PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX

SAN FRANCISCO
PUBLISHED BY THE ACADEMY
1931–1933

COMMITTEE ON PUBLICATION

Dr. Barton Warren Evermann, *Chairman and Editor*

Dr. C. E. Grunsky

Dr. Wm. E. Ritter

CONTENTS OF VOLUME XX

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 1, pp. 1-7, 3 text figures MAY 22, 1931

I

GEOGRAPHIC VARIATION IN THE RICHARDSON GROUSE

BY

HARRY S. SWARTH

Curator, Department of Ornithology and Mammalogy

Tetrao richardsonii was described by Douglas[1] from the Rocky Mountains, Lat. 52° N., Long. 115° W.; it has commonly been regarded in later years as a subspecies of the *Dendragapus obscurus* aggregation. In 1914, Taverner[2] named *Dendragapus obscurus flemingi* as a northern variant of this same group, with type locality at Teslin Lake, Yukon Territory. This was described as a dark colored form, all comparisons being made with birds from "southern British Columbia," apparently from the south-central section. I, myself, was familiar with "*richardsonii*" only as from the Okanagan region, British Columbia, and from eastern Oregon. Birds from northern British Columbia were obviously different from the southern specimens, just as Taverner described, and I accepted *flemingi* at face value, as a well marked, dark-colored, northern subspecies, probably of rather restricted distribution.

When Major Allan Brooks and I collected together in the Atlin region in 1924 he was outspokenly skeptical as to the validity of *flemingi*, assuring me that he had seen dark-colored grouse from mountains in the "wet belt" of southeastern British Columbia, remote from the described habitat of

[1] Trans. Linn. Soc. Lond., XVI, pt. 1, 1829, 141.
[2] Auk, XXXI, 385.

flemingi. This is the basis of Brooks'[3] later statement that "Swarth is well aware of the presence of a very dark form of *richardsoni* with all the characters of *flemingi* throughout the whole of the humid southern interior of British Columbia." I was aware of it in the sense that Brooks had given me this information. I am glad to pay tribute here to the keenness of Brooks' field observations and to say that I did not for a moment doubt the accuracy of what he told me, but I did not see how I could utilize the knowledge at that time, in the absence of specimens or other exact data.

The problem naturally remained in my mind, however, and it was forcibly brought to the fore when in 1928 Messrs. Mailliard and Tose, of the California Academy of Sciences, returned from Creston, British Columbia, with four adult male *Dendragapus* that were indistinguishable from birds of the Atlin region. Creston is close to the extreme southeastern corner of the province, Atlin in the extreme northwest. Following this I availed myself of the opportunity that offered to examine all the specimens of the *richardsonii* aggregation in the British Museum, the Rothschild Museum at Tring, the United States National Museum and the Field Museum of Natural History.

The result of all this is my firm though reluctant conviction that *Dendragapus obscurus flemingi* Taverner is a synonym of *Tetrao richardsonii* Douglas. Two distinguishable forms had been lumped under the one name *richardsonii* but Taverner named the wrong subspecies. There is no type specimen extant of Douglas' *richardsonii,* nor, so far as I know, any near topotypes, but I have seen enough specimens from points north, west and south of the type locality to carry conviction that, interposed between the type locality of *richardsonii* and the habitat of the pale colored southwestern form, there is continuous distribution of the dark colored northern and eastern form. The southwestern subspecies appears to be a pallid variant that has been evolved in the semi-desert conditions of the northern part of the Great Basin, extending northward together with the sage brush and a few other attendant birds, mammals and plants for a short distance into south central British Columbia.

---

[3] Condor, XXIX, 1927, 113.

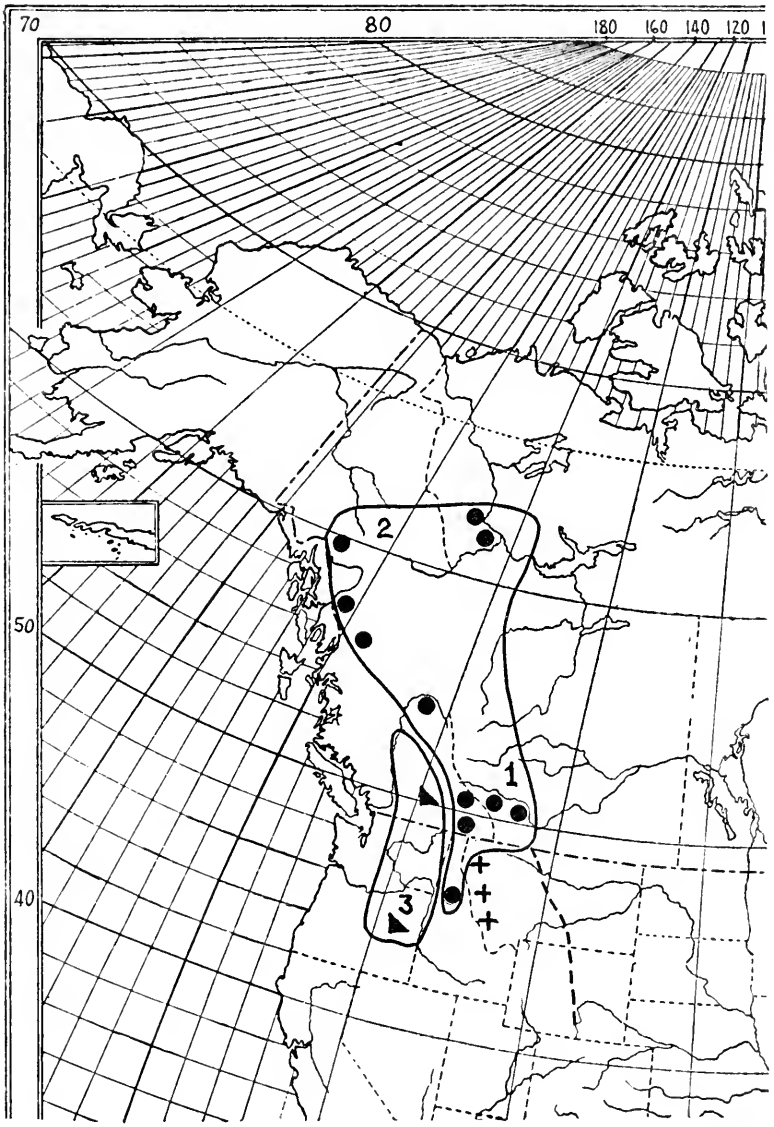


Fig. 1. Map of western North America, showing distribution of *Dendragapus obscurus richardsonii* and *D. o. pallidus*. Symbols indicate localities from which specimens were examined: circles, *richardsonii;* triangles, *pallidus;* crosses, supposed intergrades between *richardsonii* and *obscurus*. 1, type locality of *Tetrao richardsonii;* 2, type locality of *Dendragapus obscurus flemingi;* 3, type locality of *Dendragapus obscurus pallidus*.

The unavoidable readjustment of our ideas regarding this group of grouse calls for a new name for the southwestern form.

Dendragapus obscurus pallidus, new subspecies

Type: Male adult, no. 6825[4], coll. J. & J. W. Mailliard; October 14, 1894; **Cornucopia, Baker County, Oregon.**

Description: With the specific characters of *Dendragapus obscurus.* Similar to *D. obscurus obscurus* in general coloration but differs from that subspecies in not possessing a well defined terminal gray band upon the rectrices. Similar to *D. obscurus richardsonii* in the absence of the above mentioned tail marking, but differs in being of generally paler coloration.

