnion breviramosus Daws. 18585, growing on *Cladophoropsis robusta;* 18672a These collections are essentially identical with the southern California type and represent new records for Pacific Mexico. A variant of this species was recently reported by the writer from Eniwetok Atoll, Marshall Islands.

Antithamnion mcnabbii sp. nov. Fig. 7 C

Thallis minuti, abunde ramosi dense aggregati, ad 8 mm. alt. penicillos molles rubros in corallinis brevibus articulatis in saxorum superficie formantes, ex axibus intricatis ramosis monosiphonis ecorticatis, infra ca. 25 μ diam., rhizoidea plerumque simplicia multicellularia multa ferentibus constant; cellulae axiales infra ca. 150 μ long., supra 100 μ, et ad cacumina gradatim reductae; ramuli secondarii indeterminati frequentes 3-4 segmentis inter se distantes, multifarii, plerumque sine ramis tertiariis indeterminatis; ramuli ultimi determinati terni verticillati, breves, ca. 100 μ long. digitate 2-, 3-, interdum 4-furcati, cellulis in extremitatibus ad 10 μ vel minus long., atque 6-7 μ lat. magnitudine successive reductis; cellula terminalis obtusa, subacuta, aut pilum sine colore ferens; glandicellulae absentes; reproductio non visa.

Thalli minute, abundantly branched and densely aggregated, to 8 mm. tall, forming soft, red tufts on short articulated corallines on rock surfaces, consisting of interwoven branched monosiphonous, ecorticate axes about 25 μ in diameter below, bearing numerous, generally simple multicellular rhizoids, each arising from the basal cell of a determinate lateral branch; axial cells about 150 μ long below, 100 μ above and gradually reduced to the tips; secondary indeterminate branches frequent, 3-4 segments apart, multifarious, usually without tertiary indeterminate branches; ultimate determinate branchlets whorled in groups of three, short, about 100 μ long, with two, three, or sometimes four forks in a digitate manner, the first two usually of a single cell each and the last sometimes of a single cell, sometimes of two, the cells successively reduced in size to 10 μ or less long and 6-7 μ wide at the ends, the end cell blunt, subacute, or bearing a colorless hair; gland cells absent; reproduction not seen.

TYPE: Dawson 18855, scraped from rock surfaces with other minute algae from depths of about 3 feet, El Solitario rock, Bahía Agua Verde, Baja California del Sur, April 20, 1958. (LAM)

In size and superficial characters this tiny species suggests *A. breviramosus* Dawson, a species also newly recorded in the Gulf of California. The dense aggregation of axes matted together with rhizoids the absence of gland cells and the short-segmented, digitate determinate laterals are, however, amply distinctive.

Branchioglossum woodii (J. Ag.) Kylin 18723 This is a new record for the southern Gulf of California.

Schizoseris pygmaea Daws. 18673; 18873; 18568 Despite an abundance of this plant on thin sponges at depths of 3 to 6 feet on vertical walls at the landing place on Isla San Pedro Nolasco, no fertile material has appeared. Accordingly, it is not possible to make an adequate comparison with the *Myriogramme subdichotoma* Segawa (1941) from Izu, Japan, a plant that shows great resemblance to, and may be identical with, ours. Segawa has pointed out the affinity of his plant with *Schizoseris,* even to its close resemblance to the larger *Schizoseris dichotoma* (Hook. & Harv.) Kylin (1929) from New Zealand. He also indicates a likeness of his plant with Børgesen's *Myriogramme bombayensis.* Since fertile material is lacking our specimens cannot fully be compared with any of these, but in habit and size the similarity to Segawa's species is most striking.

Taenioma purpusillum (J. Ag.) J. Ag. 18948a

Centroceras clavulatum (Ag.) Mont. 18645; 18669; 18703 18740; 18782; 18786; 18867; 18875

Ceramium caudatum Setch. & Gard. 18769 is rather slender but fertile, tetrasporangial material on *Codium;* 18780. large, well-developed tetrasporangial material essentially identical with the type. Close relationship to the larger, coarser *C. ornatum* Setch. & Gard. from Isla Guadalupe is shown by the arrangement and the form of the peculiarly stalked tetrads within the tetrasporangia (Compare Setchell & Gardner 1924, pl. 27, fig. 55 and Dawson 1950, pl. 2, fig. 10); 18864, tetrasporangial

Ceramium fimbriatum Setch. & Gard. 18765; 18811

Ceramium gracillimum var. byssoideum (Harv.) G. Mazoyer 18607, sterile material on *Amphiroa;* 18807, sterile, but well developed vegetatively; 18897

Ceramium paniculatum Okam. 18578; 18579 is the same, but is a more slender form. It has many branches showing few or no spines, but others with many; 18948

Ceramium procumbens Setch. & Gard. 18653 This collection is unusual in that the opposite branching is in part suppressed in favor of alternate or irregular branching, and the tetrasporangial branches are asymmetrically curved with the sporangia immersed in the convex side. Male plants are also present and their fertile axes are more symmetrical. 18726, luxuriant fertile material of all stages; 18728 has prominent opposite branching, but the fertile axes are partly asymmetrical as noted above. It is mixed with *C. taylorii* and *C. sinicola.* 18785, on *Gelidium;* 18865

Ceramium sinicola Setch. & Gard. 18570; 18863

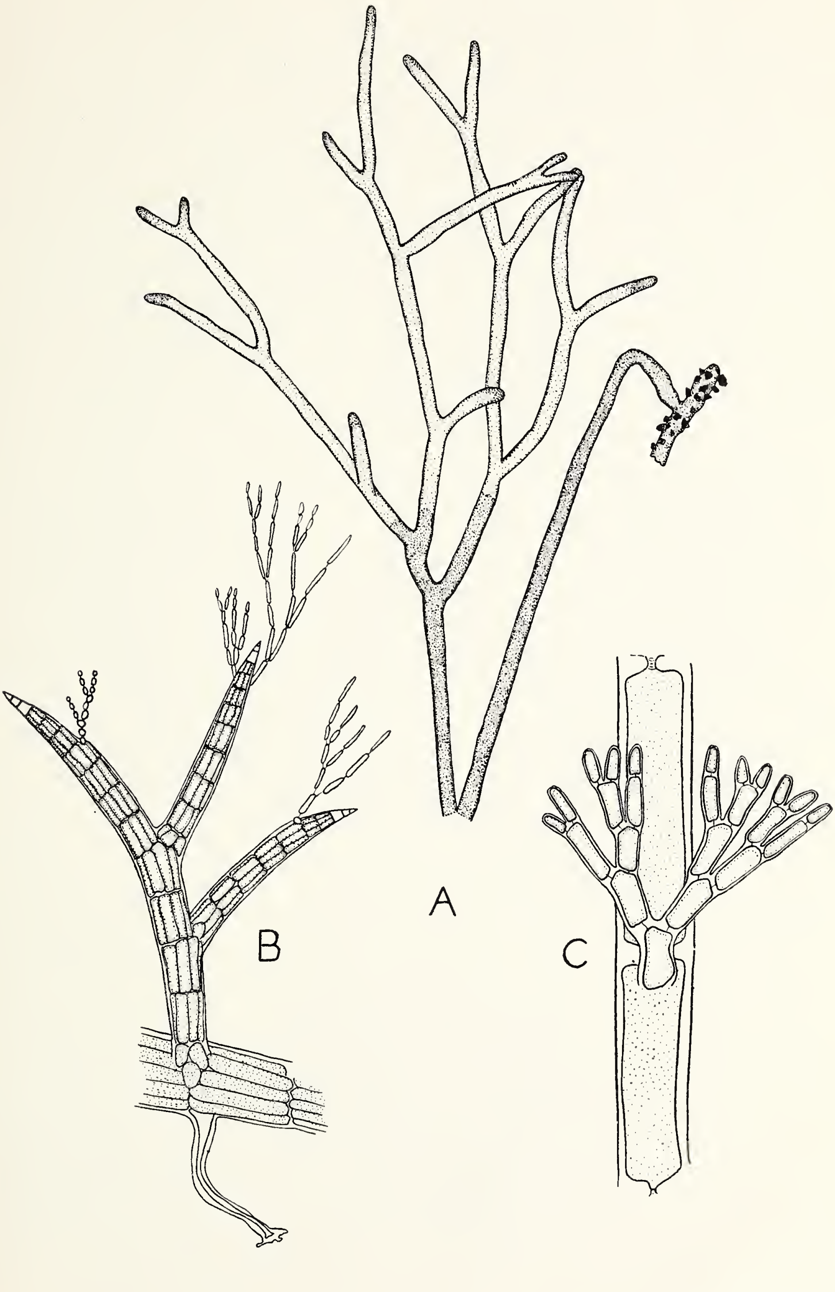
Ceramium sinicola var. *interrupta* (Setch. & Gard.) Daws. 18910, on *Codium*

Ceramium taylorii Daws. 18733, some growing on *Chaetomorpha* and some on rocks; 18874

Ceramium zacae Setch. & Gard. 18837 This tetrasporangial material, epiphytic on *Gelidium,* represents a new record for the Gulf of California.

→

Fig. 7. A. *Geppella decussata* sp. nov. Habit of a plant from the type collection showing an erect, dichotomous. decussate axis from a prostrate portion with adherent sand grains. × 64. *B. Herposiphonia spinosa* sp. nov. Portion of a prostrate axis from the type collection, showing a rhizoid and a spinose, determinate branchlet with trichoblasts, × 87.5. C. *Antithamnion mcnabbii* sp. nov. Portion of a mature axis from the type collection, showing one of three whorled, lateral, determinate branches at a node 700 μ from its tip, × 305.


A
B
C

Griffithsia tenuis C. Ag. 18556; 18619; 18644; 18667; 18712; 18732; 18762

Dasya sp. cf. *D. pedicellata* (Ag.) Ag. 18809, possibly just a reduced example with thick axes up to 500 μ in diam. below, but slender, branched pseudolaterals 12 μ thick in outer parts.

Dasya sinicola (Setch. & Gard.) comb. nov. (*Heterosiphonia sinicola* Setchell & Gardner 1924, p. 770, pl. 28, fig. 59, 60, pl. 47b) 18812; 18730; 18554 (Fig. 3 B) This material has been compared with portions of the type material and found to be identical. The structure of the plant is that of a 5 pericentral celled *Dasya* rather than a *Heterosiphonia*. The pseudolaterals are monosiphonous throughout rather than polysiphonous below. Secondary indeterminate polysiphonous lateral branches do not arise from the pseudolaterals as in *Heterosiphonia* and are not at first corticated. These uncorticated lateral branches may have led Setchell and Gardner to their disposition of the plant.

Setchell and Gardner have given good illustrations of the anatomical features of the axis, showing the pericentral cells and cortical cells of mature axes in detail. The cortication is delayed however to the extent that the immediate apices clearly show the pericentral cells which are early corticated by slender rhizoidal cells. The material under 18730 is excellent for observing the pseudolaterals and secondary branch origins. Number 18872 seems to be a dense, short, compact form superficially different in appearance from the type, but structurally the same.

Heterosiphonia wurdemanii var. *laxa* Børg. 18944c, small amount; a new record for the Gulf of California

Digenia simplex (Wulfen) Ag. 18635; 18799; 18862

Polysiphonia concinna Hollenberg[4] 18640; 18841

Polysiphonia johnstonii Setch. & Gard. 18697

Polysiphonia mollis Hook. & Harv. 18606; 18665; 18767; 18783; 18801; 18827; 18981

Polysiphonia simplex Hollenberg 18738; 18946

Herposiphonia secunda (Ag.) Ambronn 18625; 18672

Herposiphonia subdisticha Okam. 18664, very luxuriantly developed; 18714, excellent material on *Amphiroa;* 18869; 18897a. This species may now be considered to be well known in the Gulf of California, and it has been possible to compare the present collections with material of *Herposiphonia parva* Hollenberg recently described from California (Hollenberg 1943: 575, fig. 8-9). There appear to be no consistent differences between the plants from southern and northern areas along Pacific North America. The habit of growing on articulated corallines is characteristic and is identical with that of the Japanese plants illustrated by Okamura (1915, Icones III, pl. 146, fig. 11-18). These

[4] The determinations of these four species of *Polysiphonia* are provided by Dr. George J. Hollenberg of the University of Redlands, California.

Fig. 8. *Botryocladia uvarioides.* A specimen from Isla Ildefonso (18698). Natural size.

considerations call for the reduction of *H. parva* under *H. subdisticha.*

Herposiphonia tenella (Ag.) Ambronn 18896; 18742, growing on a limpet shell is a very densely branched, short-segmented example referable here with some doubt. The confined habitat may account for the peculiarities.

Herposiphonia spinosa sp. nov. Fig. 7 B

Thalli minuti. apud algas alias repentes, ex axe principali prostrato polysiphono ad 18 μ long. vel plura, 130-160 μ diam., per rhizoidea unicellularia e superficie ventrali affixo, constantes, uno rhizoideo ex extremitate anteriore cellulae pericentralis in fere omni segmento, nisi prope cacumina axis, oriente, rhizoidea per membranam convexam a cellula pericentrali absciso; cellulae pericentrales 10-12 in axibus maturis, 6-8 in ramis determinatis; segmenta matura ca. 200 μ long.; apices ascendentes et. ut solet in genere,, circinati videri solent; rami indeterminati ad omne quartum segmentum regulariter obvenientes, per 3 ramos determinatos disiuncti; rami determinati saepissime erecti, e dimidio dorsali axis prostrati orientes, longitudine usque 1 mm., infra ca. 80 μ diam. semel vel plerumque bis furcati, ramis rigidis, divaricatis atque paululum recurvatis, ad apicem acutum, e serie plerumque 3 cellularum sine colore constantem, attenuatis, omnibus ramis in segmento quarto vel quinto post cacumen spiniforme trichoblastam ramosam conspicuam non praemature deciduam ferentibus; reproductio non visa.

Thalli minute, creeping among other algae, consisting of a prostrate polysiphonous main axis to 18 mm. long or more, 130-160 μ in diameter attached by unicellular rhizoids from the ventral surface, one of these arising from the forward end of a pericentral cell on virtually every segment except near the axis tips, the rhizoid cut off from its pericentral cell by a convex wall; pericentral cells 10-12 in mature axes, 6-8 in determinate branches; mature segments about 200 μ long; apices ascending and tending to appear circinate as generally in the genus; indeterminate branches occurring regularly at every 4th segment, separated by three determinate branches; determinate branches tending to be erect, arising from the dorsal half of the prostrate axis, reaching a length of about 1 mm., about 80 μ in diameter below, once or usually twice forked, the branches rigid, divaricate and slightly recurved, tapered to a sharp point consisting of a series of usually 3 colorless cells, each branch bearing on the 4th or 5th segment back from its spine-like tip a conspicuous branched trichoblast which is not deciduous; reproduction not seen.

TYPE: Dawson 18594, scraped from a rock surface at a depth of about two feet below mean low water, east side of Isla Partida, Baja California del Sur, April 28, 1958. (LAM)

The remarkably sharply pointed, branched, rigid, determinate branches are so distinctive that this species can hardly be confused with any other *Herposiphonia*. This may be a rare plant, for although several

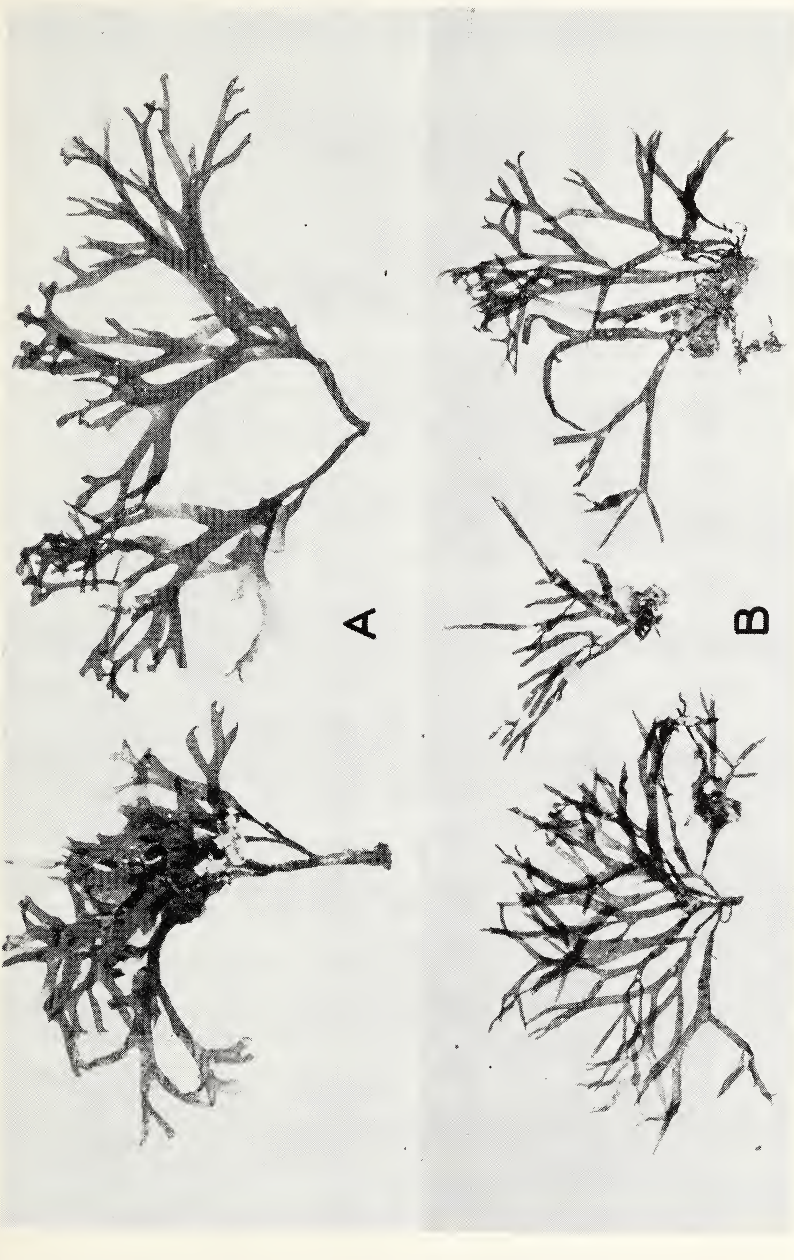


Fig. 9 A. *Rhodymenia hancockii.* Two specimens from Bahía Agua Verde (18899). Natural size.
B. *Carpopeltis stella-polaris* sp. nov. Three plants from the type collection from Isla Ildefonso. Natural size.

other species of *Herposiphonia* have been collected repeatedly in the Gulf of California, this one has appeared only in the present instance.

Lophosiphonia scopulorum (Harv.) Womersl. 18787, well developed

Laurencia hancockii Daws. 18868, topotypic; 18739, a little coarser than the type (350-400 μ thick) but in good agreement; 18748, richly developed; 18624, richly developed on a sponge. This latter material is shorter (5-7 mm. tall) than the type and has branches and axes slightly smaller in diameter (mostly 240-275 μ diam.). It seems clearly to be the same, however, as the Bahía Agua Verde material from intertidal rock pockets. The sublittoral habitat of the present material probably explains the variations observed, inasmuch as the species is apparently characteristically an inhabitant of surfy, intertidal areas.

The old and little known *Laurencia decumbens* Kützing (1863:16; 1865, Tab. Phyc. vol. 15, pl. 51) from New Caledonia is to be considered close to this species so far as form, habit and size are concerned, but Kützing's indicated magnifications are clearly incorrect and the description is fragmentary.

Laurencia obtusiuscula Setch. & Gard. Two series of rather delicately and abundantly branched laurenciae are at hand. Of these, the plants with shorter determinate branches are in best agreement with typical *L. obtusiuscula:* 18679, 18642, 18693, 18844, 18764, 18882, 18603, 18913, 18950. These were collected at levels which range from slightly below mean low water to somewhat above. Their most conspicuous feature in nature is the bright green color which, as observed by a swimmer at medium or high tide periods, makes the bottom appear like a waving green meadow. An inshore zone of this green *Laurencia* occurred at practically every station from Punta San Evaristo north to Isla Tortuga.

A similar plant, but reddish in color is represented by three collections, 18708, 18847 and 18576. These resemble the illustration of *Laurencia obtusiuscula* var. *laxa* Setch. & Gard. and are referred here with some question.

It appears unlikely that specific differences exist between plants described as *L. obtusiuscula* and *L. johnstonii.* Number 18844, for instance, is apparently equivalent to *L. johnstonii.* Setch. & Gard., but is not at all clearly distinct specifically from *L. obtusiuscula.* Numbers 18603 and 18913 show gradations also in density of branches and in color.

Laurencia papillosa var. *pacifica* Setch. & Gard. A series of seven specimens is at hand of plants which agree with the Setchell and Gardner illustration of this Gulf of California variety of the widely distributed species: 18689, 18643, 18709, 18774, 18853, 18895, 18618

Laurencia sinicola Setch. & Gard. 18691; 18724; 18871

Chondria californica (Collins) Kylin 18921; 18666; 18668; 18722, tetrasporic; 18745, tetrasporic; 18815; 18840; 18647, bearing richly developed *Jantinella.* Kylin doubted the distinctness of *Chondria* *acrorhizophora* and its parasite, *Jantinella sinicola*. Although Dawson (1944) recognized both, the present collections seem to negate the existence of two distinct species. Some specimens show acrogenous rhizoids and no strongly hooked branches, while others show a tendency for both. The habit of all is essentially as in the Pacific Coast forms of *Chondria californica*. Number 18840, with its tendency to curved tips and presence of rhizoids, suggests that *Chondria clarionensis* Setch. & Gard. may also belong here.

Chondria dasyphylla (Woodw.) C. Ag. 18860

Chondria sp. aff. *C. decipiens* Kylin 18577 This sterile material is suggestive of a dwarfish *C. decipiens*. No liquid preserved specimens were prepared, and the plant needs study on the basis of more complete and fertile collections. A comparison with southern California material shows remarkable similarity in form and structure, even to details of cortical cell form, the 5 pericentral cells, and the cell proportions in the medulla. The present collection is compressed, however, instead of subcylindrical.

Chondria sp. 18918 This plant is difficult to place. It is of the Coelochondria group, having rhizoidal attachments and a habit similar to *Chondria polyrhiza* Collins & Hervey and *C. hapteroclada* Tseng, perhaps nearest the latter. Its pericentral cells, however, show the curved lines described for *C. curvilineata* Collins & Hervey.

Jantinella verrucaeformis (Setch. & McFadden) Kylin 18647a, on *Chondria californica*

CYANOPHYTA[5]

Symploca hydnoides Kütz. 18592; 18940a, with *Spirulina subsalsa*

Hydrocoleum glutinosum (Ag.) Gom. 18592a, with *Symploca hydnoides*; 18973; 18975, on *Halimeda*; 18955, with *Calothrix crustacea* on *Liagora*

Hydrocoleum comoides (Harv.) Gom. 18622

Lyngbya majuscula (Dillw.) Harv. 18761; 18813; 18952

Lynbya aestuarii (Mert.) Liebm. 18947

Hormothamnion enteromorphoides Grun. 18766

Spirulina subsalsa Oerst. 18940, with *Symploca hydnoides*

Phormidium hormoides Setch. & Gard. 18943, on a sponge

Calothrix crustacea Thur. 18955a, with *Hydrocoleum glutinosum* on *Liagora*

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[5] The determinations of Cyanophyta are contributed by Dr. Francis Drouet of New Mexico Highlands University, Las Vegas, New Mexico.

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Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

Number 28 March 2, 1959

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: PHANEROGAMAE, MELASTOMATACEAE AND POLYGALACEAE

By J. J. WURDACK

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and itineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Melastomataceae and Polygalaceae

By J. J. Wurdack[1]

This account continues the reporting of the plant collections obtained by Expedition Botanist, E. Yale Dawson. The specimens are cited by his field collection numbers for which detailed locality data have been provided in the general account of the botany of the Expedition[2]. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13-May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15-June 10, 1956.

The first set of specimens, including isotypes of the four new species, are deposited in the Los Angeles County Museum.

The data for the distribution records of species represented in the Melastomataceae collections have been culled from Cogniaux' classic familial monograph, Glaziou's list of central Brazilian plants, Hoehne's enumeration of the collections at the larger Brazilian herbaria, and herbarium data from the New York Botanical Garden and the U. S. National Museum.

For study of the Polygalaceae, the collections at the New York Botanical Garden and U. S. National Museum have been consulted; through the courtesy of Dr. Alcides Teixeira, a generous loan of species of *Polygala* from São Paulo supplemented the materials available in the United States. From these three sources and Chodat's publications, especially his generic monograph, distributional records were compiled.

MELASTOMATACEAE

Cambessedesia espora (St. Hil. ex Bonpl.) DC. 14162; 14566 A wide-spread species in southeastern Brazil.

Cambessedesia adamantium DC. 14796 Known also from Minas Gerais and Rio de Janeiro.

Stenodon suberosus Naud. 14718 Endemic to Goiás.

Microlicia cupressina D. Don ex char. 14692 Known definitely only from Goiás. *Malme* 1698 (US), which had been determined by Ekman as this species is rather *Chaetostoma armatum* (Spreng.) Cogn.

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[1]Associate Curator, The New York Botanical Garden; New York 58, N.Y.

[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2):1-20.

Microlicia psammophila sp. nov. Fig. 1 B, a-e

A speciebus 32-34 Monographiae Cogniauxii et *M. reichardtiana* Cogn. et *M. setosa* (Spreng.) DC. differt foliis parvioribus.

Sect. *Microlicia*. Fruticulus statim ramosus glaber ad 18 cm. altus. Folia sessilia plerumque 2.5(−3) × 0.7-0.9 mm. (seta exclusa) anguste lineari-triangularia apice acuta et uniaristata (arista 0.4-0.6 mm. longa) integerrima appressa superficie rugulosa et epunctata laxe imbricata (internodiis 2-6 mm. longis) obscure uninervata. Flores 5-meri solitarii terminales; hypanthium 2.5 mm. longum glabrum; calycis lobi 2.6 × 1.3 mm. (setis exclusis) triangulares apice uniaristati (arista ca. 0.6 mm. longa) glabri. Petala ut videtur rosea 7 × 5-5.4 mm. obovata apice (0.7 mm.) mucronulato-acuminata. Staminum maiorum: filamenta 3.3 mm.; thecae (rostro excluso) 1.9 mm. longae, rostro 1.5 mm. longo; connectivum sub theca 1.0 mm. prolongatum lineare 0.25-0.3 mm. latum non incrassatum. Staminum minorum: filamenta 3 mm.; thecae (rostro excluso) 1.7 mm. longae, rostro 0.7 mm. longo; connectivum sub theca 0.8 mm. prolongatum 0.2 mm. latum non incrassatum. Stylus 6.1 × 0.4 mm.; stigma truncatum; ovarium 3-loculare glabrum.

TYPE: *Dawson* 14620 (holotype R; isotype NY, LAM), "wet sandy margins of sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956". PARATYPE: *Dawson* 14774, "wet spring area among some rocks on gentle slope 10 km. from Veadeiros on Cavalcante road, elev. 5600 ft., Goiás, Brazil, May 1, 1956".

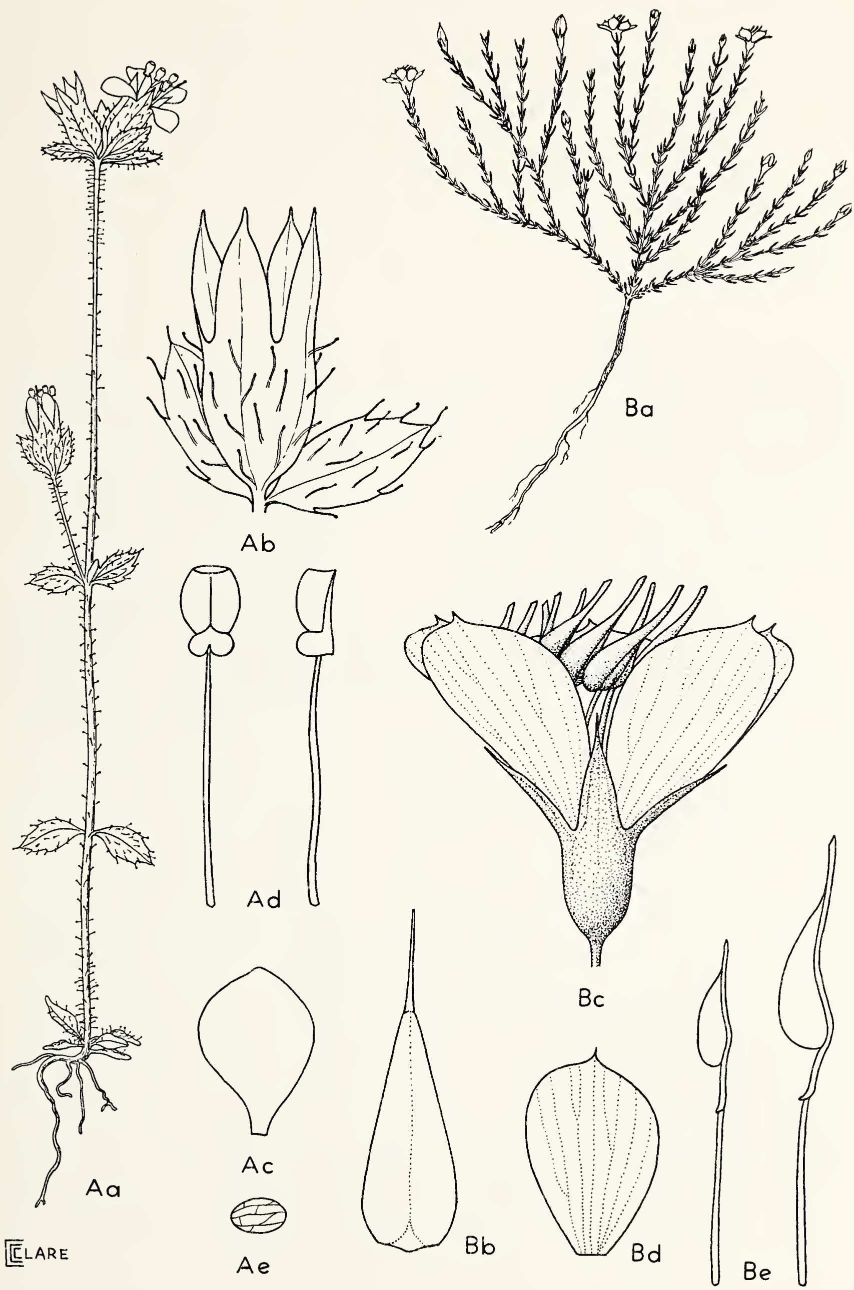
Among the postulated relatives with unexpanded connective of *M. psammophila*, *M. ericoides* D. Don has densely imbricate merely acute leaves and merely acute calyx lobes, *M. martiana* Berg ex Triana has acute densely impressed-punctate leaves, *M. juniperina* St. Hil. has proportionately longer calyx lobes, and *M. setosa* shows apical hypanthial setae. All of the relatives have leaves 1.5-4 times as long as in *M. psammophila*, while *M. reichardtiana* (ex descr. and photo) is a more robust species with expanded stamen connective.

Microlicia cryptandra Naud. ex char. 14611 Endemic to Goiás.

Microlicia vestita DC. 14240 Known also from Bahia and Piauhy.

→

Fig. 1. A. *Siphanthera dawsonii* sp. nov. a, habit, × 2; b, hypanthium and calyx, × 10; c, petal, × 10; d, stamen, × 15; e, seed, × 15. B. *Microlicia psammophila* sp. nov. a, habit × 0.5; b, leaf, × 15; c, flower, × 5; d, petal, × 3.5; e, small and large stamens, side view, × 7.5.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Microlicia consimilis sp. nov. Fig. 2

Sect. *Microlicia*. Ab congeneribus distincta propter conjunctionem connectivi staminis non dilatati subtus vix appendiculati et folia angustiora.

Frutex multiramosus ca. 0.3 m. altus. Ramuli densiuscule puberuli et glandulosi vetustiores efoliati. Folia sessilia 5-9 × 1-2 mm. oblongo-linearia acuta laxe imbricata obscure trinervia supra et subtus sparse vel modice brevi-puberula et dense glanduloso-punctata. Flores in ramulis brevibus terminales. Hypanthium 3.2 × 2 mm. cum calycis lobis modice

Fig. 2. *Microlicia consimilis* sp. nov. The holotype specimen.

brevi-puberulum et densiuscule glanduloso-punctatum, calycis lobis 2.5 × 0.9 mm. anguste oblongis apice acutis. Petala rosea 5 × 3.1-3.4 mm. obovata apice late acuta. Staminum maiorum: filamenta 2.2 mm.; thecae (rostro excluso) 1.5 mm. longae, rostro 0.3 mm. longo; connectivum sub theca 1.4 mm. prolongatum non dilatatum infra insertionem filamenti breviter (0.5 mm.) bicorniculatum. Staminum minorum: filamenta 1.8 mm.; thecae (rostro excluso) 1.4 mm. longae, rostro 0.3 mm. longo; connectivum sub theca 0.8 mm. prolongatum infra insertionem filamenti non prolongatum. Stylus 7.7 × 0.35 mm.; stigma punctiforme; ovarium 3-loculare.

TYPE: *Dawson* 14275 (holotype R; isotype fragment LAM), "shaded dry creek in hilly cerrado area 23 km. N. of São João da Alianca, region of the Chapada dos Veadeiros, Goiás, Brazil, April 16, 1956."

M. consimilis is suggestive of such vegetatively polymorphic species as *M. euphorbioides* Mart., *M. fasciculata* Naud., and *M. fulva* (Spreng.) Cham., all of which have proportionately wider leaves and well-defined stamen connective expansion below the anther. *M. glandulifera* Cogn. has proportionately wider apically obtuse leaves. *M. decussata* Naud. is vegetatively suggestive of *M. consimilis,* but has leaves proportionately slightly wider and the large stamen connective prolongation dilated and truncate at the base. *M. neglecta* Cogn. has larger leaves and the basally obtuse large stamen connective prolongation 10-11 mm. long. *M. cuneata* Naud. differs at least in its lance-ovate proportionately wider leaves with sparser glandular punctation.

Dawson 14597, from a sandstone outcrop 7 km. south of Veadeiros, has not been placed generically, despite the excellent material. The collection is superficially quite like *Microlicia macrophylla* Naud., differing in such minor details as the shorter calyx lobes and in one important feature, a 5- rather than a 3-celled ovary. The photograph of *Microlicia pilosissima* Cogn. shows a great similarity also to the Dawson material, but with smaller dimensions throughout as well as (ex char.) a 3-celled ovary. I have combed the genera *Lavoisiera*, *Rhynchanthera*, and *Trembleya*, as far as material at New York and Washington permits, for a possible relative, but have had no satisfaction when such details in the Dawson collection as the 5 lobes prolonged above the ovary and the stamen connective prolongation shape are considered. Yet I feel sure that 14597 should be placed in one of these genera; it seems best to plead ignorance until these predominantly Brazilian genera are better understood.

Lavoisiera suberosa Cogn. ex char. 14720 Known otherwise only from Serra da Balisa and a Glaziou collection from Chapada dos Veadeiros.

Siphanthera gracillima (Naud.) comb. nov.

Tulasnea gracillima Naud. Ann. Sci. Nat. III, 2: 143. 1844.

Poteranthera gracillima (Naud.) Cogn. DC. Monog. Phan. 7: 121. 1891.

I have examined the holotype (*St. Hilaire C*[1], 700, P). *S. gracillima* is in general aspect quite like the next-described species, but has distinct staminodia.