There do not seem to be any minor details of color, markings or measurements to distinguish between the two subspecies *richardsonii* and *pallidus.* The differences are of a general nature. One is developed to a dark extreme, the other to a pale extreme, and there is an accentuation of white markings in the one form, a softening of such markings in the other. *Pallidus* seems to be in character, as it is in geographical distribution, intermediate between *D. obscurus obscurus* and *D. obscurus richardsonii.* Between *D. o. obscurus* and *D. o. pallidus* there is no difference that I can see in body color and markings, and almost no difference in the shape of the tail. The fully adult *obscurus* has just such a square-cut tail as *pallidus* and *richardsonii.* So that the only difference there lies in the presence or absence of the terminal tail band.

Distribution: Dendragapus obscurus richardsonii. From northwestern British Columbia (Atlin) and southern Yukon (Lake Teslin) east into southwestern Mackenzie (vicinity of Fort Simpson and Fort Halkett), south through east-central and southeastern British Columbia (Rocky Mountains, Selkirk Range, and smaller ranges) and through western Alberta (vicinity of Banff and Calgary) into northern Idaho.

[4] The Mailliard collection belongs to the California Academy of Sciences but has not yet been catalogued.

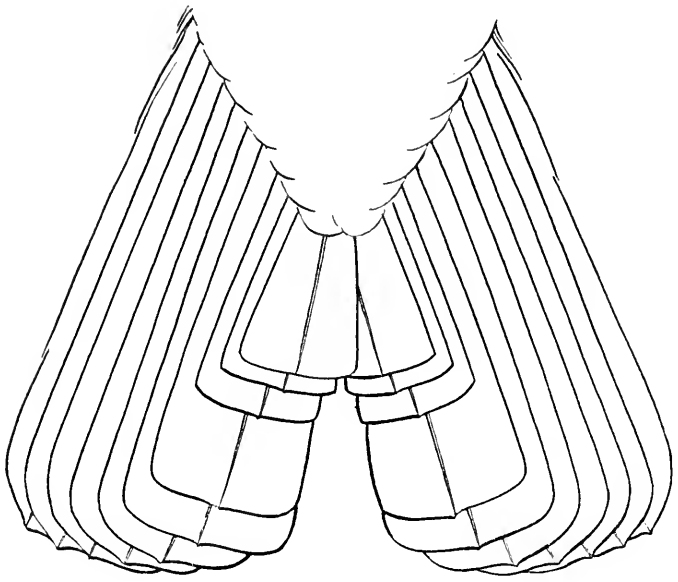


Fig. 2. Tail of *Dendragapus obscurus richardsonii,* dorsal view; adult male (Museum of Vertebrate Zoology, no. 44664); ½ natural size. This bird, shot September 1, has nearly finished the annual molt; the lateral rectrices are full grown; the central ones less than half emerged.

Dendragapus obscurus pallidus. From south central British Columbia southward over eastern Washington and northeastern Oregon.

The subspecific identity of *"flemingi"* and *richardsonii* can, I think, be accepted as an established fact. Likewise, the northern boundaries of *richardsonii* are, I believe, indicated with fair accuracy on the accompanying map. Conditions are not so clear, however, at the southern boundaries of *richardsonii* and *pallidus,* and in the territory where either or both approach the habitat of *obscurus.*

I have examined various specimens from points on the eastern slope of the Rocky Mountains in Montana, that, when I saw them singly in the several museums where I happened to be visiting, seemed to me to belong without doubt to the form I now term *pallidus.* There were, however, one or two specimens from more western points in Montana and from Idaho that were dark colored and otherwise typical of *richard-*

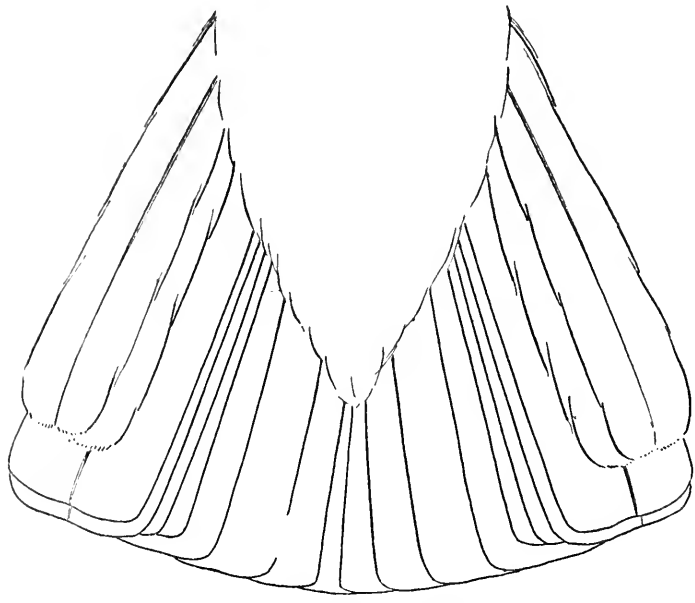


Fig. 3. Tail of *Dendragapus obscurus pallidus,* ventral view; immature male (coll. of J. and J. W. Mailliard, no. 6824); ½ natural size. This bird is near the end of its first annual molt and is assuming the adult type of tail. The two outermost rectrices on each side are of the previous year's (immature) plumage, not yet discarded though the central rectrices are full grown.

sonii. To interpret the pale colored Montana birds as representative of *pallidus* would result in a disconnected habitat for that subspecies, with a *richardsonii*-inhabited area interposed. While most of the debateable Montana birds were examined by me singly before I realized the need of further comparisons, I have several available at this writing and also good specimens of *obscurus* from Colorado. I now believe that the pale colored Montana birds are in all likelihood illustrative of intergradation between *obscurus* and *richardsonii.* There is remarkably little difference between *obscurus* and *pallidus* except for the tail marking, and a slight change in this character from the *obscurus* mode would produce just such *pallidus*-like birds as those that I have seen from the western slope of the Rocky Mountains in Montana. This is my present interpretation of the facts but the whole matter should, of course,

be considered open for further investigation. Anyone who has the opportunity should make a thorough study of variation in these grouse in Montana and Idaho.

Molts and the succession of plumages in *Dendragapus* are rather complicated. In a previous publication[5] I have set forth what I knew on this subject, but in the present study a fresh fact came to light that seems worth presenting. In the male *richardsonii*, as in others of the genus, there are conspicuous differences in the tails of young and fully mature, two years old and more (Swarth, *loc. cit.*, fig. C). There are also, it seems, differences in the manner of molt of the rectrices. In the old bird the outermost tail feathers are lost first and their successors are nearly full grown when the central pair are dropped. The result is a lyre-shaped tail that is conspicuous in flight, and that serves readily to identify such old males as are flushed in August and early September. In the year-old male first assuming the adult plumage this procedure is reversed, as shown by a specimen at hand, and the outer rectrices are the last to be renewed (see figs. 2, 3).

The map presented herewith was prepared by Miss Margaret W. Wythe, the drawings of tail feathers by Mrs. Frieda Abernathy.

---

[5] Swarth, Univ. Calif. Publ. Zool., vol. 30, 1926, pp. 73-84, text figs. B-E.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 2, pp. 9-104 NOVEMBER 18, 1931

II

THE FLORA OF THE REVILLAGIGEDO ISLANDS

BY

IVAN M. JOHNSTON

Gray Herbarium of Harvard University

The four Revillagigedo Islands, Socorro, San Benedicto, Roca Partida and Clarion, are a group of scattered and apparently distinct peaks projecting from deep water several hundred miles off the west coast of Mexico. In origin they are chiefly if not exclusively volcanic. They lie along lat. 19° N and are spread out over 200 miles of ocean from east to west. They are arid, uninhabited, and only rarely visited, and are the most isolated and remote bits of land claimed by Mexico.