Siphanthera dawsonii sp. nov. Fig. 1 A, a-e

S. vaupesanae Wurdack affinis sed cum antherarum thecis ovalibus erostratis.

Herba pusilla ad 8 cm. alta, caulibus foliis bracteis hypanthiisque sparse pilosulis, pilis erectis gracilibus glanduliferis. Petioli 0.3-1 mm. longi; lamina 2.5-4.5 × 1.5-2.5 mm. ovata apice acuta ad margines pauciserrulata uninervata vel debiliter trinervata. Flores 4-meri in apicibus ramulorum singuli vel plerumque 2-3-aggregati bracteati subsessiles (vix 0.5 mm. supra bracteas pedicellati); bracteae foliaceae subsessiles ca. 2.5 mm. longae oblongo-ovatae. Hypanthium 1.8 × 1.5 mm.; calycis lobi 1.8 × 0.8 mm. triangulares acuti glabri vel basim versus sparse glanduloso-pilosuli. Petala 2.2 × 1.5 mm. obovata subligulata apice obtusa glabra. Stamina 4, ante sepala; antherae 0.55 × 0.55 mm. (connectivo excluso) rostro nullo, poro lato 0.3 mm. diam.; connectivum sub anthera 0.2 mm. longum et 0.4 mm. latum rotundato-bilobatum; filamenta 2.2 mm. longa; staminodia ut videtur in alabastris et floribus maturis desunt. Ovarium biloculare; stylus 3.5 ×0.15 mm. apicem versus ad 0.7 mm. expansus; stigma subcapitatum. Semina ellipsoidea 0.5 × 0.3 mm. laxe elongato-areolata.

TYPE: *Dawson* 14626 (holotype R; isotype NY, LAM), "wet sandy margins of sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956".

S. vaupesana has short-rostrate oblong anthers with a minute pore, as well as relatively shorter calyx lobes. *S. dawsonii* is much like the Brazilian species, *S. tenera* Pohl, *S. subtilis* Pohl, and *S. gracillima* (Naud.) Wurdack, all of which have alternisepalous staminodia. *S. pratensis* Mgf. was described as having rostrate anthers but staminodia were not mentioned. Unfortunately at present, the Rio Museu Nacional sheet (*Comm. Rondon Hoehne* 1926, labeled "unica") shows only fruiting hypanthia, but this specimen differs from *S. dawsonii* at least in its much longer hypanthia. Incidentally, the erroneous statement in the original description of *S. vaupesana* concerning the stamen position should be corrected to "stamina ante sepala", as the perfect stamens are in all species of the genus.

Acisanthera limnobios (DC.) Triana 15163 A wide-spread species from Central America and the West Indies through tropical South America.

Pterolepis glaziovii Pilger ex char. 14152, 14292, 14551 Endemic to Goiás and otherwise known only by the original Glaziou collection.

Tibouchina stenocarpa (DC.) Cogn. 14205 Wide-spread in southern Brazil.

Tibouchina pogonanthera (Naud.) Cogn. 15056 Known also from Maranhão and Mato Grosso.

Tibouchina nodosa sp. nov. Fig. 3

T. tuberosae (Gardn. ex Tr.) Cogn. et *T. crassirami* Cogn. affinis sed calycis lobis brevioribus.

Frutex ut videtur parvus, ramis primum dense brevi-strigosis demum decorticantibus et nodosis. Petioli 5-10 mm. longi dense brevi-strigosi; lamina ad 9 × 4 cm. ovato-elliptica apice hebeti-acuta basi subcordata supra modice tuberculato-strigulosa, subtus densissime villosula ad nervos densissime brevi-strigosa, 5-vel vix 7-nervatis nervis lateralibus usque ad basim liberis, subtus dense reticulato-venosa. Panicula ca. 4-6 cm. longa multiflora cum pedicellis brevi-strigosa; flores 5-meri breviter (ca. 1.5 mm.) pedicellati ad basim bibracteati; bracteae caducae ca. 8 mm. longae et latae apice rotundatae extus modice sericeo-strigulosae intus glabrae. Hypanthium 5.3 × 5 mm. cum calycibus densissime sericeo-strigosum; calycis tubus ca. 1 mm. longus, lobis 3.5 × 2.7 mm. oblongis apice rotundatis intus glabris. Petala 9.5-10 × 8-8.5 mm. obovata apice rotundata dense ciliolata. Stamina fere isomorphica; filamenta 5.5-7 mm. longa basim versus inconspicue et sparsissime glanduloso-pilosula; thecae 5.6-6 mm., connectivo sub thecis 0.5-0.6 mm. prolongato ad basim vix bilobulato. Stylus 11 × 0.4-0.7 mm. basim versus sparsissime glanduloso-pilosulus; stigma punctiforme; ovarium apice per 2 mm. dense strigosum.

TYPE: *Dawson* 14596 (holotype R; isotype fragment LAM), "sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos Veadeiros, Goiás, Brazil, April 24, 1956."

As compared to *T. nodosa*, the New York isotype of *T. tuberosa* shows much finer, denser, upper leaf-surface pubescence and much longer, acute calyx lobes. The same differences apply (ex char.) for *T. crassiramis*, which has much larger flowers. From the Macbride photograph (*F16775*), *Glaziou* 21354 (*T. nodosa* Cogn. ined.) seems to be the same as *Dawson* 14596. Glaziou cited 21354 (Bull. Soc. Bot. Fr. 54 Mem. 3C: 266. 1908) as "T. tuberculata Glaz. n. sp.?". *Glaziou* 21354 and *Ule* 2905 (type no. of *T. crassiramis*) both were collected on the Serra dos Pyreneos in Goiás.

Miconia macrothyrsa Benth. 14230 A wide-spread species in eastern South America from Trinidad and Venezuela to southern Brazil.

Heterotrichum octonum (Bonpl.) DC. 15009 Ranging throughout tropical America.

POLYGALACEAE

Polygala hebeclada DC. 14643; 14715 Widespread in the Brazilian campos.

Fig. 3. *Tibouchina nodosa* sp. nov. The holotype specimen.

Polygala ignatii Chod. 14782 Apparently known otherwise by the type collection from Serra do São Ignacio in interior Bahia.

Polygala galioides Poir. var. *major* Benn. 14181 This collection agrees well with material collected by Warming at Lagoa Santa, *Regnell III* 189 from Minas Gerais, and *Morong* 325 from Paraguay. The capsules and seeds are intermediate in size between those of *P. galioides* var. *galioides* and *P. asperuloides* HBK., but never approach in dimensions those of *P. molluginifolia* St. Hl.

Polygala timoutou Aubl. 14640; 14798 Widespread in northern tropical America.

Polygala comata A. W. Benn. ex descr. & photograph 14400; 14838 Restricted to Goiás, where first collected by Pohl.

Polygala sp. 14649 This collection is undoubtedly to be placed in Chodat's *Glochidiatae* but cannot be referred to any species presently placed here. It seems to more-or-less agree (ex char.) with *P. exigia* Benn., which however Chodat placed in Series *Tenues* with non-glochidiate seed pubescence. No authentic material of *P. exigia* was available at New York, Washington, or São Paulo. *Dawson* 14884 is identical with 14649 qualitatively but has much larger flowers.

Polygala longicaulis HBK. 14179 Widespread in the American tropical savannas.

Polygala herbiola St. Hil ex char. 14644; 14769 Restricted to Minas Gerais and Goiás.

Polygala tenuis DC. 14768 This collection agrees with other determined by Grondona as *P. tenuis* var. β Chodat.

Polygala celosioides Mart. ex Benn. 14799 Campos of central and eastern Brazil.

Polygala pseudocoelosioides Chod. 14657 Known only from Goiás and Piauhy.

Bredemeyera velutina A. W. Benn. 14474 Known only from Minas Gerais and Goiás.

LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

The Machris Brazilian Expedition

Other Subjects

Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

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By

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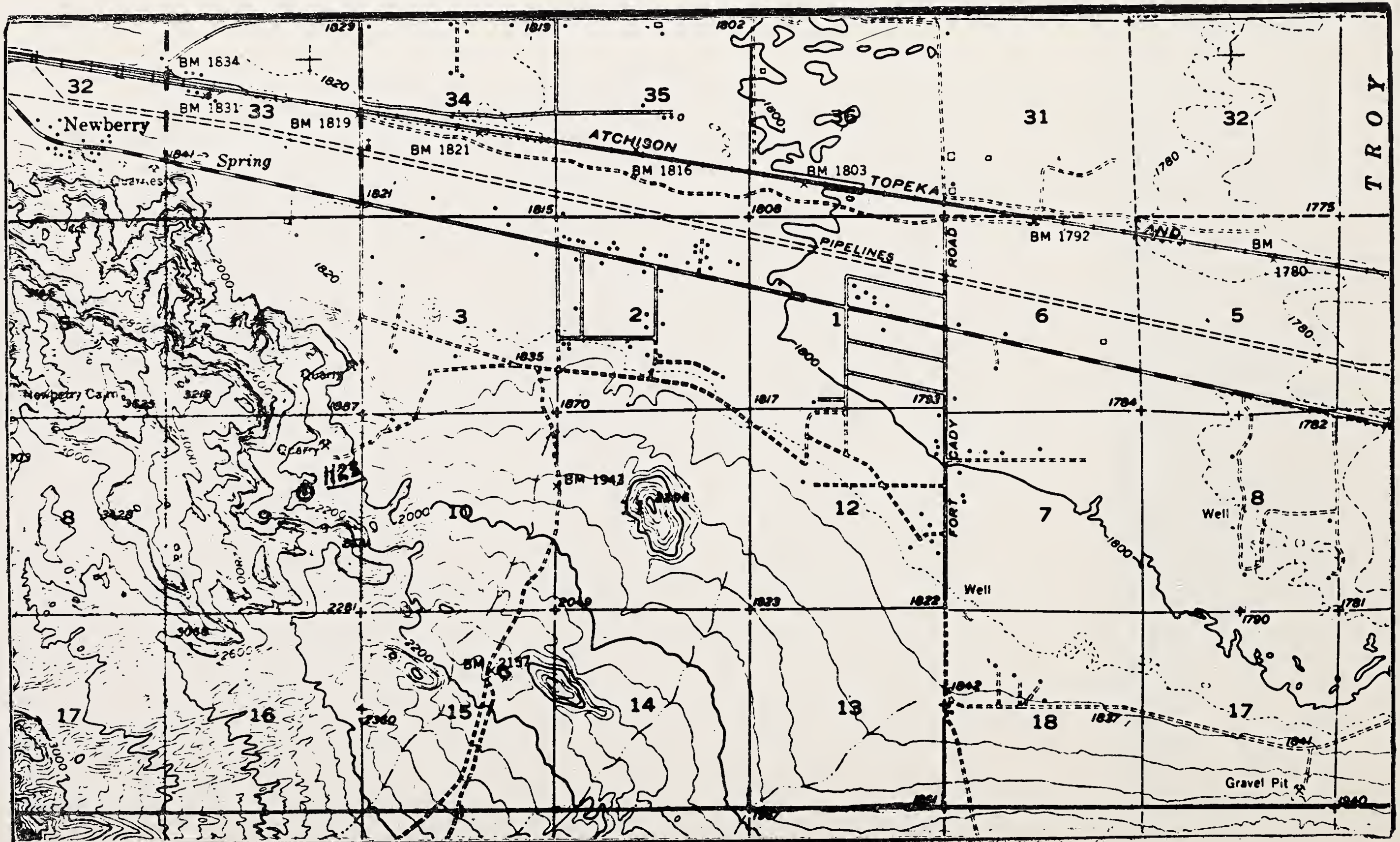
Los Angeles County Museum Exposition Park • Los Angeles 7, Calif.



Newberry
Spring
BM 1834
BM 1831
BM 1819
BM 1821
BM 1816
BM 1803
BM 1792
BM 1943
ATCHISON
TOPEKA
AND
PIPELINES
ROAD
FORT
CADY
TROY
Newberry Cam
Quarry
Well
Gravel Pit

QUATERNARY ANIMALS FROM SCHUILING CAVE IN THE MOJAVE DESERT, CALIFORNIA

By THEODORE DOWNS[1], HILDEGARDE HOWARD[2], THOMAS CLEMENTS[3], AND GERALD A. SMITH[4]

INTRODUCTION

This is a report on a cooperative investigation of a recently discovered cave in Southern California by archeologists, paleontologists and geologists from three institutions: the San Bernardino County Historical Society, the Los Angeles County Museum, and the University of Southern California. The discovery of this cave brings to light the first complete account of a southern California Pleistocene cave fauna. A preliminary paper, stressing archeological finds, has been published by G. A. Smith (1955). Howard (1955a, p. 20) has briefly discussed the birds, and Brattstrom (1958) has written on the reptiles from the cave.

The data from this study aid considerably in the interpretations of age relationships of the Mojave Desert geologic events, provide more information on the paleogeographic distribution and morphology of the late Pleistocene mammals of the coastal area, and give a brief view of the environment of the not too distant past of the Mojave Desert region.

The cave is located approximately two miles southeast of Newberry in San Bernardino County, California, in the SW¼, NE¼, Sec. 9, T8N, R3E, San Bernardino Base and Meridian. This area is shown on the Newberry quadrangle map of the U.S. Geological Survey, 1955 ed. The locality has been given Los Angeles County Museum, Vertebrate Paleontology locality No. 1123 (see fig. 1). The cave measures approximately 18 feet in width, 13 feet in horizontal depth and 7 feet in height, and is situated about 10 feet above the floor of the present dry canyon that cuts through the volcanics and old alluvial fill. The site is approximately 2160 feet above sea level.

In December of 1953, Dr. Walter Schuiling, Curator for the San Bernardino County Museum Association, discovered the small cave and found that it contained a great variety of prehistoric life forms. After the initial discovery, Schuiling was assisted by Ritner Sayles and G. A. Smith in the recovery of human remains from the top layers (24-30 inches) of the cave deposits.

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Fig. 1. Location of Schuiling Cave, L.A.C.M. V.P. No. 1123; shown on part of the Newberry, California quadrangle, San Bernardino Co., U. S. Geol. Survey, topographic map, 1955 ed. Scale 1:62,500.

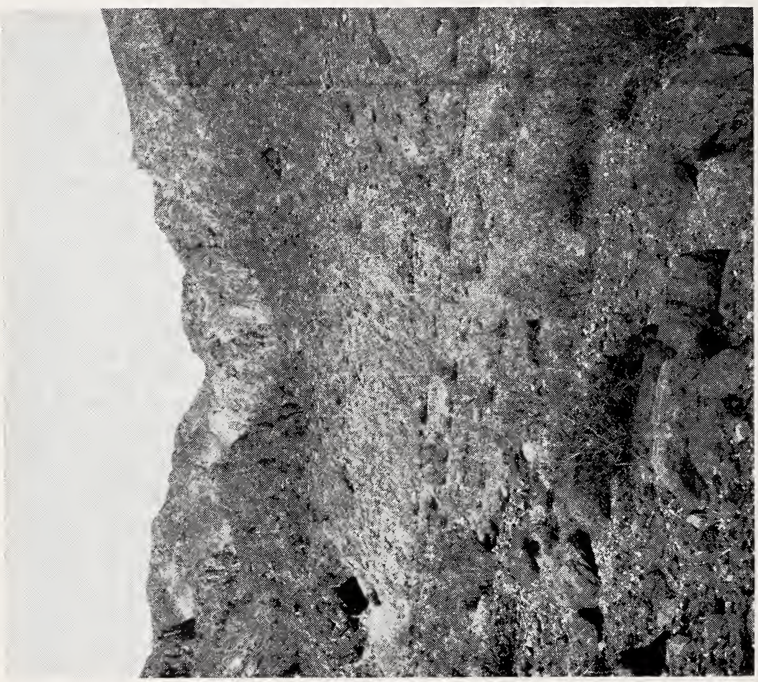


Fig. 2. View toward the west looking up stream in the dry canyon that has cut through the tilted rhyolite flow (left center) with Schuiling Cave (dark area) and old alluvial fan remnant.

Fig. 3. View toward the northeast, with six foot man standing at cave entrance. Old alluvial fan remnant extends across center of picture, fading out into dry basin in background.

Extinct animals were first located below the human remains in December of 1953, and soon thereafter Dr. Smith invited the Los Angeles County Museum paleontologists to continue excavation and study of the material. Many individuals contributed their time and energy in digging out the fossil material; only a few of these can be mentioned: Mr. Burr Belden, Mr. Carl Cambridge, Mr. Thomas Heric and Mr. Leonard C. Bessom. We are indebted to Mr. Geoffrey D. Woodard and Mr. R. H. Tedford for helpful suggestions and Mr. Arnold G. Kluge for aid in plotting the cave horizon data. Mr. George F. Brauer made the photographs of the map and specimens; Mr. Richard W. Saar prepared the final charts of the cave fauna distribution.

L.A.C.M. refers to Los Angeles County Museum, vertebrate paleontology specimen numbers; SB refers to San Bernardino County Museum Association specimen numbers.

EXCAVATION PROCEDURE

Three basic reference points were established for measuring the position of the material in the cave. Point A (see fig. 7) was the lowest prominent rock projecting from the roof of the cave, at a distance of 4 feet from the rear of the cave and about 9 feet from the entrance. Two more reference points were established near the ceiling at the northwest rear corner (West point) and northeast rear corner (East point). These points (see fig. 8) were marked by inserting permanent iron spikes in the cave wall. Horizontal measurements were taken from the West and East points, and depth measurements were taken from point A for each specimen discussed in this report and other lesser materials not itemized.

Before the cave was disturbed, the top layer of pack rat guano and debris accumulation was about six inches below the ceiling of the cave. Excavation operations were discontinued when the apparent floor of the cave was reached at about seven feet below the ceiling.

A more detailed account of excavations performed by the San Bernardino County Historical Society and the Los Angeles County Museum personnel is given in Smith (1955).

GEOLOGY

Schuiling Cave is a shallow opening in the side of a small canyon cut in rhyolite of probable Miocene age (fig. 2). It is but one of many such caves in the area, and probably originated as a large gas pocket in the lava. Apparently the cave was exposed when the canyon was cut in the rhyolite during the normal process of erosion.

When first discovered, Schuiling Cave was almost completely filled with unconsolidated angular fragments, mostly of rhyolite, in a matrix of finer particles of the same material, and fine aeolean dust. Some perlite fragments (volcanic glass) also were present, presumably derived from outcrops observed up the hill from the cave. While some of the larger chunks of rhyolite in the cave may have fallen from the roof, much of the material is alluvial fill, washed by streams into the cave after it was first opened by erosion. This is evidenced not only by the nature of the material, but also by the fact that the fill is similar to remnants of alluvial deposits that remain along the borders of the canyon wall just down stream from the cave (fig. 3).

The last-mentioned remnants of alluvial fill, now deeply dissected, occur on both sides of the canyon, and indicate that after having been cut originally, the canyon was later filled, at least to an elevation approximating that of the top of the cave and possibly some 10 feet higher. Still later, this fill was dissected and largely removed as the canyon was again eroded or exhumed. The canyon, therefore, has had a somewhat complex history.

It is the opinion of the writers that the canyon was first cut by stream erosion and the cave exposed in early Pleistocene time, when the Newberry Mountains were first uplifted. It is further postulated that a later rise of local base level caused the stream to aggrade its channel, and filling started. This aggradation must have been brought about by the presence of a lake, possibly ancestral Troy Lake, in the basin to the north and east into which the stream probably drained (see fig. 1). A more humid climate of the Ice Age was probably responsible for the presence of this lake, as well as for similar lakes in other basins throughout the desert (as for example, in Death Valley and Manix).

When the canyon fill reached the elevation of the floor of the cave, the cave also began to fill as the ancient stream, meandering on its aggrading floor, occasionally swept in material. It was probably during the early part of this period of deposition that the bones of various Pleistocene mammals, reptiles, and birds (which included water birds) were buried. These were either washed in by the stream, or brought in by other animals, or were the bones of animals using the cave for shelter. The bones were buried as more detrital material was carried in by the stream. Possibly in the later part of the same depositional period the artifacts were brought in and buried as the cave continued to fill.

With the change in climate at the end of the Pleistocene, and the advent of greater aridity, the lake disappeared, and base level was again lowered. The rejuvenated stream, although enfeebled by the diminished rainfall, nevertheless began the dissection of the deposits that had accumulated in the canyon while the lake was present. But whereas an aggrading stream sweeps from side to side, and could fill a cave, a degrading stream cuts vertically downward, and so the canyon was rejuvenated without apparent disturbance of the deposits in the cave.

It is possible that during the time of the stream rejuvenation, the artifacts and a few of the skeletal remains were buried in the cave dust that is so common in the upper strata. This would imply a difference in time of deposition of some of the bones. The definite restriction of the human remains to the upper levels of the cave (see fig. 7) substantiates the idea that at least the cultural materials may have been buried at a later date than the remains found at lower depths.

It certainly is well within the realm of probability that there are other similar caves and comparable remains, not only in the same basin, but in other of the desert basins where a like combination of cavernous rocks and Pleistocene lake may be found.

FOSSIL VERTEBRATES

At least 28 species of vertebrates are represented by the 90 or more identifiable mineralized specimens recovered from the lower levels of the cave. As may be seen from the following list, mammal remains are most abundant but there are more avian species represented.

Twenty-nine bird bones were recovered, of which 25 were identifiable. These represent 15 species. Strictly speaking there are no extinct forms represented, although certain bones (fig. 4) of California Condor (no. 2584) and Horned Owl (no. 2588) are of the large size characteristic of *Gymnogyps* and *Bubo* as found in the Pleistocene deposits of Rancho La Brea. Fisher (1944, p. 290) has assigned the Rancho La Brea condor to the extinct species *Gymnogyps amplus* Miller on the basis of its large size and certain minor distinguishing characters of the skull. However, with few exceptions, measurements of various limb elements reveal overlapping in range of size between the Recent and Pleistocene forms (Fisher, 1947), and there is little doubt that *G. amplus* is the direct ancestor of the present-day *G. californianus*. Similar overlap occurs in the size range of skeletal elements of the Horned Owl of Rancho La Brea and the present-day *Bubo virginianus* (Howard, 1947, p. 12), although, again, the fossil form averages considerably larger. In this instance detailed studies of the skull have not been made and the La Brea Pleistocene Horned Owl retains the name of the Recent species. The two bones of the California Condor (rostrum and partial humerus) and the measurable specimens of Horned Owl taken in Schuiling Cave are larger than those of any skeleton of the modern forms available for measurement and fall within the size range of Pleistocene forms.

Three species of reptiles and ten species of mammals are represented in the cave. At least five of the mammals are known to be extinct (see list). The reptile representatives appear to have no special attributes that distinguish them from Recent forms, according to Brattstrom (1958, p. 11).

Taxidea cf. *taxus* is represented by a nearly complete skull, jaws, limb elements and vertebrae (L.A.C.M. No. 1992) of apparently one individual (fig. 4). The material is notable in the absence of the P_2 in both mandibles, and the rami are slightly heavier than the average for *T. taxus* as known in the area today. Hall (1940) noted that only 2% of 110 specimens of *T. t. neglecta* showed an absence of a premolar or presence of an extra tooth; therefore, it seems remarkable to obtain a record of a fossil form of *Taxidea* so characterized. However, the fossil could simply be a

SCHUILING CAVE FAUNAL LIST
(Approximately 150 specimens collected)

		Number Individuals[5]	Number Specimens[6]
Reptiles			
Gopherus agassizi	Desert tortoise	1	Many frags., 1 partial carapace
Sauromalus obesus	Chuckwalla	1	4
Crotalus[7]	Rattlesnake	1	2
Birds			
Anas cf. *platyrhynchos*	Mallard duck	1	1
Anas cf. *carolinensis*	Green-winged teal	1	1
Mareca americana (?)	Baldpate duck (?)	1	1
Nyroca cf. *americana*	Redhead duck	2 ?	2 ?
Oxyura jamaicensis	Ruddy duck	1	1
Mergus merganser	American merganser	1	1
***Gymnogyps amplus*	Ancestral California condor	1	2
Aquila chrysaetos	Golden eagle	1	1
Buteo jamaicensis	Red-tailed hawk	2	2
Fulica americana	Coot	3	4
Recurvirostra americana	Avocet	1	1
Zenaidura macroura	Mourning dove	1	1
***Bubo virginianus*	Horned owl	4	5
Colaptes cafer	Flicker	1	1
Corvus corax	Raven	1	1
Mammals			
Perognathus	Pocket mouse	2	2
Neotoma	Wood rat	2	3
Taxidea cf. *taxus*	Badger	1	15
Canis cf. *lupus*	Wolf	1	1
Urocyon	Gray fox	2	2
**Equus* sp. small	Small horse	2	23
**Equus* sp. large	Large horse	1	1
*cf. *Tanupolama*	Llama-like camel	1	4
*Camelid sp. large	Large camel	1	3
**Breameryx* sp.	Diminutive antelope	1	2

**Pleistocene form ?
*Extinct form

[5]Figures represent minimum possible number of individuals
[6]Identifiable specimens
[7]Two vertebrae of the rattlesnake *Crotalus* recorded by Brattstrom in the museum catalogue, but the record is unpublished

variant, similar to those rarely found in Recent skulls; until more specimens are found it is deemed inadvisable to attach taxonomic significance to this material.

Two skull fragments (L.A.C.M. No. 1983) of *Urocyon*, the Gray fox, were found but were not identifiable beyond the generic designation.

The proximal half of a third metacarpal (L.A.C.M. No. 3698) assignable to *Canis* was recovered at the 39 inch level. Gross inspection eliminates the possibility of assignment to the coyote on the basis of the large size of the fossil. However, there is resemblance to the living wolf; a specimen of *Canis lupus nubilus* (Univ. of Calif. at Los Angeles, department of Zoology No. 16708) shows greater size but similar proportions. A random series of specimens of the dire wolf, *Canis* (*Aenocyon*) *dirus* from Rancho La Brea was compared (table 1), and the measurements definitely indicate a stouter or thicker shaft in the metacarpal of the La Brea species. The nature of the material allows only the designation *Canis* cf. *lupus* for L.A.C.M. No. 3698.

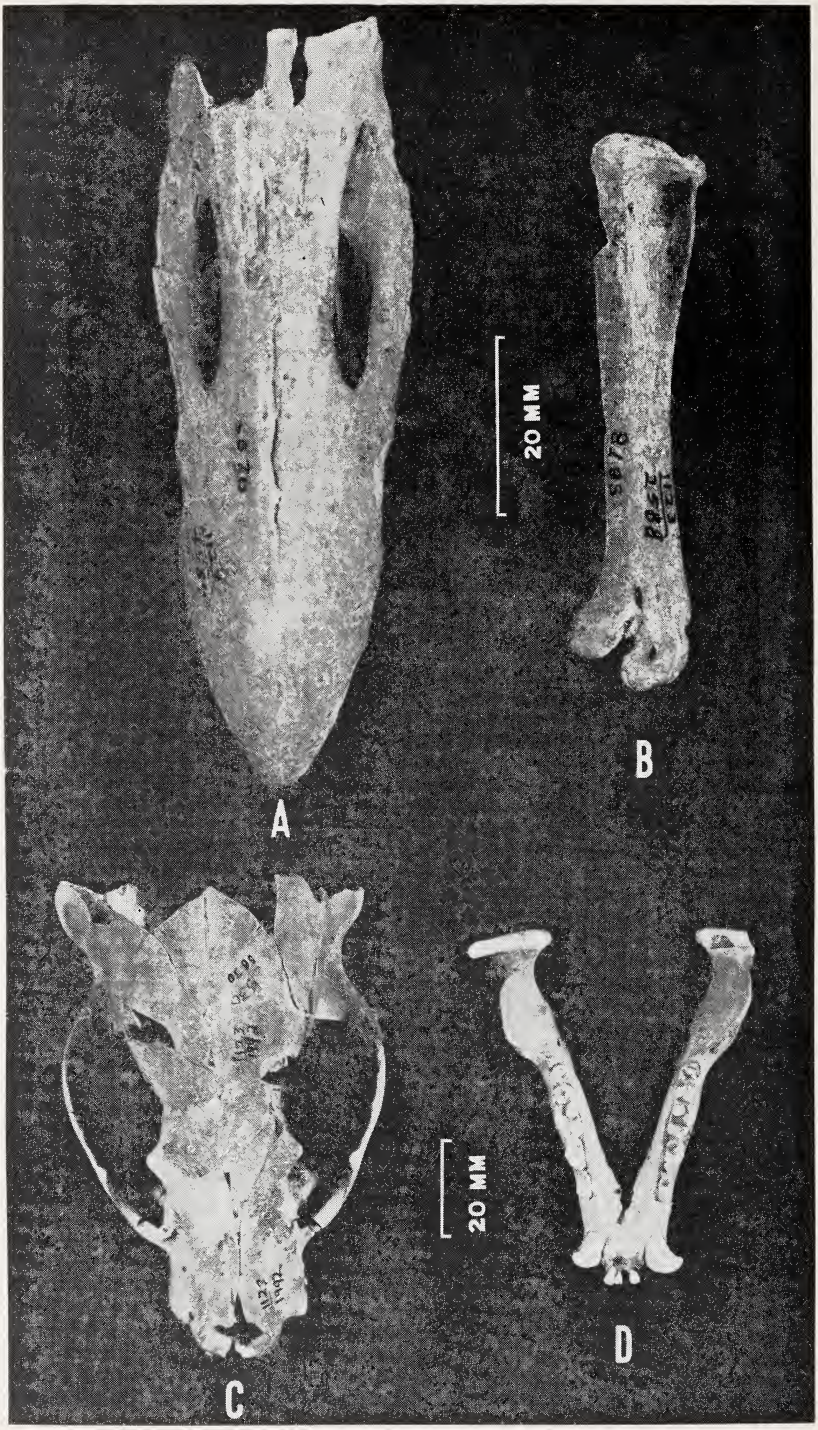
One of the most important genera recovered from the cave is the horse, *Equus*. This is apparently represented by a large and a small species, as evidenced particularly by the foot elements. There are more specimens representing this genus (23 identifiable elements) than any other mammal or bird recovered from the cave.

Among the foot elements are five small phalanges indicating that there are at least two individuals of the small horse represented. Table 2 shows that the proximal phalanges (L.A.C.M. No. 1991), cuneiform (L.A.C.M. No. 1979) and astragalus (L.A.C.M. No. 1572) are small compared to the Rancho La Brea horse and suggest possibly smaller size than the horse from San Josecito Cave, Mexico, which has been characterized in part by

TABLE 1

Comparative measurements of the third metacarpal in *Canis* species (in millimeters)

	Number Samples	Mean	Observed Range
Greater Proximal Width			
Schuiling Cave	1	10.8	10.8
Rancho La Brea *Canis* (A.) *dirus*	48	11.8	9.5 - 13.5
Recent *Canis 1. nubilus*	1	11.5	11.5
Greatest Width at 25 mm From Proximal End			
Schuiling Cave	1	7.5	7.5
Rancho La Brea *Canis* (A.) *dirus*	48	9.3	8.0 - 11.0
Recent *Canis 1. nubilus*	1	8.4	8.4


20 MM
20 MM
A
B
C
D

its small feet (see Stock, 1953, in which he uses the name *Equus conversidens leoni* subsp. nov. without a description or diagnosis). A horse magnum (L.A.C.M. No. 1990) from Schuiling Cave is as large as that of the La Brea horse (see table 2), and we tentatively consider this bone to be from a larger form than the species represented by the phalanges, cuneiform and astragalus. That the small horse bones do not represent young individuals is indicated by complete ossification of the fully formed extremities (no epiphysial separation) of the phalanges, and presence of a clear, well-formed groove for articulation of the metapodial.

Dentition of one species (probably "sp. small") is represented by an adult partial mandible bearing P_3 - M_3 and fragments of isolated teeth (L.A.C.M. No. 1532). The teeth show (fig. 5) the subgeneric, V-shape plesippine character of the groove between the metaconid and metastylid and a possible caballine subgeneric trait in the absence of the parastylids (Savage, 1951, and McGrew, 1944). However, according to McGrew the absence of the parastylid is particularly true of *milk* dentition in caballine horses. The teeth in the mandible measure as follows: anteroposterior diameter, P_3 27.7 mm., P_4 29.0 mm. and M_2 26.4 mm.

The taxonomic relationships of the genus *Equus* and interpretations of paleogeographic distribution of the "cave equids" and even of those from Rancho La Brea, McKittrick and other late Pleistocene faunas of fluviatile origin, remain as unsolved problems; they need further investigation, particularly with respect to gaining a true knowledge of probable variation in population samples. Questions of taxonomy and morphologic interpretations involve the allocation of the names *Equus, Asinus, Plesippus,* etc. to North American populations. Briefly, we shall consider some of these points.

Hibbard (1958, and personal communication) considers *Asinus* to be a plesippine-like horse characterized by great depth of the lower jaw and presence of the V-shaped groove between the metaconid and metastylid. Quinn (1957) has characterized the lower dentition of the genus *Asinus* particularly by the V-shaped "valley," presence of a plicaballinid, and a median valley shortened and not protruding beyond the flexids. Using either interpretation (Hibbard or Quinn) these features may apply with respect to the Schuiling Cave specimen. It seems probable that a small plesippine-like horse existed in the late Pleistocene North American faunas, and such a form might represent an introduction of *Asinus* (which is apparently plesippine-like) from the Old World or separate evolution of a convergent line in North America. The question as to what taxonomic relationship is correct with respect to these plesippine-like equids is not

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Fig. 4. A. Dorsal view of the rostrum of the ancestral California Condor, *Gymnogyps amplus* (L.A.C.M. No. 2584). B. Nearly complete tarsometatarsus of the Horned Owl, *Bubo virginianus* (L.A.C.M. No. 2588). C. Dorsal view of the skull of the Badger, *Taxidea cf. taxus* (L.A.C.M. No. 1992). D. Occlusal view of the mandible of *Taxidea cf. taxus* (L.A.C.M. No. 1922). All from Schuiling Cave.

finally settled. It seems most reasonable, for the present at least, to follow the opinion that the genus *Equus* should embrace the North American Pleistocene forms of horses, and thus favorably compare and equivalently rate with the characters diagnostic of other genera in the family Equidae. Perhaps a subgeneric designation (*Asinus*) would be justified for the later Pleistocene horses that retain plesippine-like characters. The early Pleistocene, true plesippine forms might be allocated the subgeneric rank *Plesippus* under the genus *Equus*.

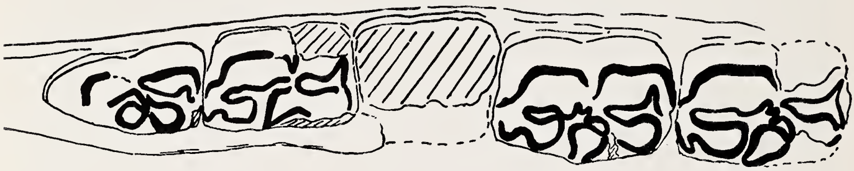

Fig. 5. Occlusal view of left mandible (L.A.C.M. No. 1532), *Equus* sp. small, from Schuiling Cave. Reduced approximately 1/5.

TABLE 2

Comparative measurements of the foot elements of *Equus* (in millimeters)

	Number Samples	Mean	Observed Range
Proximo-Distal Length of Proximal Phalanx			
Schuiling Cave	3	68.8	66.6 - 70.6
San Josecito Cave	28	74.14	66.6 - 82.1
Shelter Cave	6	77.4	72.2 - 82.3
Rancho La Brea	18	84.9	77.8 - 93.2
Distal Tranverse Diameter Of Astragalus			
Schuiling Cave	1	44.1	44.1
Shelter Cave	1	50.9	50.9
Rancho La Brea	11	64.7	58.8 - 70.7
Greatest Transverse Diameter Of Cuneiform			
Schuiling Cave	1	38.8	38.8
Rancho La Brea	16	58.2	53.5 - 68.0
Greatest Transverse Diameter of Magnum			
Schuiling Cave	1	50.0	50.0
Rancho La Brea	19	51.2	47.0 - 54.7

The Schuiling Cave mandible (L.A.C.M. No. 1532) and foot bones of the small species of *Equus* show great resemblance to the dentition and small proportions of the feet in horses found in San Josecito Cave in Mexico, Shelter Cave and Conkling Cavern in New Mexico, Gypsum Cave in Nevada, and the Manix Lake beds (in part) in California.

There are two types of camels represented in the collection, neither of which is positively identifiable as to genus. However, it is very probable that the llama-like *Tanupolama* was living in the area, as indicated by the character of three proximal phalanges (L.A.C.M. No. 1987 A and B, and S.B. 54) and one median phalanx (L.A.C.M. No. 3671). The small, slender form of these bones compares favorably with phalanges of *Tanupolama* from McKittrick (see table 3 and fig. 6). Evidence of a large camel is meager, but the epiphysis of half of the distal end of a young metapodial (L.A.C.M. No. 1986), measuring 36.0 mm. in transverse diameter, is too large for *Tanupolama*. It is slightly smaller than a series of seven young *Camelops hesternus* from Rancho La Brea, which measure in transverse diameter of one-half of the distal end of the metapodial, as follows: mean 37.3 mm., observed range 36.2 - 41.5 mm. A half portion of a Schuiling Cave camel molar (L.A.C.M. No. 3699), measuring 19.5 mm. in antero-posterior diameter at the base, probably belongs to the large form.

The identification of the small antelope, *Breameryx* sp., is based on two distal ends of metapodials (L.A.C.M. No. 1982) that are similar to Rancho La Brea specimens in general size and morphology (fig. 6). Measurements are as follows (in millimeters):

	Schuiling Cave	Rancho La Brea
Greatest transverse diameter	16.0 - 16.5; mean 16.3	15.4 - 16.7; mean 15.8
Greatest antero-posterior diameter	12.8 - 13.5; mean 13.2	10.8 - 12.3; mean 11.7

A slightly larger size in the Schuiling Cave material as compared to the La Brea form is indicated, but not enough specimens of the cave material are at hand to test the significance of this difference.

TABLE 3

Comparative measurements of the proximal phalanx of Camelidae (in millimeters)

	Number Samples	Mean	Range Observed
Greatest Length			
Schuiling Cave, cf. *Tanupolama*	2	90.4	89.7 - 92.1
McKittrick, Calif. *Tanupolama*	12	96.9	82.2 - 111.6
Least Transverse Diameter			
Schuiling Cave, cf. *Tanupolama*	3	15.3	14.7 - 16.2
McKittrick, Calif. *Tanupolama*	13	14.8	13.5 - 16.6

A few rodent bones, representing *Perognathus* and *Neotoma*, may have sifted downward from higher levels in the cave. However, the bones appear to be mineralized. If series of fossil specimens were available from the cave and compared with Recent species, possibly more definite determinations could be made. The present record is inadequate.

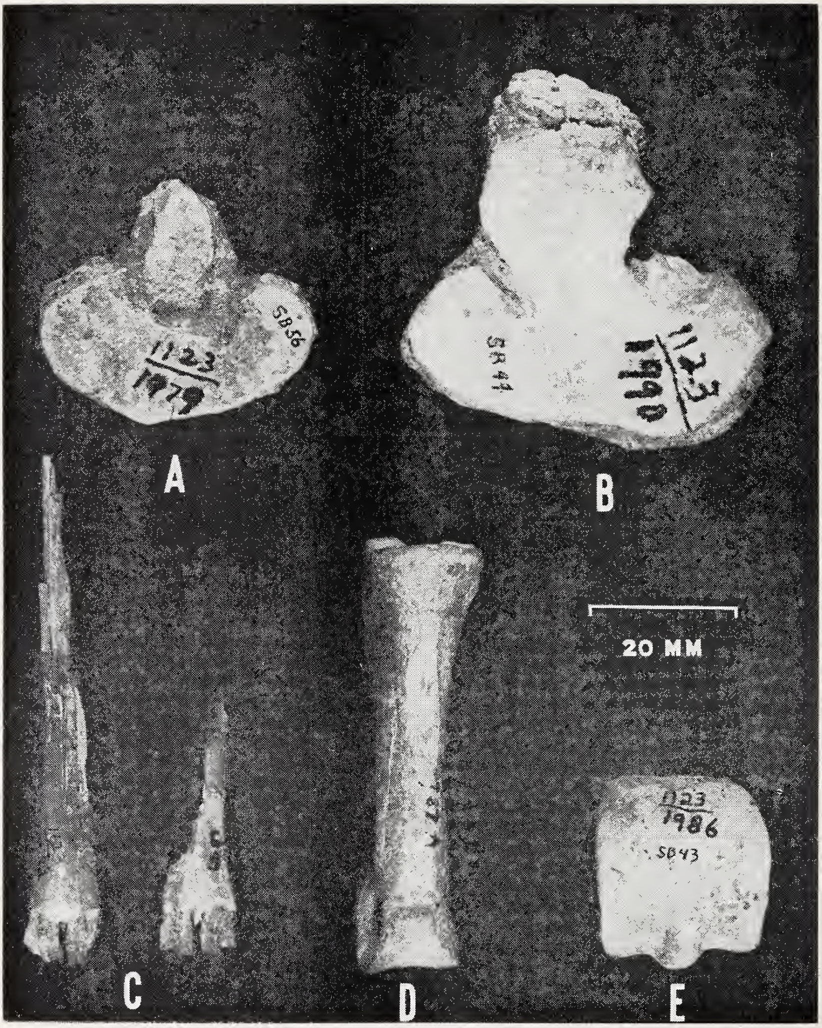

Fig. 6. A. Proximal view of cuneiform of the horse, *Equus* sp. small, (L.A.C.M. No. 1979). B. Distal view of the magnum of *Equus* sp. large, (L.A.C.M. No. 1990). C. Distal ends of metapodials of diminutive antelope, *Breameryx* sp. (L.A.C.M. No. 1892). D. Anterior view of proximal phalanx of llama-like Camel, *cf. Tanupolama* (L.A.C.M. No. 1987A) E. Anterior view of the half of a distal metapodial of Camelid sp. large (L.A.C.M. No. 1986). All from Schuiling Cave, and to same scale.

Remains of apparent mountain sheep were found although generally at a higher level than the other mammals; possibly they represent recent additions to the cave. Horn cores were not recovered and thus more detailed identification is not feasible.

STRATIGRAPHIC OCCURRENCE

The bird bones were unassociated and widely scattered throughout the cave (see fig. 7 and 8). None was found above the 2 foot level; most of them occurred between 3' and 4' 7", with three owl bones at 5' 8" – 5' 10", and a dove bone at 7' 10". Only four species are clearly represented by more than one specimen: the condor, owl, coot and hawk. The two bones of the genus *Nyroca* may represent two species. It is possible that the two bones of condor are from the same individual; they were found at the same depth about 2½ feet apart. At least four individual Horned Owls appear to be represented. The coot bones all occurred on the east side of the cave, but at varying depths; at least three individuals are represented. Data as to location in the cave are available on only one of the two Red-tailed Hawk bones; however, the specimens show a difference in preservation that suggests nonassociation.

The disassociation of the bird bones indicates that their accumulation in the cave was entirely fortuitous, possibly being washed in with the sediments in which they were found or brought in by other animals. With the exception of the Horned Owl and condor, none of the species would normally seek shelter in a cave. There is nothing to indicate that the owls whose bones were found actually died in the cave; in fact the absence of more complete skeletal material is evidence to the contrary.

All of the mammalian remains are fragmentary, seemingly scattered at random in the deposit. The most complete specimen is the badger skull with jaws. Possibly this particular animal crawled into the cave and died; this is probably true also of tortoises represented by one nearly complete carapace and many scattered shell remains. The tortoise is abundant throughout the deposits horizontally and vertically and is known today to frequent cave shelters in order to conserve body water and escape the heat of the day.

There is concentration of most of the fossil material toward the central part of the cave (between the 3 and 5 foot levels). This concentration may be due, in part, to the nature of the ancient stream current passing in and out of the cave, perhaps forming an eddy accumulation.

In brief, it is believed that the animals could have been deposited in one or more of the following ways: (1) washed in during stream deposition or flooding as the old alluvial fill was accumulating; (2) carried in by natural predators (especially such victims as the antelope, woodpecker and water-birds); (3) died in the cave (especially the tortoise and badger); (4) brought in by humans (any of the edible vertebrates).

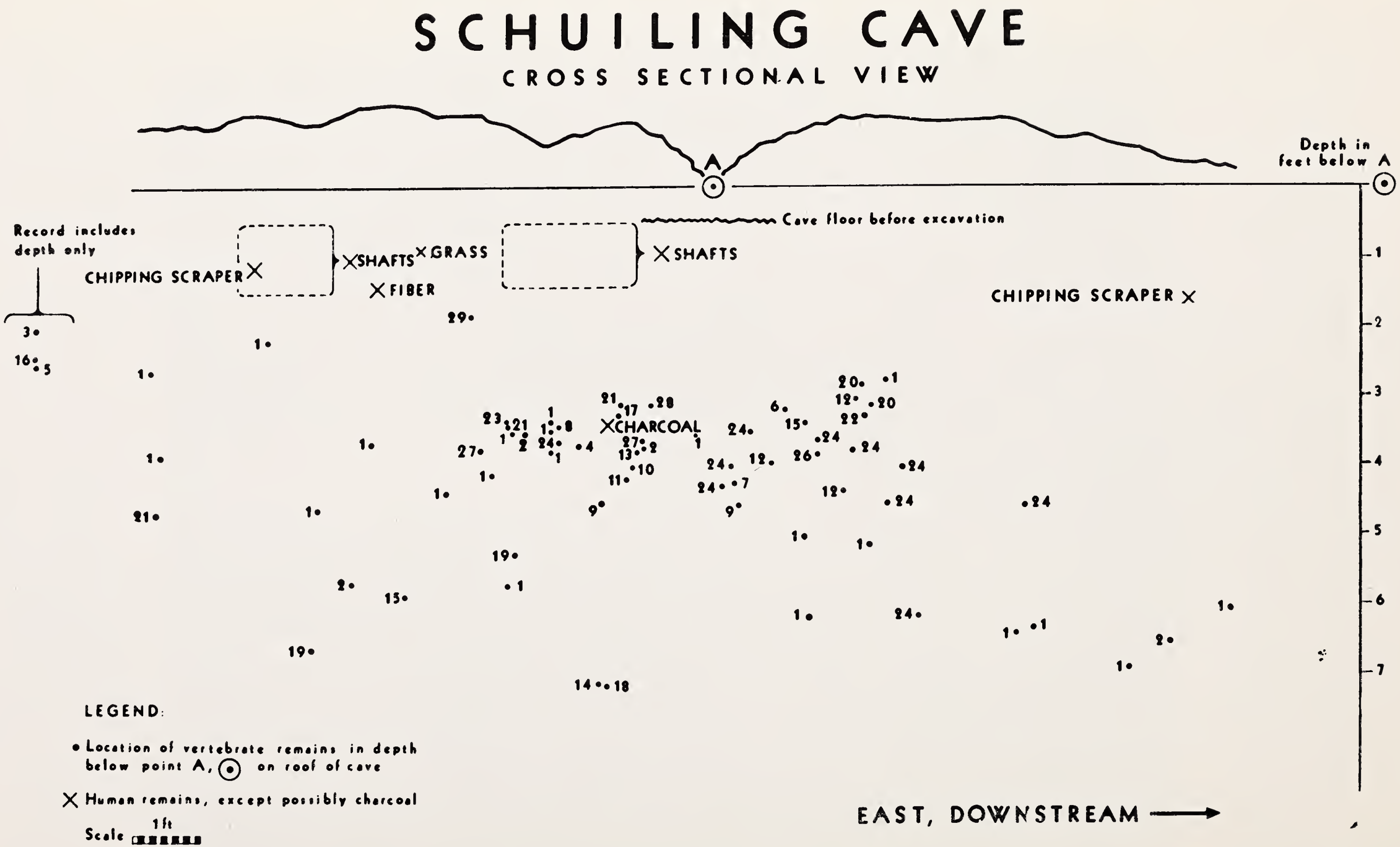

Fig. 7. Distribution of critical human cultural and vertebrate skeletal remains in Schuiling Cave.

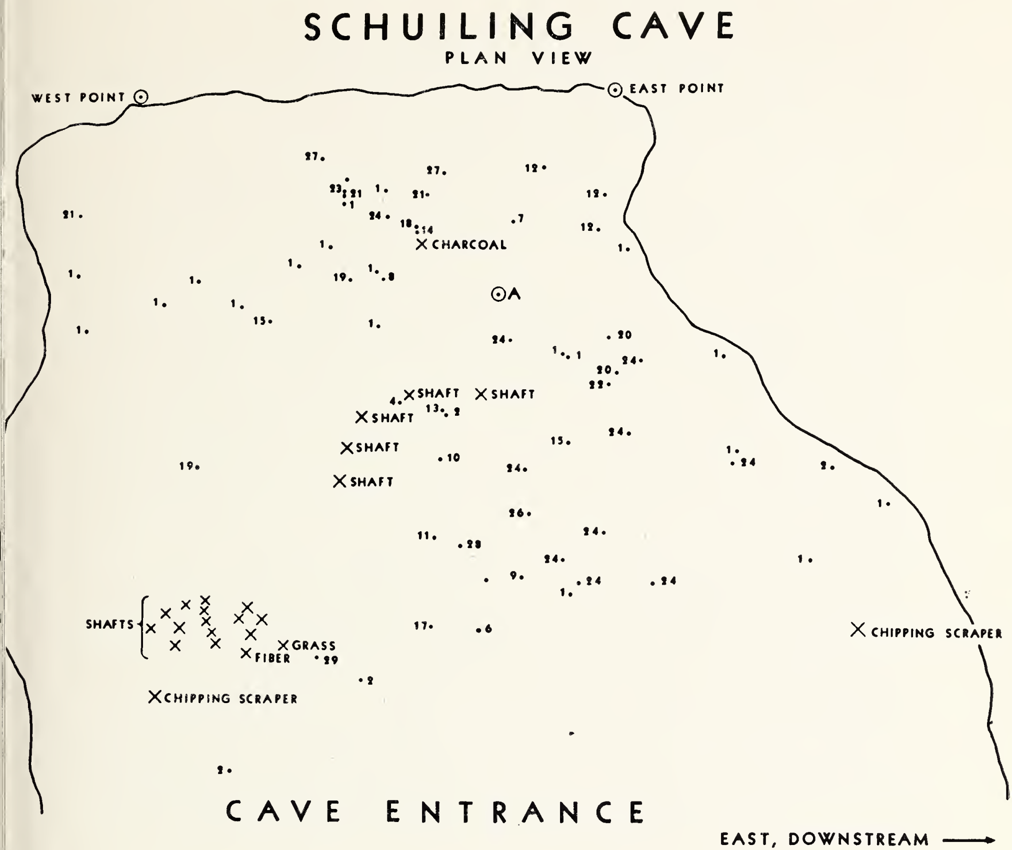

Fig. 8. Distribution of critical human cultural and vertebrate skeletal remains in Schuiling Cave. Plan view of the position of the specimens in the cave.

KEY TO DISTRIBUTION OF CAVE FOSSILS
Shown in Figs. 7 and 8

1. Tortoise
2. Chuckwalla
3. Mallard
4. Teal
5. Baldpate ?
6. Redhead duck
7. Ruddy duck
8. American merganser
9. Ancestral California condor
10. Golden eagle
11. Red-tailed hawk
12. Coot
13. Avocet
14. Mourning dove
15. Horned owl
16. Flicker
17. Raven
18. Rabbit
19. Pocket mouse
20. Wood rat
21. Badger
22. Wolf
23. Gray fox
24. Small horse
25. Large horse (no depth data)
26. Llama-like camel
27. Large camel
28. Diminutive antelope
29. Sheep (?Recent)

The last possibility is the least probable on the basis of present evidence. Fluviatile deposition might be used to explain all of the occurrences of animals in the deposits, although it seems possible that a combination of (1), (2) and (3) above actually occurred.

HUMAN REMAINS

There are no certain associations of human and animal remains known from Schuiling Cave (see Smith, 1955). The only suggestion of such association is the occurrence of the fragments of carbon found with extinct mammal bones at the 48 inch depth. The carbon could have washed into the cave as isolated pieces of charcoal resulting from fires caused by lightning. On the other hand, charcoal from fires of later human occupants could have sifted downward in the cave dust.

The accompanying chart (fig. 7) presents a diagrammatic view of the position of material in the cave. Most of the fossils were found at or below the 2 - 2½ foot level and toward the center of the cave. The fossil material becomes increasingly scarce in the lower limits and only a few identifiable remains (such as tortoise, horse and owl) and some crumbling fragments were taken at the 7 foot level below the present ceiling of the cave. All of the *identifiable* human cultural materials occur at or above the 30 inch level. Smith (1955) has listed cultural remains from these depths which include: cane shafts, cordage and stone chippings (jasper and chalcedony flakes) that would have been suitable for scraping and shaping shafts.

It would not be unreasonable to expect man to be associated with the extinct fossil remains, but the striking zonation of a lower horizon of extinct vertebrate remains and definitely higher horizon of identifiable cultural remains strongly indicates that there was a time difference in these occurrences in this cave assemblage.

ENVIRONMENT

With the exception of the condor, living representatives of all species of the birds recorded occur today in the desert regions of California. Of significance, however, is the large representation of water birds, indicative of the proximity of a lake or pond. There is no body of water in the immediate vicinity of the cave today that would normally support these species, although Troy dry lake, approximately six miles east of the site, could have been a suitable environment during more moist conditions of the past. The alluvial deposits that form the matrix bearing the fossils and continuing in the surrounding area outside the cave, imply the earlier occurrence here of a more abundant water supply.

The mammal specimens collected from this cave lead one to believe that climatic conditions were different from those of today. The mammals surely had varied diets and habitat preferences that could not be satisfied in today's extreme desert conditions. The badger, wolf and fox may have been accustomed to open country but with an occasional bush for concealment. The horses, no doubt, made use of some grassland areas, whereas the two camels were probably browsers and grazers. *Breameryx*, being so diminutive, may have had to rely on wooded areas for protection and survival. Vertebrate life in the Mojave was apparently more abundant and varied at the time the Schuiling Cave animals lived than it is today. This implies that there was a different environment with possibly cooler summers and a more abundant source of water.

Evidence reported in a recent paper on the climatic record at Searles Lake in California (Roosma, 1958), indirectly substantiates the interpretation of evidence contained in this paper on the environment of Schuiling Cave. Roosma presents palynological data indicating that the environment at or near Searles Lake (which is about 60 miles northwest of Schuiling Cave) in late Pleistocene time was different from today's desert conditions. Roosma states, "The existence of a rather extensive woodland community at times of more favorable moisture conditions seems to be indicated." He further states that this was at the time of the "moisture peak" of the Wisconsin glacial stage.

AGE RELATIONSHIP

Pleistocene lake beds are known to the northeast of Schuiling Cave in the area of Manix, and it is postulated (Gardner, 1940, p. 290) that the ancient lake south of Daggett and west of Schuiling Cave may have been contemporaneous with Manix Lake. Alluvium, conceivably contemporaneous with that of Schuiling Cave, overlies the Daggett lake beds (Gardner, *loc. cit.*), suggesting the possibility of more recent age for the cave deposits than for Daggett lake. Although a direct comparison cannot be made between the Schuiling Cave deposits and those of Manix Lake, the avian fauna suggests that Manix Lake (in part at least) was older. Three clearly extinct species have been identified from the Manix deposits and a large grebe gives evidence of being the Pleistocene ancestor of the present day Western Grebe (Howard, 1955). Although an exact age determination has not been made for the Manix Lake beds, most of the avian fossils reviewed suggest the late Pleistocene and probable general contemporaneity with the typical late Pleistocene of Rancho La Brea and of Fossil Lake, in Oregon. Possibly, therefore, the Schuiling Cave avifauna suggests slightly younger age than that of Rancho La Brea.

Blackwelder (1954) has mapped a late Pleistocene lake (presumably the Troy Lake area) between Newberry station and Pisgah crater, east of Schuiling Cave. He considers the age of this lake to be probably equivalent to the Tahoe glacial substage (early Wisconsin). Further field work is needed to determine chronologic relationships of this lake and the Schuiling Cave deposits.

Precise age determination is not possible from the study of the mammals, although reasonably conclusive evidence is at hand for assignment of late Pleistocene age for the fauna. As mentioned above, the avian species are remarkably like the Recent species. The ecologic relationships suggested by both birds and mammals, plus evidence of a period of fluvial deposition, indicate change in climatic conditions since the cave beds were deposited. The occurrence of definitely extinct mammalian species firmly establishes some antiquity for the fauna. None of the extinct mammalian genera is known to be restricted to either early or late Pleistocene age; however, a late Pleistocene age for the Schuiling Cave fauna is strongly indicated by a consideration of other factors, as for example: the resemblance of the small horse from Schuiling Cave to advanced species of *Equus* known from the probable late Pleistocene sediments of Manix Lake, San Josecito Cave, Gypsum Cave, Conkling Cavern and Shelter Cave; the probable contemporaneous occurrence of *Breameryx,* at Rancho La Brea, Shelter Cave and Schuiling Cave; and the presumed contemporaneity of *Tanupolama* at Manix, McKittrick and Schuiling Cave.

It is necessary to emphasize that the particular conditions of preservation at Schuiling Cave may have been responsible for the type of faunal complex represented. Thus some forms may have been excluded from this small cave although they may have been present in the area; for example, the typically late Pleistocene *Bison* (see Savage, 1951).

The meager sampling of charcoal recovered from the center of the cave and at a level near remains of extinct vertebrates was submitted to Yale University laboratories for carbon 14 dating. Unfortunately it was later determined that an insufficient quantity of carbon was available for proper analysis.

SUMMARY

Some of the principal results derived from this study are as follows:

1. This is the first complete account of a southern California Pleistocene cave faunal deposit.

2. A total of approximately 150 fossil vertebrate remains were recovered including 28 species of reptiles, birds and mammals. Five of these species represent clearly extinct animals including: *Equus* sp. small, *Equus* sp. large, cf. *Tanupolama,* Camelid sp. large, and *Breameryx* sp.; *Gymnogyps amplus* and *Bubo virginianus* are probably extinct ancestral forms.

3. The total faunal content and the sequence of geologic and climatic events indicate late Pleistocene age for the cave fauna, at least part of the cave sediments and the alluvial fan remnant.

4. The concentration of definite human cultural specimens stratigraphically above the remains of extinct vertebrates indicates probable difference in time of accumulation of the cultural and fossil material.

5. Considering the small size of the cave area (approximately 18 feet width, and 13 feet depth horizontally), the amount of fossil material recovered is good and suggests that there may have been a fair abundance of animal life in the area. In turn, the record of varied types of life and

mode of deposition indicates that the climate was different from that of today with possibly more equable or cooler conditions in the summer, a more abundant water source and a greater amount of grass and woodland vegetation at hand.

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LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS
IN SCIENCE

THE MACHRIS BRAZILIAN EXPEDITION

No. 1. General Account, by Jean Delacour.
No. 2. Botany: General, by E. Yale Dawson.
No. 3. Botany: A New Dodder from Goiás, by T. G. Yuncker.
No. 4. Botany: The Lichens, by Carroll W. Dodge.
No. 5. Botany: Cyanophyta, by Francis Drouet.
No. 6. Botany: A New Mint from Goiás, by Carl Epling.
No. 7. Botany: Phanerogamae, various smaller families, edited by E. Yale Dawson.
No. 10. Botany: A New Columnar Cactus from Goiás, by E. Yale Dawson
No. 11. Botany: Chlorophyta; Euglenophyta, by G. W. Prescott.
No. 12. Entomology: General; Systematics of the Notonectidae (Hemiptera), by Fred S. Truxal.
No. 13. Botany: Phanerogamae, Leguminosae, by Richard S. Cowan.
No. 14. Entomology: Gelastrocoridae (Hemiptera), by E. L. Todd.
No. 17. Botany: Phanerogamae, Bromeliaceae and other smaller families, by Lyman B. Smith.
No. 18. Botany: Musci, by Howard Crum.
No. 21. Botany: Phanerogamae, Euphorbiaceae, Lentibulariaceae, Rubiaceae, by Julian A. Steyermark.
No. 22. Botany: Gramineae, by Jason R. Swallen.
No. 23. Botany: Phanerogamae, Alstroemeriaceae and other families, by Lyman B. Smith and collaborators.
No. 24. Botany: Fungi, by G. W. Martin and collaborators.
No. 26. Botany: Hepaticae, by Margaret Fulford.
No. 28. Botany: Phanerogamae, Melastomataceae and Polygalaceae, by J. J. Wurdack.

OTHER SUBJECTS

No. 8. Notes on Eastern Pacific Insular Marine Algae, by E. Yale Dawson.
No. 9. A New Species of Passerine Bird from the Miocene of California, by Hildegarde Howard.
No. 15. Marine Algae of the Pacific Costa Rican Gulfs, by E. Yale Dawson.
No. 16. A Classification of the Oscines (Aves), by Jean Delacour and Charles Vaurie.
No. 19. A new Race of the Pocket Gopher *Geomys bursarius* from Missouri, by Charles A. McLaughlin.
No. 20. Further Bird Remains from the San Diego Pliocene, by Loye Miller and Robert I. Bowman.
No. 25. Miocene Sulids of Southern California, by Hildegarde Howard
No. 27. Marine Algae from the 1958 Cruise of the Stella Polaris in the Gulf of California, by E. Yale Dawson.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

[Nu]MBER 30 JULY 1, 1959

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: PHANEROGAMAE

AMARANTHACEAE AND OTHER FAMILIES

By LYMAN B. SMITH AND COLLABORATORS

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and intineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

HILDEGARDE HOWARD
Editor

E. YALE DAWSON
Associate Editor

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Amaranthaceae and other families

By LYMAN B. SMITH[1] AND COLLABORATORS

The plant collections reported upon below were obtained by E. Yale Dawson, Expedition Botanist, and are cited by his field collection numbers. Detailed locality data for these may be found in his general account of the botany of the Expedition[2]. Briefly, however, specimens bearing numbers from 14133 to 14815 came from the Chapada dos Veadeiros, between São João da Aliança and Veadeiros, April 13 - May 3, 1956. Those bearing numbers from 14816 to 15236 came from the region between Amaro Leite and Peixe, especially in the southern Serra Dourada, May 15-June 10, 1956.

The present report contains several supplements to previously noted families because a number of specimens were overlooked or misfiled in the original sorting into groups for specialists.

The families are arranged alphabetically. The treatments are by L. B. Smith unless otherwise indicated.

The first set of specimens, including isotypes of the four new species, is deposited in the Los Angeles County Museum.

AMARANTHACEAE

Alternanthera brasiliana (L.) O. Kuntze 14936 Southern Mexico and the West Indies to Brazil.

Alternanthera ficoidea (L.) R. Br. 14533 Tropical America.

Amaranthus spinosus L. 14970 Worldwide in tropical and temperate regions.

Pfaffia aff. *sericea* (Spreng.) Mart. 14663 Specimen incomplete.

References: M. Seubert in Mart. Fl. Bras. 5(1): 161-252. 1875. P. C. Standley in North American Flora 21, pt. 2: 95-169. 1917.

APOCYNACEAE (supplement)

Aspidosperma macrocarpon Mart. 15233 Venezuela, Brazil, Paraguay, Bolivia.

Reference: Robert E. Woodson, Jr., Ann. Missouri Bot. Gard. 38: 119-206. 1951.

ARACEAE

Anthurium aff. *kunthii* Poepp. & Endl. 15069

Caladium bicolor (Ait.) Vent.? 14755 Sterile material. The corm used as a tonic and to purify the blood; called "inhame roxo."

[1]Curator, Division of Phanerogams, U. S. National Museum, Smithsonian Institution, Washington, D. C.

[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2): 1-20.

Monstera pertusa (L.) de Vriese 15010 Tropical America.
Philodendron bipinnatifidum Schott? 14412 Leaf only.
Philodendron aff. *eximium* Schott 14637; 14917; 14992
Philodendron aff. *laciniatum* (Vell.) Engl.? 14509 Leaf only.
Spathiphyllum cannifolium (Dryand.) Schott 15135 Tropical South America.

References: A. Engler in Mart. Fl. Bras. 3(2): 25-224. 1878. Pflanzenreich IV. Fam. 23, pt. A: 1-70. 1920; pt. B: 1-330. 1905; pt. B^2: 1-160. 1908; pt. C: 1-130. 1911; pt. Da: 1-134. 1912; pt. Db: 1-143. 1913; pt. Dc: 1-78. 1915; pt. E: 1-139. 1920; pt. F: 1-274. 1920. The Brazilian species of the family are under revision by Dra. G. M. Barroso of the Jardim Botânico, Rio de Janerio.

BURSERACEAE

det. by J. Cuatrecasas, Division of Phanerogams,
U. S. National Museum, Smithsonian Institution,
Washington, D. C.

Protium dawsonii Cuatr. sp. nov. Figs. 1, 2

Arbor ramis terminalibus leviter striatis brunnescentibus vel cinerascentibus densiuscule pubescenti-hirtulis pilis tenuibus patulis ad 0.5 mm. longis.

Folia alterna imparipinata 8-17 cm. longa, 1-3-juga, petiolo rigido robusto supra fere plano subtus semitereti striolatoque utroque latere angulato 3-4 cm. longo utrinque dense pubescenti-hirtuli, pilis patulis; internodiis rhachis 1.5-2.5 cm. longis pubescenti-hirtulis, supra bicanaliculatis subtus semiteretibus. Petioluli laterales breves robusti patulo-pilosi supra bisulcati, 1-2 (-3) mm. longi, terminalis 7-12 mm. longus. Foliola firmule coriacea ovata vel lanceolato-ovata basi (praeter terminalium) plus minusve asymmetrica subcordata vel late rotundata, apice breviter attenuata et obtusiuscule acuminata, margine levissime sinuato-dentata vel integra, 3.5-8.5 cm. longa, 1.8-5.2 cm. lata, acumine ad 5 mm. longo 3 mm. lato; supra visu glabra sed pilis sparsis teneris acutis patulis ad 0.5 mm. longis munita costa angusta prominula lutecenti nervis lateralibus prominulis discoloribus bene conspicuis reliqua superficie laevi pallide viridi; subtus tactu mollia pilis patulis teneris plus minusve copiosis munita, pallide viridia costa crassiuscula pallida magis pilosa nervis secundariis circa 10 utroque latere prominentibus pallidis valde conspicuis subpatulis marginem versus furcato-evanescentibus nervulis minoribus parum conspicuis superficie laevis.

Inflorescentiae axillares breves paniculatae 1-2 cm. longae axi brevissimo vel nullo ramulis angulosis robustiusculis pubescenti-hirtulis. Bracteae ovato-triangulares crassae acutiusculae amplectentes 1.5-1 mm. longae minute pubescentes. Pedicelli 1-2.5 mm. longi crassiusculi angulati patulo-pubescenti. Flores visu hermaphroditi tetrameri. Calyx cupularis circa 1 mm. altus, breviter 4-dentatus dentibus acutis, extus sparse patulopilosus. Petala 4, crassiuscula oblonga sursum paulo angustata subacuta apice crassiuscule breviterque acuminato-inflexa, 2.2-2.4 mm. longa, 1.2-1.3

Fig. 1. *Protium dawsonii* sp. nov. An isotype specimen.

mm. lata extus pilis crassiusculis irregularibus copiosis intus papillosa ad marginem tomentella. Stamina 8, filamentis complanatis crassiusculis glabris quatuor oppositisepalis brevioribus circa 0.8 mm. longis quatuor oppositipetalis; antheris linearibus lanceolatis 0.5 mm. longis verisimiliter sterilibus. Ovarium glabrum ovoideum circa 0.7 mm. altum apice attenuatum in stylum crassiusculum erectum circa 1.5 mm. longum. Stigmata crasse capitata 4-lobata. Discus crassus annularis leviter octogonus. Ovarium 4-loculare loculis biovulatis. Fructus pedicelatus calyculatusque, pedicello 2-3 mm. longo angulato patulo-pubescenti. Drupa valde asymmetrica ovata apice plus minusve angustata acuta cum stylo persistenti apiculata basi subite in pseudopedicellum attenuata unipyrena siccitate 11-14 mm. longa pseudopedicello (1.5-2 mm.) excluso; exocarpio carnoso 1 mm. crasso; endocarpio oblongo-ellipsoideo leviter compresso cartilagineo utrinque obtuso.

TYPE: Museu Nacional do Brasil, Rio de Janeiro, collected in cerrado area 20½ km. north of São João da Aliança, region of the Chapada dos Veadeiros at W. Long 47°30'; S. Lat. 14°30', Goiás, Brazil, April 20, 1956, by E. Yale Dawson (No. 14465). Isotypes in the United States National Museum and the Los Angeles County Museum.

Another collection from the same region is *Dawson* 14263 (US), hilly cerrado, 23 km. north of São João da Aliança, April 16, 1956.

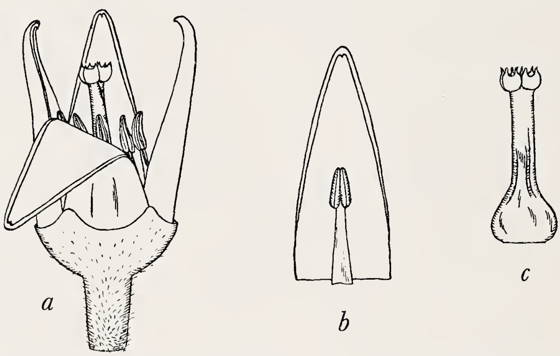

Fig. 2. *Protium dawsonii* sp. nov. a. Flower, × 10; b. petal and stamen, × 10; c. pistil, × 10.

Protium dawsonii is closely related to *P. almecega* March. from Lagoa Santa in Minas Gerais and to *P. llanorum* Cuatr. from Los Llanos of Venezuela and Colombia. The Dawson plant differs from the above mentioned species by its short and strong petiolules, by the spreading indument of the petioles, rhachises, and branchlets, by the broadly ovate basally subcordate or rotundate leaflets, by the tetramerous flowers, by the outwardly puberulous petals, and by the long style.

CYPERACEAE

Bulbostylis junciformis (H.B.K.) Lindm. 14622 Cuba, British Honduras, Panama, northern South America.

Bulbostylis paradoxa (Spreng.) C. B. Clarke 14496 Cuba, Panama, northern South America.

Bulbostylis scabra (Presl) C. B. Clarke 14887; 14277 (pathological); 14670 (lax variety). Southern Brazil, Paraguay, northern Argentina.

Bulbostylis sphaerocephala (Boeckl.) C. B. Clarke 14134 Southern Brazil, Bolivia, Paraguay, northern Argentina.

Bulbostylis sp. 14146; 14555 Spikelets fascicled in an ample diffuse panicle.

Bulbostylis sp. 14403 Inflorescences subcorymbose; spikelets in subglobose heads.

? *Bulbostylis* sp. 14636 Inflorescence subumbellate; spikelets large, solitary.

Cyperus amabilis Vahl 14635 Pantropical.

Cyperus flavus (Vahl) Nees 14233 Tropical and temperate America.

Cyperus haspan L. 14242; 14913 Pantropical.

Cyperus simplex H.B.K. 14935 Tropical America.

Eleocharis capillacea Kunth 14745 São Paulo and Minas Gerais to Paraguay.

Eleocharis nana Kunth 14248; 14260a Florida, Cuba, British Guiana, Brazil.

Eleocharis sulcata (Roth) Nees 14911 Mexico to Argentina.

Eleocharis sp. 14260

Fimbristylis dichotoma (L.) Vahl. (*F. annua* R. & S.) 14257 Cosmopolitan.

Fuirena umbellata Rottb. 14876 Pantropical.

Lagenocarpus kunthii (Miq.) Uitt. [*L. strictus* (Kunth) Pfeiffer] 14603; 14710 Colombia, Guiana and Bahia to Rio Grande do Sul. New to Goiás.

Lagenocarpus rigidus (Kunth) Nees 14689 Minas Gerais. New to Goiás.

Lagenocarpus tenuifolius (Boeckl.) O. Kuntze. 14773 Minas Gerais, Goiás.

Lipocarpha sellowiana Kunth 14237 Brazil, Bolivia, Paraguay, Uruguay, Argentina.