As the exploration of the equally remote islands off the west coast of South America has yielded such interesting botanical results, it is most surprising that the Revillagigedos, the most promising and remote islands off the west coast of Mexico and Central America, have never had a detailed floristic study. The floristic literature concerning the islands is most fragmentary and scattered. It consists chiefly of two short, very incomplete lists that were published over 30 years ago. With the increased interest that has since developed in insular floras and in the problems they present in plant dispersal, there has come a distinct need for a detailed enumeration and analysis of the flora of the Revillagigedos. I am, accordingly, presenting in this paper a critically prepared catalogue of the insular species

and have given such data as bear upon the floristic relationships and origin of the flora of the islands. While more collecting must be done on the islands, particularly upon Socorro, and especially during the rainy season, before the flora is completely known, I believe that the data I have been able to present here are sufficient to give a reasonably good general idea of the island-flora and of its relationship to the flora of the continent.

BOTANICAL EXPLORATION

Although the islands were discovered in 1533 [cf. McLellan, Science, n. s., 62: 172 (1925)], the first recorded botanical work done upon them appears to have been that of George Barclay, botanist on the "Sulphur", who collected on Clarion December 29, 1839. In Capt. Belcher's Narrative of the Voyage of the Sulphur, 1: 349 (1843), are found the first comments on the flora of the islands by any one of botanical experience. Concerning Clarion Island [Barclay was unable to land on Socorro] Captain Belcher remarks:— Mr. Barclay notices, "Argyreia rosea [*Ipomoea halierca*], and a species of ruta [*? Tribulus*], run along the sand, the former extending upwards of 25 feet in length. Cassia pendula [*? Calliandra*], Guilandina bonducella [*Caesalpinia crista*], and a species of tetranthera [*? Irisine*], are among the plants which I found upon higher ground. Convolvulus purpurea [*Ipomoea cathartica*], and two species of phaseolus [*Phaseolus atropurpureus* and *? Canavalia apiculata*], are abundant in the ravines; and a species of euphorbia [*E. anthonyi*], like the species heterophylla, and prickly pears [*Opuntia* sp.], cover the ground in many places, and form a kind of stage for the leguminous plants to run upon." These notes are obviously from Barclay's manuscript journal, a portion of which I have seen, thanks to the kindness of Captain Ramsbottom of the British Museum of Natural History. The only other species mentioned in his journal are *Sophora tomentosa* and *Dodonaea viscosa*. The plants collected during the 1836-42 cruise of the "Sulphur" were studied by George Bentham and treated in his well known Botany of the Voyage of the Sulphur, which was published in 1844 and 1845. A search through this volume

has failed to disclose a single reference to Clarion Island or the Revillagigedos. It is quite possible that Barclay's Clarion collections were among those he mentions in his journal, under June, 1837, as having been ruined by damp storage on board ship. If his specimens are still extant they may be preserved in the herbarium of the British Museum of Natural History.

The real beginning of the botanical exploration of the islands occurred in 1889 with the visit of the "Albatross". Anchorages were made at Sulphur Bay, Clarion Island, March 4-5; at Braithwaite Bay, Socorro Island, March 8-9; and along the east side of San Benedicto Island on March 10. Botanical collections were made on Clarion and Socorro by Charles H. Townsend, the ornithologist of the voyage. These were studied by Vasey and Rose and formed the basis of their paper, Proc. U. S. Nat. Mus. 13: 145-149 (1890), entitled "Plants collected in 1889 at Socorro and Clarion Islands, Pacific Ocean." This remains the longest paper that has yet been published on the insular flora and the only one to date devoted exclusively to it. Twelve species were reported from Clarion and 19 from Socorro. Townsend did get to the crest of the main ridge of Clarion, but from his notes and collections it is obvious that his botanizing on Socorro was confined to the lower slopes near the sea. Consequently, his collections lack the distinctive plants of the islands, the numerous endemics growing on the higher slopes of Socorro. His most interesting discoveries were *Teucrium townsendii* on Clarion, and *Perityle socorrosensis* on Socorro. He did obtain material of the endemic species of *Borreria, Ipomoea, Euphorbia, Erigeron* and *Stenophyllus,* but this was neither sufficient nor good enough to be described by Vasey and Rose. The complete first set of Townsend's collections is in the U. S. National Herbarium. A good set of duplicates is to be found in the Gray Herbarium. His specimens were not numbered.

It was not until 1897, when the islands were visited by the "Wahlberg", that the really distinctive features and the riches of the Revillagigedo flora were discovered. This schooner, fitted for exploration and in charge of A. W. Anthony, the ornithologist, spent more than a month among the islands. Over two weeks, early in May, were devoted to a visit to Socorro where three anchorages were made, "two on the south side and one in a little bay on the north". Well over a week

was spent on Clarion at anchor in Sulphur Bay. Three different stops were made at San Benedicto, with the anchorages all being made on the southeast side of the island. The botanizing on the islands was done by A. L. Stockton, a young nephew of Katherine Brandegee. His collections were the first made on San Benedicto and the first obtained on the middle slopes of Socorro. Many of the endemic species of the latter island were consequently first collected by him. Stockton's collections were turned over to T. S. Brandegee for study and distribution. The direct result was the appearance in December, 1898, of a paper by Brandegee, Erythea 7: 1-9, entitled "New Species of Plants from Mexico", in which 11 new species were described from the islands, 8 of them being from Socorro alone. A year and a half later Brandegee, Zoe 5: 19-28 (1900), published his paper entitled, "Voyage of the Wahlberg", the last two pages of which contain bare lists giving the species then known from each of the Revillagigedo Islands. This list has remained the most complete exposition of the flora to date. In it, 5 species are attributed to San Benedicto, 27 to Clarion and 41 to Socorro.

Although Stockton collected the specimens, it should be noted that they were distributed and were cited in Brandegee's papers under Anthony's name. Duplicates of these collections have been distributed widely, in all cases, except the original collection of *Nicotiana stocktoni,* with only Anthony's name on the label. Consequently in the present paper I have followed the labels and have attributed the collections to Anthony. It is difficult to estimate the size of the total collection. Certain specimens, probably those of which a goodly number of duplicates were obtained, were distributed in numbered sets accompanied by completely printed labels. There is, however, certainly an equally large, if not larger number of collections that are unnumbered, and which have hand-written labels. These probably represent those collections of which very few or no duplicates were obtained. Notes I have assembled show that the numbered collections were allotted as follows, 369-372 for San Benedicto, 375-401 for Socorro, and 403-417 for Clarion. Of the total series of numbers, 369-417, I have not seen 373, 374, 402 nor 407. Number 394 has been applied to both *Zanthoxylum* and *Corcopsis* and number 405 to both *Lepidium* and *Canavalia.* Number 371, *Stenophyllus,* has ap-

peared on labels transposed as 317. I have record of 25 unnumbered collections not represented in the numbered series. No doubt there are others that I have not encountered. As my records stand, however, Stockton's botanizing resulted in 6 collections from San Benedicto, 25 from Clarion and 41 from Socorro. The labeling of the collection seems to be prevailingly reliable. In fact, the only questionable labeling is that on the original collection of *Nicotiana stocktoni*. This species is given as from Socorro although I suspect it really came from Clarion. Though Brandegee lists *Scaevola* from Socorro, the specimens that he distributed are labeled as from Clarion. In this case I believe the label is correct. The full set of the Stockton collections is preserved in the herbarium of the University of California. The first set of duplicates of Stockton's plants is in the Gray Herbarium.