Rhynchospora brevirostris Griseb. 14480; 14886 Cuba to São Paulo and Mato Grosso. New to Goiás.

Rhynchospora cephalotes Vahl 14961 Viviparous. West Indies to Goiás and Mato Grosso.

Rhynchospora aff. *confinis* (Nees) C. B. Clarke 14633 Inflorescence lax.

Rhynchospora consanguinea (Kunth) Boeckl. var. *speciosa* (Kunth) Boeckl. 14241 Pará, Minas Gerais, Goiás.

Rhynchospora emaciata (Nees) Boeckl. (*R. tenuis* var. *emaciata* Lindm.) 14874; 14882 Amazonas and Bahia to Rio Grande do Sul, Argentina, and Bolivia.

Rhynchospora exaltata Kunth 14453 Brazil, with varieties in Guiana and Paraguay.

Rhynchospora glauca Vahl 14877 Pantropical.

Rhynchospora globosa (H.B.K.) R. & S. 14236; 14875 West Indies to Uruguay and Argentina.

Rhynchospora hirta (Nees) Boeckl. 14289 Pará to São Paulo, Goiás, and Bolivia.

Rhynchospora pilosa (Kunth) Boeckl. 14634 Bahia, Minas Gerais, Paraná. New to Goiás.

Rhynchospora sp. 14878 Pathological, no fruit.

Scleria hirtella Sw. 14235 Southeastern United States to Bolivia, Paraguay, and Uruguay; southern Africa.

Scleria melaleuca Reichb. ex Schlecht. & Cham. 15124 Southern Mexico and the West Indies to Brazil and Bolivia.

Scleria minima C. B. Clarke ex char. 14783 Goiás; Amazonas.

Scleria secans (L.) Urban 14960 Mexico and the West Indies to Bolivia and Paraguay.

Scleria verticillata Muhl. 14630 Eastern Canada to Guiana and Pará. New to Goiás.

Scleria sp. 14910

References: M. Barros, Gen. & Sp. Pl. Argentinarum 4(1): 3-243. 1947; (2): 259-530. 1947. H. K. Svenson, North American Flora 18(9): 505-556. 1957. H. Uitten, Fl. Surinam 1: 72-149. 1934. *Cyperus*: G. Kükenthal, Pflanzenreich IV. Fam. 20 (Heft 101): 1-671. 1935-36. *Lagenocarpus*: H. Pfeiffer, Fedde Rep. Spec. Nov. 18: 72-93. 1922. *Rhynchospora*: G. Kükenthal, Engler Bot. Jahrb. 74: 375-509. 1949; 75: 90-126, 127-195, 273-314. 1950-51. *Scleria*: E. L. Core, Brittonia 2: 1-105. 1936.

DIOSCOREACEAE

Dioscorea sp. 14908 Staminate flowers only.

Reference: R. Knuth, Pflanzenreich IV. Fam. 43: 1-387. 1924.

DROSERACEAE

Drosera montana St.-Hil. var. *montana* 14883 Minas Gerais; Bolivia.

Drosera montana St.-Hil. var. *tomentosa* (St.-Hil.) Diels 14650 Minas Gerais.

Both the above identifications are uncertain because the material lacks mature seeds.

Reference: L. Diels, Pflanzenreich IV. Fam. 112: 1-136. 1906.

ICACINACEAE

det. by Richard A. Howard, Arnold Arboretum,
Harvard University, Cambridge, Mass.

Emmotum nitens (Bentham) Miers 14586 Bahia, Minas Gerais, Goiás, Mato Grosso. The type of this species is *Gardner* 3309, collected in Goiás without specific locality. The present collection is the first to give a definite locality within the state.

IRIDACEAE

det. by Robert C. Foster, Gray Herbarium,
Harvard University, Cambridge, Mass.

Cypella sp. 14791 Almost certainly an undescribed species.

Sisyrinchium vaginatum Spreng. 14183a Southern Brazil, Uruguay, Paraguay, Argentina.

Trimezia sp. 14777 Belongs in the *Lansbergia* group, members of which are virtually impossible to name at the present time.

LAURACEAE

Ocotea sp. 14447

References: C. Mez, Jahrb. Bot. Gart. Berlin 5: 1-556. 1889. Ida de Vattimo, Jardim Botânico, Rio de Janeiro.

LENTIBULARIACEAE (supplement)

Utricularia neottioides St.-Hil. 14675 On rocks in running water below falls 14 km. south of Veadeiros in sandstone area.

Reference: N. Sylvén, Arkiv Bot. 8(6): 1-48. 1908.

LORANTHACEAE

Phoradendron emarginatum Eichl. 14476 Amazonas to Bahia; Bolivia.

Phoradendron undulatum (Pohl) Eichl. 14373 Minas Gerais, Rio de Janeiro; Bolivia.

Psittacanthus biternatus (Hoffmsegg.) Blume 14607 Pará, Bahia; southern Venezuela.

Psittacanthus robustus Mart. 14261; 14454 Central and southern Brazil.

Struthanthus aff. *dichotrianthus* Eichl. 14565 In fruit, diagnostic parts lacking.

Struthanthus flexicaulis Mart. 14262 Minas Gerais, São Paulo.

References: A. G. Eichler in Mart. Fl. Bras. 5(2): 1-136. 1868. W. Trelease, The Genus Phoradendron 1-224. 1916. C. T. Rizzini, Jardim Botânico, Rio de Janeiro.

OCHNACEAE

Ouratea castaneifolia (DC.) Engler 14719 Amazonas and Mato Grosso to Piaui and Rio de Janeiro.

Ouratea floribunda (St.-Hil.) Engler 14436; 14830 Minas Gerais, São Paulo. The second number has the inflorescence heavily infected with a witches broom that is frequent in this genus.

Sauvagesia erecta L. 14903 Weed of tropical America and Africa.

References: A. Engler in Mart. Fl. Bras. 12(1): 297-366. 1876. E. Gilg, Pflanzenfam. ed. 2, 21: 53-87. 1925.

RHAMNACEAE

Gouania virgata Reiss. 14484 Minas Gerais; Guiana, Nicaragua.

Reference: S. Reissek in Mart. Fl. Bras. 11(1): 81-120. 1861.

ROSACEAE

det. by Bassett Maguire, New York Botanical Garden,
New York, N. Y.

Hirtella burchellii Britton 15130 Hitherto *H. burchellii* has been known only by the type *Rusby* 1222 from Beni River, Bolivia (type and isotype NY), and according to Britton, by *Burchell* nos. 6331, 6416, and 6571. Urban (Fl. Brasiliensis 1, pt. 1: 10) indicates that all three came from the vicinity of the city of Goiás.

Hirtella racemosa Lam. sens. lat. (*H. americana* Aubl., not L.) 14270 This collection apparently must be referred to *H. racemosa* var. *gracilipes* Hook. f., which is rather widespread in the central Brazilian plateau region. This variant is quite similar to *H. brachystachya* Spruce ex Hook. f. of the middle Amazon and Rio Negro region.

Licania sp. 14812 This collection may represent an undescribed species, but because of the plethora of species of uncertain application in this complex genus, I hesitate at this time without adequate further exploration of its taxonomy, to propose a new name in *Licania.*

SAPINDACEAE

Cupania vernalis Camb. 14363 Southern Brazil, Bolivia, Paraguay, Uruguay, northern Argentina.

Serjania erecta Radlk. 14232; 14467 Minas Gerais, Goiás, Mato Grosso, São Paulo; Paraguay, Argentina.

Serjania aff. *glabrata* H.B.K. 14431 (fruits lacking).

Serjania mansiana Mart. 14396 Paraná, São Paulo, Minas Gerais to Bolivia.

Serjania or *Paullinia?* 14923 (fruits lacking).

Urvillea ulmacea H.B.K. 14386 Texas, Mexico, and the West Indies to Bolivia, Paraguay, and Argentina.

References: L. Radlkofer, Fl. Brasiliensis 13(3): 225-658. 1892-1900. Pflanzenreich IV. Fam. 165: 1-1539. 1931-34.

THEACEAE (supplement)

Kielmeyera pulcherrima L. B. Smith, sp. nov. Fig. 3

A *K. rubriflora* Camb. et *K. speciosa* St.-Hil., cuibus affinis, foliis verticillatis, floribus ad apices ramorum solitariis sessilibusque differt.

Branching shrub; branches opposite, suberose-corticate, densely whitish-pubescent at the apices, soon glabrous below; leaves sessile, elliptic to obovate, broadly rounded at base and apex, frequently retuse, to 55

Fig. 3. *Kielmeyera pulcherrima* sp. nov. An isotype specimen.

mm. long and 35 mm. wide, flat, coriaceous, closely and strongly reticulate on both sides, white-tomentose on the midnerves beneath; flowers solitary and sessile at the ends of the branches, bracteate; bracts few, ovate, 5-6 mm. long, carinate, cuspidate, fulvous-velutinous; sepals very broadly ovate, distinctly unequal, 7-10 mm. long, fulvous-velutinous; petals obovate, strongly asymmetric, to 55 mm. long, rose, wholly glabrous; filaments slender; anthers oblong, eglandular; ovary ovoid, densely white-lanate.

TYPE: Museu Nacional do Brasil, Rio de Janeiro, collected on sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos Veadeiros at W. Long. 47° 30'; S. Lat. 14° 30', Goiás, Brazil, by E. Yale Dawson (No. 14588a). Isotypes in the United States National Museum and the Los Angeles County Museum.

This species appears to be unique in *Kielmeyera* on account of its verticillate leaves and solitary flowers, but the floral structure is quite typical. Its large rose petals must make it one of the most striking and beautiful shrubs of the region.

Kielmeyera variabilis Mart. 14486 Minas Gerais to Paraná and Goiás.

References: H. Wawra in Mart. Fl. Bras. 12(1): 261-334. 1886. Engler, Pflanzenfam. ed. 2, 21: 169, 172, 173. 1925 (under Guttiferae).

THEOPHRASTACEAE

Clavija integrifolia Mart. & Miq. 15032 Minas Gerais, Mato Grosso. The present determination is only tentative as it is not possible to solve certain taxonomic problems without much more material. Miquel in the Flora Brasiliensis (Pl. 26) shows a paracorolla as an appendage to the filament-tube in the staminate flower, while Mez in his monograph makes no mention of such a structure, and his illustrations of other species show appendages on the corolla but not on the filament-tube. The structure that Mez shows has been verified and there is a possibility that Miquel's illustration is an error due to faulty interpretation of dried material.

References: F. A. G. Miquel in Mart. Fl. Bras. 10: 269-324. 1856 (under Myrsineae). C. Mez, Pflanzenreich IV. 236a: 1-48. 1903.

TURNERACEAE

Piriqueta duarteana (Camb.) Urb. 14983 Central and northeastern Brazil.

Turnera incana Camb. 14980 Goiás.

References: I. Urban in Mart. Fl. Bras. 13(3): 85-170. 1883.

VELLOZIACEAE

Barbacenia flavida Goeth. & Henr. ex char. 14717 Minas Gerais.

Vellozia alexandrinae (Schomb.) Goeth. & Henr. vel aff. 14580; 14785 British Guiana, Venezuela.

Vellozia glauca Pohl 14434 Goiás, a variety in Mato Grosso.

Vellozia phalocarpa Pohl 14724 Endemic in Goiás.

? *Vellozia* sp. 14674 Past flowering. Genus uncertain, but plant shows similarities to *V. rhynchocarpa* Goeth. & Henr.

? *Vellozia* sp. 14680 Past flowering. A distinct species apparently related to number 14674.

? *Vellozia* sp. 14723 Past flowering.

References: M. Seubert in Mart. Fl. Bras. 3(1): 65-84. 1847. J. T. Henrard, Blumea 2: 339-383. 1937.

XYRIDACEAE

det. by Lyman B. Smith,
and by Robert J. Downs, Plant Industry Station,
U. S. Department of Agriculture, Beltsville, Maryland.

Xyrus dawsonii Smith & Downs, sp. nov. Figs. 4, 5

A *X. asperula* Mart., cui affinis, bracteis castaneis lucidisque, spicis paucifloris differt.

Bulbous; roots slender, almost filiform; leaves 20-27 cm. long, flat; sheaths merging with the blades, to 8 cm. long, linear then abruptly dilated at the extreme base and prominently nerved, glabrous above the suborbicular minutely ciliolate base, the ligule wanting; blades linear, 1 mm. wide, obliquely acute, obscurely nerved, finely tuberculate throughout; scape very slender, twisted, to 45 cm. high, terete, ecostate, densely and finely tuberculate; scape-sheath 8-9 cm. long, bladeless, closely enfolding the scape, acute; spike ellipsoid, 10 mm. long, 4-5 mm. in diameter, few-flowered; bracts elliptic, obtuse, entire or with a minute hyaline margin at apex, lustrous, castaneous, concolorous, coriaceous, the lower reduced, the median 8 mm. long; posterior sepals free, subequilateral, lanceolate, acute, 7 mm. long, the narrow keel entire and glabrous; petal-blades elliptic, 6 mm. long; anthers linear-sagittate, 2.5 mm. long; staminodes densely penicillate; placentae basal.

TYPE: Museu Nacional do Brasil, Rio de Janeiro, collected on wet, sandy margins of sandstone outcrop 7 km. south of Veadeiros, region of the Chapada dos Veadeiros at W. Long. 47° 30'; S. Lat. 14° 30', Goiás, Brazil, April 24, 1956, by E. Yale Dawson (No. 14624). Isotypes in the United States National Museum and the Los Angeles County Museum.

Xyris machrisiana Smith & Downs, sp. nov. Fig. 6, 7

A *X. simulante* Alb. Nilsson, cui affinis, foliis ciliatis, bracteis breviter carinatis, sepalis posterioribus breviter connatis differt.

Bulbous; leaves 8-15 cm. long, flat, densely white-ciliate; sheaths merging with the blades, 5 cm. long, linear then abruptly dilated and dark castaneous at base, the ligule minute; blades linear, 2 mm. wide, obliquely acute, the sides smooth, glabrous, the marginal nerves thickened; scape twisted, 44-55 cm. high, terete, obscurely costate, smooth, glabrous or obscurely ciliate; scape-sheath 7-10 cm. long, closely enfolding the scape, the blade very short; spike subglobose, 9-13 mm. long, rather many-flowered; bracts elliptic, obtuse, strongly carinate toward apex, reddish brown with a narrow white lacerate margin at apex, sublustrous, the basal somewhat reduced, the median 7 mm. long, the dorsal area very obscure or wanting; anterior sepal enclosed by the posterior, enfolding the

Fig. 4. *Xyris dawsonii* sp. nov. The holotype specimen.

young corolla; posterior sepals short-connate, lanceolate, acute, 8 mm. long, the keel white-fimbriate toward apex; petal-blades suborbicular, 5 mm. long; anthers linear-sagittate, 2 mm. long; ovary 4 mm. long; placentae basal.

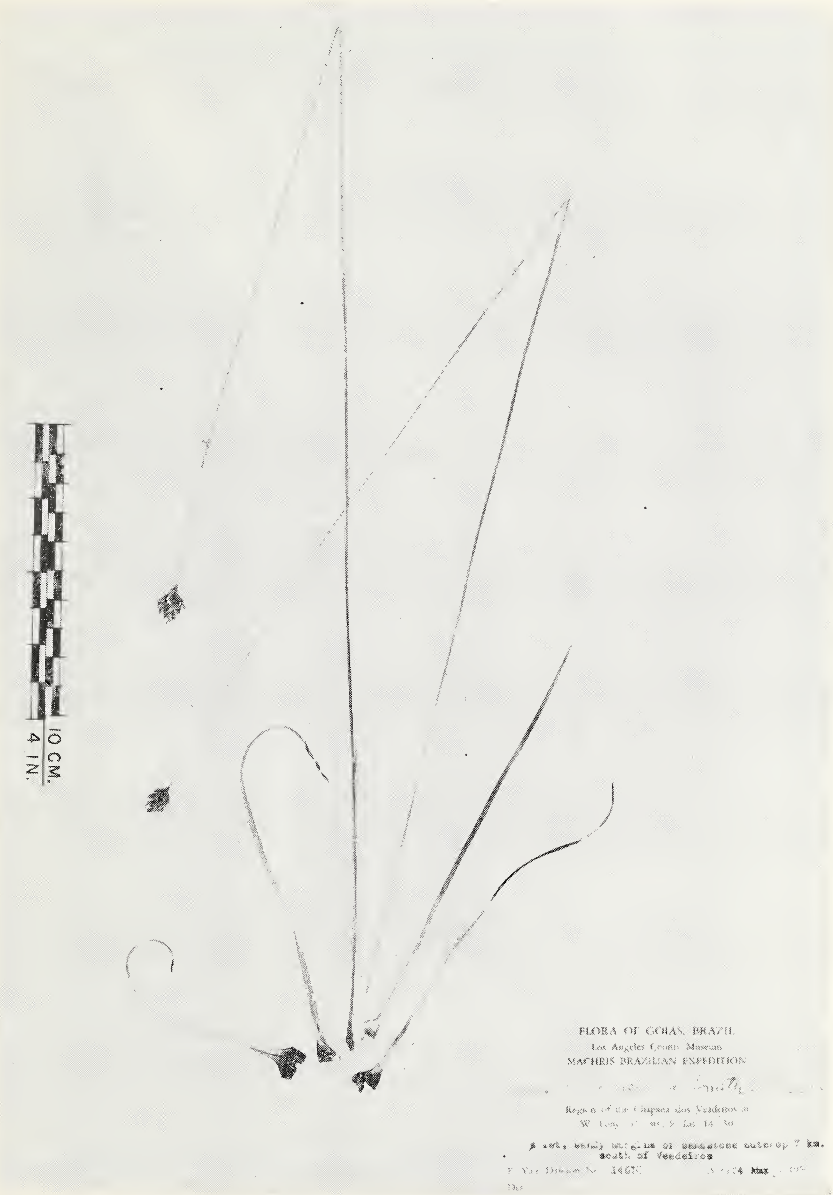

Fig. 5 *Xyris machrisiana* sp. nov. An isotype specimen.

TYPE: Museu Nacional do Brasil, Rio de Janeiro, collected on wet, sandy margins of sandstone outcrop 7 km. south of Veadeiros, region of Chapada dos Veadeiros at W. Long. 47° 30'; S. Lat. 14° 30', Goiás, Brazil, April 24, 1956, by E. Yale Dawson (No. 14610). Isotypes in the U. S. National Museum and the Los Angeles County Museum.

Xyris aff. *metallica* Kl. ex Seubert 14238 Leaves lacking, identification uncertain.

Xyris savanensis Miq. var. *savanensis* 14627 South America south to Paraguay and northern Argentina.

Xyris tenella Kunth var. *tenella* 14641 São Paulo and Paraná to Mato Grosso and Paraguay.

Reference: G. Malme, Arkiv Bot. 13(3): 1-103. 1913.

ZINGIBERACEAE

Costus aff. *spiralis* (Jacq.) Roscoe 14941 Species not in Pflanzenreich.

Renealmia goyazensis K. Schum. 15223 Described from Goiás without further locality.

Reference: K. Schumann, Pflanzenreich IV. Fam. 46: 1-458. 1904.

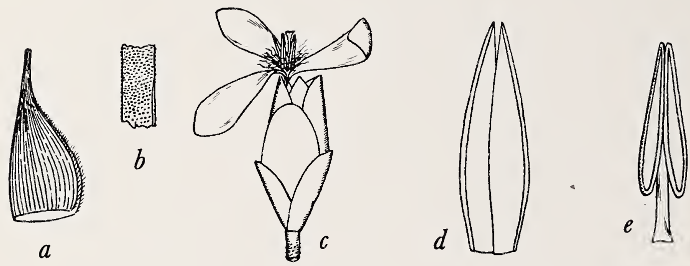

Fig. 6. *Xyris dawsonii* sp. nov. a. Base of leaf, × 2; b. apex of sheath, × 4; c. spike, × 2; d. posterior sepals, × 5; e. stamen, × 10.

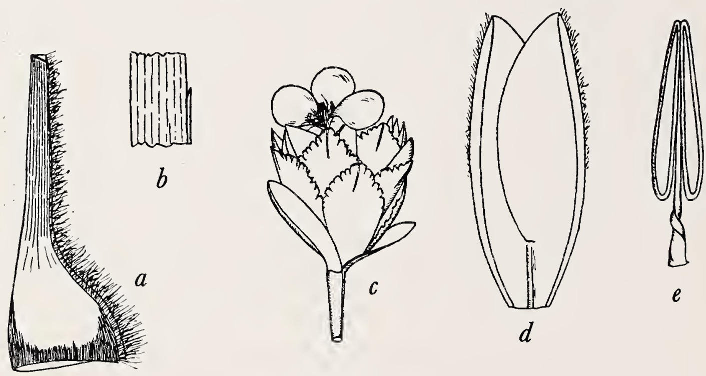

Fig. 7. *Xyris machrisiana* sp. nov. a. Base of leaf, × 2; b. apex of sheath with ligule, × 4; c. spike, × 2; d. posterior sepals, × 5; e. stamen, × 10.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

MBER 31 — October 14, 1959

LATE PLEISTOCENE INVERTEBRATES OF THE NEWPORT BAY AREA, CALIFORNIA

By George P. Kanakoff and William K. Emerson

Los Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

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LATE PLEISTOCENE INVERTEBRATES OF THE NEWPORT BAY AREA, CALIFORNIA

By George P. Kanakoff[1] and William K. Emerson[2]

INTRODUCTION

This paper records late Pleistocene metazoan invertebrates from three localities near Newport Bay, Orange County, California. The fauna is discussed in terms of the known Quaternary history of the southern California district, and paleoecological interpretations are undertaken based on a collected assemblage of 496 species, mostly mollusks, from the lowest exposed terrace of the San Joaquin Hills and the Newport Mesa. Vertebrates previously recorded from this area (see p. 8) number at least 40 species. The fauna is the largest assemblage of megafossils thus far reported from western America. The terrace fauna is considered to be essentially an equivalent of the fauna of the Palos Verdes sand, and the date of platform cutting and age of the associated marine deposits are inferred to be post-early Pleistocene, probably ad-Wisconsin stage.

This study was initiated in the spring of 1940 when Mr. and Mrs. F. L. Grouard of Santa Ana, California, brought to the attention of the senior author a small number of Pleistocene mollusks from the premises of the Irvine Estate, north of Newport Bay. A new record for the Pleistocene of California and a new species were contained in this collection. This prompted the senior author to visit the region the following year and make additional collections from several localities on the Newport Mesa and from the cliff across Newport Bay fringing the north side of the San Joaquin Hills. As these collections contained new records for the late Pleistocene faunas of the Los Angeles basin, including several new species, subsequent visits to the Newport area were made and several hundred pounds of screenings were obtained, sorted and identified. World War II interrupted the senior author's studies, but the late George Willett completed the sorting and identification of the collections from two of the collecting localities. From this material, Willett (1944) described two new pelecypods,[3] and four new gastropods[4] were later described in a posthumously published paper (Willett, 1948).

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[1]Los Angeles County Museum, Los Angeles 7, California.

[2]American Museum of Natural History, New York 24, New York.

[3]*Cardita hilli* and *Chione picta.*

[4]*Turbonilla* (*T.*) *grouardi, Odostomia* (*Menestho*) *effiae, O.* (*Chrysallida*) *elsiae,* and *Triphora kanakoffi.*

←

Fig. 1. Map of the Newport Bay area showing fossil collecting localities of Bruff (1946), those preceded by A, and the present report (base and geology after Poland and Piper, 1956, pl. 3). According to Vedder *et al.* (1957) the Tertiary rocks designated as "Tu" should include the middle Miocene "Monterey shale" or Puente formation.

Upon his return to the Museum in 1945, the senior author was encouraged by the late Dr. Chester Stock to make a series of weekly collecting trips to the area which resulted in the procuring of a large collection from more than 15 exposures in the terrace deposits. One particular site (Los Angeles County Museum Invertebrate Paleontology locality 66-2),[5] exposed in a gully cut into the terrace surface on the northwest side of the San Joaquin Hills, was found to be especially rich. Here a 21-foot thick pocket of sediments, overlying the conglomerate resting on the terrace platform, was entirely removed and the sediment screened (Fig. 4). This site yielded an abundance of vertebrate remains, including fish, bird and mammal bones, numerous invertebrates, and even plant remains. Several papers resulting from the study of the vertebrate elements of these collections have been published, see page 8. Additional studies of the large collection of mammal material are being continued by Dr. Theodore Downs, Curator of Vertebrate Paleontology of the Los Angeles County Museum. The only reptilian remains found were plastron fragments of a large turtle.

Owing to the vast number of invertebrates collected, only the material taken from two sites, one from each side of Newport Bay, are included in the present study. These include the one previously mentioned from the southeastern side of the bay, locality 66-2, and one from the northwestern part of the bay, localities 68-A and 68-B. In order to give an indication of the abundance of the molluscan elements of the fauna, the number of every constituent collected at each locality was carefully noted by the senior author and is recorded for each species in the faunal list below.

The senior author has briefly discussed the fauna (Kanakoff, 1948; 1950) and has described a new species of gastropod, (*Diodora constantiae*, Kanakoff, 1953).

Owing to the senior author's preoccupation with other duties, the junior author was invited to collaborate in the preparation of this paper. In 1958, he accompanied the senior author on a reconnaissance of the area and later visited the region in the company of Dr. Warren O. Addicott of the General Petroleum Company of Los Angeles. The junior author is largely responsible for preparing this paper for publication.

The project could have not been completed without the assistance of a number of people. We are greatly indebted to the following for various kinds of aid: Mr. and Mrs. F. L. Grouard, Mr. W. B. Willis, Mr. Edgerton B. Sprague, Miss Arminta Neal, Mr. and Mrs. David Packard, Mrs. Eleanor McLauchlan, Mr. and Mrs. Robert Zava and Mr. and Mrs. Harry R. Turver. In addition to the late George Willett, Drs. Leo George Hertlein, S. Stillman Berry, Mr. Allyn G. Smith, and the late A. M. Strong collaborated with the senior author in the identification of certain of the molluscan constituents of the fauna. Mr. Robert G. Thomas determined the elevations of the fossil localities by leveling. The Director of

[5]L.A.C.M.I.P. localities are hereafter referred to as localities 66-2, 68-A, and 68-B.

the Allan Hancock Foundation of the University of Southern California permitted us to use two line cuts (figures 2 and 3 of this report) from the Foundation's "Occasional Papers" series, Number 20 (Stevenson and Emery, 1958).

Dr. Warren O. Addicott, Dr. Hildegarde Howard, and Mr. John G. Vedder kindly read the manuscript and offered helpful suggestions. Any errors of commission or omission, however, remain the responsibility of the authors.

PREVIOUS PALEONTOLOGICAL STUDIES

Passing mention of the presence of late Pleistocene megascopic invertebrates in the Newport Bay area has been made by a number of writers, but faunal lists have appeared in only two previously published papers. Arnold (1903, p. 56) listed a total of 21 species of mollusks from the Newport Mesa (Costa Mesa) and considered the assemblage to be equivalent to the "Upper San Pedro series." These records, together with

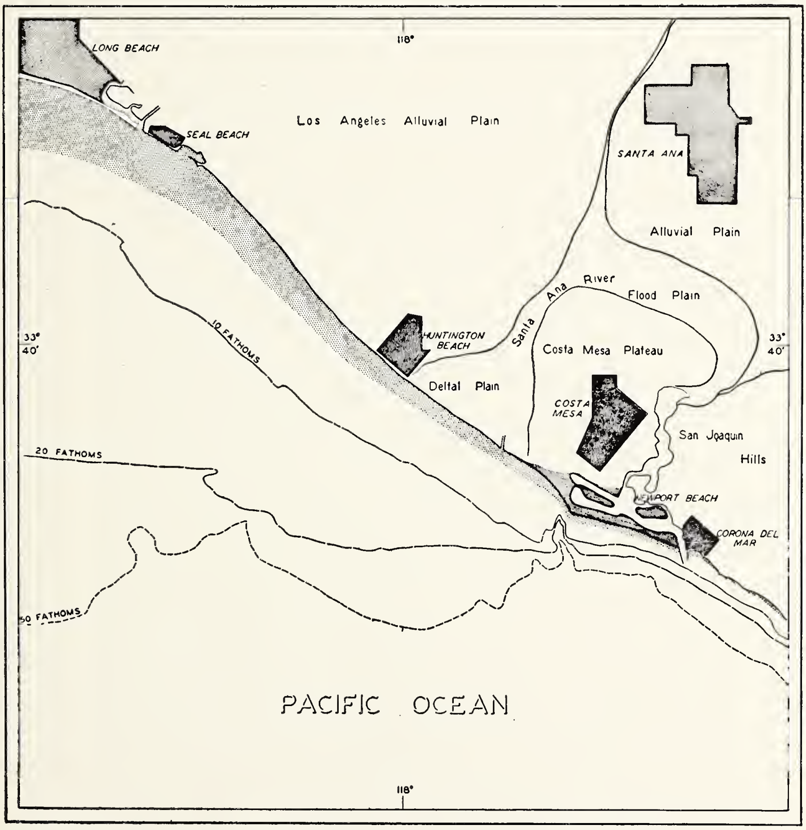

Fig. 2. A chart showing the coastal region of southern California from Long Beach to Corona Del Mar (after Stevenson and Emery, 1958, fig. 8).

additional species noted in various collections, were included in the valuable compilation of Grant and Gale (1931).

Bruff (1940) completed a study of the Pleistocene history of the Newport Bay area and shortly thereafter published an important contribution on the paleontology of this invertebrate fauna (Bruff, 1946). He recorded a total of 169 taxa, chiefly species of marine mollusks, from 10 localities on the Newport Mesa and one locality on the lowest terrace on the north side of the San Joaquin Hills. Bruff believed the deposits to be equivalent to the "Palos Verdes sands" of the San Pedro area. He concluded the Pleistocene hydroclimate to have been warmer by approximately 3.4° F. than that of the present littoral, near-shore waters of this latitude. Two predominant types of habitats were recognized: protected rocky shores and bay-estuaries with rocky, sandy and muddy bottoms. A depth of more than 60 feet was postulated over the western part of Newport Mesa area (Costa Mesa), becoming shallower with the deposition of marine sediments on the terrace platform.

Poland *et al.* (1956, p. 54), in a study of the ground-water geology of the region, cited Arnold's (1903) list of fossils from the area and reported the conclusion of George Willett, based on his study of part of the present collections, that this fauna was essentially the same age as the one previously described by Willett (1937) from "upper Pleistocene beds (Palos Verdes sand) near Playa del Rey."

In addition to the invertebrates, numerous remains of marine and terrestrial vertebrates have been reported from late Pleistocene deposits of the Newport Bay area. Mr. John E. Fitch of the California State Fisheries Laboratory recognized 16 species of marine fishes from locality 66-2 (Kanakoff, 1956). All are extant forms now living along the southern California coast.

From several localities in the Newport Bay area, including the present collections, Howard (1948a; 1948b; 1949; 1955; 1958) has recorded 18 species of birds, all of which could have occurred in a marine environment. Of these, two (possibly three) species are extinct forms, and the others are known to occur in the coastal region of southern California at the present time, or within geologically Recent time (two are known only from kitchen middens).

Lance (1948) briefly compared the mammalian fauna of the Palos Verdes sand of Newport Bay Mesa with the Rancho La Brea fauna and concluded that the two faunas have some species in common, but the former differs strikingly by: the presence of *Tanupolama*, the relatively better representation of *Tapirus* and the apparent absence of mylodont sloths.[6] Savage *et al.* (1954) mentioned the presence of land and marine birds and mammals in marine (Palos Verdes sand) and near-shore deposits at Newport Bay, San Pedro, Santa Monica, and Playa del Rey. In addition

[6]Dr. Theodore Downs reports (*in literis*) the previously unrecorded occurrence of *Nothrotherium, Megalonyx* and *Bison* from the Newport Bay deposits, locality 66-2.

to marine inhabitants, they record such land dwellers as ground sloths, horses, tapirs, camels, bisons, mammoths, and several terrestrial birds, and suggest that the presence of *Bison* indicates a Rancholabrean age for these faunas.

REGIONAL PLEISTOCENE SEDIMENTS

Newport Bay is bordered by the San Joaquin Hills to the southeast and Newport Mesa to the north and northwest (see Fig. 2). The fauna enumerated in this paper occurs in deposits on the lowest emergent, wave-cut terrace on the bay side of the San Joaquin Hills and from correlative sediments capping Newport Mesa on the northern side of the Bay. In order to discuss the Newport fauna in terms of the known Quaternary history of the western border of the Los Angeles basin, it is necessary to describe briefly the present topography and the post-Pliocene sediments of this region.

The Los Angeles basin is bordered by the Santa Monica mountains to the northwest and by a succession of hills and mountains to the north and east. The coastal plain is interrupted by several gaps, which divide the region into a series of low hills and mesas of irregular configuration, and by a high headland, the Palos Verdes hills, situated about mid-way along the coastal margin of the Basin. Tongues of the central plain extend to the coast through six prominent lowlands cut largely by streams through the mesas and between the hills of the Newport-Inglewood belt. Newport Mesa, separated by the Santa Ana Gap and Newport Bay, is the most southeasterly of these coastal mesas.

Off shore, five major submerged platforms have been recognized on the mainland shelf, the off-shore island shelves, and the bank tops of the continental borderland. These have been interpreted as erosional marine terraces cut during times of lower stands of the Pleistocene sea, possibly during Wisconsin time (Emery, 1958).

The low hills and coastal mesas along the Newport-Inglewood structural zone are capped by largely unconsolidated sediments, interfingering beds of sand, gravel, silt and clay of Pleistocene age, which underlie Recent deposits and overlie late Pliocene or older rocks. The Pleistocene beds attain a maximum thickness of about 1000 feet along the coast and of approximately 3000 feet inland beneath the Downey Plain. Three distinct units have been recognized: 1, Palos Verdes sand, late Pleistocene, 2, unnamed late Pleistocene deposits, and 3, San Pedro formation, early Pleistocene.

The basal San Pedro formation, the thickest unit of the three beds, outcrops on Newport Mesa only on the southwest edge of the mesa and near the head of Newport Bay. On the basis of subsurface data from core samples, it appears to underlie the mesa northward from these two exposures, and dips gently northward.

From logs of wells near Dominguez Hill and Wilmington, Poland *et al.* (1956, p. 55) recognized certain strata that occur between definite or probable correlatives of the Palos Verdes sand and the San Pedro formation and referred to them as "unnamed upper Pleistocene deposits." The contact, however, between this unnamed deposit and the overlying Palos Verdes sand has not been discovered in outcrop, and this deposit is not present at least on the southeastern part of Newport Mesa as the Palos Verdes sand bevels rock of Miocene and Pliocene age. Poland *et al.* (1956) consider the unnamed late Pleistocene beds to be, at least in part, correlative with deposits on the twelve older terraces of the Palos Verdes hills. This suggests a possible correlation of these beds with the deposits on older terraces of the San Joaquin Hills and with some of the older terrace deposits occurring elsewhere along the coast.

A thin layer of locally fossiliferous gray sand and gravel outcrops beneath the surface at various places on the hills, mesas and plains along the Newport-Inglewood belt. These sediments were originally described in part by Arnold and Arnold (1902) and designated the "Upper San Pedro Series" with the type locality at the "lumber yard" exposure at San Pedro (Arnold, 1903). Woodring *et al.* (1946) formally defined the unit and restricted the name "Palos Verdes sand" to the marine deposits on the lowest terrace of Arnold's "Upper San Pedro Series." In addition to the type area, similar terrace deposits in the Los Angeles basin, ranging from Santa Monica in the north to Newport Bay in the south, were presumed to be essential equivalents of the Palos Verdes sand. The apparent correlation of these beds was largely based on the presence of a warm-water fauna deposited on the lowest emergent terrace platform which bevels formations ranging in age from early Pleistocene to Miocene. In the type area the formation ranges in thickness from a few inches to about 15 feet. Exposures elsewhere in the basin, in regions which have undergone strong structural deformation, attain a maximum thickness of nearly 90 feet.