The next event in the botanical exploration of the islands was the visit there, between May 14 and July 9, 1903, of an expedition sent out by the California Academy of Sciences. The botanical collecting on the expedition was done by Fredrick E. Barkelew. His collections were being studied by Alice Eastwood when they were destroyed, along with her notes, in the San Francisco disaster of 1906. Fortunately, however, duplicates of Barkelew's collections had been sent out previously to various institutions in the United States. The best sets are now at the University of California and in the Gray Herbarium.

The expedition spent May 14-26 anchored off San Benedicto, from May 27 to July 2 exploring Socorro, and July 6-8 visiting Clarion. A letter to Joseph R. Slevin from Rollo H. Beck, head of the expedition, kindly forwarded me by Dr. Evermann, gives the following details of the botanist's activities:—"A young man named Barkelew collected some specimens and my notes contain the following: Ensenada, April 30, 1903, 100 specimens; San Martens Is., May 3, few plants; San Benedicto, May 15, 6 species taken; Socorro, May 27 to July 2, Barkelew found about 70 species; Clarion, July 6 and 8, quite a few flowers." It is especially to be noted that the expedition did visit Clarion, that Barkelew did collect there, and that the dates, May 27-July 3, 1903, written in on many labels of Barkelew's collections, properly apply only to the visit to Socorro.

While Barkelew's collections contain a goodly number of species not previously obtained on the islands—for he appears to have been the first to botanize on the higher slopes of Socorro—their value is greatly lessened by the very questionable geographic data that accompany at least some of his specimens. His specimens are attributed on the printed labels only to Socorro and San Benedicto. I have seen none of his collections labeled as from Clarion, although he is known to have collected there. I am, however, quite certain that some of the specimens, given as from Socorro, are mislabeled and came in fact from Clarion. The clearest cases seem to be *Caesalpinia* (no. 207), *Ipomoea* (no. 245), *Sophora* (no. 246), *Melochia* (no. 247), *Phaseolus* (no. 248) and *Cressa* (no. 252). Doubtless there are other similar cases of confusion which I have not detected. A collection of *Dodonaea* (no. 188) labeled as from San Benedicto is also questionable. That shrub is not otherwise known from San Benedicto, a fact which seems significant when it is realized that Barkelew does not have collections from Socorro and Clarion where it is a conspicuous plant.

I have assembled all the data I could, regarding Barkelew's collections. This indicates that his Revillagigedo collections fall in the gamut of numbers 169-252. I have seen a few collections that are unnumbered. The numbers 169-176 are all associated with plants attributed to San Benedicto. The remaining ones seen by me, except the *Dodonaea* (no. 188) which I have mentioned, are all labeled as from Socorro. I have not seen the specimens associated with the following numbers: 185, 186, 195, 209, 212, 213, 219, 226, 234, 235, 237-41 and 249-251.

The most recent explorations of the Revillagigedos were those made by the California Academy of Sciences in 1925. During this expedition, anchorages were made at Sulphur Bay, Clarion Island, from April 26 to May 1; at Braithwaite Bay, Socorro Island, from May 2-11; and on the east side of San Benedicto on May 12. A detailed account of the expedition, with maps, has been given by Hanna, Proc. Calif. Acad. Sci., ser. 4, **15**: 29-66 (1926). The botanist was Herbert L. Mason. Forty-four collections (nos. 1550-1593) were made on Clarion, 83 (nos. 1596-1678) on Socorro, and 9 (nos. 1680-1688) on San Benedicto. Mason reached the summit of

Socorro and appears to have made the first botanical collections ever obtained there. His collections are reported upon for the first time in the present paper. The first set and all type-specimens in his collections are deposited in the Herbarium of the California Academy of Sciences. A set of duplicates has been presented to the Gray Herbarium, by the California Academy of Sciences.

Although several large collections have been made in the Revillagigedo Islands they still remain a promising field for further botanical work. Each succeeding exploration has discovered additional undescribed species and has found more continental species not previously reported for its flora. Further collecting, especially on Socorro and particularly on its higher slopes, will doubtless add more species, especially if carried on, not in the dry months of May and June as previously, but in the growing season during the period of occasional showers from August to December. Careful and extensive collecting at a favorable time will probably show that we now know only about 75%, or even less, of the total insular flora.

While the discovery of each species additional to the recorded flora of the islands is of some scientific interest and is a source of personal satisfaction for the collector, the most important botanical work now awaiting attention on the islands concerns not species so much as the vegetation and the living plant. The past collectors on the islands have been quite satisfied in making a single collection of each species found on each of the islands. No attempt has been made to make repeated collections either to show variation of the plants or their distribution on particular islands. There is almost nothing on record regarding the abundance, habits, stature, habitats, associates, flower-color, etc., of the various plants of the islands. Few, if any, notes have been made which would permit the botanists who have not visited the islands to visualize the living plant and see it in relation to its environment. The plant ecology of the islands is an untouched subject.

Future collecting on the islands promises not only the discovery of heretofore unrecorded species and presents the opportunity for much needed and valuable observation on the habits of the species and their ecological relations, but offers,

in addition, the chance to check critically in the field the list of species now reported from the several islands. Each of the islands has a rather distinctive flora. This has been here and there obscured by questionable records, traceable, no doubt, to mislabeling that has resulted from a mixing of collections from different islands. Not only should collectors maintain the most scrupulous accuracy in the data for their own specimens, but they can, by their notations that certain records could not be verified despite alert and continued watchfulness on the islands, give us more basis to doubt these questionable records and eventually permit us to disregard them as almost certainly false.

SOCORRO AND ITS FLORA

Socorro, the largest of the Revillagigedos, is roughly quadrangular in shore-line with a long axis, lying NW to SE, of about 9[1] miles in length. Its width varies from about 7 miles at the NW end to about 4 miles at the SE. The island contains approximately 50 square miles. The topography is simple, the land sloping from the shore prevailingly upward towards the center of the island. Socorro is, hence, a broadly conical peak. Its summit is 1130 meters above the sea. In structure the island appears to be entirely volcanic, the central peak, in fact, being a small quiescent volcano that has been reported in eruption as late as 1848. Such volcanic activity, however, does not appear to have been of a devastating nature, at least for a good many centuries. The biota of the island indicates a considerable antiquity.

The island is situated at about lat. 18° 50′ N and long. 111° 00′ W. It lies about 260 miles S by W from the tip of the peninsula of Lower California and about 320 miles WSW from Cape Corrientes (in Jalisco), the most westerly point on the mid-section of the Pacific coast of the Mexican mainland. From Maria Madre, the largest of the Tres Marias Islands, it lies 310 miles away SW by W. The land nearest to Socorro is the island of San Benedicto which lies only about

[1] Since the only surveys of the islands have been by navigators and the best maps, consequently, are navigation charts, I have given distances in and about the islands in nautical miles (roughly 6080 ft. or 1853 meters). All other measurements are in the metric system.