A characteristically reddish-brown colored, non-fossiliferous sand caps the highlands and plains of the Newport-Inglewood structural belt. The terrace cover generally overlies the Palos Verdes sand or locally rests directly on the terrace platform to form the present land surface. Although the cover appears to be largely alluvial or slope wash, the thinner coastal veneer locally is composed of weathered wind-blown beach sand and coastal dune and bay-lagoon deposits.

NEWPORT BAY AREA

Topography

The Newport "valley" forms a deeply incised canyon between Newport Mesa and the base of the San Joaquin Hills (fig. 3). As this trench cuts through the mesa and separates it from the lowest terrace on the San Joaquin Hills, it is the seventh and most southerly situated coastal gap in the Newport-Inglewood structural belt. According to Poland *et al.* (1956, p. 28) the canyon extends approximately 6 miles inland, is 0.2 to 0.8 miles wide, about 115 feet in greatest depth near the coast, but shallows to 20 feet at its head. The inland arm of the present bay occupies the southwestern part of the canyon.

Newport Mesa is approximately 100 feet in elevation near the present sea cliff and dips about 20 feet in a mile to pass beneath the central Downey Plain at an altitude of about 30 feet above sea level (Poland, *et al.*, 1956). The mesa faces the Santa Ana River to the northwest, the

Fig. 3. Aerial photo-mosaic showing the Newport Bay area, from Costa Mesa to Corona Del Mar (after Stevenson and Emery, 1958, fig. 1).

inner Newport Bay on the southeast and the barrier beach of Newport Beach on the southwest. The mesa terminates in river-cut bluffs approximately 100 feet in elevation facing the Santa Ana Gap and the present channel of inner Newport Bay, but a sea-cut cliff borders the lagoon and the oceanfront on the west side.

The San Joaquin Hills, viewed from the northwest, rise in a series of five marine terraces with elevations of about 100, 200, 300, 600, and 900 feet above present sea level (Poland *et al.*, 1956). The two lower terraces are the broadest and best preserved. The older terraces have been largely destroyed by erosion. The lowest terrace, which contains fossiliferous deposits and is at about the same elevation as the Newport Mesa, extends inland and is covered by the coastal margin of the central Downey Plain.

Pleistocene Geology

Sand, gravel and conglomerate referable to the Palos Verdes sand cover the peneplained-surface of the Newport Mesa and veneer the platform of the lowest terrace on the bordering San Joaquin Hills. This formation is in turn largely capped with brownish-red silty sand and a thin surface layer of reddish colored soil.

The formation is thinnest along the end of the mesa facing the western part of the Inner Bay Channel, where the sediments average 10 to 15 feet thick and rest with a marked angular unconformity on Miocene rocks of the Monterey shale.[7] The underlying rocks that crop out along the upper bay channel are apparently of Pliocene age and have been referred, in part, to the Capistrano and an unnamed formation. Miocene and Pliocene rock are exposed near the base of the cliff inside the entrance of the Inner Bay and along the southwestern face of the mesa, respectively. Along most of the ocean front Tertiary strata are not exposed in the sea cliff and the Pleistocene sediments attain a maximum exposed thickness of 90 feet.

The essentially flat-lying Pleistocene beds parallel the irregular surface bevelled off the folded Tertiary rocks which have a 4 to 5 degree northwest dip. As the overlying Pleistocene beds dip approximately 3 degrees northwesterly, the difference in dips at the contact explains the thickening of the covering sediments toward the northwest (Bruff, 1946, p. 217). Also, the central part of the Los Angeles basin presumably filled rapidly with sediments causing depression in that region with subsequent thickening of sediments basinward (Woodford *et al.*, 1954, p. 74).

Newport Mesa extends across the upper end of the Inner Bay, interrupted locally by the drainage system, and continues as the cover on the lowest terrace platform of the San Joaquin Hills. The surfaces of the wave-cut terrace and of the Mesa are at approximately the same 100-

[7]The formational names of the Tertiary sediments follow the nomenclature of Vedder *et al.* (1957).

foot elevation. The thin veneer of Palos Verdes sediments covering the terrace platform, however, is about 12 to 20 feet thick in places (localities 66-2, 66-10). The Pleistocene sediments rest on the terrace platform cut into the Miocene and Pliocene rocks, the contact being at an elevation of 60 to 65 feet near the base of the old sea cliff of the terrace.

Although the fossiliferous sediments are mostly gray, fine to coarse sands, the largely non-fossiliferous, buff-colored, silty sands are more abundant. Some sandy lenses show cross-bedding. Fossils occur chiefly in beds of poorly sorted, largely unconsolidated sands resting on basal conglomerates or directly on the platform in the absence of the conglomerates. The lenticular conglomeratatic beds, composed of pebbles and cobbles, are, however, not limited in distribution to the surface of the terrace platform and the fossils are scattered irregularly throughout most of the beds (Bruff, 1946).

Bruff (1946, p. 219) believed the 1 to 10 feet of brownish-red sandy clay, capping the marine deposits on the Mesa platform and the lowest terrace, to be part of the Palos Verdes formation. He states that fossils occur occasionally throughout this "member" as the result of a minor change in facies. The cover, however, has not been demonstrated to be entirely of marine origin and the fossils may have been reworked from previously deposited beds. The presence in this area of numerous Recent invertebrates from kitchen midden sites further confuses the problem. Inasmuch as Woodring *et al.* (1956, p. 56) restricted the Palos Verdes sand to include only marine deposits, it is convenient, for the present time, to consider the uppermost beds as non-marine cover. These, at least in part, probably date from Wisconsin time to present.

Pleistocene History

The late Pleistocene history of this area was discussed in some detail by Bruff (1946). As was characteristic of the views held at the time of his investigation, Bruff ascribed the emergence of the Mesa to its present height to tectonic uplift rather than to eustatic change in sea level, or to a combination of these phenomena. The evolution of Newport Bay was more recently interpreted by Stevenson and Emery (1958, p. 10).

Bruff postulated that the antecedent Santa Ana River carved the Newport Bay "valley" before the Palos Verdes sand was deposited. He believed that Palos Verdes sediments completely filled the "valley" and were subsequently removed by erosive action of the river. His conclusions were largely based on the local thickening of deposits along the face of the present cliffs of the bay channel (Bruff, 1946, figs. 8, 10, 12).

Stevenson and Emery (1958, p. 10, fig. 16) ascribed the cutting of the bay channel to the erosive action of the Santa Ana River and other streams during the "middle of the Pleistocene," at a time when "sea level was more than 100 feet lower than today." They suggested that the upper portion of the Newport Submarine Canyon (see Fig. 2) may have been carved during this period of emergence, but admitted that it could have been cut during a prior or subsequent emergence. From data obtained from drill holes, they recorded the bottom of the Santa Ana River bed to be a maximum of 123 feet below present sea level.

The available geologic evidence, however, does not conclusively date the inner bay channel as a pre-Palos Verdes feature. As John G. Vedder has pointed out (*in literis*), some of Bruff's supposedly isolated deposits of Palos Verdes sand in the cliff face of the present bay channel are displaced slump-blocks and, moreover, there is no evidence that these sediments are present in the channel below present sea level. Furthermore, the "valley" more likely originated as a submarine canyon during early Palos Verdes time and the cutting of the inner channel to a depth of more than 100 feet below the present sea level probably occurred in Wisconsin time. Although this interpretation is only one of several possibilities, it would appear to be a more plausible explanation for the origin of the "valley" and the incised channel.

Regardless of the phenomena involved in the evolution of the "valley," a rise in sea level is indicated in Palos Verdes time by the occurrence of marine fossils in the sediments veneering the Mesa platform and in the correlative deposits on the lowest terrace of the San Joaquin Hills.[8] On the basis of the composition of these fossil assemblages, Stevenson and Emery (1958, fig. 17) believed the Mesa to have been an island during "Upper-most Pleistocene" time and the marine inundation to have extended seven to ten miles inland. The existence of a large mesa-island in late Palos Verdes time is not corroborated by the geologic evidence. Although small islands may have resulted from the inundation of the subaerially eroded surface of the coastal region during early Palos Verdes time, the entire Newport Mesa area was eventually covered by the marine sediments as indicated by the subsurface data (Poland *et al.*, 1956). Therefore, by the close of Palos Verdes time, the Mesa was covered by shallow water, and the lowest terrace was cut into the exposed slopes of the San Joaquin Hills. This terrace apparently extended as a continuous coastal plain northeastward to include the presently interrupted Huntington Beach and Bolsa Chica Mesas (Poland *et al.*, 1956). The terrace also extended southward along the coast for some distance. It was mapped by Vedder *et al.* (1957) as a correlative unit as far south as San Clemente, and continues nearly uninterruptedly to the vicinity of Encinitas, north of Escondido Creek.

At the close of Palos Verdes time, the now very shallow embayment apparently became locally confined by the accumulation of marine and continental sediments and the development of temporary bars and spits that produced large back-bay lagoons. With the advent of the Wisconsin epoch, the emergent mesa was mantled with alluvial and eolian cover and extensively eroded. The channel of the Inner Bay was largely cleared of bay-fill, presumably by the erosive action of the Santa Ana River or

[8] An eustaticly controlled rise in sea level is assumed, but in a tectonicly active area such as the Los Angeles Basin, tectonic uplift of some degree also may be involved.

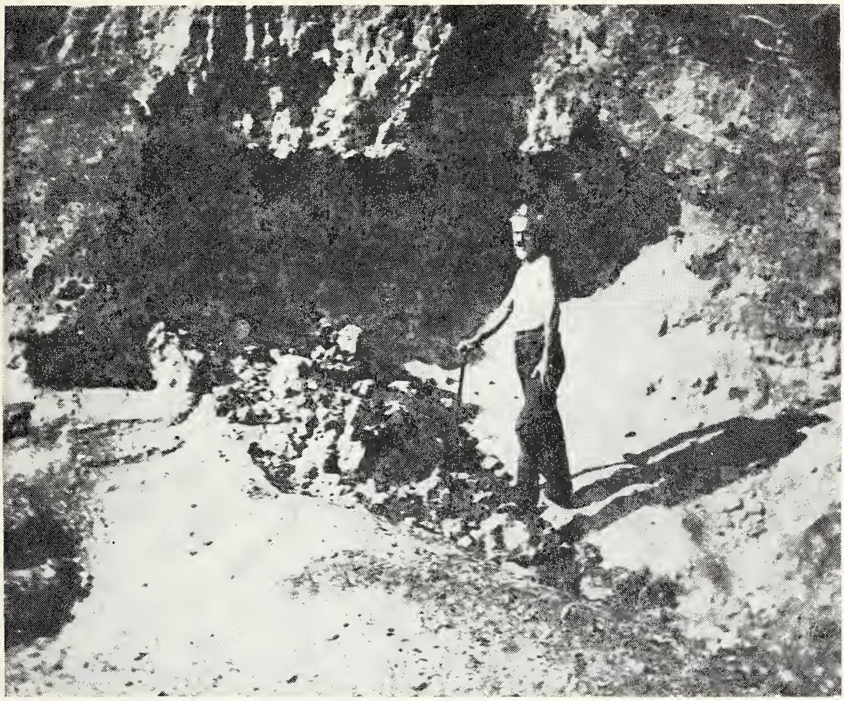

Fig. 4. Excavation site at locality 66-2; senior author removing overburden from the exposure after a minor land slide (photograph by Arminta Neal).

other streams. The subsequent rise in sea level in late Wisconsin and Recent time, together with subaerial forces of erosion, has largely produced the present topography of this area (Fig. 3).

Collecting Localities

Invertebrates were collected by the senior author from more than fifteen exposures in the area. This study is limited to three especially rich collections, two from localities on the southwestern edge of Newport Mesa (68-A and 68-B) and one from the terrace deposits on the opposite side of the Inner Bay, near the air field (66-2). Reference is also made to the faunal lists of Bruff (1956, pp. 232-334) representing 10 localities on the Mesa and one on the terrace.[9] The collecting stations are indicated on the locality map, Fig. 1.

The following descriptions are taken from the senior author's field notes: Locality 66-2 (Latitude 33° 38′ 37″ N., Longitude 117° 52′ 37″ W.). The exposure occurs in a north-facing erosion channel cut into the surface of the terrace a short distance from the base of the next terrace (Figs. 4 and 5). Fossils were excavated from a rich horizon immediately

[9]Bruff's locality A-3133 from the northeastern edge of the Mesa is not considered, for it appears to be from an exposure of sediments older than Palos Verdes sand.

above a 1 to 2-foot basal conglomerate overlying Pliocene rocks. In this area, the Palos Verdes sand was estimated to be 20-36 feet thick and to be covered by 8 to 15 feet of alluvium.

The stratigraphic section exposed at locality 66-2 above the angular unconformity between the Palos Verdes sand and the Pliocene rock is:

AGE	THICKNESS	DESCRIPTION
Late Pleistocene (?) and Recent	8-15′	Alluvium, brownish-red.
Late Pleistocene (Palos Verdes sand)		
Upper part	10-20′	Gray, fine grained sand; fossils rare.
Basal part	9-11′	Rust-colored, fine to coarse, very fossiliferous sand, becoming coarser with depth and grading into a basal 1-2 foot thick conglomerate of well rounded boulders composed of shale and sandstone.
	[Angular unconformity]	
Late Pliocene "Unnamed sandstone" of Vedder *et al.*, 1957	? (only erosional surface exposed)	Light gray, fine grained sandstone.

Fig. 5. Locality 66-2 exposed in gulley in the lowest emergent terrace of the San Joaquin Hills with the third terrace in the background (photograph by Arminta Neal).

The plane table survey of Mr. R. G. Thomas shows the Pleistocene-Pliocene contact to be at an elevation of 65 feet (± 1 foot), and the top of the richly fossiliferous sand member to be 77 feet (± 1 foot), or about 12 feet thick. At a nearby exposure(L.A.C.M.I.P. 66-10) the top and base of the fossiliferous stratum were determined to be 80 feet (± 2 feet) and 60 feet (± 2) feet, respectively.

The two other collecting localities recorded herein, are from an exposure in the cliff face of the Mesa on the opposite side of the Inner Bay channel. These are from the same exposure, but one station (locality 68-A) is about 8 to 10 feet lower in the section than the other (locality 68-B). The lower stratum is richly fossiliferous and near the Pliocene-Miocene contact. The sediments consist of fine grain sand near the top of the section and show a gradation from fine to coarse-grained sand towards the base. The Pleistocene sediments are only 12 to 18 feet thick at this exposure. The base level is reported by Mr. Thomas to be 82 feet (± 1 foot).

The measured base level corresponds well with elevations determined for the lower level of Bruff's fossil localities from along the Mesa side of the channel and the corresponding elevation on the edge of the terrace across the channel (see Fig. 5 for the location of these collecting stations). These range from 78 to 82 feet, but considering the irregular surface of the terrace platform and possble errors in surveying, the differences in elevations are minor.

The apparent lower elevation of the terrace platform, 13 to 22 feet, near the fore-edge of the second terrace (localities 66-2 and 66-10) requires brief comment. If these figures are correct, this "pocket" in the terrace shelf could be explained as the result of local deformation or erosion occurring prior to the deposition of the Palos Verdes sand. More likely, the platform was channelled by currents or by some other means before or during deposition of the sediments.

NEWPORT BAY FAUNA

This section enumerates the largest assemblage of metazoan invertebrates known from the marine Pleistocene deposits of western North America. The identified species number 3 stony corals, 32 bryozoans, 2 brachipods, 436 mollusks, 5 echinoids, 14 crabs, and 4 barnacles for a total of 496 species. In addition to these the collections include species representing 5 genera of annelid worms. The remaining unidentified species of varous phyla account for a collected fauna of more than 500 species.

Bruff (1946) reported 169 species, chiefly mollusks, from 11 collecting stations in the Palos Verdes sand of the Newport Bay area. All but 29 of the species cited by Bruff were previously recorded in Arnold's (1903) list of 305 species from the "Upper San Pedro Series" of the San Pedro area. Willett (1937) recorded 326 taxa from the Palos Verdes sand at Playa del Rey.

The largest Pleistocene fauna previously reported from western North America is that recorded by Jordan (1936). He listed 441 taxa of larger invertebrates, mostly mollusks, from terrace deposits on the leeward side of Magdalena and Margarita islands in Magdalena Bay, Baja California, Mexico.

Faunal Constituents

Annelida

Dr. Olga Hartman of the Allan Hancock Foundation, University of Southern California, identified the following genera of marine annelids from locality 66-2: *Protula, Spiochaetopterus, Spirorbis, Dodecaceria,* and *Salmacina.* The specimens could not be identified to species, for the opercula were not found.

Brachiopoda

Only two species representing this phylum were encountered among the vast amount of material examined from the three stations. These are *Glottidia albida* (Hinds) and *Terebratalia transversa* (Sowerby) from locality 66-2. The former is reported to range at the present time from Monterey Bay, California to Acapulco Bay, Mexico, and the latter from Alaska to Ensenada, Baja California (Hertlein and Grant, 1944b).

Bryozoa

The bryozoan material was identified by the late Dr. Raymond C. Osburn and by Dr. John D. Soule of the Allan Hancock Foundation of the University of Southern California. A total of 31 species of ectoprocts were recognized from localities 68-B and 66-2. Of this number, 23 were previously recorded from these localities by Soule and Duff (1957). The remaining eight species were subsequently identified by Dr. Soule and are indicated in the list below by an asterisk preceding the names. Another species collected in the same terrace deposit as 66-2, but across the road, brings the total to 32. All are extant species.

	68-B	66-2
Antropora tincta (Hastings)	—	x
Callopora circumclathrata (Hincks)	—	x
Cauloramphus spiniferum (Johnston)	—	x
**Cellaria diffusa* Robertson	x	—
Cellaria mandibulata Hincks	—	x
Celletosia radiata (Moll)	—	x
Conopeum commensale Kirkpatrick and Metzelaar	—	x
Costazia costazi (Audouin)	—	x
**Diaperoecia californica* (Orbigny)	x	—
**Diaperoecia rugosa* Osburn = ? *floridana* Osburn	x	x
Discoporella umbellata (Defrance)	—	x
**Heteropora magna* O'Donoghue	—	x
Hippopodina feegeensis (Busk)	—	x

Hipporporella gorgonensis Hastings	—	x
Hippoporidra edax (Busk)	—	x
**Hippothoa hyalina* (Linné)	—	x
Holoporella brunnea (Hincks)	—	x
Lagenipora punctulata (Gabb and Horn)	—	x
Membranipora savarti (Aubouin)	—	x
Membranipora tenuis Desor	x	—
Membranipora tuberculata (Bosc)	—	x
**Microporella californica* (Busk)	—	x[10]
Microporella ciliata (Pallas)	—	x
Microporina borealis (Busk)	x	—
Mucronella microstoma (Norman)	—	x
**Porella concinna* (Busk)	—	x
Porella porifera (Hincks)	—	x
**Rhynchozoon rostratum* (Busk)	—	x
Rhynchozoon tumulosum (Hincks)	—	x
Thalamoporella californica (Levinsen)	—	x
**Tubulipora tuba* (Gabb and Horn)	—	x
Tubulipora tuba fasciculifera (Hincks)	—	x

On the basis of the available distributional data (Osburn, 1950; 1952; 1953), all but three of the bryozoan constituents of the fauna are known to live at the present time in the southern California region in habitats ranging from intertidal to shallow infratidal. Several species appear to be cosmopolitan, and many others are known to range from British Columbia to Panama. Of the three locally extinct species, one (*Conopeum commensale*) ranges from Baja California to Peru. The other two (*Heteropora magna* and *Mucronella microstoma*) are not known to occur south of Puget Sound, Washington and British Columbia, respectively, in the Eastern Pacific.

Cnidaria

According to Dr. J. Wyatt Durham of the University of California Museum of Paleontology four species of stony corals are represented in the present collections, as follows:

Balanophyllia elegans Verrill
Dendrophyllia oldroydi Faustino
Paracyathus stearnsii Verrill (= *P. pedroensis* Vaughn, *fide* Durham and Barnard, 1952)
? *Sphenotrochus* sp. (juveniles)

All of the species occur at the present time in infratidal depths off the southern California coast. The corals are rare in the collections, and several of the specimens are badly worn.

[10]Not known from L.A.C.M.I.P. localities 68-B or 66-2, but recorded from locality 136, Newport Bay Road, Newport, California, the same terrace deposit as locality 66-2.

The three identified species have been reported previously from the Pleistocene of the southern California-Baja California district (Durham, 1947; Emerson, 1956).

Crustacea

Crabs

The large collecton of cheliped propods and actyls of decapod crabs is largely unidentified. Menzies (1951), however, identified four extant species of the brachyuran genus *Cancer* in material from the terrace deposit, locality 66-2. These are: *Cancer branneri* Rathbun, *Cancer gracilis* Dana, *Cancer jordani* Rathbun, *Cancer magister* Dana. These species live in shallow water, in bays or near shore. With one exception, they are known to occur along the southern California coast at the present time. *Cancer branneri* has been taken from some of the Channel Islands and at several localities along the Baja California coast, but is not reported from the southern California mainland (John S. Garth, *in literis*).

The following additional species also have been identified by Dr. Robert J. Menzies, Columbia University, from the designated localities:

	68-A	68-B	66-2
Callianassa californiensis Dana	—	—	x
Callinectes arcuatus Ordway	—	x	—
Callinectes bellicosus (Stimpson)	x	—	—
Cancer productus Randall	—	—	x
Cycloxanthops novemdentatus (Lockington)	—	—	x
Hemigrapsus nudus Dana	—	—	x
Hemigrapsus oregonensis Dana	—	—	x
Portunus xantusi (Stimpson)	—	x	—
Pugettia producta (Randall)	—	—	x
Speocarcinus californiensis Lockington	—	—	x

Although these species live at the present time along the southern California coast, the two species of *Callinectes* are southern ranging forms commonly found in warmer waters. *Callianassa* and *Speocarcinus* are mudflat inhabitants of protected bays.

Additional records of crabs from the Pleistocene deposits of the Los Angeles basin have been reported by Rathbun (1926), Willett (1937), and Menzies (1951).

Cirripedia

Barnacle remains, representing 7 or 8 species, are not uncommon from 66-2. Specimens apparently referable to *Balanus tintinnabulum californicus* Pilsbry, *Tetraclita squamosa* (Brugrière), and *Coronula diadema* (Linnaeus) comprise about 90 per cent of the barnacle collection. The present range of at least one species, *Coronula reginae* Darwin, may be extra-limital. Species of *Coronula*, "whale barnacles," however, are widely distributed by their cetacean hosts.

Echinodermata

The echinoids from locality 66-2 were identified by Dr. J. Wyatt Durham of the University of California Museum of Paleontology as follows:

Dendraster excentricus (Eschscholtz)
Dendraster vizcainoensis Grant and Hertlein
Dendraster vizcainoensis similaris Grant and Hertlein
Dendraster sp. (juveniles)
Lytechinus sp.
Mellita new sp. (=*M. longifissa* Kew, not Michelin)
Strongylocentrotus franciscanus (A. Agassiz)
Strongylocentrotus purpuratus (Stimpson)

According to Dr. Durham this previously unrecognized species of *Mellita* is known to be living off the Central American coast at the present time.

Dendraster vizcainoensis was described from "Quaternary beach" deposits at Punta Santa Rosalia and Puerto de Santo Domingo, Baja California, Mexico, and the form *D. v. similaris* is known from late Pleistocene (Palos Verdes sand or equivalent) deposits near Signal Hill and Playa del Rey in the Los Angeles area (Grant and Hertlein, 1938). This species was believed to be extinct, but living specimens of the typical form were recently collected along the open coast of Vizcaino Bay in the vicinity of Miller's Landing by E. C. Allison and F. H. Kilmer of the University of California Museum of Paleontology. The remaining identified species occur in the modern fauna at the latitude of Newport Bay.

Mollusca

The mollusks are the predominant element of the collected fauna. The inferred ecological requirements and climatic significance of the Newport fauna, therefore, are largely based on the mollusks. The 436 recognized taxa are enumerated in the check list and the numbers of taxa and specimens are tabulated below by class and collecting locality.

	68-A		68-B		66-2		Total No. of	Total No. of
	Taxa	Specim.	Taxa	Specim.	Taxa	Specim.	Taxa	Specim.
Pelecypoda	68	3,260	56	3,858	128	31,647	128	38,765
Gastropoda	101	1,441	143	4,483	281	33,314	289	39,238
Scaphopoda	1	120	3	388	7	1,628	7	2,136
Amphineura	4	161	5	171	11	830	12	1,162
Totals	174	4,982	207	8,900	427	67,419	436	81,301

Of the 436 identified species and varieties, 427 are represented in the collections from locality 66-2. This rich locality also yielded 67,419 specimens of the 81,301 specimens collected from the three localities.

The taxa are listed alphabetically in the following check list. The nomenclature largely follows the usage of Keen (1937). For each locality, the number of specimens of each species is recorded; the number of recognizable fragments is indicated by numerals enclosed in parentheses.

Pelecypoda	68-A	68-B	66-2
Aligena cerritensis Arnold	5	10	5
Americardia biangulata (Broderip and Sowerby)	1	—	4
Amiantis callosa (Conrad)	4(1)	8(2)	678
Anatina undulata (Gould)	(3)	—	3(113)
Anomia peruviana Orbigny	35	33	1,253
Apolymetis biangulata (Carpenter)	(2)	1	176
Arca perlabiata Grant and Gale	5	1	81
Barbatia bailyi (Bartsch) = ? *B. pernoides* (Carpenter)	1	—	41
Barnea pacifica Stearns	—	—	12
Brachidontes adamsianus (Dunker)	—	—	239
Cardita hilli Willett	5	—	421
Cardita ventricosa Gould	—	—	57
Chama pellucida Broderip	2	—	211
Chione californiensis (Broderip)	67	16	237
Chione cortezi (Carpenter) = *Venus gibbosula* Deshayes MS., not Reeve	—	—	48
Chione fluctifraga (Sowerby)	21	—	123
Chione gnidia (Broderip and Sowerby)	3	3	173
"*Chione*" *picta* "Dall" Willett	62	31	453
Chione undatella (Sowerby)	—	—	512
Cooperella subdiaphana (Carpenter)	—	—	3
Corbula luteola Carpenter	338	226	1,115
Crassinella branneri (Arnold)	616	309	209
Crassinella nuculiformis Berry	600	543	1,600
Cryptomya californica (Conrad)	16	(3)	98
Cumingia californica Conrad	—	—	19
Cyathodonta undulata Conrad	—	17	10
Cyclinella singleyi Dall	—	—	6
Cyclinella subquadrata (Hanley)	—	—	5
Diplodonta orbellus (Gould)	—	—	7
Diplodonta sericata (Reeve)	78	29(2)	1,065
Donax californicus Conrad	81	114	1,922
Donax gouldi Dall	107	72	2,949
Dosinia ponderosa (Gray)	1	—	17
Gari californica (Conrad)	—	—	7
Gari edentula (Gabb)	—	—	5
Glans carpenteri (Lamy)	2	—	18
Glycymeris subobsoleta (Carpenter)	2	—	1,668
Heterodonax bimaculata (Linnaeus)	—	—	1

Pelecypoda (cont.)	68-A	68-B	66-2
Hiatella arctica (Linnaeus)	—	—	4
Hinnites multirugosus Gale	(2)	—	48
Kellia laperousi (Deshayes)	—	—	2
Laevicardium elatum (Sowerby)	—	—	14
Laevicardium substriatum (Conrad)	11	2	259
Lima hemphilli Hertlein and Strong = *L. dehiscens* auct., not Conrad, 1837	1	—	14
Lithophaga plumula kelseyi Hertlein and Strong (1946)	—	—	7
Lucina approximata (Dall)	—	48	101
Lucina californica Conrad	2	1	33
Lucina excavata Carpenter	2	—	9
Lucina nuttalli Conrad	9	110	665
Macoma elongata (Hanley)	—	—	7
Macoma indentata tenuirostris Dall	(3)	1(3)	7
Macoma irus Hanley = *M. inquinata* (Deshayes)	—	—	6
Macoma nasuta (Conrad)	7(2)	(2)	510
Macoma pacis Pilsbry and Lowe	—	—	145
Macoma secta (Conrad)	2(1)	1	61
"*Macrocallista*" *squalida* Sowerby	—	—	15
Mactra californica Conrad	(2)	(5)	4(14)
Mactra nasuta Gould	—	—	(2)
Miodontiscus prolongatus Carpenter	—	—	2
Modiolus capax (Conrad)	1	—	65
Modiolus modiolus (Linnaeus)	—	2	1
Modiolus rectus (Conrad)	2	—	7
Mulinia pallida modesta Dall	2	9(4)	10(48)
Mytilus californianus Conrad	5	2	171
Nucula exigua Sowerby	727	873	3,456
Nuculana taphria (Dall)	3	873	5
Ostrea laticaudata Carpenter	2	—	15
Ostrea lurida Carpenter	89	25	949
Ostrea megodon Hanley	—	—	3
Pandora punctata Conrad	—	43	11
Panope generosa Gould	—	(5)	10(12)
Parapholas californica (Conrad)	—	—	3
Pecten bergingianus Middendorff	—	—	1
Pecten caurinus Gould	3	2	4
Pecten circularis aequisulcatus Carpenter	14	6	746
Pecten diegensis Dall	1	—	6
Pecten hericius Gould	—	—	1
Pecten latiauratus Conrad	48	186	1,145
Pecten monotimeris Conrad	2	—	26

Pelecypoda (cont.)	68-A	68-B	66-2
Pecten rubidus rubidus Hinds = *hindsi* Carpenter	—	—	5
Pecten rubidus venturaensis Waterfall	—	—	1
Pecten vogdesi Arnold	—	—	6
Periploma planuiscula Sowerby	7	10	395
Petricola californiensis Pilsbry and Lowe	4	1(2)	9
Petricola gracilis parallela Pilsbry and Lowe	(36)	(11)	1,560
Petricola tellimyalis (Carpenter)	—	—	13
Philobrya setosa (Carpenter)	—	—	2
Pholadidea ovoidea (Gould)	4	—	12
Pitar newcombianus (Gabb)	1	—	2
Pitar vulnerata (Broderip)	—	—	10
Platyodon cancellatus Conrad	(2)	(13)	31(16)
Protothaca grata Say	—	—	12
Protothaca staminea (Conrad)	—	(5)	190
Protothaca staminea forma *laciniata* (Carpenter)	—	1	16
Protothaca ternerrima (Carpenter)	—	—	21
Pseudochama exogyra (Conrad)	—	—	803
Rochefortia aleutica Dall	—	3	2
Rochefortia reyana Willett	—	3	2
Sanguinolaria nuttalli Conrad	1	—	76
Sanguinolaria nuttalli forma *orcutti* Dall	—	—	18
Saxidomus nuttalli (Conrad)	—	3	115
Schizothaerus nuttalli (Conrad)	(2)	—	29(19)
Semele decisa (Conrad)	—	—	118
Semele pulchra (Sowerby)	48	34(2)	53
Semele striosa (C. B. Adams)	—	—	5
Septifer bifurcatus (Conrad)	12	—	563
Siliqua lucida (Conrad)	(2)	(13)	(32)
Solen rosaceus Carpenter	(37)	(2)	1(8)
Solen sicarius Gould	—	(40)	(66)
Spisula californica Carpenter	—	—	20(11)
Spisula falcata (Gould)	29(4)	6(8)	367
Spisula hemphilli (Dall)	4	—	686
Spisula planulata Conrad	—	—	64
Tagelus californicus (Conrad)	(12)	2(8)	26
Tagelus subteres (Conrad)	(4)	—	40(18)
Tellina bodegensis Hinds	—	—	6
Tellina idae Dall	—	1(21)	3
Tellina meropsis Dall	5	3	21
Tellina rubescens Hanley	—	—	20

Pelecypoda (cont.)	68-A	68-B	66-2
Tellina santarosae Dall	—	—	2
Tivela stultorum (Mawe)	1	27	203
Tivela stultorum forma *scarificata* Berry	—	—	9
Trachycardium procerum (Sowerby)	40	12	1,138
Trachycardium quadragenarium (Conrad)	2	3	217
Ventricola fordi (Yates)	—	—	2(21)
Verticordia ornata (Orbigny)	—	—	2
Yoldia cooperi Gabb	—	1	108
Zirfaea pilsbryi Lowe	(2)	—	49(225)
Gastropoda			
Acanthina lugubris (Sowerby)	—	—	5
Acanthina spirata (Blainville)	1	3	157
Acmaea asmi (Middendorff)	—	—	3
Acmaea depicta (Hinds)	5	—	22
Acmaea insessa (Hinds)	—	1	183
Acmaea limatula Carpenter	—	—	19
Acmaea paleacea Gould	1	1	36
Acmaea pelta Eschscholtz	—	—	2
Acmaea persona Eschscholtz	—	—	1
Acmaea scabra (Gould)	1	1	126
Acteocina culcitella (Gould)	49	176	232
Acteocina inculta (Gould)	11	52	6
Acteocina smirna Dall	—	—	14
Acteon punctocaelatus (Carpenter)	6	3	33
Acteon traski Stearns	(1)	1	51(21)
Admete gracilior (Carpenter)	—	4	12
Aesopus chrysalloideus (Carpenter)	36	14	822
Aesopus sanctus Dall	5	2	32
Alabina californica (Dall and Bartsch)	—	—	7
Alabina tenuisculpta (Carpenter)	12	36	52
Alabina tenuisculpta forma *phalacra* Bartsch	—	—	48
Alabina turrita (Carpenter)	—	8	5
Aletes squamigerus Carpenter	35	(21)	13
Alvania acutilirata (Carpenter)	—	—	1
Alvania fossilis Bartsch	—	—	5
Amphissa reticulata Dall	—	—	2
Amphissa versicolor Dall	—	—	18
Anachis penicillata Carpenter	—	3	145
Antiplanes perversa (Gabb)	—	4	—
Antiplanes santarosana Dall	—	—	1
Assiminea translucens (Carpenter)	—	—	4
Astraea gibberosa (Dillwyn) = *A. inaequalis* (Martyn)	—	—	(1)
Astraea undosa (Wood)	(1)	1	98

Gastropoda (cont.)	68-A	68-B	66-2
Atys casta Carpenter	—	1	6
Balcis compacta (Carpenter)	—	—	1
Balcis micans (Carpenter)	40	82	22
Balcis monicensis (Bartsch)	—	—	14
Balcis oldroydi (Bartsch)	—	—	30
Balcis rutila (Carpenter)	—	30	60
Balcis thersites (Carpenter)	—	—	10
Barbarofusus kobleti (Dall)	—	—	2
"*Barleeia*" *acuta* (Carpenter)	—	—	1
Barleeia marmorea (Carpenter)	—	—	4
Barleeia subtenuis var. *rimata* (Carpenter)	—	—	158
Bellaspira grippii Dall	—	—	2
Bittium interfossa Carpenter	—	—	2
Bittium quadrifilatum Carpenter	9	1	93
Bittium rugatum Carpenter	1	502	650
Bivonia compacta Carpenter	—	—	1
Borsonella bartschi (Arnold)	—	—	1
Bursa californica (Hinds)	—	4(10)	132
Caecum californicum Dall	6	250	88
Calliostoma dolarius (Holten) = *C. canaliculatum* (Martyn)	46	18	9
Calliostoma eximium (Reeve)	3	—	12
Calliostoma ligatus (Gould)	—	—	6
Calliostoma gemmulatum Carpenter	36	24	164
Calliostoma supragramosum Carpenter	—	—	3
Calliostoma tricolor Gabb	10	35	21
Calyptraea contorta Carpenter	1	37	10
Cancellaria bullata Sowerby	—	—	1
Cancellaria tritonidea Gabb	—	—	39
"*Cantharus*" *lugubris* (C. B. Adams)	—	—	3
Cavolina trispinosa Lessor	—	—	1
"*Centrifuga*" *leeana* (Dall)	—	—	3(11)
Cerithidea albonodosa Gould and Carpenter	—	—	54
Cerithidea californica (Haldeman)	10	5	529
Cerithiopsis alcima Bartsch	—	4	9
Cerithiopsis antefilosa Bartsch	2	10	10
Cerithiopsis antemunda Bartsch	1	—	8
Cerithiopsis carpenteri Bartsch	—	—	2
Cerithiopsis cesta Bartsch	—	1	1
Cerithiopsis cosmia Bartsch	2	—	18
Cerithiopsis diegensis Bartsch	—	—	1
Cerithiopsis fossilis Bartsch	—	—	20
Cerithiopsis oxys Bartsch	1	10	15
Cerithiopsis pedroana Bartsch	—	—	1