25 miles away to the NNE. The small barren, bird-rock, Roca Partida, lies over 80 miles away W by N. Clarion Island, the most remote member of the archipelago, is situated about 220 miles away to the westward. Socorro is separated from the close-lying San Benedicto by ocean depths of over 2900 meters. To the north and east of these two islands, however, and separating them from the peninsula and mainland of Mexico, are depths of over 3000 meters. To the west, between Socorro and Clarion, depths of 3600 meters are recorded. South and west of the archipelago the ocean is more than 4000 meters deep.

The climate of Socorro is an arid one and, except for the rare and local torrential storms that visit most desert areas, the precipitation is scanty. The upper slopes of the island, however, are favored with another source of moisture. These upper slopes, two to three times higher than those on the other Revillagigedos, reach into the strata of clouds borne on the trades and are thus benefited not only by a somewhat increased humidity and protection from the sun but to a greater or lesser extent by actual moisture obtained from the clouds. The only mesophytic flora on the islands, which have a prevailingly xerophytic one, is found on these fog-brushed higher slopes of Socorro.

Concerning even the general features of the vegetation on Socorro there has been very little written. Anthony, Auk ser. 2, 15: 312 (1898), states that "The greater part of the island is covered with a very dense growth of underbrush, the weather side (north and northwest exposures) being especially thickly covered, making travel, except in favored spots, well nigh impossible. Trees are abundant on the weather side of the island but on the south and east sides they are mostly confined to cañons, and were smaller than on the north slopes. They were nowhere seen over forty or fifty feet in height, though usually covering considerable area with their broad spreading branches". The large trees mentioned are probably *Ficus cotinifolia.*

In Hanna's account, Proc. Calif. Acad. Sci., ser. 4, 15: 49-58 (1926), of the ascent of Mt. Evermann, the central peak of Socorro, there are passages which give more details concerning the vegetation and the physical features of the island. The party started from Braithwaite Bay at the south-

ern end of the island and ascended the peak from the eastern side. Dr. Hanna writes, "We set out northwest at first, up a small rocky gulch to escape as much as possible the stiff brush of the lowlands. This took us to a series of bare red hills which we crossed toward the mountain. Several gullies and ridges were crossed with great difficulty on account of the heavy brush. This was excessively fatiguing and half an hour after we left the beach all of us were drenched with perspiration. . . . On the way across the red hills (foothill section) we were impressed by some areas which were entirely barren of vegetation and at first we were at a loss for an explanation. Some parts were covered with dead brush, all flattened on the ground and pointing in the same direction. This indicated the action of water and we decided that the small section of the island had been visited by a great cloudburst at some previous time but probably subsequent to 1903. This supposition was fully proved next day when we found a box cañon leading down from the area to the sea. This was scoured out completely to bed rock while in front on the mouth there was an enormous quantity of boulders piled up. Such downpours as this must be of rare occurrence on Socorro because evidence elsewhere was lacking; in fact, most of the cañons indicated the passage of very insignificant quantities of water at any season. . . . About 11 a. m. we passed out of the zone of brush on the lower slopes of Mt. Evermann and entered the cañons which were densely forested with many kinds of strange trees. The traveling here was much easier and, to all of us, far more interesting. The trees were teeming with bird life, and the "Bumelia" trees afforded great quantities of delicious fruit, which we ate with relish. . . . One of the trees with white bark like a sycamore was about 40 feet high, one foot in diameter and bore long spikes of cream-white flowers. The fruit was about half an inch in diameter, pale green in color, and was not eaten by birds; therefore, we did not try it. The forests in the cañons were so dense that sunlight rarely penetrated to the ground; hence mosses, lichens, ferns and orchids were abundant on the trees and branches. Some of the Bumelia fruit trees were fully 50 feet high and although the larger trunks were irregular in growth they were at least five feet in diameter. What appeared to be canes of a species of blackberry grew to the extreme length of 200 feet but it had neither

fruit nor flowers and the identification could not be made with certainty. There was almost no underbrush in these cañons but the ridges and "hog-backs" were practically impassable, we learned through bitter experience during the afternoon. . . . Early in the evening, as the fogs of the mountain top closed in, we made our camp at the head of a heavily timbered cañon, and a fortunate choice this was, indeed. The fog passed over at each side and below us, but our camp was dry. This was a great relief because we had no bedding and the night was cold. A fire was kept up most of the night and we were fairly comfortable. The camp was made at an elevation, indicated by our barometer, as 2300 feet, seemingly an insignificant climb but the excessive heat and heavy brush wore us down. The temperature was only 82° to 88°F. during the day but it seemed much warmer than that. . . . After breaking camp [next morning] we climbed the obsidian ridge ahead of us, 200 feet and into the fog. Then we realized how fortunate we had been to select a dry camp site. The vegetation all about was drenched with the mist, yet there was not a drop of water to drink. . . . Evidently sheep frequent the open, brush-free summit because well beaten trails lead away in every direction. Some charred brush was found nearby in a position which indicated that a fire had passed through. Probably this was a remnant of the fire started by [the castaway] Grayson and which led to his rescue. He spoke of its having spread far and wide over the mountain-side before he was out of sight on his homeward journey. Even today the south side of the mountain is remarkably free of brush and is principally grown over with grass and some cactus. . . . From the top we were able to study the best means of approaching the mountain and found it unquestionably to be from Grayson's Cove. . . . Wooded cañons are absent on the south side [of the island] but are abundant on the north, east and west. Between them brush-covered ridges radiate outward like spokes in a wheel. . . . Careful search was made from the top in every direction for evidence of water but not a sign could be seen. To the eastward in one cañon there was a dry lake bed which unquestionably does contain a small amount of water during the rainy season. Up to this time we had thought there might be some reason for the supposition of Captain Colnett that a fresh-water lake existed on the island "because of the teal ducks"

found flying down to the sea. But with the unobstructed view we had we were thoroughly convinced that no permanent lake now exists on the island. It is barely possible that this dry lake bed did hold water throughout the year at the time of Capt. Colnett's visit and has silted up in the meatime. From what we saw of the erosion produced by a cloudburst on the east side of the island it seems entirely possible for a small lake to be entirely filled with sediment in one rainstorm."

The complete list of the flora of Socorro, with indications of the occurrence of the species on Clarion and San Benedicto, and a summary of their range off the archipelago, is given in the following tabulations:

NAME	San Benedicto	Clarion	DISTRIBUTION AND REMARKS
1. Polystichum muricatum	....	....	Guerrero to Costa Rica
2. Asplenium potosinum, var.	....	....	San Luis Potosi
3. Asplenium formosum	....	....	Nayarit to Costa Rica; West Indies
4. Adiantopsis radiata	....	....	Vera Cruz to Guatemala; West Indies
5. Pteridium caudatum	....	....	Nayarit to Salvador; West Indies
6. Polypodium polypodioides	....	....	Sinaloa southward; West Indies
7. Polypodium pulchrum	....	....	Colima to Costa Rica
8. Cheilanthes peninsularis, var.	....	×	Endemic
9. Psilotum nudum	....	....	Jalisco southward; West Indies
10. Eragrostis ciliaris	....	....	Lower California southward; West Indies
11. Jouvea pilosa	....	....	Lower California to Nicaragua
12. Sporobolus purpurascens	....	....	Vera Cruz to Costa Rica; West Indies
13. Aristida pansa	....	×	Arizona and Texas to San Luis Potosi
14. Paspalum longum	....	....	Endemic
15. Setaria geniculata	....	....	Lower California southward; West Indies
16. Cenchrus myosuroides	×	....	Lower California to Puebla; West Indies
17. Sorghastrum nutans	....	....	Lower California to Guatemala
18. Heteropogon contortus	....	....	Lower California southward; West Indies
19. Cyperus ligularis	....	....	Tres Marias Islands southward: West Indies
20. Cyperus duripes	×	×	Endemic
21. Cyperus aff. brunneus	....	....	Central America, so. Mexico, West Indies
22. Stenophyllus nesioticus	×	?×	Endemic
23. Pleurothallis unguicallosa	....	....	Endemic
24. Cattleya aurantiaca	....	....	Michoacan to Costa Rica
25. Epidendrum rigidum	....	....	Oaxaca to Costa Rica; West Indies
26. Peperomia chrysolepida	....	....	Endemic
27. Peperomia socorronis	....	....	Endemic