Gastropoda (cont.)	68-A	68-B	66-2
Clathrodrillia fancherae Dall	—	42	67
Clathrodrillia ophioderma Dall	2	2	4
"*Clathurella*" *conradiana* Gabb	—	—	3
Coleophysis carinata (Carpenter)	—	75	222
Coleophysis harpa (Dall)	—	—	2
Conus californicus Hinds	4	57	456
Crassispira montereyensis (Stearns)	—	—	5
Crepidula arenata (Broderip)	90	88	1,218
Crepidula norrissiarum Williamson	—	—	176
Crepidula nummaria Gould	3	11	28
Crepidula onyx Sowerby	24	25	595
Crepidula princeps Conrad	—	1	4
Crepipatella lingulata (Gould)	1	1	54
Crucibulum spinosum (Sowerby)	121	114	737
Cylichna attonsa Carpenter	—	91	20
Cystiscus regularis (Carpenter)	—	—	91
Cytharella hexagona (Gabb)	1	—	4
Cytharella merita (Hinds)	—	—	3
Cytharella merita var. *painei* (Arnold)	—	—	40
Diodora aspera (Eschscholtz)	—	—	3
Diodora constantiae Kanakoff	16	4	25
Diodora densiclathrata (Reeve)	(1)	—	6
Diodora inaequalis (Sowerby)	4	2	80
Diodora murina (Dall)	—	—	3
Elaeocyma empyrosia (Dall)	—	—	3
Elaeocyma hemphilli (Stearns)	40	11	242
Epitonium acrostephanum Dall	—	3	2
Epitonium bellastriatum (Carpenter)	—	17	5
Epitonium californicum (Dall)	—	—	2
Epitonium clarki T. S. Oldroyd	—	36	22
Epitonium cooperi Strong	53	29	19
Epitonium indianorum (Carpenter)	—	—	19
Epitonium rectilaminatum (Dall)	1	—	6
Epitonium tinctium (Carpenter)	25	19	14
Erato columbella Menke	—	—	15
Eupleura muriciformis Broderip	(1)	2	23
Fartulum occidentale (Bartsch)	—	10	34
Fissurella volcano Reeve	11	5	258
Forreria belcheri (Hinds)	—	5(5)	101
Glyphostoma adana Dall	—	—	4
Haliotis corrugata Gray	—	—	3
Haliotis cracherodi Leach	—	—	4
Haliotis fulgens Philippi	—	—	1
Haliotis rufescens Swainson	—	(1)	4

Gastropoda (cont.)	68-A	68-B	66-2
Halistylus subpupoideus (Tryon)	—	—	91
Haminoea virescens (Sowerby)	—	—	30
Hipponix antiquatus (Linné)	2	12	113
Hipponix tumens (Carpenter)	—	1	42
Homalopoma carpenteri (Pilsbry)	—	—	1
Homalopoma paucicostatum (Dall)	—	—	2
"*Hyalina*" *californica* (Tomlin)	2	—	66
Iselina fenestrata (Carpenter)	1	—	27
Jaton festivus (Hinds)	—	—	20(56)
Kellettia kelletti (Forbes)	20	3	32
Kurtzia gordoni Bartsch	—	—	15
Kurtzia roperi (Dall)	—	1	—
Lacuna marmorata Dall	—	72	2
Lacuna unifasciata Carpenter	—	18	140
Lamellaria stearnsi Dall	—	—	2
Liota acuticostata Carpenter	—	1	9
Littorina planaxis Philippi	—	—	6
Littorina scutulata (Gould)	3	3	530
"*Lora*" *fidicula* (Gould)	—	—	1
Lottia gigantea Sowerby	—	—	3
Lucapinella callomarginata (Dall)	19	3	108
Macron lividus (A. Adams)	—	—	3
"*Mangelia*" *cetolaca* Dall	6	61	370
"*Mangelia*" *hooveri* Arnold	—	—	3
"*Mangelia*" *interlirata* Stearns	—	—	5
"*Mangelia*" *variegata* Carpenter	42	251	634
Margarites optabilis (Carpenter)	—	—	3
Margarites parcipictus (Carpenter)	10	9	482
Maxwellia gemma (Sowerby)	—	—	(12)
Maxwellia santarosana (Dall)	—	—	(1)
Megasurcula carpenteriana (Gabb)	—	2	10
Megatebennus bimaculatus (Dall)	(1)	—	9
Megathura crenulata (Sowerby)	3	2	5
Melampus olivaceus Carpenter	36	—	239
Metaxia convexa (Carpenter)	—	—	10
Metaxia diadema Bartsch	6	1	13
Micranellum crebricinctum (Carpenter)	6	36	17
Mitra catalinae (Dall)	1	1	2
Mitra fultoni E. A. Smith	—	—	5
Mitra idae Melville	—	—	6
Mitrella carinata (Hinds)	98	208	7,548
Mitrella carinata forma *gausapata* (Gould)	42	98	2,000
Mitrella tuberosa (Carpenter)	1	14	163
Mitromorpha filosa (Carpenter)	—	—	13

Gastropoda (cont.)	68-A	68-B	66-2
Mitromorpha gracilior Hemphill	—	2	4
Nassarius cerritensis (Arnold)	7(5)	4	130
Nassarius delosi (Woodring)	(1)	48	47
Nassarius fossatus (Gould)	(1)	3	41
Nassarius mendicus (Gould)	—	—	8
Nassarius mendicus forma *cooperi* (Forbes)	—	—	6
Nassarius perpinguis (Hinds)	38	143	60
Nassarius tegulus (Reeve)	6(5)	3	33
Neptunea tabulata (Baird)	—	—	66
Norrisia norrisi (Sowerby)	1	—	37
Ocenebra barbarensis (Gabb)	—	—	1
Ocenebra foveolata (Hinds)	—	—	11
Ocenebra interfossa Carpenter	—	—	10
Ocenebra lurida (Middendorff)	1	(1)	3
Ocenebra poulsoni Carpenter	3	7	12
Odostomia acrybia Dall and Bartsch	—	—	2
Odostomia aepynota Dall and Bartsch	—	—	7
Odostomia amianta Dall and Bartsch	—	—	1
Odostomia atossa Dall	—	5	5
Odostomia donilla Dall and Bartsch	3	—	99
Odostomia effiae Willett	2	—	6
Odostomia elsiae Willett	3	2	4
Odostomia fetella Dall and Bartsch	—	—	3
Odostomia helena Bartsch	—	9	30
Odostomia helga Dall and Bartsch	—	—	5
Odostomia io Dall and Bartsch	—	—	3
Odostomia navisa Dall and Bartsch	—	1	1
Odostomia nemo Dall and Bartsch	—	32	105
Odostomia pulcia Dall and Bartsch	—	—	2
Odostomia talama Dall and Bartsch	1	2	2
Odostomia tenuisculpta Carpenter	—	—	5
Odostomia terricula Dall and Bartsch	—	—	3
Odostomia virginalis Dall and Bartsch	—	—	2
Olivella baetica Carpenter	12	476	2,908
Olivella biplicata (Sowerby)	2	37	129
Olivella pedroana (Conrad)	93	27	2,313
Opalia insculpta Carpenter	—	—	17
Opalia wroblewskyi chacei Strong	—	—(1)	1
Petaloconchus complicatus Dall	—	—	15
Phasianella compta Gould	105	183	1,151
Phasianella pulloides Carpenter	—	—	18
Phasianella substriata (Carpenter)	—	10	14
"*Phyllonotus*" *radix nigritus* (Philippi)	—	—	67
Pleurtomella herminea Dall	—	—	1

Gastropoda (cont.)	68-A	68-B	66-2
Polinices altus Arnold	—	41	66
Polinices draconis (Dall)	—	—	5
Polinices lewisi (Gould)	1	—	9
Polinices reclusianus (Deshayes)	8	85	171
Pseudomelatoma penicillata var. *semiinflata* Grant and Gale	—	—	4
"*Pterorytis*" *monoceros* (Sowerby)	—	—	52
"*Pterorytis*" *nuttalli* (Conrad)	1	—(2)	38(15)
Pusula californianus (Gray)	—	—	12
Pusula radians (Lamarck)	—	—	4(1)
Pusula solandri (Sowerby)	—	—	16
Pyramidella mazatlanica Dall and Bartsch	—	—	2
"*Pyramidella*" *pedroana* Dall and Bartsch	—	—	1
Rissoina californica Bartsch	—	—	5
Rissonia cf. *R. nereina* Bartsch	—	1	1
Rissoina pleistocena Bartsch	—	10	36
Seila montereyensis Bartsch	4	5	112
Sinum scopulosum (Conrad)	2	10	13
Skenea coronadoensis (Arnold)	—	1	42
Spiroglyphus lituellus (Mörch)	3	2	12
Tachyrhynchus lacteolus (Carpenter)	—	—	18
Tegula aureotincta (Forbes)	—	—	49
Tegula funebralis (A. Adams)	—	1	—
Tegula gallina (Forbes)	—	—	21(112)
Tegula gallina forma *multifilosa* Stearns	11	21	133(31)
Tegula ligulata (Menke)	12	26	698
"*Tegula*" *montereyi* (Kiener)	2	1	—
Terebra pedroana Dall	22	71	275
Terebra specillata Hinds	—	—	418
Thais haemastoma biserialis (Blainville)	—	—	69
Trimusculus reticulatus (Sowerby)	—	—	5
Triphora hemphilli (Bartsch)	1	—	1
Triphora pedroana Bartsch	1	—	8
Triphora kanakoffi Willett	—	—	1(1)
Turbonilla almo Dall and Bartsch	—	14	25
Turbonilla antemunda Dall and Bartsch	1	—	—
Turbonilla antestriata Dall and Bartsch	—	16	16
Turbonilla arnoldi Dall and Bartsch	—	87	44
Turbonilla asser Dall and Bartsch	1	31	15
Turbonilla attrita Dall and Bartsch	12	—	27
Turbonilla buttoni Dall and Bartsch	1	16	91
Turbonilla callimene Bartsch	—	—	3
Turbonilla canfieldi Dall and Bartsch	—	4	33
Turbonilla castanea (Keep)	—	—	1

Gastropoda (cont.)	68-A	68-B	66-2
Turbonilla grouardi Willett	—	—	3
Turbonilla halia Dall and Bartsch	—	1	—
Turbonilla halistrepta Dall and Bartsch	—	—	111
Turbonilla hypolispa Dall and Bartsch	—	1	—
Turbonilla idae T. S. Oldroyd	—	6	—
Turbonilla jewetti Dall and Bartsch	—	—	3
Turbonilla laminata Carpenter	2	4	18
Turbonilla latifundia Dall and Bartsch	—	—	3
Turbonilla lowei Dall and Bartsch	4	16	84
Turbonilla pecora T. S. Oldroyd	—	—	10
Turbonilla pedroana Dall and Bartsch	—	—	204
Turbonilla pentalopha Dall and Bartsch	—	3	14
Turbonilla ralphi Dall and Bartsch	—	4	6
Turbonilla simpsoni Dall and Bartsch	—	—	1
Turbonilla stylina Carpenter	—	3	21
Turbonilla tenuicula (Gould)	22	12	397
Turbonilla torquata Dall and Bartsch	—	—	5
Turbonilla tridentata (Carpenter)	—	84	192
Turbonilla weldi Dall and Bartsch	—	3	2
Turritella cooperi Carpenter	—	3	3
Turritella goniostoma Valenciennes	—	—	5
Vermicularia eburnea (Reeve)	—	—	1
Vermicularia pellucida Broderip and Sowerby	—	13	68
"*Vesica*" *punctulata* (A. Adams)	(4)	1	38
Vitrinella oldroydi Bartsch	—	—	1
Volvulella cylindrica (Carpenter)	—	18	5
Williamia peltoides (Carpenter)	—	1	1
Zonaria spadicea (Swainson)	—	(1)	29
Fresh Water Species			
Gyraulus similaris Baker	—	9	66
Helisoma cf. *H. trivolvis* (Say)	2	2	6(1)
"*Paludestrina*" *curta* Arnold	—	2	1
"*Paludestrina*" *protea* Gould	—	—	11
Physa osculans Haldeman	6	2	2
Valvata humeralis Say	—	2	3
Rangia lecontei Conrad	—	—	4(5)
Terrestrial Species			
Glyptostoma newberrianum (W. G. Binney)	—	—	5
Helmithoglypta sp. indet.	—	—	2
Quickella cf. *Q. rehderi* Pilsbry	1	—	2
Scaphopoda			
Cadulus fusiformis Pilsbry and Sharp	—	45	12
Dentalium agassizi Pilsbry and Sharp	—	—	1(1)

Scaphopoda (cont.)	68-A	68-B	66-2
Dentalium neohexagonum Sharp and Pilsbry	120	338	1,544
Dentalium numerosum Pilsbry and Sharp	—	—	2
Dentalium pretiosum Sowerby	—	—	32
Dentalium semipolitum Broderip and Sowerby	—	5	27
Siphonodentalium quardifissatum (Dall)	—	—	9
Amphineura[11]			
Acanthochitona avicula Carpenter	—	—	2
Callistochiton crassicostatus Pilsbry	—	—	16
Callistochiton palmulatus Carpenter	2	37	15
Cyanoplax hartwegi (Carpenter)	1	—	1
Ischnochiton conspicuus "Carpenter" Pilsbry	—	—	4
Ischnochiton acrior "Carpenter" Pilsbry	157	117	583
Ischnochiton magdalenensis (Hinds)	1	12	177
Lepidochitona keepiana Berry	—	—	2
Lepidopleurus nexus (Carpenter)	—	1	—
Lepidozona brunnea (Dall)	—	—	17
Mopalia acuta (Carpenter)	—	—	7
Mopalia muscosa (Gould)	—	4	6

HABITAT REQUIREMENTS

Inasmuch as Bruff (1946, pp. 299-331) has made a detailed analysis of the habitat requirements of the previously known constituents of the fauna, only brief comment is needed on this subject. Most of the species live at the present time in mud, sand, or rocky rubble of semi-protected embayments or in similar substrates of exposed coasts in shallow depths below strong wave action. Minor elements in the fauna include back-bay tidal flat inhabitants, sandy beach dwellers of the open coast, rock and rocky rubble inhabitants of both open and protected coasts, species restricted bathymetrically to depths greater than 10 fathoms, freshwater inhabitants from adjacent streams and pools, and land dwellers from nearby marsh lands.

At the present time most of the faunal components live in depths of ten fathoms or less. Species representing constituents of the minor, deep-water element are largely fragmental or worn and were apparently carried shoreward by storm waves and mixed with the shallow water deposits.

In addition to the intermittent development of isolated bays and estuaries, behind temporary barrier bars, the entire embayment was afforded partial shelter from northwestern weather by the Palos Verdes island-headland and other large highlands bordering the coast to the north, and by the Channel Islands off shore.

The great diversity of habitats represented in these collections and the

[11]Identifications by S. S. Berry.

large number of species and specimens comprising the samples suggest that a major part of the fauna was carried by southeastward flowing currents from different environments of the local embayment and deposited in the shallower water along the shore bordering the sea cliff of the San Joaquin Hills. A contributing cause of this ecological diversity undoubtedly was temporal change in local substrate composition produced by regional alterations of physiographic and hydrographic factors, such as the temporary development of bars and spits, the shoaling of the embayment, and influx of fresh water from migrating mouths of ancestral Santa Ana and San Gabriel rivers.

The abundance of protected shore inhabitants, especially shallow water rock and rubble dwellers, in the collection from locality 66-2, apparently reflects the presence of a semi-protected shore along the base of the sea cliff. This locality obviously was protected from the southwest by the San Joaquin highlands. Most of the rocky shore associates are lacking in the present collections from localities along the northern side of the Inner Bay, but, as Bruff (1946) has pointed out, these assemblages contain a small protected-shore element mixed with the predominant bay-estuarine element.

The presence of protected-shore forms in Bruff's collections apparently prompted Stevenson and Emery (1958, p. 10, fig. 17) to conclude that Newport Mesa stood during part of Palos Verdes time as a low island with protected shore assemblages occurring on the leeward shore. As suggested above, however, this faunal element apparently lived along the semi-protected bay shore of the San Joaquin highland and was eventually deposited with other assemblages in the local embayment. Moreover, geologic evidence for the existence of a large island-mesa is lacking (see p. 14).

Temperature Requirements

A thermal diversity greater than that now existing at this latitude is indicated for the paleohydroclimate by the number of locally extinct species in the fauna. Many of the faunal components are limited in range, at the present time, to points north or south of the Newport Bay area. Of considerable ecological significance is the large number of thermophilic (warm-limited) species, (see Table 1). These are mostly Panamic Province faunal constituents that are now restricted in their northern distribution to the large lagoons along the southern west coast of Baja California or to the Gulf of California. This tropical element of locally extinct species comprises about 12 per cent of the Newport fauna. In addition to these, the fauna contains a large group of locally extant species with their present northern end-point of range terminating in the southern California area. Most significant of these sub-tropical species are: *Americardia biangulata, Anatina undulata, Diplodonta sericata, Laevicardum elatum, Laevicardium substraitum, Semele striosa, Tellina meropsis, Morula lugubris* and *Pusula solandri.*

(cont. on p. 42)

Table 1

Locally Extinct "Southern" Indicators in the Newport Bay Fauna with Present Range and Occurrences in other West American Pleistocene Faunas
(asterisk indicates first record of the species for the Palos Verdes sand)

Species List	Present Range	Los Angeles area San Pedro Sand	Los Angeles area Palos Verdes sand or equivalents	San Diego area	San Quintín Bay	Magdalena Bay
Mollusca						
Pelecypoda						
Aligena cerritensis	La Jolla, California to Magdalena Bay, Baja California (Dall, 1921)	—	x	x	x	x
Arca perlabiata	Magdalena Bay, Baja California to Tumbez, Peru (Hertlein and Strong, 1943)	—	x	—	—	x
**Chione cortezi*	Magdalena Bay, Baja California to Guaymas (Keen, 1958a)	—	—	—	—	—
Chione gnidia	Cedros Island, Baja California to Paita, Peru (Hertlein and Strong, 1948)	—	x	x	—	x
"Chione" picta	Magdalena Bay, Baja California to Panama (Hertlein and Strong, 1948)	—	x	—	—	x
Crassinella branneri	Scammon Lagoon, Baja California (Woodring *et al.*, 1946) to Panama (Jordan, 1936)	—	x	x	x	x
Crassinella nuculiformis	Cape San Lucus, Baja California (Woodring *et al.*, 1946)	—	x	x	—	—
Cyathodonta undulata	Gulf of California to Peru (Hertlein and Strong, 1946)	—	x	—	—	x
Cyclinella singleyi	Scammon Lagoon, Baja California to Panama (Keen, 1958b)	—	x	—	—	—

**Cyclinella subquadrata*	Guaymas, Mexico to Paita, Peru (Hertlein and Strong, 1948)	—	—	—	—	—
Dosinia ponderosa	Scammon Lagoon, Baja California to Paita, Peru (Hertlein and Strong, 1948)	—	x	x	x	x
**Macoma elongata* Hanley	Baja California to Panama (Hertlein and Strong, 1949)	—	—	—	—	—
**Macoma pacis*	Gulf of California to Golfito, Costa Rica (Hertlein and Strong, 1949)	—	—	—	—	—
"*Macrocallista*" *squalida*	Scammon Lagoon, Baja California to Mancora, Peru (Hertlein and Strong, 1948)	—	x	—	x	x
Mulinia pallida modesta	Magdalena Bay, Baja California to Gulf of California (Hertlein and Strong, 1950)	x	x	x	—	?
**Ostrea megadon*	Scammon Lagoon, Baja California to Paita, Peru (Hertlein and Strong, 1946)	x	—	—	x	—
Pecten vogdesi	Magdalena Bay, Baja California to Paita, Peru (Hertlein and Strong, 1946)	—	x	x	x	—
Petricola gracilis parallela	Scammon Lagoon, Baja California to Corinto, Nicaragua (Hertlein and Strong, 1948)	—	x	—	—	—
**Pitar vulneratus*	Magdalena Bay, Baja California to the Bay of Panama (Hertlein and Strong, 1948)	—	—	—	—	—
**Protothaca grata*	Cape Colnett, Baja California to Antofogasta, Chile (Hertlein and Strong, 1948)	—	—	—	—	x
Tellina rubescens	Tenacatita Bay, Mexico to Tumbez, Peru (Hertlein and Strong, 1949)	—	x	—	—	?
Trachycardium procerum	Lagoon Head, Baja California to Lobos Island, Peru (Hertlein and Strong, 1947)	x	x	x	x	x
Gastropoda						
Acanthina lugubris	Todos Santos Bay, Baja California to Panama (Burch, 1945)	—	x	x	?	x
**Acteocina smirna*	San Diego, Calif. to El Salvador (Dall, 1921)	—	—	—	—	—

Table 1 (Continued)

Species List Mollusca Gastropoda	Present Range	Los Angeles area San Pedro Sand	Los Angeles area Palos Verdes sand or equivalents	San Diego area	San Quintín Bay	Magdalena Bay
Acteon traski	San Diego, California to Panama (Dall, 1921)	—	x	x	x	—
Cancellaria (Trigonostoma) bullata	Cedros Island, Baja California to Panama (Burch, 1945)	—	x	—	—	—
"Centrifuga" leeana	Guadalupe Island to Cedros Island, Baja California Mexico (Burch, 1945)	—	x	—	—	—
**Cerithiopsis cesta*	San Diego, California (Bartsch, 1911)	—	—	—	—	—
**Crepidula arenata*	Scammon Lagoon, Baja California to Santa Elena, Ecuador (Berry, 1950)	—	—	—	—	—
**Diodora constantiae*	Puertocita, Baja California, and Puerto Peñasco, Sonora, Mexico (Faye Howard, collector)	—	—	—	—	—
Eupleura muriciformis	Cedros Island, Baja California, Mexico, to Lobitos, Peru (Hertlein and Strong 1955)	x	x	x	—	x
**Glyphostoma adana*	Concepcíon Bay, Baja California Mexico (Dall, 1919)	—	—	—	—	—
"Mangelia" cetolaca	Baja California, to Salina Cruz, Mexico (Dall, 1921)	x	x	x	—	—
Mitra fultoni	San Diego, California to Point Abreojos, Baja California, Mexico (Burch, 1945)	—	x	—	—	—

**Odostomia acrybia*	Point Abreojos, Baja California, Mexico (Dall and Bartsch, 1909)	—	—	—	—	—
**Odostomia talama*	Scammon Lagoon, Baja California, Mexico (Dall and Bartsch, 1909)	—	—	—	—	—
**Phyllonotus radix nigritus*	Scammon Lagoon (Jordan, 1924) and Magdalena Bay, Baja California (Cooke, n.d.) and Gulf of California, Mexico (Keen, 1958b)	—	—	x	—	x
"*Pterorytis*" *monoceros*	Baja California, Mexico (Grant and Gale, 1931)	—	x	—	—	—
**Pusula radians*	Magdalena Bay, Baja California to Ecuador (Keen, 1958b)	—	—	—	—	x
**Rissoina nereina*	Point Abreojos to Cape San Lucas, Baja California (Burch, 1946)	—	—	—	—	x
Skenea coronadoensis	Todos Santos Bay, Baja California (Burch, 1946)	—	x	x	—	—
**Terebra specillata*	Concepcíon Bay, Baja California to Piñas Bay, Panama (Hertlein and Strong, 1955)	—	—	—	—	?
Thais haemastoma biserialis	Cedros Island, Baja California, to Peru (Woodring *et al.*, 1946)	—	x	—	—	x
**Triphora hemphilli*	Point Abreojos, Baja California (Bartsch, 1907)	—	—	—	—	x
**Turritella goniostoma*	La Paz, Baja California to Ecuador (Keen, 1958b)	—	—	x	—	?
**Vermicularia pellucida*	"Panama" (Keen, 1958b)	—	—	—	—	—
"*Vesica*" *punctulata*	Magadalena Bay, Baja California to Peru (Keen, 1958b)	—	x	?	—	x

Table 2

Locally Extinct, and Certain Extant Species in the Newport Bay Fauna having Northern Implications, with Present Range and Occurrences in other West American Pleistocene Faunas Indicated

(asterisk indicates first record of the species for the Palos Verdes sand)

Species List	Present Range	Los Angeles area San Pedro Sand	Los Angeles area Palos Verdes Sand or equivalents	San Diego area	San Quintín Bay	Magdalena Bay
Mollusca Pelecypoda						
Cardita ventricosa	Belkoffski Bay, Alaska to off San Diego, California (Dall, 1921)	x	x	x	—	—
Gari californica	Japan, Kamchatka, Aleutian Il. and south to San Diego, California (Grant and Gale, 1931)	x	x	x	—	—
Glycymeris subobsoleta	Aleutian Islands to Puget Sound, Washington (Dall, 1921)	x	x	x	—	—
Macoma irus	Japan, Bering Strait and south to Monterey Bay, California (Dall, 1921)	x	x	x	—	—

Pecten caurinus	Channel Il., Orca Inlet, Cordova, Alaska to Point Reyes, California (Hertlein, 1940)	x	x	—	—	—
Pecten hericius	Port Athorp, Alaska to San Diego, California (Dall, 1921)	x	x	—	—	—
Pecten rubidus	Bering Sea to San Diego (Dall, 1921)	x	x	—	—	—
Rochefortia aleutica	Bering Sea to Coronado Isl., Baja California, Mexico (Dall, 1921)	—	x	—	—	—
Modiolus modiolus	Japan, Arctic Ocean south to Monterey, California also Atlantic Ocean (Soot-Ryen, 1955)	—	x	—	x	—
Gastropoda						
**Amphissa reticulata*	Port Althorp, Alaska to off San Diego, California (Dall, 1921)	—	—	—	—	—
Antiplanes perversa	Forrester Island, Alaska to off San Diego, California (Dall, 1921)	x	x	—	—	—
Calliostoma doliarium	Afognak Island, Alaska to San Diego, California (Burch, 1946)	x	x	x	x	—
Calliostoma ligatum	Prince William Sound, Alaska to San Luis Obispo Co., California (Burch, 1946)	x	x	x	—	—
"*Lora*" *fidicula*	Aleutian Islands, Alaska to Puget Sound, Washington (Dall, 1921)	?	x	—	—	—
Polinices draconis	Port Althorp, Alaska to Catalina Island, California (Dall, 1921)	—	x	—	—	—

Table 3

Extinct Molluscan Species in the Newport Fauna, with Other Occurrences and Known Living Allied Forms Noted.

Species	Reported Occurrences and Allied Living Forms
Pelecypoda	
Cardita hilli	Newport fauna only; said by Willett (1944) to resemble some forms of *C. crebricostata* Krauss, Recent, Point Barrow, Alaska to Monterey, California.
Pecten venturaensis	"Upper Pico," early Pleistocene, Ventura Co., California; a form of *P. hindsi,* Recent, Bering Sea to San Diego, California.
Rochefortia reyana	Palos Verdes sand, late Pleistocene, Baldwin Hills, Los Angeles basin; closely allied to *R. pedroana* Dall, Recent, Morro Bay to San Pedro, California.
Tivela scarificata	"Pleistocene of San Pedro," no definite locality given; biological validity questionable, probably an ecophenotypic variety of *T. stultorum* Mawe.
Gastropoda	
Alvania fossilis	Pleistocene, "sand rock, San Pedro California."
Balcis monicensis	Palos Verdes sand, Late Pleistocene, Santa Monica, Los Angeles basin.
"*Cancellaria*" *tritonidea*	Pliocene and Pleistocene of California; occurs in the Pleistocene San Pedro sand and Palos Verdes sand of the Los Angeles basin; no closely related living species is known, but genus has southern implications.
Cerithiopsis fossilis	Pleistocene, Los Angeles basin; probably a variety of *C. arnoldi,* ? Recent, San Pedro, California.
Crepidula princeps	Miocene to Pleistocene of western North America; occurs in the Pleistocene Timms Point silt and Palos Verdes sand of the Los Angeles basin; possibly related to the Recent boreal species, *C. grandis* Middendorff, but more likely has southern implications.
Epitonium clarki	Palos Verdes sand, late Pleistocene, Santa Monica, Los Angeles basin; closely allied to *E. bellastriatum* (Carpenter), Recent, Monterey, California to Todos Santos Bay, Baja California.

Odostomia effiae	Newport fauna only; similar to *O. grammatospira* Dall and Bartsch, Recent, Cape San Lucas, Baja California and Pleistocene of San Diego, California.
Odostomia elsiae	Newport fauna only; similar to *O. talama* Dall and Bartsch, Recent, Scammon Lagoon, Baja California.
Opalia insculpta	Santa Barbara formation, early Pleistocene, Santa Barbara and Palos Verdes sand, late Pleistocene; Los Angeles basin; closely allied to, if not conspecific with, *O. crenimarginata* (Dall), Recent, Santa Monica, California to Puerto Libertad, Mexico (Burch, 1945).
Pseudomelatoma penicillata var. *semiinflata*	Palos Verdes sand, late Pleistocene, Los Angeles basin; apparently a variety of *P. penicillata* (Carpenter).
Rissoina pleistocena	Palos Verdes sand, late Pleistocene, Playa del Rey, California; Bay Point formation, late Pleistocene, San Diego, California; related to species now living south of Newport (Woodring *et al.*, 1946).
Triphora kanakoffi	Newport fauna only; similar to *T. pedroana* (Bartsch), Recent, Redondo Beach, California to South Coronado Island, Baja California, Mexico (Dall, 1921).
Turbonilla arnoldi	Pleistocene of Los Angeles basin, California; Bay Point formation, late Pleistocene, San Diego, California.
Turbonilla grouardi	Newport fauna only; similar to *T. calvini* Dall and Bartsch, Recent, off La Paz, Baja California, Mexico.
Turbonilla idae	San Pedro sand, early Pleistocene, Nob Hill, Los Angeles Co. and Santa Barbara formation, early Pleistocene, Ventura Co., California; similar to *T. taylori* Dall and Bartsch, Recent, British Columbia to Puget Sound, Washington.
Turbonilla latifundia	San Pedro Sand, early Pleistocene, and Palos Verdes sand, late Pleistocene, of San Pedro, California.
Turbonilla pecora	San Pedro sand, early Pleistocene, Nob Hill, Los Angeles Co.; related to *T. dinora* Bartsch, Recent, San Diego, California.
Turbonilla ralphi	Pleistocene of Los Angeles basin and San Diego, California; closely allied to *T. torquata* (Gould), Recent, Monterey, California to Todos Santos Bay, Baja California

The presence of a tropical element in the fauna suggests the hydroclimate to have been warmer, at least in local areas, than at the present time. The mean annual surface water temperature today is recorded to be 57.8°F. off Newport Beach (Bruff, 1946) and about 61°F. off San Pedro (Hertlein and Grant, 1944a). It seems probable that the hydroclimate of the back-bay habitats within the Los Angeles basin during Palos Verdes time was comparable to similar environments of the present day lagoons along the west coast of Baja California from Scammon Lagoon to Magdalena Bay. Most of the species of the tropical element are now living in these shallow, warm-water lagoons. The present mean annual surface temperature of San Ignacio Lagoon, which is located in about the center of this series of protected embayments, is about 65°F. (Hertlein and Grant, 1944a). It would appear, therefore, that the hydroclimate of similar protected habitats within the Newport embayment was at least 4°F. warmer than at the present time.

The northern element in the fauna comprises many species that now range from higher latitudes southward in progressively greater depths, but only 2 per cent of the fauna is composed of northern ranging species which are not known at the present time to live at this latitude. These include six mollusks (see Table 2) and two bryozoans. The presence of this boreal element may reflect the former existence of coastal water masses cooler than now exist in this region. Some of these species, which may be living undetected off the present coast in deeper waters, may have lived during Palos Verdes time near shore in coastal areas of intense upwelling. On the basis of the present collections alone, however, it is not possible to determine the possible influence of upwelling on the composition of the local faunas.

In order to determine the regional hydroclimate, a knowledge of the composition of late Pleistocene fossil assemblages from sites of possible upwelling along the open coast south of San Joaquin highlands is required. Through the courtesy of John G. Vedder, information on the composition of the large collections made by the U. S. Geological Survey when mapping this area was made available to the writers. Assemblages from deposits on the lowest emergent terrace approximately seven miles south of Newport Bay, in the Laguna Beach area, are a mixture of subtropical and transition elements, including: *Crassinella branneri, Thais biserialis, "Chione" picta, Amercardia biangulata, Pusula solandri, Nassarius delosi,* and *Acmaea mitra* (U.S.G.S. F586, F587). Farther south, in the Capistrano Beach-San Clemente region, the assemblages appear to have fewer of the subtropical species represented and several cold water indicators appear, such as *"Cryptochiton" stelleri, Tegula brunnea, "Tegula" montereyi* and *Clinocardium nuttalli* (U.S.G.S. F592). Willett (1938) recorded a cool water assemblage, including *Clinocardium nuttalli, Placiphorella velata* and *Calliostoma ligatum,* from undesignated deposits at Capistrano Beach.

Although Willett's locality no longer exists, about 100 of the molluscan species from the San Clemente exposure (U.S.G.S. F592) are common to Willett's Capistrano Beach assemblage (Vedder, *in literis*).

The apparent absence of the Panamic tropical element in the coastal terrace deposits indicates the open coast hydroclimate to have been cooler than the hydroclimate of the semi-protected bay environment. The occurrence of cold water indicators in the Capistrano Beach deposits may reflect the former presence of locally severe upwelling in the region south of Dana Point.

The regional composition of the late Pleistocene faunas of southern California and northwestern Baja California requires the contemporaneous existence of a cooler hydroclimate along parts of the open coast and a warmer hydroclimate in the protected embayments than exist in this region at the present time. It has been previously suggested that the present distributional pattern of water temperatures along the southern part of Pacific Baja California may approximate the marine environment of the Los Angeles basin during Palos Verdes time. Along this part of Baja California, tropical species are now largely confined to the lagoons and protected bays,[12] warm-temperate elements occur in adjacent coastal waters, and "northern" species appear in local sites of seasonal upwelling along the open coast (Emerson, 1956).

AGE AND CORRELATION

Although the Newport Mesa invertebrate fauna is essentially modern in composition, about 5 per cent of the constituents (22 mollusks and 1 echinoid) are not known to be living. Many of the apparently extinct molluscan species are closely allied to modern forms. Several of them (see Table 3) may prove to be conspecific with Recent species when the range of specific variation of the forms is better known. Others may eventually be found living off the North American west coast. Of the 22 molluscan forms not known to be living, only two lack close relatives in the modern Eastern Pacific faunas. "*Cancellaria*" *tritonidea* occurs in the Pliocene and Pleistocene of California, but does not appear to be closely related to any known Recent species. *Crepidula princeps* commonly occurs in Miocene and Pliocene deposits of western North America, but is rarely found in Pleistocene deposits of southern California. It does not appear to be closely related with similar Recent forms.

Most of the species representing the previously mentioned locally extinct northern and southern elements of the fauna are reported, respectively, from the early Pleistocene of the Los Angeles embayment and the

[12]Some tropical species of invertebrates have been reported from the southern half of Vizcaino Bay, where Dawson (1952) demonstrated the presence of both relatively warm and cold water algal associations living in near proximity in the well-circulated coastal waters. Additional collections must be made along the open coast of Vizcaino Bay in order to determine if the thermophiles that appear to be largely restricted to the protected lagoons and bays also occur in this exposed bay.

late Pleistocene embayments at lower latitudes (see Tables 2, 3). The presence of these elements and of the extinct species would seemingly be sufficient faunal evidence alone to preclude assigning a post-Wisconsin age to the fauna. The limited available radiocarbon evidence corroborates this conclusion. Carbon-14 age determinations for fossil deposits on the lowest emergent terraces at San Pedro (Kulp *et al.*, 1952) and Santa Cruz, California (Bradley, 1956) indicate ages greater than 30,000 years B. P.

The physiographic evidence also attests to the antiquity of these deposits. The emergent terrace has been considerably modified since Palos Verdes time by the deposition of continental sediments and by erosion. Streams and rivers have incised channels in the terrace to depths greater than 100 feet below the present sea level, and the modern sea has truncated the western margin of the terrace plane. On the other hand, the occurrence of the fossiliferous sediments on the platform of the lowest (youngest) emergent terrace of the region, together with the faunal composition, requires a post-early Pleistocene age. Correlation of the deposits with the Palos Verdes sand of late Pleistocene age is indicated by faunal comparison with the Pacific coast Cenozoic stages based on the metazoan chronology (Weaver *et al.*, 1944). The fauna contains the warm water element that characterizes the fauna of the regional type section at San Pedro (Woodring *et al.*, 1946). Most of these thermophilic (warm-limited) species have been reported from deposits on the lowest emergent terrace elsewhere in the Los Angeles basin and are known to occur locally in similar deposits along the southern California and western Baja California coast (see Table 1). Subaerial erosion and regional deformation have reduced this terrace to discontinuous remnants that defy correlation by conventional methods. All of the available data, however, suggest the fossiliferous Newport Mesa terrace deposits to be a temporal equivalent of the Palos Verdes sand. Moreover, deposition of the sediments near the close of the third inter-glacial stage may be postulated, but is not demonstrable. The possibility of a glacial age (presumably *ad*-Wisconsin) for the fauna is conceivable if the theory of thermal lag of the Pleistocene marine hydroclimates is considered. Under this interpretation (Stokes, 1955), highest ocean temperatures are postulated during phases of glacial advance, the period when the warm near-shore waters gradually cooled attendant with an increase in rates of oceanic and coastal upwelling (Emerson, 1956).

Our present state of knowledge does not permit recognition of marine deposits in terms of the glacial-interglacial sequence. Consequently, a definite age classification of the Newport Mesa fauna and associated sediments is not possible, and the deposits must be referred with discernment to a time interval later than early Pleistocene and prior to the deglacial phase of the Wisconsin stage.

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LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

The Machris Brazilian Expedition

Other Subjects

Los Angeles County Museum

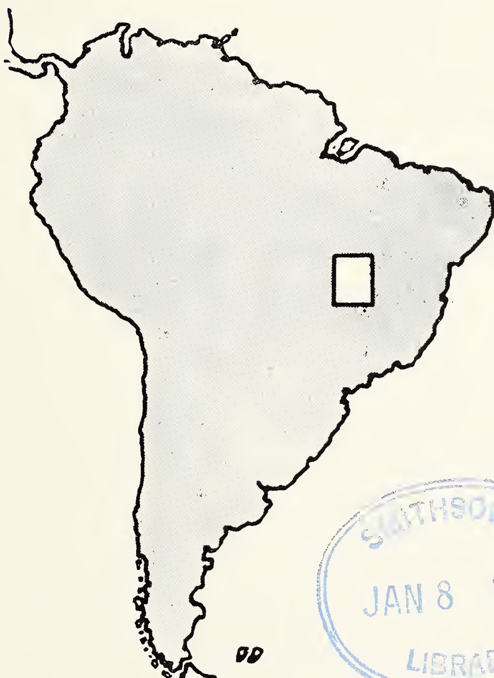
CONTRIBUTIONS IN SCIENCE

MBER 32 December 15, 1959

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Acanthaceae

By Emery C. Leonard



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CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and intineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: Phanerogamae, Acanthaceae

By EMERY C. LEONARD[1]

The plant specimens in this report were collected by E. Yale Dawson, Expedition Botanist. In all, 19 specimens of the family Acanthaceae were procured. Of these, numbers 14860, 14915, 14964, 15003, 15023 and 15028 were collected in the region of the southern Serra Dourada at W. Long. 48° 59′; S. Lat. 13° 45′. The others, namely, numbers 14225, 14360, 14362, 14380, 14381, 14489, 14499, 14531, 14599, 14662, 14687, 14730 and 14751e came from the region of the Chapada dos Veadeiros at W. Long. 49° 30′; S. Lat. 14° 30′. Detailed locality data for these may be found in the general account of the botany of the Expedition.[2]

The genera are arranged alphabetically, as are the species, when more than one, within each genus.

The first set of specimens, including isotypes of the four new species, is deposited in the Los Angeles County Museum.

Geissomeria ciliata Rizzini, Dusenia 3:186. 1952. 14964; 15028 The species, so far as known, is limited to Goiás and Minas Gerais. The type (A. Macedo 1852) was collected at Queixada, Jatai, in Goiás. Macedo also obtained material of it at S. Vicente, Ituiutaba, Minas Gerais.

Geissomeria dawsonii sp. nov. Figs. 1, 2

Herba vel suffrutex, caulibus glaucis plus minusve bifariam strigosis; lamina foliorum oblongo-lanceolata, acuta vel subacuminata (apice ipso subobtuso et minute mucronulato), basi angustata et in petiolum decurrens, supra glabra, costa et venis (8-10 paribus) parce strigosis exceptis, subtus hirtella, pilis basi crassis; cystolithis nullis; petioli dense pilosi; spicae solitariae et terminales vel plures et terminales et subterminales, pedunculatae; bracteae ovatae firmae, puberulae, pilis glandulosis et glandulosis intermixtis; bracteolae lanceolatae, subcarinatae, puberulae, pilis glandulosis et eglandulosis intermixtis; calycis segmenta 4, puberula, graciliter striato-nervosa; corolla purpurea, apice aliquanto dense pubescens, pilis patulis, glandulosis, purpureis, valde articulatis, labiis aequalibus, labio superiore cucullato, emarginato, labio inferiore trilobato, lobis latioribus ovalibus rotundatis, lobo medio lato, apice valde emarginato; ovarium glabrum.

Herbaceous or suffrutescent; stems subcylindrical, glaucous, more or less bifariously strigose, the hairs upwardly subappressed, up to 0.32 mm. long; leaf blades oblong-lanceolate, up to 16 cm. long and

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[2]Dawson, E. Yale. 1957. The Machris Brazilian Expedition. Botany: General. Los Angeles Co. Mus. Contr. Sci. (2) :1-20.

5.5 cm. wide, acute or subacuminate, the tip itself subobtuse and minutely mucronulate, narrowed at base and decurrent on the petiole, moderately firm, entire or very shallowly crenate, drying olive green, the upper surface

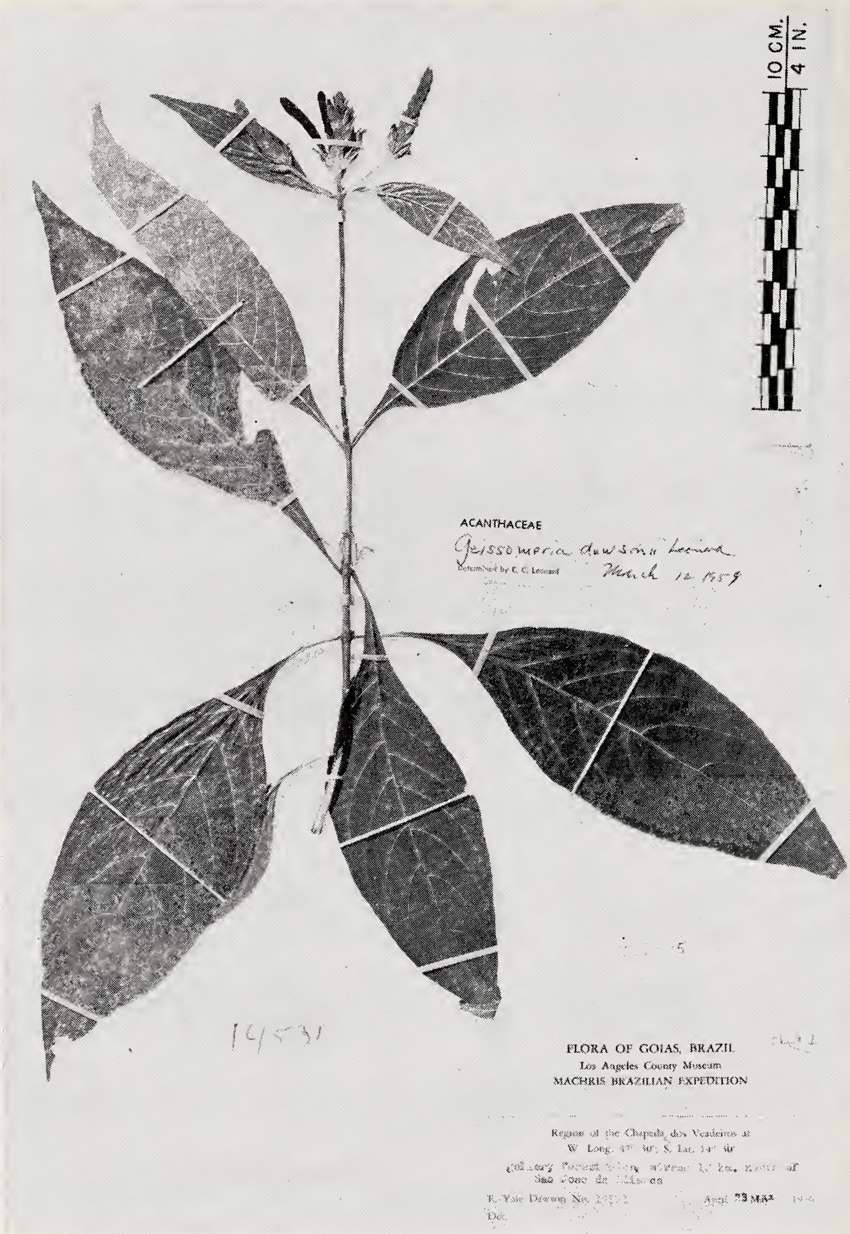

Fig. 1. *Geissomeria dawsonii* sp. nov. An isotype specimen.

glabrous or nearly so except the veins and costa, these sparingly strigose, the hairs up to 0.15 mm. long, the lower surface drying to grayish green, hirtellous, the costa densely so, the hairs ascending, arising from thickened bases, the costa and lateral veins (8 to 10 pairs) prominent beneath, less so above; cystoliths absent; petioles (unwinged portion) up to 12 mm. long, densely pilose, the hairs similar to those of the stem; young axillary branches sericeous and pale, the hairs very dense; spikes terminal and solitary or terminal and subaxillary, up to 3 cm. long, and 5 to 10 mm. broad, the subtending leaves smaller than the main stem leaves, up to 6 cm. long and 1.5 cm. wide, the peduncle of the terminal spike 4 to 8 mm. long, those of the subterminal spikes 2 cm. long, all densely and softly pubescent with yellowish white ascending hairs up to 0.48 mm. long; rachis densely pubescent with spreading or ascending hairs similar to those of the pedicels; flowers sessile, imbedded in the furrows of the rachis; bracts oblong-ovate, 7 mm. long, 4 mm. wide near the middle, firm and subcoriaceous, green, acute, puberulous with glandular and eglandular hairs intermixed, these up to 0.1 mm. long or the acute ones somewhat longer, the costa and 3 pairs of lateral nerves rather prominent, the inner surface of the bracts glabrous; bractlets lanceolate, 5 mm. long, 1.5 mm. wide, subacute, subcarinate, puberulous without, the hairs similar to those of the bracts, glabrous within, the costa obscure; calyx 4.5 mm. long, the segments oblong to lanceolate, the outermost 2 mm. wide, the medial 1.5 mm. wide, the inner 1 mm. wide, all subacute, puberulous without, the hairs similar to those of the bracts, glabrous within, finely striate-veined; corolla about 3 mm. long, and 4 mm. broad at throat, puberulous and purple, rather sparingly pilose with spreading hairs, these purple, 0.28 to 0.38 mm. long, gland-tipped, conspicuously jointed,

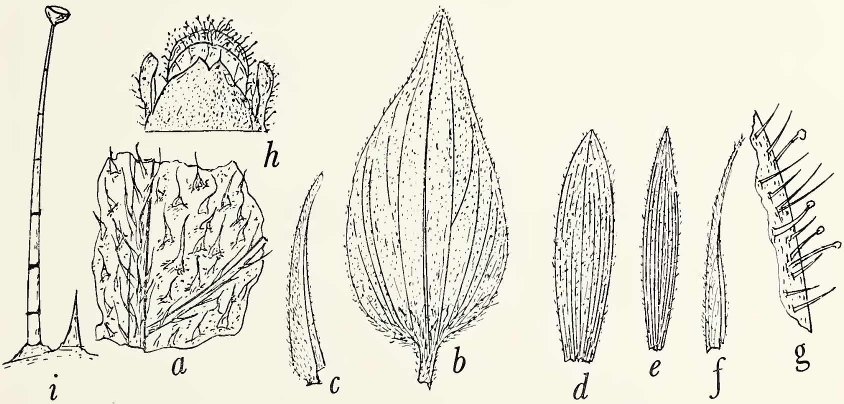

Fig. 2. *Geissomeria dawsonii* sp. nov. a. Lower surface of leaf blade enlarged to show pubescence; b, bract; c. bractlet; d, posterior calyx segment; e, one of the anterior calyx segments; f, one of the lateral segments of the calyx; g, portion of calyx segment enlarged to show character of the pubescence; h, tip of corolla; i, a glandular and an acute hair from tip of corolla.

the segments up to 0.08 mm. long, the corolla lips subequal, the upper lip cucullate, emarginate, covering the lower before expansion, the lower lip 3-lobed, the lateral lobes oval, rounded, the middle lobe broad, sharply notched at tip; ovary 1.25 mm. long, glabrous.

Fig. 3. *Jacobinia rigida* (Nees.) Lindau var. *desertorum* (Nees) Leonard. Dawson 14225.

TYPE: Museu Nacional do Brazil, Rio de Janeiro, collected in gallery forest along stream 18 km. north of the São João da Aliança, in the region of Chapada dos Veadeiros, April 23, 1956, by E. Yale Dawson (No. 14531). Isotypes in the United States National Herbarium and the Los Angeles County Museum.

Superficially, *Geissomeria dawsonii* resembles *G. ciliata* Rizz., but in that species the leaf blades are most abruptly narrowed toward the base and the bracts are more conspicuously ciliate and bear no minute gland-tipped hairs.

Jacobinia rigida (Nees) Lindau var. desertorum (Nees) comb. nov. 14225 Figs. 3, 4. *Sericographis rigida* Nees *β. desertorum* Nees, in Mart. Fl. Bras. 9:108. 1847. Nees cites several collections of *Sericographis rigida* var. *desertorum* in 1847 (DC. Prodr. 11:360). One of these, Riedel's no. 2413, was collected at Uberosa, Goiás.

Justicia allocota sp. nov. Figs. 5, 6

Herba vel suffrutex, caulibus subquadrangularibus, leviter sulcatis, bifariam hirtellis, pilis curvatis; lamina foliorum oblongo-ovata vel ovato-lanceolata, apice acuta vel breviter acuminata, basi cuneata, in petiolum decurrens, (sicca) viridis, aliquanto firma, integra vel undulata, glabra vel subglabra, costa et venis lateralibus (8-10-paribus) parce puberulis (pilis curvatis) exceptis, cystolithis gracilibus; petioli puberuli; flores sessiles, plures, pare bracteis foliiformibus suffultae, capitulis pedunculatis; bracteae apice subulatae, marginibus albis, ciliatis, costa conspicue viridi; calycis laciniae 5, oblongo-lanceolatae, acutae, puberulae, ciliatae; corolla purpurea, minute pubescens, labio superiore oblongo, apice bilobato, lobis suborbicularibus, labio inferiore trilobato, lobis oblongo-obovatis, apice rotundatis; stamina leviter exserta, antheris oblique sagittatis, lobo inferiore calcarato; ovarium glabrum.

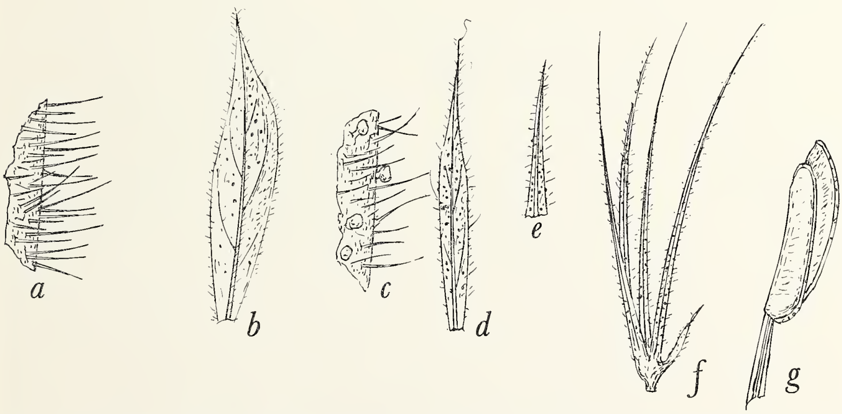

Fig. 4. *Jacobina rigida* (Nees) Lindau var. *desertorum* (Nees) Leonard. a, Portion of stem enlarged to show hairs; b, bract; c, small portion of bractlet enlarged to show hairs; d, bractlet; e, tip of bractlet; f, calyx; g, anther.

Herbs or shrubs up to 3 meters high; stems subquandrangular, shallowly grooved, bifariously hirtellous, the hairs upwardly curved, up to 0.4 mm. long; leaf blades oblong-ovate to ovate-lanceolate, up to 15 cm. long and 6.5 cm. wide, acute to short-acuminate at tip, cuneate at base and decurrent on the petiole, drying bright green, medium firm, entire or

Fig. 5. *Justicia allocota* sp. nov. An isotype specimen.

undulate, glabrous or nearly so except the costa and lateral veins (8 to 10 pairs), these moderately to sparingly puberulous, the hairs upwardly curved, up to 0.16 mm. long, the venation of the lower surface more prominent than that of the upper, the cystoliths delicate, up to 0.16 mm. long; petioles (unwinged portion) up to 4 cm. long, the pubescence that of the costa; flowers terminal and subterminal, several, these sessile, crowded and subtended by a pair of foliaceous bracts, these bracts ovate, about 3 cm. long and 1.6 cm. wide, acute or acuminate, the color, texture, venation and pubescence that of the leaf blades, the flower clusters solitary or in pairs, the peduncles ascending, about 1.5 cm. long, subquadrangular, green, 0.75 mm. thick at base, 1.5 mm. thick at tip, the pubescence that of the stems; bractlets lance-subulate, 1.5 cm. long, 1.5 mm. wide at base, thence gradually narrowed to a long slender tip, glabrous within, sparingly puberulous without, the hairs closely and upwardly appressed, up to 0.128 mm. long, the basal portion ciliate with spreading hairs 0.15 mm. long, the margins of the bracts and bractlets white, the medial portion and the prominent costa green; calyx segments 5, oblong-lanceolate, the calyx tube 1 mm. long, the segments 11 to 12 mm. long, 1.5 wide at base, gradually enlarged to 2.5 mm. at 6 mm. above base, thence narrowed to a slender tip, glabrous within, inconspicuously puberulous without, the hairs 0.08 to 0.128 mm. long, closely and upwardly appressed, ciliate with spreading or ascending hairs up to 0.32 mm. long; corolla purple, 4 cm. long, 2.5 mm. broad at base, 4 mm. broad at about 5 mm. above base then narrowed to 3 mm., the throat 6 mm. broad, finely and inconspicuously

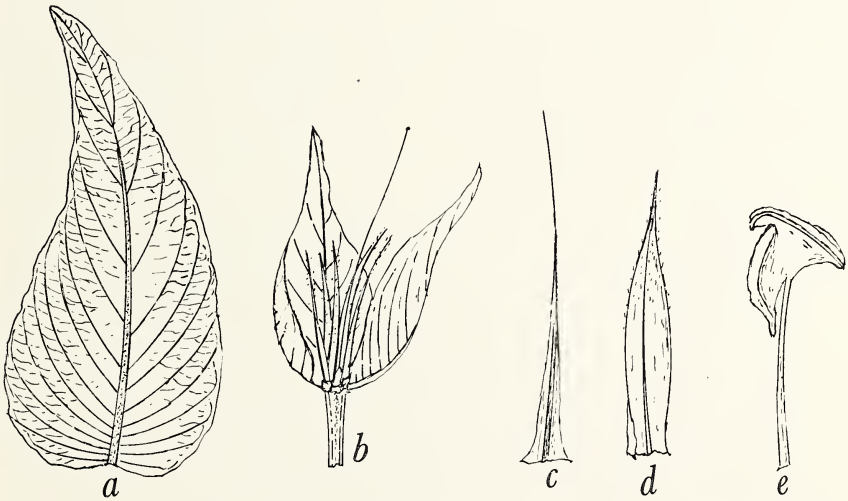

Fig. 6. *Justicia allocota* sp. nov. a, One of the two large bracts subtending the flower cluster; b, large bracts spread to show flower cluster of head; c, bractlet; d, one of the calyx segments; e, anther.

pubescent, the hairs weak, mostly spreading, up to 0.32 mm. long, the lips subequal, 22 mm. long, the upper lip oblong, 6.5 mm. wide near base, narrowed to 3 mm. at tip, 2-lobed, the lobes suborbicular, 1.5 mm. long, about 2 mm. wide, the lower lip 3-lobed, the lobes oblong-obovate, the middle lobe 9 mm. wide near tip, the lateral lobes 5.5 mm. wide, all rounded or obtuse at tip; stamens exserted about 5 mm. beyond the mouth of the corolla, the anthers obliquely sagittate, the lobes 4 mm. long, one attached to the connective slightly above the other, the lowermost calcarate, the connective 3 mm. broad near base, the filaments glabrous; ovary glabrous; style minutely and sparingly puberulous toward base, the stigma minute; capsule not seen.

TYPE: Museu Nacional do Brazil, Rio de Janeiro, collected in the forested area near Ribeirão Cristalino, 34 km. east of Formoso, May 21, 1956, by E. Yale Dawson (No. 15023). Isotypes in the United States National Herbarium and the Los Angeles County Musuem.

Justicia allocota resembles in a superficial way some of the large-bracted species of *Dicliptera.* The hexagonal stems and peduncles and the contracted, flattened, fan-like cymules are characteristic of *Dicliptera,* but in this new plant the flowers are clustered and sessile, not arranged in fan-like cymules. This and the subquadrangular stems and peduncles justify its placement with *Justicia.* Two other species with similar inflorescences should be transferred to *Justicia*:

1. **Justicia involucrata** (Nees) comb. nov. *Dicliptera speciosa* Nees & Mart., Nov. Act. Nat. Cur. 11:143. 1823. *Beloperone involucrata* Nees, in Mart. Fl. Bras. 9:143. 1847 (Syntypes are cited from Sebastianopolis, Federal District, and from Bahia.)

In this species the leaves are smaller (up to 9 cm. long and 2.5 cm. wide) than those of *J. allocota,* and the enveloping bracts, shorter than the calyces, do not have the rather numerous, conspicuous lateral veins. Furthermore, the pedicelled flower clusters are solitary in the axils of the leaves, whereas in *J. allocota* they are usually in pairs.

2. **Justicia thunbergioides** (Lindau) comb. nov. *Beloperone thunbergioides* Lindau, Bull. Herb. Bois. Ser. 2, 5:372. 1905. Type: Malme 3026, in Mato Brosso, Brazil.

In this species the leaf blades are strictly ovate, that is, nearly as wide as long, definitely rounded at base and abruptly acuminate at the tip. In our new species the blades are cuneate at the base and the tips more gradually acuminate.

Justicia ixodes sp. nov. Figs. 7, 8

Herba vel suffrutex, caulibus subquadrangularibus, bifariam pilosis et puberulis, pilis longioribus patulis, acutis vel glandulosis, pilis brevioribus retrorse curvatis, acutis; lamina foliorum oblongo-ovata apice subacuminata, apice ipso late obtuso, basi angustata, in petiolum decurrens, aliquanto firma, integra vel undulata, aliquanto pilosa et ciliata, pilis patulis vel ascendentibus, costa et venis vix prominentibus; cystolithis nullis; petioli breves pilosi vel in canalibus dense puberuli, pilis acutis, curvatis, spicae laxae simplices vel furcatae, terminales et axillares, ascendentes, rhache pilosa et puberula, pilis longioribus patulis, acutis vel glandulosis, pilis minoribus acutis, curvatis; bracteae ramos inflorescentiae subtendentes foliaceae, eae flores subtendentes parvae, pilis acutis et pilis

Fig. 7. *Justicia ixodes* sp. nov. An isotype specimen.

glandulosis intermixtis; bracteolae lineares; calycis segmenta, linearia, acuta, 3-nervata, intus glabra, extus pilosa, pilis patulis, acutis vel glandulosis; corolla purpurea, parce pilosa et puberula, pilis longioribus acutis, brevioribus glandulosis, in faucem plicata, labio superiore erecto, ovato, apice bilobato, lobis triangularibus, labio inferiore plus minusve patulo 3-lobato, lobis rotundatis; stamina vix exserta, lobis superpositis, lobo superiore dorse hirsuto, lobo inferiore calcarato, glabro, connectivo plano, lato, triangulato; ovarium parce puberulum, pilis acutis vel glandulosis.

Herbs or suffrutescent plants up to 1 meter high or more; stems subquadrangular, bifariously pilose and puberulous, the long hairs spreading, either glandular or acute, 1.5 to 2.5 mm. long, the understory of retrorsely recurved small hairs, up to 0.25 mm. long, acute; leaf blades oblong-ovate, up to 10.5 cm. long and 3.8 cm. wide, subacuminate, the tip itself broadly obtuse, narrowed at base and decurrent on the petiole, moderately firm, entire or undulate, rather moderately pilose, ciliate, the hairs spreading or ascending, up to 0.16 mm. long, or those of the costa of the lower leaf surface up to 0.32 mm. long, the venation somewhat inconspicuous (the lateral veins 6-8 pairs); cystoliths absent; petioles up to 1 cm. long, pilose with spreading acute hairs up to 2 mm. long, the channels also densely puberulous with acute curved hairs up to 0.25 mm. long; spikes lax, simple or branched, axillary and terminal, ascending, up to 12 cm. long, the rachis both pilose and puberulous with straight spreading hairs, the longer ones mostly gland-tipped, up to 1 mm. long, the small understory hairs curved, acute and about 0.16 mm. long; bracts subtending the branches of the inflorescence lanceolate, mostly about 1 cm. long and 1.5 mm. wide, acute, narrowed at base, pilose with spreading

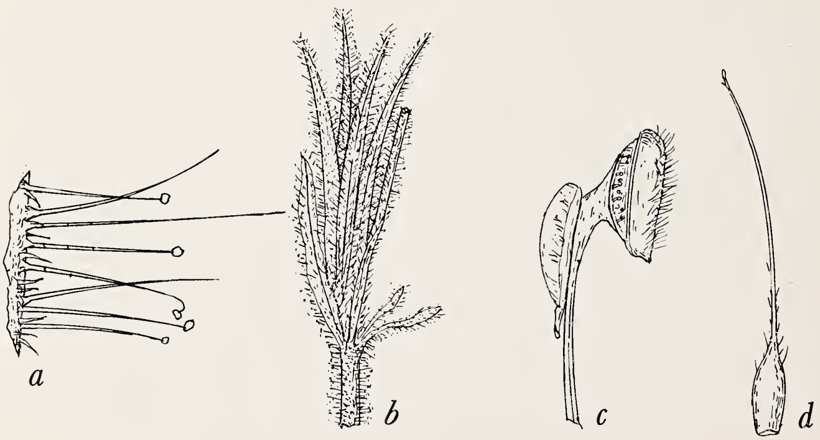

Fig. 8. *Justicia ixodes* sp. nov. a, Hairs from stem; b, node of inflorescence showing bract, bractlet and calyx; c, anther; d, pistil.

acute and gland-tipped hairs intermixed; these up to 1 mm. long, the bracts subtending the flowers spathulate, usually about 6 mm. long and 1.25 mm. wide, subobtuse at tip, gradually narrowed from above middle to base, the pubescence similar to that of the larger bracts; bractlets linear, 3 mm. long and 0.5 to 0.75 mm. wide, subacute, the pubescence similar to that of the bracts; calyx segments 4, linear, 11 mm. long, 1.5 to 1.75 mm. wide, acute, 3-nerved, glabrous within, pilose without, the hairs straight, spreading, acute or gland-tipped, up to 0.5 mm. long; corolla purple, sparingly pilose, with mostly spreading hairs up to 0.25 mm. long and more densely puberulous with short gland-tipped hairs about 0.05 mm. long, the tube 12 mm. long, 5 mm. broad at base, enlarged to 5 mm. above base and narrowed to 4 mm. 8 mm. above base, 7 mm. broad at throat, the upper lip erect, ovate, 10 mm. long, about 6 mm. wide just above base, narrowed to 1 mm. at notched tip, the lobes triangular, 0.5 mm. long and wide, acute, the lower lip more or less spreading, 10 mm. long, 3-lobed, the lobes rounded, about 5 mm. long, 3.5 mm. wide, the throat plaited; stamens exserted 4 mm. beyond the mouth of the corolla, the anther lobes obliquely attached, 2.5 mm. long and 1 mm. wide, the upper anther lobe glabrous except the dorsal ridge, this hirsute, the hairs straight and erect, 0.38 mm. long, the lower anther lobe spurred, the spur white, about 0.5 mm. long, the connective flat, triangular, 1.5 wide at base, 0.5 mm. wide at tip, the filaments flat, glabrous; ovary sparingly puberulous, the hairs acute or gland-tipped, 0.032 mm. long; style 18 mm. long, bearing a few mostly acute ascending hairs toward base, these 0.16 mm. long; stigma oblique, very short.

TYPE: Museu Nacional do Brazil, Rio de Janeiro, collected on banks and margins of small stream running through hilly cerrado 20 km. east of Formoso, May 17, 1956, by E. Yale Dawson, (No. 14915). Isotypes in the United States National Herbarium and the Los Angeles County Museum.

Justicia nodicaulis (Nees) comb. nov. 14360; 14381

Beloperone nodicaulis Nees, in Mart. Fl. Bras. 9:140. 1847. (Syntypes from Minas Gerais, Goiás and Mato Grosso are cited. A photograph of the syntype collected by Pohl in Goiás is in the U. S. National Herbarium.) *Amphiscopia grandis* Rizzini, Dusenia 3:185. 1952. Type: Macedo 1854, Queixada, Jatai, Goiás, April 14, 1949. Isotype (US).

Justicia lanstyakii Rizzini, Rev. Brasil Biol. 6:522, fig. 11-17. 1946. 14730 Limited to Minas Gerais (type) and Goiás. Some recent collections procured by A. Macedo are: 2413, 2427, and 2477 from Minas Gerais; 2612 from Goiás.

Lophostachys cyanea sp. nov. Figs. 9, 10

Suffrutex, caulibus subquadrangularibus, dense hirsutis, pilis ascendentibus cinnamomeis; lamina foliorum ovata vel obovata, apice rotundata vel obtusa, basi angustata, in petiolum decurrens, aliquanto firma, integra vel undulata, utrinque pilosa vel costa dense pilosa, marginibus ciliatis, pilis patentibus vel ascendentibus, cystolithis nullis vel paucis; petioli breves, pilosi; spicae 1 vel 2, floribus compactis, secundis; bracteae, dorsales, sessiles, virides, oblongo-ovatae, breviter acuminatae basi angustatae, intus glabrae, nitidae, extus pilosae, marginibus ciliatis, costa et nervis lateralibus prominentibus; bracteolae lineari-subulatae, ciliatae, costa prominente; calycis segmenta valde inaequalia, cyanea, intus glabra, extus pilosa, marginibus ciliatis, nervis prominentibus, segmentum superius

Fig. 9. *Lophostachys cyanea* sp. nov. An isotype specimen.

ellipticum, acutum, segmentum inferius elliptico-ovatum, apice oblique bilobatum, lobis triangularibus, acutis, cuspidatis, segmenta lateralia lineari-subulata, puberula, pilis acutis subtilibus et pilis crassis patulis glandulosis intermixtis praeditis; corolla cyanea, puberula pilis minutis acutis et pilis glandulosis intermixtis, tubo angusto, labiis aequalibus, labio superiore ovato, rotundato, emarginato, labio inferiore patulo 3-lobato, lobis ovatis, rotundatis; stamina leviter exserta, antheris staminum superiorum 2-lobatis, lobis parallelis, leviter superpositis, antheris staminum inferiorum 1-lobatis; capsulae ovoideae, nitidae, glabrae, callis parce hirtellis exceptae; retinacula gracilia; semina pilosa.