NAME	San Benedicto	Clarion	DISTRIBUTION AND REMARKS
28. Ficus cotinifolia	....	....	Lower California to Costa Rica
29. Phoradendron townsendi	....	....	Endemic
30. Aristolochia brevipes	×	....	Lower California to Oaxaca
31. Boerhaavia caribaea	....	×	Lower California southward; West Indies
32. Portulaca pilosa	....	×	Lower California southward; West Indies
33. Rubus sp	....	....	Affinities in southern Mexico
34. Prunus capuli	....	....	Lower California to Guatemala
35. Calliandra socorroensis	....	×	Endemic
36. Calliandra sp	....	....	Affinities in western Mexico
37. ?? Cæsalpinia crista	....	×	Record questionable
38. ?? Sophora tomentosa	....	×	Record questionable
39. Canavalia apiculata	....	×	Sinaloa to Colima
40. Phaseolus lunatus	....	....	Nayarit to Nicaragua; West Indies
41. ?? Phaseolus atropurpureus	....	×	Record questionable
42. Rhynchosia minima	....	....	Lower California southward; West Indies
43. Tribulus cistoides	....	×	Lower California southward; West Indies
44. Zanthoxylum insulare	....	....	Tres Marias Islands, West Indies and South America
45. Bursera nesopola	....	....	Endemic
46. Croton masonii	....	....	Endemic
47. Acalypha umbrosa	....	....	Endemic
48. Hippomane mancinella	....	....	Oaxaca southward; West Indies
49. Euphorbia incerta	....	....	Lower California to Tres Marias Islands
50. Euphorbia anthonyi var	×	....	Endemic
51. Ilex socorroensis	....	....	Endemic
52. Cardiospermum halicacabum	....	×	Lower California southward; West Indies. The Clarion plant is glabrate
53. Dodonaea viscosa	?	×	Lower California southward; West Indies
54. Meliosma nesites	....	....	Endemic
55. Rhamnus discolor	....	....	Oaxaca to Costa Rica
56. Triumfetta socorrensis	....	....	Endemic
57. Abutilon californicum	....	....	Lower California
58. Sida rhombifolia	....	....	Lower California southward; West Indies
59. Sida nesogena	....	....	Endemic
60. Gossypium hirsutum	....	....	Sinaloa southward; West Indies
61. ?? Melochia pyramidata	....	×	Record questionable
62. Waltheria americana	....	×	Lower California southward; West Indies
63. Hypericum eastwoodianum	....	....	Endemic
64. Opuntia sp	....	?×	No specimens seen
65. Conocarpus erecta	....	....	Lower California southward; West Indies
66. Psidium galapageium	....	....	Galapagos Islands
67. Psidium socorrense	....	....	Endemic
68. Oreopanax xalapense	....	....	Oaxaca to Costa Rica

NAME	San Benedicto	Clarion	DISTRIBUTION AND REMARKS
69. Bumelia socorrensis	....	....	Endemic
70. Forestiera rhamnifolia	....	....	Vera Cruz; West Indies
71. Metastelma sp	....	....	Affinities Mexican
72. Ipomoea triloba	....	....	Lower California southward; West Indies
73. Ipomoea pes-caprae	×	×	Lower California southward; West Indies
74. ?? Ipomoea cathartica	....	×	Record questionable
75. ?? Ipomoea halierca	....	×	Record questionable
76. ?? Cressa truxillensis	....	×	Record questionable
77. Cordia brevispicata	....	....	Lower California to Salvador
78. Tournefortia hartwegiana	....	....	Lower California to Oaxaca
79. Heliotropium curassavicum	....	×	Lower California southward; West Indies
80. Verbena litoralis	....	....	Lower California southward; West Indies
81. Lantana involucrata	....	....	Lower California southward; West Indies
82. Teucrium affine, var	....	....	Endemic
83. Sphacele hastata	....	....	Lower California and Hawaii
84. Physalis sp	....	....	Affinities in so. Mexico and Central America
85. Solanum madrense	....	....	Sonora to Nicaragua
86. Nicotiana nesophila	....	....	Endemic
87. ?? Nicotiana stocktoni	....	×	Record questionable
88. Cestrum pacificum	....	....	Endemic
89. Elytraria squamosa	....	....	Lower California southward; West Indies
90. Chiococca alba	....	....	Lower California southward; West Indies
91. Guettarda insularis	....	....	Endemic
92. Borreria nesiotica	....	×	Endemic
93. Galium mexicanum	....	....	Sinaloa to Guatemala
94. ?? Scævola plumierii	....	×	Record questionable
95. Vernonia littoralis	....	....	Endemic
96. Eupatorium pacificum	....	....	Endemic
97. Brickellia peninsularis, var	....	×	Endemic
98. Erigeron socorrensis	....	....	Endemic
99. Gnaphalium attenuatum	....	....	Jalisco to Costa Rica
100. Coreopsis insularis	....	....	Endemic
101. Perityle socorrosensis	×	×	Endemic
102. Viguiera deltoidea, var	....	....	Lower California

There has, thus, been a total of 102 species reported from Socorro. Of these, however, I hold that 9 *(Caesalpinia, Sophora, Phaseolus, Melochia, Ipomoea* spp., *Cressa, Nicotiana* and *Scaevola)* have been included because of error in labeling the specimens. Excluding these 9, the statistics for the remaining 93 unquestioned members of the flora are as follows:

30 spp. (31%) occur also in Lower California. Of this group only 3 (*Abutilon*, *Sphacele* and *Viguiera*) do not occur as well in Sonora or Sinaloa.

41 spp. (44%) occur also in the coastal states of the Mexican mainland north of southern Colima. Only 2 of this number do not also occur still further south.

13 spp. (14%) of the non-endemics do not occur in Lower California or from Sonora to Colima. The names and the ranges of these are:

Polystichum muricatum...Guerrero, Vera Cruz, Chiapas to Costa Rica
Asplenium potosinum, var. San Luis Potosi
Adiantopsis radiata.....Vera Cruz and Yucatan to Guatemala; West Indies
Sporobolus purpurascens..Vera Cruz to Costa Rica and West Indies
Aristida pansa.....Arizona and Texas to San Luis Potosi
Cyperus aff. *brunneus*....Southern Mexico, Central America and West Indies
Cattleya aurantiaca.....Michoacan, Oaxaca, Yucatan to Costa Rica
Epidendrum rigidum.....Oaxaca and Vera Cruz to Costa Rica; West Indies
Hippomane mancinella...Oaxaca and Vera Cruz and south; West Indies
Rhamnus discolor.....Oaxaca to Costa Rica
Psidium galapageium.....Galapagos Islands
Oreopanax xalapense.....Oaxaca to Costa Rica
Forestiera rhamnifolia....Vera Cruz; West Indies

34 spp. (36%) occur also in the West Indies.

5 spp. (5%) not identified.

31 spp. (33%) are endemic to the Revillagigedos. Of these,
23 are restricted to Socorro,
1 is restricted to Socorro and San Benedicto,
4 are restricted to Socorro and Clarion,
3 are restricted to Socorro, San Benedicto and Clarion.

SAN BENEDICTO AND ITS FLORA

San Benedicto Island, lat. 19° 20′ N, long. 110° 49′ W, is the most northern and eastern of the Revillagigedos, and, excluding Roca Partida, the most barren of the group. Lying over 30 miles north of Socorro, it is separated from that island by depths of over 2900 meters. In shape it is elongate, being 3 miles long and averaging about a half-mile in width. It is a bold volcanic island rising very abruptly from the sea. The southern half of the island consists of an ash-cone, 297 meters high. The northern half is a plateau, 200 meters high,

largely built of lavas. No water is known on the island. Due, no doubt, to the scanty rains and the poverty of the soil and its porous nature, the flora of San Benedicto is a small one. The species reported from the island are as follows:

NAME	Socorro	Clarion	DISTRIBUTION AND REMARKS
1. Eragrostis diversifolia	....	....	Sinaloa and Colima
2. Cenchrus myosuroides	×	....	Lower California to Puebla; West Indies
3. Cyperus duripes	×	×	Endemic
4. Stenophyllus nesioticus	×	?×	Endemic
5. Aristolochia brevipes	×	....	Lower California to Oaxaca
6. Euphorbia anthonyi, var	×	....	Endemic
7. ?? Dodonæa viscosa	×	×	Record questionable
8. Ipomoea pes-caprae	×	×	Lower California southward; West Indies
9. Teucrium affine, var	....	....	Endemic
10. Erigeron crenatus	....	....	Endemic
11. Perityle socorrosensis	×	×	Endemic

The most conspicuous member of the flora is the *Cenchrus*. It is said to be very common on the flats and other accessible areas where its extensive, head-high growths and its abundant burs, not only impede travel but make it very disagreeable. The only other plant present in any conspicuous abundance is the *Euphorbia*. Large slopes on the island are barren or have only a very meagre vegetation.

Excluding from consideration the *Dodonaea*, which I believe was erroneously attributed to the island, the statistics regarding the flora of San Benedicto are as follows:

3 spp. (33%) occur also in Lower California. These occur likewise in Sonora or Sinaloa.

4 spp. (40%) occur also in the coastal states of the Mexican mainland north of southern Colima; only one (*Eragrostis*) does not range further south.

None of the non-endemic species is absent from the region between Lower California and southern Colima.

2 spp. (20%) occur also in the West Indies.

6 spp. (60%) are endemic to the Revillagigedos. Of these,
2 are restricted to San Benedicto.
1 is restricted to San Benedicto and Socorro,
0 is restricted to San Benedicto and Clarion,
3 are restricted to San Benedicto, Socorro and Clarion.

The flora of San Benedicto has a very close and strong affinity with that of Socorro and was probably largely if not entirely derived from it. Of all the species found on the island only the *Eragrostis* is unknown from Socorro or does not have an immediate endemic relative there. This *Eragrostis* is known off San Benedicto only from a few collections in Sinaloa and Colima. It seems very strange that it could have reached San Benedicto, where it is common, and not also have attained Socorro. I shall be surprised if it is not eventually found on that island.

CLARION AND ITS FLORA

Clarion Island, lat. 18° 22′ N, long. 114° 44′ W, is the most western of the Revillagigedo group and the most isolated. It lies over 200 miles to the west and slightly south of Socorro and is surrounded by ocean depths of over 3600 meters. In shape it is roughly oblong, having a length of about 5 miles and a width of about 2 miles. It is divided by elevated passes into three distinct hills, the highest one, that at the west end of the island, having an altitude of 335 meters. The eastern and western ends of the island are rough and precipitous. The northern side consists of a series of perpendicular, rocky cliffs, about a hundred meters in height, which culminate in the principal ridge of the island. From this ridge the land slopes rapidly at first and then more gradually, to a plain which stretches from the foot of the hills to the sea in the neighborhood of the two sand beaches on the south side of the island. Black and brown basalt and red scoria are the most evident rocks. The hills are rounded by erosion and show few cañons of any size. Over most of the island there is a deep reddish brown soil that suggests antiquity. Undoubtedly erosion now takes place very slowly; the rainfall is slight but the island is well covered with vegetation.

According to Townsend, Proc. U. S. Nat. Mus. 13: 132 (1890), "The central portion [of the island] is a plateau about 1,000 feet high, with a few elevations perhaps 500 feet higher. It is mostly overgrown with long grass, head high, through which the pedestrian flounders helplessly; the slopes of the lesser elevations are clearer, with scattered bushes and

low, scrubby trees. I was not able to reach the plateau until after two hours of laborious struggle through the wilderness of cactus that covers its southern slopes, cutting nearly every yard of the way with a sharp *machete*. No other members of the party attempted it. Cactus renders all the lower portions of the island practically impassable. The island is probably without fresh water, although a small lagoon near the south beach contained slightly brackish water at the time of our visit there in March. Southerly gales would probably drive sea water into the lagoon and for a time at least render this wretched supply entirely worthless". Anthony, Auk ser. 2, 15: 312 (1898), describes it similarly,—"A few low trees or shrubs, the largest not over ten feet in height, are scattered along the main plateau, and in a few places reach the level ground that lies between the mesa and the coast on the south side. Nearly the entire flat between the mesa and the beach is covered with a dense growth of cactus *(Platopuntia)* over which has grown a mass of vines. Passage through this belt is only accomplished with diligent and constant use of the brush knife. A short distance from the beach were found two small shallow ponds which contain water during the rainy season only, but as the high tides evidently wash over the barriers and flood them with sea water it is doubtful if they are ever otherwise than brackish. At the time of our visit, in May, they had been dry for some months and no water was found anywhere on the island."

The most notorious plant on Clarion, as the above quotations show, is the uncollected, unidentified, and probably unnamed species of *Opuntia* that forms the extensive, spiny thickets in a broad zone on the plain along the south side of the island. Interspersed among the large patches of this cactus are the two milky-juiced, shrubby Euphorbias, *E. anthonyi* var. and *E. californica,* and the thorny shrubs of *Zanthoxylum fagara.* The resulting spiny, thorny, and offensively milky barrier that is formed is entangled and overgrown by the vines of the brightly blue-flowered morning-glories, *Ipomoea cathartica* and *I. halierca.* The north slopes along the crest of the island are overgrown with *Cyperus duripes,* which forms the very coarse, rank, dense, grass-like growths noted by Townsend. *Tribulus,* because of its conspicuous yellow corollas, *Canavalia,* because of its large pods, and *Ipomoca pes-caprae,*

because of its very elongate stems, are the conspicuous plants along the beaches. The small brackish pools back of the beaches near Sulphur Bay are notable for the only occurrence on the islands of *Scirpus robustus* var., *Sapindus saponaria, Sida hederacea* and *Cressa truxillensis. Caesalpinia crista, Sophora tomentosa* and *Scaevola plumierii* occur near the beach on the south shore. These well known tropical American strand-shrubs or -trees are also not otherwise known in the archipelago. From the point of view of distribution and the problems they present in dispersal, the *Sophora* and the *Scaevola* rank among the most interesting plants on the island.