Suffrutescent plants up to 1 meter or more high; stems subquadrangular, at least the upper portions densely brownish hirsute, the hairs ascending, mostly up to 1 mm. long; leaf blades ovate to obovate, up to 5 cm. long and 4 cm. wide, rounded or obtuse at apex, narrowed at the base and decurrent on the petiole, rather firm, entire or undulate, both surfaces rather sparingly pilose but more densely so on the costa of the lower surface, or the entire surface of the young leaves densely pilose, the hairs mostly up to 1.5 mm. long or a few reaching to 2 mm., spreading or ascending, the margins ciliate, the costa and lateral veins (about 4 pairs), prominent on the lower surface of the leaf blade, less so above, the cystoliths present or lacking, the upper surface of the blades dull green (dry), nitid, the lower green, minutely scurfy; petioles up to 5 mm. long, yellowish pilose; spikes terminal or in pairs with one subterminal, up to 6 cm. long and 2 cm. broad, the flowers densely crowded and secund; bracts green, dorsally arranged on the spike, oblong-ovate, 14 mm. long, 7 mm. wide, briefly acuminate, narrowed to a sessile base 3 mm. wide, the inner surface glabrous, nitid, the outer pilose, the hairs subappressed, up to 0.5 mm. long, the margins ciliate, the hairs spreading, up to 1.5 mm. long, the costa and the 4 or 5 pairs of lateral nerves prominent, the bractlets up to 12 mm. long and 0.5 mm. wide, linear-subulate, ciliate, the costa prominent; calyx segments 4, very dissimilar, subhyaline, strongly nerved, the large outermost (anterior) segment elliptic-ovate, 17 mm. long, 13 mm. wide, 2-lobed at apex, each lobe triangular, 5 mm. long, 4 mm. wide at base, cuspidate, the inner surface glabrous, nitid, the outer rather densely pilose, the hairs ascending, up to 0.5 mm. long, the margins ciliate, the hairs up to 1.5 mm. long, the posterior segment elliptic, 2 cm. long, 11 mm. wide, acute, the pubescence and venation similar to that of the posterior bract; lateral segments linear-subulate, 9 mm. long, 1.5 mm. wide, puberulous, the hairs 0.25 mm. long, ciliate with similar hairs, the dorsal surface bearing in addition to the fine ascending hairs, short, erect heavy glandular ones, these about 0.2 mm. long, the costa prominent; corolla blue, rather sparingly puberulous, with both acute and gland-tipped hairs, these up to 0.16 mm. long, the corolla tube about 13 mm. long and 2 mm. broad, the upper lip erect, ovate, 5 mm. long, 4 mm. wide, rounded, emarginate, the lower lip spreading, 3-lobed, 5 mm. long, the lobes ovate, rounded, 4 mm. long, the middle lobe 1.75 mm. wide, the two lateral ones 1.25 mm. wide; stamens 4, the longer upper pair exserted about 4 mm., the lower shorter pair exserted about 1 mm., the anthers of upper pair 2-lobed, the lobes parallel, 2.5 mm. long, 0.75 mm. wide, one slightly superimposed above the other, rounded at both ends, the anthers of the

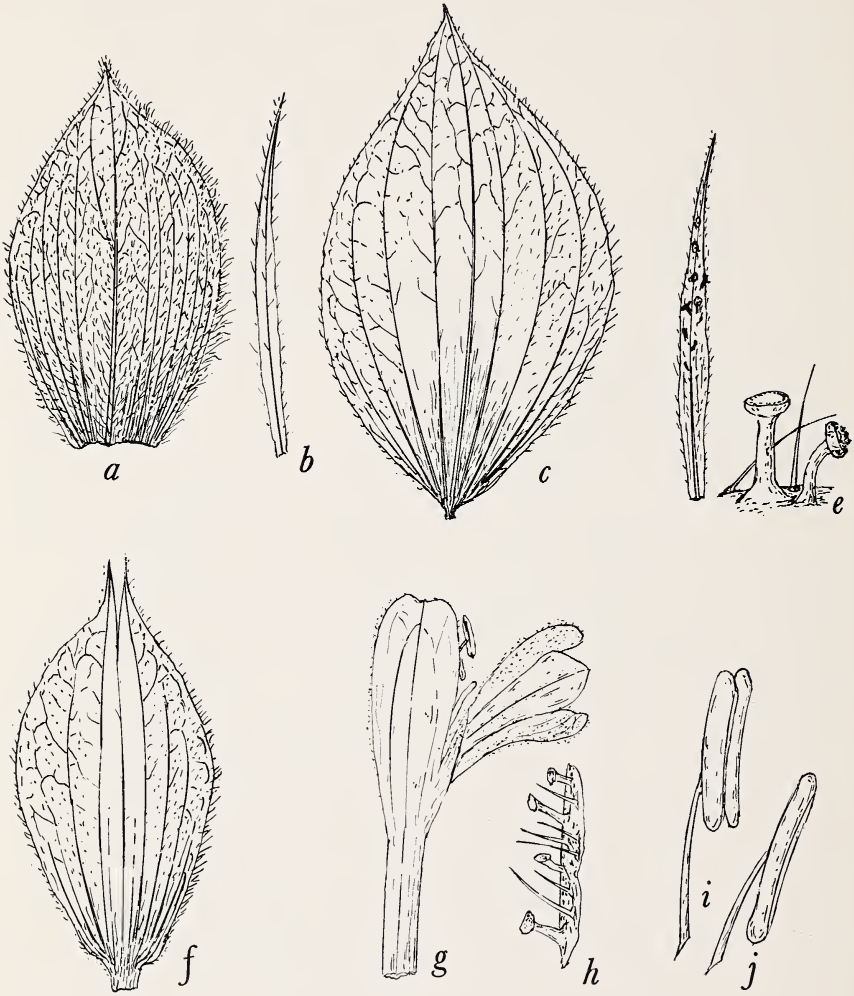

Fig. 10. *Lophostachys cyanea* sp. nov. a, Bract; b, bractlet; c, posterior calyx segment; d, one of the lateral calyx segments; e, small portion of lateral calyx segment enlarged to show pubescence; f, anterior calyx segment; g, upper half of corolla; h, small portion of corolla lobe enlarged to show pubescence; i, anther of one of the upper pair of stamens; j, anther of one of the lower pair of stamens.

lower pair of stamens 1-lobed, the lobe similar to those of the 2-lobed anthers; capsule narrowly ovoid, 13 mm. long, 4 mm. broad, about 2 mm. thick, glabrous, nitid except the callus, this bearing a few rigid acute spreading hairs about 0.128 mm. long; seeds 4, ovate (immature), 4 mm. long, 1.5 mm. broad, densely and softly pilose, the hairs more or less appressed, whitish, soft, about 0.25 mm. long; retinacula about 2.5 mm. long, gradually narrowed to a slender blunt tip.

TYPE: Museu Nacional do Brazil, Rio de Janeiro, collected in gallery forest margin along stream 18 km. north of São João da Aliança, April 20, 1956, by E. Yale Dawson, (No. 14489). Isotypes in the United States National Herbarium and the Los Angeles County Museum.

Lophostachys cyanea is different from all other previously described species in its blue flowers and bracts (dry) and in the two-celled anthers of the upper pair of stamens and the one-celled anthers of the lower pair. Its closest relative is perhaps *L. diandra* Nees, collected at Esperança, Brazil (Province unknown) by Riedel. In that species the corolla is white with blue veins and the stamens 2 in number. All other species of *Lophostachys* hitherto described have 4 didymous stamens.

Lophostachys laxifolia Nees, in Mart. Fl. Bras. 9:68. 1847. 14362; 14499; 15003 The plants of this species are both conspicuous and attractive because of their brilliant red outer calyx segments and corollas with a white tube and a red-violet throat and lip. Nees based his description on three syntypes: woods near Sumidouro, Serra dos Orgãos, Federal District, Beyrich; Mandioca, Riedel; and Engenho da Cebola, Sellow. Hugh C. Cutler found it growing in woods and old cutover and cultivated fields at Fazenda Monjolinho, 20 km. northeast of Anapolis, Goiás, altitude 1,000 meters, June 5, 1943, No. 8012 (US). Here it was reported to be poisonous to cattle. Mello Barreto collected it at Estrada de Catiara, Patos, Minas Gerais, June 19, 1936, No. 4393, (US). A photograph of the syntype collected by Sellow is in the U. S. National Herbarium.

Ruellia adenocalyx Lindau, Bot. Jahrb. Engler 25, Beibl. 60: 46. 1898. 14751e Figs. 11-12. The type came from "inter Guarirobea et Siriaeo," Goiás, Brazil. The leaves of this species are softly pilose with upwardly ascending whitish hairs up to 1 mm. long. These are dense on the upper surface of the leaf blades, but distinct. On the lower surface they are very dense and more or less matted (subtomentose). The corollas are bright red. The calyx segments are long, narrow and glandular-pilose, hence, the specific epithet.

Ruellia angustior (Nees) Lindau, Bot. Jahrb. Engler 25, Beibl. 60:46. 1898. 14599; 14662; 14687 The type (*Stemonacanthus angustior* Nees, in Mart. Fl. Bras. 9:54. 1847) was collected at "S. Felis prope fluvium Trahiras," Goiás, by Pohl. A photograph of the holotype in the

Vienna Herbarium is in the U. S. National Herbarium (Photo 32735). The panicles or racemes are narrow and few-flowered, and the corolla is bright red. The species is rather closely related to *R. adenocalyx.*

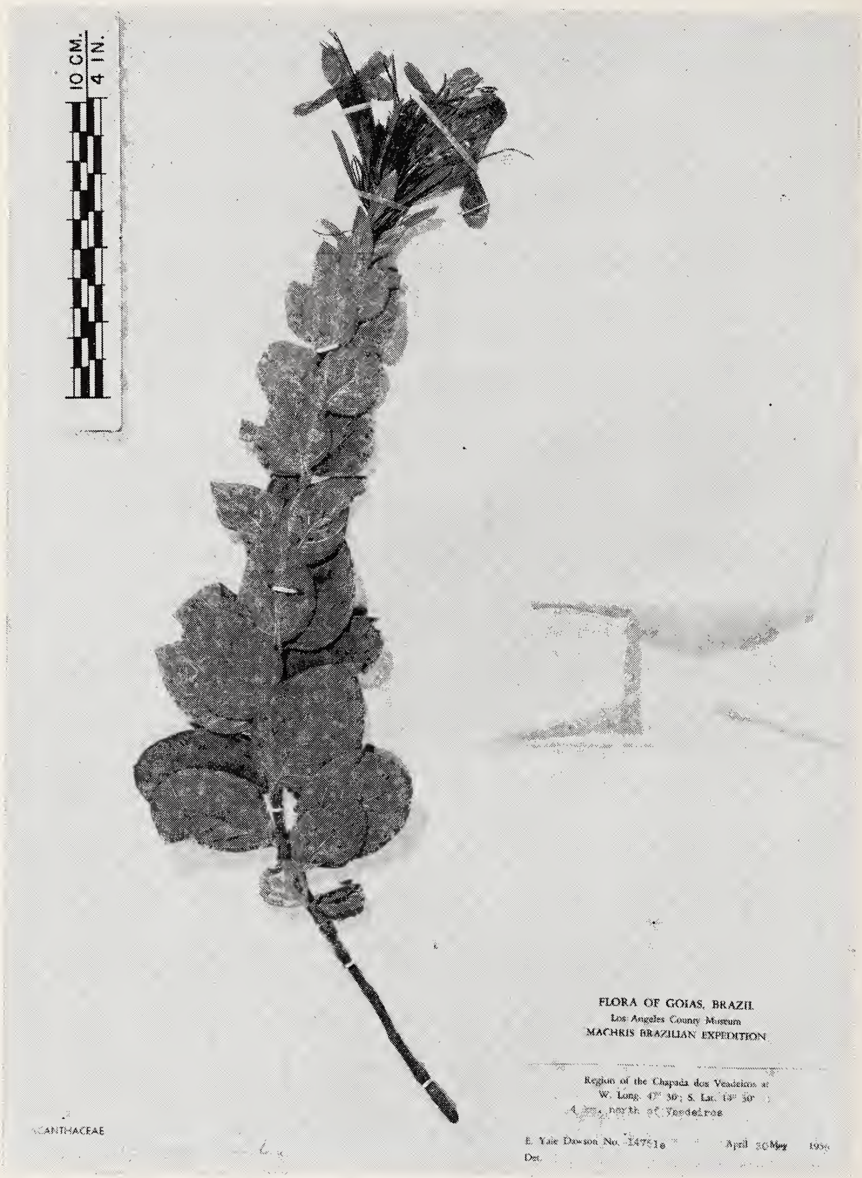

Fig. 11. *Ruellia adenocalyx* Lindau. Dawson 14751e.

Ruellia puri (Nees) Mart. ex Jackson, Index Kew. 1:775. 1893. 14380 This plant is rather widely spread in central Brazil, but is most abundant in Minas Gerais. Nees cites several syntypes of his *Dipteracanthus puri* in Martius' Flora Brasiliensis 9:35. The corollas are a clear lilac with rather long, very narrow tube. The specific epithet, *puri*, (clean, pure) may possibly allude to the attractive corollas.

Ruellia vindex (Nees) Lindau, in Engler & Prantl, Naturl. Pflanzenfam. 4,3b:311. 1895 14860 Nees cites several syntypes of his *Dipteracanthus vindex* in Martius' Flora Brasiliensis 9:42. 1847. Three of these were from Minas Gerais: one of his own specimens from Contendas, one collected at S. Lucia by Riedel, and one from Arrayal Porteira collected by Sellow. A fourth was collected from the District of Guyana in the Province of Venezuela by Otto. Several additional collections are mentioned by Nees in DeCandolle's Prodromus, 11:139. 1847. Among them is Gardener's 3954 from Campo Assayas, also in Minas Gerais. A photograph of this is in the U. S. National Herbarium (Photo 26608), and its resemblance to Dawson 14860 is close indeed. Plants of this species are low herbs with firm, glabrous leaves (hirsute in original description) and long (9 cm.) slender-tubed blue corollas. The specific epithet *vindex*, meaning a defender, protector or vindicator, is a fanciful name without any special allusion to the nature of the plant.

Fig. 12. *Ruellia adenocalyx* Lindau. Dawson 14751e. a, Bract; b, bractlet; c, hairs from bractlet; d, calyx; e, tip of calyx segment; f, stigma.

LOS ANGELES COUNTY MUSEUM CONTRIBUTIONS IN SCIENCE

The Machris Brazilian Expedition

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No. 4. Botany: The Lichens, by Carroll W. Dodge.
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Los Angeles County Museum
CONTRIBUTIONS IN SCIENCE

MBER 33 | December 15, 1959

THE MACHRIS BRAZILIAN EXPEDITION

ORNITHOLOGY: Two New Birds from Central Goias, Brazil

By Kenneth E. Stager

Angeles County Museum • Exposition Park • Los Angeles 7, Calif.

CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

The MACHRIS BRAZILIAN EXPEDITION from the Los Angeles County Museum was sponsored by Mr. and Mrs. Maurice A. Machris and Mrs. Maybell Machris Low. It was conducted under the auspices of the Museu Nacional do Brasil. Botanical and zoological collections were made from April through June, 1956, in the region of the headwaters of the Rio Tocantins in the state of Goiás. General accounts and intineraries are given in papers 1 and 2 of this series. Technical type specimens of new entities are deposited in the Museu Nacional in Rio de Janeiro.

THE MACHRIS BRAZILIAN EXPEDITION

ORNITHOLOGY: Two New Birds from Central Goiás, Brazil

By Kenneth E. Stager[1]

During the study of the birds collected in Central Goiás by the Machris Brazilian Expedition, a spine-tail (Furnariidae) and a motmot (Momotidae) appear to be subspecifically new.

I am grateful to Dr. Dean Amadon of the Department of Birds of the American Museum of Natural History for the opportunity to make use of the vast collections of that institution as well as for the loan of pertinent specimen material needed to complete this particular study. Names of colors are capitalized when direct comparison has been made with Ridgway's "Color Standards and Color Nomenclature."

The two new forms from Central Goiás are described as follows:

Anumbius annumbi machrisi, new subspecies
(Figs. 1, 2)

Type: From 20 kms. north of São João da Aliança, Goiás, Brazil, No. 33162 Los Angeles County Museum. Adult female, collected April 28, 1956, by Kenneth E. Stager (KES 15804). Holotype to be deposited in the Museu Nacional do Brasil, Rio de Janeiro. Paratypes (2) in the Los Angeles County Museum.

Diagnosis: Similar to *Anumbius a. annumbi* of Southern Brazil and Argentina, but easily distinguishable by the almost complete lack of dark brown spots and striations which outline the light colored throat of individuals of the nominate race. Forehead more uniformly rich chestnut, and dark brown striations of the crown greatly reduced; dark brown streaks of mantle and back also reduced in number.

Range: Known only from the type locality on the Chapada dos Veadeiros, an area drained by the Rio Tocantins of the Amazonian network. The subspecies was relatively abundant in this locality.

Description of type: Forehead Hazel with no dark brown centers to feathers; dark tipped feathers at margin of forehead and loreal area absent; supraorbital stripe Warm Buff; dark brown centers of crown feathers reduced in size and number; throat dull white with border necklace of dark brown spots and striations almost completely absent. Breast and abdomen as in the nominate form. Mantle and back similar in color to that of nominate form, but with the dark-centered feathers reduced in numbers. Rump and tail similar in color to those of nominate form. The light colored tips of rectrices a deeper Buff than shown in specimens from the south. Wing, 81.8 mm.; tail, 88.9 mm.; culmen from base, 20 mm.; exposed culmen, 16.3 mm.; tarsus, 26.1 mm. Holotype and paratypes all in fresh, unworn plumage.

Remarks: *Anumbius annumbi* (Vieillot) was previously known only from southern Brazil, Uruguay and adjacent parts of Paraguay and Argen-

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[1]Curator of Ornithology, Los Angeles County Museum.

tina. It is, therefore, of interest to note that this new subspecies extends the range some 500 miles to the north of the previously recorded boundary of the species.

The subspecific name honors Mr. Maurice A. Machris, co-sponsor of the 1956 Expedition to Goiás, Brazil.

SPECIMENS EXAMINED

Anumbius a. annumbi
- Brazil (AMNH)
  - Rio Grande do Sul, So. of Victoria, 2 ♂ 2 ♀
  - Rio Grande do Sul, Urugaiana, ♀
  - Rio Grande do Sul, Vaccaria, 2 ♂ 2 ♀
  - Rio Grande do Sul, Santa Isabel, ♂ ♀
  - Rio Grande do Sul, W. of Lagoa da Manguerira, 2 ♂ 2 ♀
  - Rio Grande do Sul, Candiota, ♂
  - Rio Grande do Sul, São Francisco de Paulo, ♀
  - Rio Grande do Sul, Quinta, ♀
- Paraguay (AMNH)
  - Chaco, Mission Vieja, 2 ♂ 1 ♀
  - Sapucay, ♂
- Argentina (AMNH)
  - Buenos Aires, Baracas al Sud, ♂ 2 ♀
  - Buenos Aires, Tigre, ♀

Anumbius a. machrisi
- Brazil (LACM)
  - Goiás, 20 kms. no. of São João da Aliança
  - ♂ Paratype (LACM 33161)
  - ♀ Holotype (LACM 33162)
  - ♀ Paratype (LACM 33163)

Baryphthengus ruficapillus berlai, new subspecies

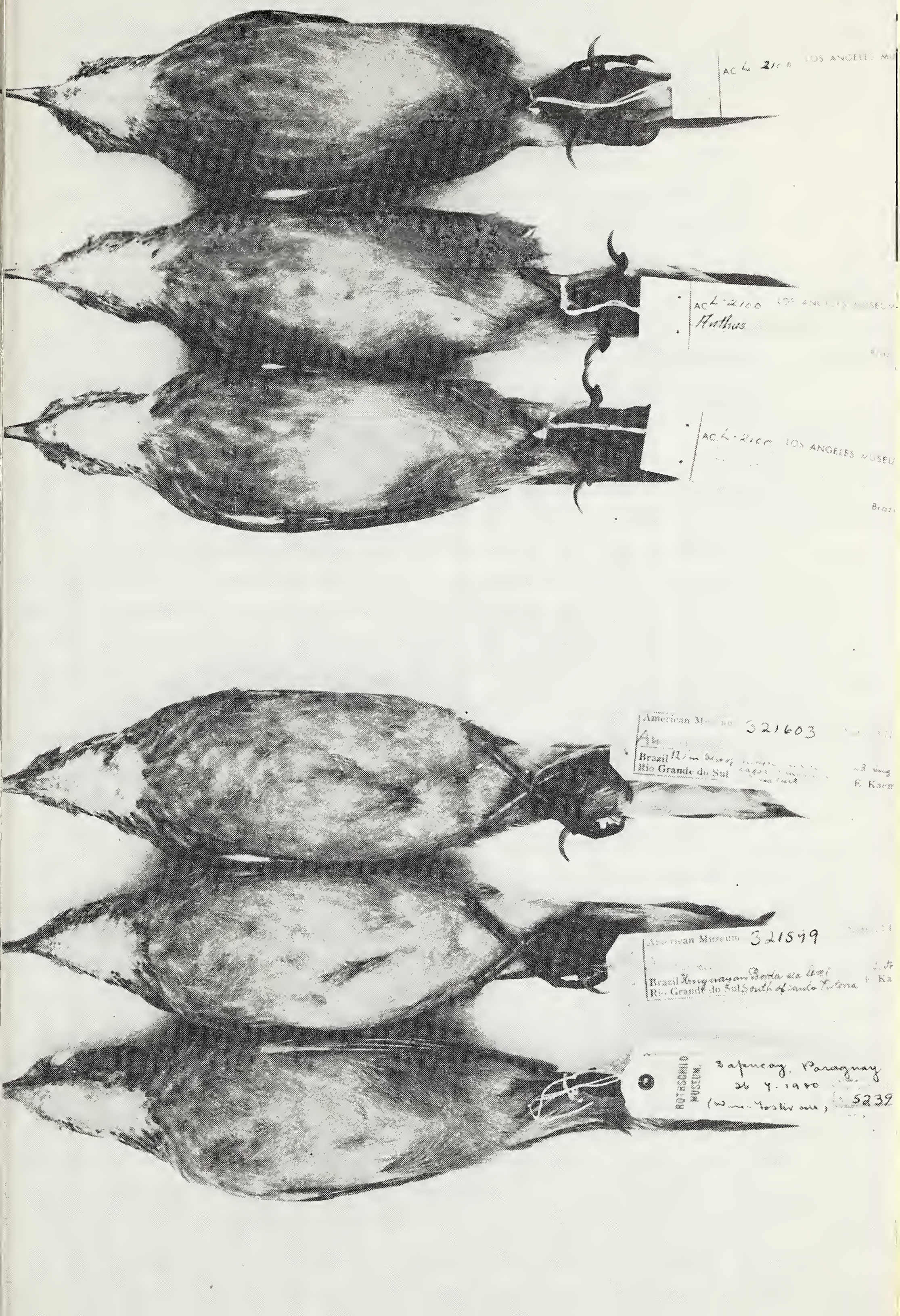
TYPE: From 20 kms. north of São João da Aliança, Goiás, Brazil. No. 32483, Los Angeles County Museum. Adult male collected April, 30, 1956, by Kenneth E. Stager (KES 15822). Holotype to be deposited in the Museu Nacional do Brazil. Paratypes (8) in the Los Angeles County Museum.

DIAGNOSIS: Nearest to *Baryphthengus r. ruficapillus* of southeastern Brazil, but distinguishable by the overall more pallid tone to colors of crown, nuchal area, throat, breast and abdomen. Rufous band of lower breast wider and paler than in specimens from southeast Brazil.

RANGE: Known only from the Chapada dos Veadeiros and the Serra Dourada areas of the upper Rio Tocantins drainage area of Central Goiás.

→

Fig. 1. Ventral view of type series of *Anumbius annumbi machrisi* Stager (right) compared with three specimens of the nominate race *Anumbius a. annumbi* (Vieillot) from southern Brazil and Paraguay. Holotype third specimen from right.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E. Kaem
American Museum 321599
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ROTHSCHILD MUSEUM.
Sapucay, Paraguay
26 7. 1900
(Wm. Foster coll.)
5239

DESCRIPTION OF TYPE: Crown and nape Kaiser Brown with the color extending well down upon the mantle. Back and sides of neck Kronberg's Green, shading into a deeper green on rump, wings and tail. Outer webs of primaries Jay Blue. Throat Ochraceous Buff shading into Yellowish Citrine on upper breast; lower breast with a wide (45 mm.) band of bright Tawny. Abdomen Tea Green. Central rectrices untrimmed. Specimen is in fresh, unworn plumage. Wing, 155 mm.; tail, 224 mm.; exposed culmen, 36 mm.; culmen from base, 46 mm.; tarsus, 28 mm.

REMARKS: A series of nine specimens in fresh plumage show this proposed form to be uniformly lighter in color tone, and more suffused with rufous buff than a comparative series of specimens of the nominate form from the states of São Paulo, Minas Gerais and Bahia. The form *B. r. berlai* shows very strong affinities with the coastal form, *B. r. ruficapillus*, rather than with *B. r. martii* to the northwest. It is highly doubtful that *B. r. martii* and other forms of *Baryphthengus* of northwestern South America and Central America are, in reality, conspecific with *Baryphthengus ruficapillus* of southeastern Brazil, as proposed by some authors (Peters, J. L., Checklist Birds of the World, V, 1945:224-225).

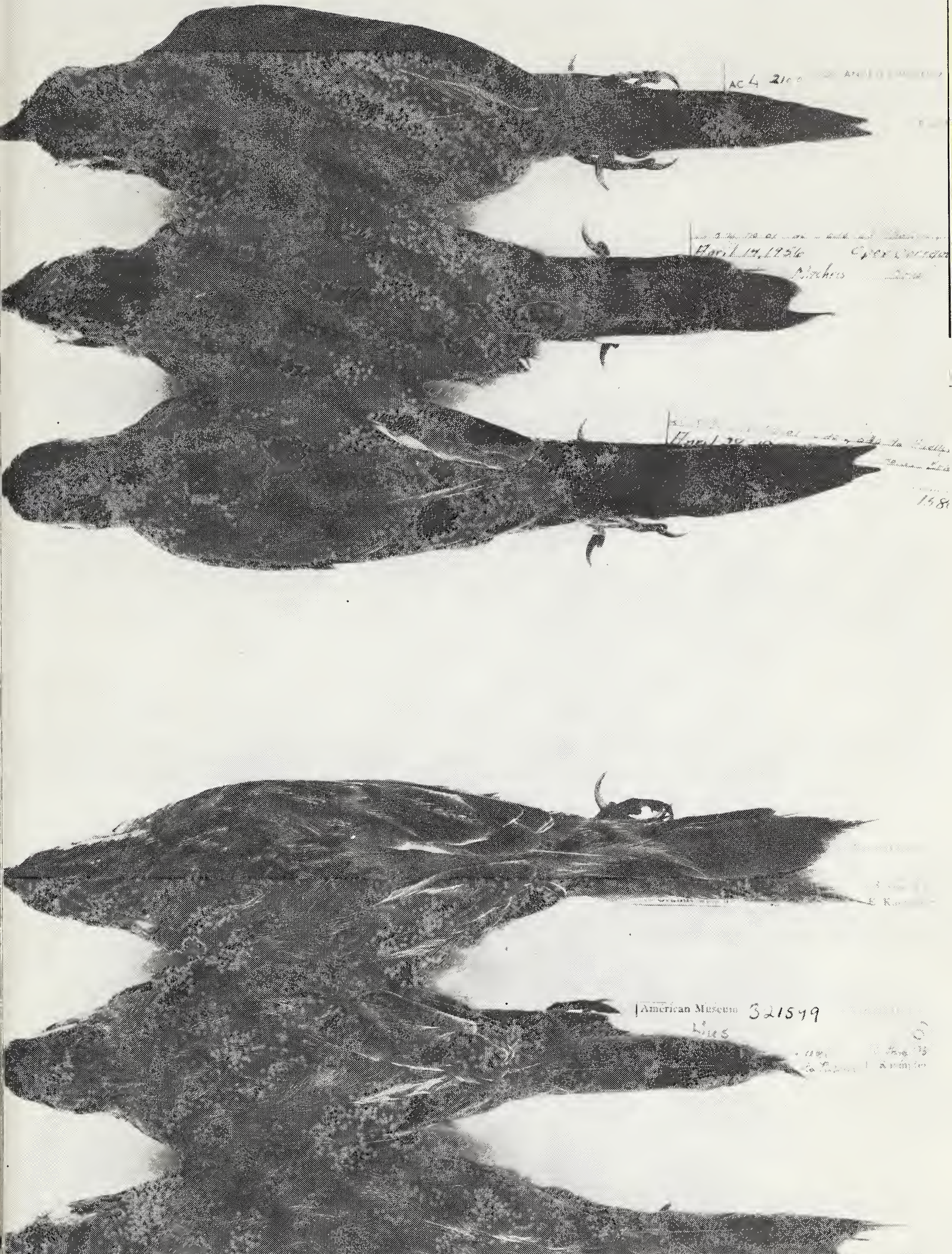
The subspecific name honors Mr. Herbert F. Berla, ornithologist of the Museu Nacional do Brasil, who assisted the author on the expedition to Goiás, Brazil.

SPECIMENS EXAMINED

B. r. ruficapillus
- Brazil
  - São Paulo, Maresias, 2 ♂ 1 ♀ (LACM)
  - São Paulo, Anumbi, ♂ (LACM)
  - São Paulo, Mun. de Iguape, ♂ (LACM)
  - Minas Gerais, 41 kms. no. of Raul Soares, ♀ (LACM)
  - Bahia, Cajareiras, 4 ♂ 2 ♀ (AMNH)
  - Rio Grande do Sul, Lagoa da Forma, 2 ♀ (AMNH)

B. r. berlai
- Brazil (LACM) Holotype and 8 paratypes.
  - Goiás, 20 kms. no. of São João da Aliança, 3 ♂ 2 ♀
    - ♂ Paratype (LACM 32481)
    - ♀ Paratype (LACM 32482)
    - ♂ Holotype (LACM 32483)
    - ♀ Paratype (LACM 32484)
    - ♂ Paratype (LACM 32485)
  - Goiás, 24 kms. so. e. of Formoso, Serra Dourada, 4 ♀
    - ♀ Paratype (LACM 32478)
    - ♀ Paratype (LACM 32479)
    - ♀ Paratype (LACM 32480)
    - ♀ Paratype (LACM 32486)

Fig. 2. Dorsal view of type series of *Anumbius annumbi machrisi* Stager (right) compared with three specimens of the nominate race *Anumbius a. annumbi* (Vieillot) from southern Brazil and Paraguay. Holotype third specimen from right.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No. 34. A new Giant Water Bug from Mexico, by Arnold S. Menke.

Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

MBER 34 December 15, 1959

A NEW GIANT WATER BUG FROM MEXICO

(Hemiptera: Belostomatidae)

By Arnold S. Menke[1]

In the course of identifying the specimens of *Lethocerus* in the Entomological Collection of the Los Angeles County Museum (LACM) as a part of a study of the Western Hemisphere members of the genus, a new species was found which is closely related to *L. colossicus* (Stal) and *L. camposi* (Montandon). Consequent to this discovery, additional material was obtained through the courtesy of the California Academy of Sciences (CAS) and the David R. Lauck Collection (DRL), University of Illinois. The author (AM) recently took more material while on a collecting trip into Mexico. The abbreviations, indicated in parentheses above, designate the place of deposition of type specimens.

I would like to acknowledge the loan of specimens of *L. camposi* by Dr. John S. Garth of the Hancock Foundation, University of Southern California.

Lethocerus truxali new species
(Figs. 1, 5)

Size: Male, length 68-73 mm.; holotype, length 73 mm., width 29 mm.

Description of male: Interocular space with an irregular median carina near apex; inner margins of eyes subparallel for most of their length but diverging rather suddenly near vertex; ratio of narrowest interocular distance to widest, 3 : 4; eye width (measured through eye at inner posterior angle) less than greatest interocular distance; dorsal outline of eye (viewing head from front) curved; widest postocular space one-half width of clypeus; lateral margin of pronotum evenly arcuate, foliaceous and light brown; anterior lobe of pronotum dark brown with two broad, diverging, light brown stripes (best seen in alcohol); hemelytron evenly

[1]University of California, Davis, Calif.

colored, not irrorate; veins of corium very prominent; metasternum produced into a spine posteriorly; abdominal venter evenly colored dark brown, although with a tendency to be irrorate in some specimens; connexival plate I covered mesally with appressed pubescence; profemur dorsally with a median, longitudinal, dark brown stripe, the length to width ratio, 18.7 : 3.7; outer margin of metatibia nearly straight; width of metatarsal segment I less than least interocular distance, the ratio, 2.7 : 3.1; aedeagus as in figures 1 and 5.

FEMALE: Similar to male.

TYPES: Holotype male: Acapulco, Guerrero, Mexico, Dec. 15, 1955, Alex Elias (LACM). Allotype female: Guaymas, Sonora, Mexico, Sept. 19, 1955, B. C. Templeton (LACM). Paratypes as follows: 72 mi. so. Los Mochis, Sinaloa, Mexico, July 17, 1956, A. Lewis (LACM) ♂; Mazatlan, Sinaloa, Mexico, June 27, 1918, J. A. Kusche (CAS) ♂; Tuxpan, Nayarit, Mexico, Aug. 12, 1957, D. Lauck and W. Wheatcroft (DRL) 6 ♂♂, ♀; Tepic, Nayarit, Mexico, Aug. 26-27, 1959, A. Menke and L. Stange (AM) 9 ♂♂, 6 ♀♀. Paratypes from the David R. Lauck and the A. Menke collections will be deposited in the collections of the University of Kansas, the U. S. National Museum and the Stockholm Natural History Museum.

DISTRIBUTION: In Mexico this species is probably restricted to the west coastal drainage system, being the counterpart in the west of *Lethocerus colossicus* (Stal, 1855)[2] which is found along the east coast of Mexico and on into Central America and the West Indies. *Lethocerus truxali* probably occurs in Central America also, as indicated by two female specimens taken by David Lauck at Dario, Matagalpa, Nicaragua. The specimens agree in every way with *L. truxali* but males will have to be seen for positive identification.

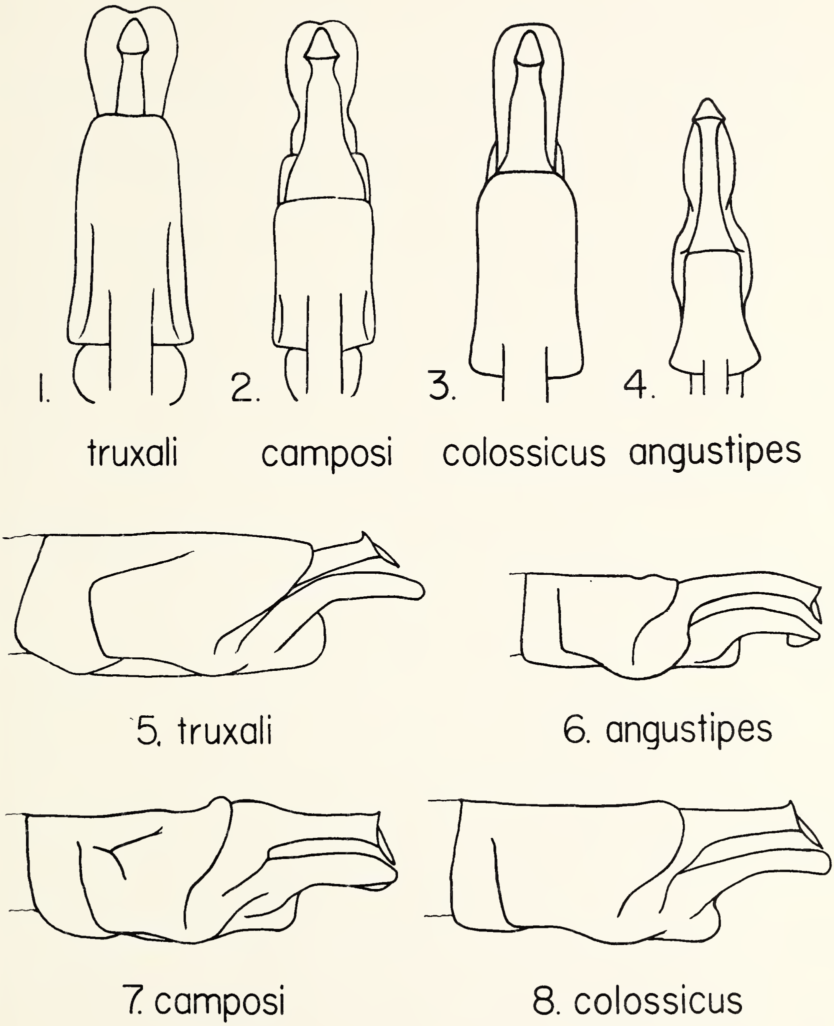
COMPARATIVE NOTES: For one using Cummings' (1933) key to *Lethocerus, L. truxali* will key out to *L. camposi* (Montandon, 1900) which is known only from Ecuador. These two species are very similar externally but *truxali* can be distinguished by the two diverging light brown stripes on the pronotum. The pronotum of *camposi* is more uniform in color. The aedeagus differs in the two species (Figs. 1, 2, 5, 7). *L. truxali* is also readily separated from *L. colossicus*.[3] The latter has peculiar eyes that are flat along the dorsal margin and nearly as wide as long. In addition, the postocular space is wider than one-half the width of the clypeus in *L. colossicus*. In *L. truxali* the eyes are rounded along the dorsal margin and are obviously longer than wide. The aedeagus of *colossicus* is distinct

[2]The name was spelled *collossicus* in the original description, but this was obviously a printer's lapsus since the species name was derived from the Greek word *kolossos* and should have been spelled with one "l" as corrected by Stal in later references.

[3]Dr. Eric Kjellander of the Stockholm Natural History Museum kindly loaned me the type of *L. colossicus*. It agrees with Stal's description. The specimen is a female and bears the following data on labels: Honduras (hand written), Hjalmarson (hand written), typus (machine printed on red card), and the numbers 59-86. The specimen measures 78.5 mm. long and 30.5 mm. wide.

(Figs. 3, 8). *L. angustipes* (Mayr, 1871), is the only other Mexican species which might be confused with *L. truxali*, but it is smaller and has a distinct aedeagus (Figs. 4, 6).

This species is named in honor of Dr. Fred S. Truxal who has made many contributions to the taxonomy of the aquatic Hemiptera.



Figs. 1-8. Aedeagus of related species of *Lethocerus*. Figs. 1-4, dorsal view; figs. 5-8, lateral view.

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