The complete list of the Clarion plants, with indications of their occurrence on Socorro and San Benedicto, and a summary of their range off the archipelago, is given in the following table:

NAME	Socorro	San Benedicto	DISTRIBUTION AND REMARKS
1. Cheilanthes peninsularis, var...	×	....	Endemic
2. Sporobolus argutus.....	....	....	Lower California to Salvador
3. Aristida pansa.....	×	....	Arizona and Texas to San Luis Potosi
4. Erichloa acuminata.....	....	....	Lower California to Oaxaca
5. ? Stenophyllus nesioticus.....	×	×	Endemic
6. Cyperus duripes.....	×	×	Endemic
7. Scirpus robustus, var.....	....	....	Lower California and Sonora northward
8. Commelina virginica.....	....	....	Lower California southward; West Indies
9. Irisine celosia.....	....	....	Lower California southward; West Indies
10. Bœrhaavia caribaea	×	....	Lower California southward; West Indies
11. Sesuvium portulacastrum.....	....	....	Lower California southward; West Indies
12. Portulaca pilosa.....	×	....	Lower California southward; West Indies
13. Lepidium lasiocarpum.....	....	....	Lower California and Sinaloa northward
14. Calliandra socorrensis.....	×	....	Endemic
15. Cæsalpinia crista.....	?	....	Sinaloa southward; West Indies
16. Sophora tomentosa.....	?	....	West Indies; tropics of Old World
17. Canavalia apiculata.....	×	....	Sinaloa to Colima
18. Phaseolus atropurpureus.....	?	....	Lower California to Salvador
19. Galactia striata.....	....	....	Tres Marias Islands southward; West Indies
20. Tribulus cistoides.....	×	....	Lower California southward; West Indies
21. Zanthoxylum fagara.....	....	....	Lower California southward; West Indies
22. Euphorbia californica.....	....	....	Lower California to Sinaloa
23. Euphorbia anthonyi, var.....	....	....	Endemic

	Name	Socorro	San Benedicto	Distribution and Remarks
24.	Cardiospermum halicacabum...	×	....	Lower California southward; West Indies. The Socorro plant is pubescent
25.	Sapindus saponaria.....	....	....	Lower California southward; West Indies
26.	Dodonæa viscosa.....	×	?	Lower California southward; West Indies
27.	Karwinskia humboldtiana.....	....	....	Lower California to Guatemala
28.	Sida hederacea.....	....	....	Lower California and Sonora northward
29.	Melochia pyramidata.....	?	....	Lower California southward; West Indies
30.	Waltheria americana.....	×	....	Lower California southward; West Indies
31.	Opuntia sp.....	?	....	No specimens seen
32.	Ipomoea pes-caprae.....	×	×	Lower California southward; West Indies
33.	Ipomoea cathartica.....	?	....	Oaxaca to West Indies
34.	Ipomoea halierca.....	?	....	Endemic
35.	Cressa truxillensis.....	?	....	Lower California northward; also, Peru, Chile
36.	Heliotropium curassavicum....	×	....	Lower California southward; West Indies
37.	Teucrium townsendii.....	....	....	Endemic
38.	Physalis angulata.....	....	....	Central America; West Indies
39.	Nicotiana stocktoni.....	?	....	Endemic
40.	Borreria nesiotica.....	×	....	Endemic
41.	Scaevola plumierii.....	?	....	Lower California, Galapagos, West Indies
42.	Brickellia peninsularis, var.....	×	....	Endemic
43.	Perityle socorrosensis.....	×	×	Endemic

Accepting the *Stenophyllus* as a member of the flora—although the record may be questionable—and disregarding some extremely doubtful records from Socorro, the statistics for the flora of Clarion are as follows:

23 spp. (53%) occur also in Lower California; of these only one (*Scævola*) does not occur in Sonora or Sinaloa.

26 spp. (60%) occur also in the coastal states of the Mexican mainland north of southern Colima; only 5 of these do not occur still further south.

4 spp. (9%) of the non-endemic flora are not in the area between Lower California and southern Colima. These are,

Aristida pansa.....Arizona and Texas to San Luis Potosi

Sophora tomentosa....West Indies, northern South America, Old World

Ipomoea cathartica...Oaxaca, Yucatan, Central America, West Indies

Physalis angulata....Central America, West Indies

20 spp. (46%) occur also in the West Indies.
1 sp. (*Opuntia*) not identified.
11 spp. (26%) are endemic to the Revillagigedos. Of these,
4 are restricted to Clarion,
4 are restricted to Clarion and Socorro,
0 is restricted to Clarion and San Benedicto,
3 are restricted to Clarion, Socorro and San Benedicto.

GENERAL FLORISTICS

By those whose interest in an insular flora is limited to a listing of its species, and who do not care for the distributional problems involved, the flora of the Revillagigedos would be characterized as of Mexican origin; and, upon noting that most of the insular species also occur in Lower California or in western Mexico, or commonly even in both these areas, it might be dismissed by them as having been transported by ocean-currents and winds from the east and northeast. Such a perfunctory characterization of the relationships and origins of the Revillagigedo flora does cover certain obvious facts and does account rather well for the larger part of the flora. It ignores, however, complications presented by a relatively small group of species and so passes over those problems which make the study of insular florulas of particular interest and which usually proves them to have had a much more involved history than was first apparent. It has seemed well, therefore, to give a detailed consideration and analysis of the distribution and affinities of the Revillagigedo flora. From the facts which I present it will be realized that the flora is much more than a chance gathering of species washed up by currents or blown in on the trades. It seems in fact to have been built up of widely distributed species, many of them probably rather recent arrivals on wind or wave, around a small relic flora derived from an old land-mass, perhaps now marked only by the islands, or from a continental connection, now long destroyed.

As now known, the vascular flora of the Revillagigedo Islands consists of 121 species and subspecies. Of this total, 5 are as yet unidentified. The 116 identified kinds, for convenience of discussion, may be said to consist of 37 endemic and 79 non-endemic species and subspecies. The 79 non-

endemics may be grouped and their distribution summarized as follows:

42 spp. (53%) occur also in Lower California; of these only 4 are not found also in Sonora or Sinaloa. These are:
Abutilon californica....Socorro and Lower California
Sphacele hastata.....Socorro, Lower California, Hawaii
Scaevola plumierii.....Clarion, Lower California, Galapagos, West Indies
Viguiera deltoidea, var..Socorro and Lower California

59 spp. (75%) occur also in the coastal states of the Mexican mainland north of southern Colima; only 6 of these do not range further south.

16 spp. (20%) do not occur in the coastal states from Colima to Lower California. Of this group 8 occur also in the West Indies. Of the total 16 there are the following exclusive groupings,
7 spp. range from the Pacific states of so. Mexico into Central America. These are, *Polystichum*, *Cattleya*, *Epidendrum*, *Hippomane*, *Rhamnus*, *Oreopanax* and *Ipomoea*. Of these, 2 reach the West Indies.
3 spp. range from the Atlantic states of so. Mexico into Central America. These are *Adiantopsis*, *Sporobolus* and *Cyperus*. All extend into the West Indies.
1 sp. comes from San Luis Potosi (*Asplenium*).
1 sp. ranges from Arizona and Texas to San Luis Potosi (*Aristida*).
1 sp. ranges from Central America into the West Indies (*Physalis*).
1 sp. ranges through the West Indies into Vera Cruz (*Forestiera*).
1 sp. ranges in the West Indies, northern South America and the tropics of the Old World (*Sophora*).
1 sp. comes from the Galapagos Islands (*Psidium*).

63 spp. (80%) occur also in southern (Pacific and Atlantic) Mexico south of Colima, of which,
11 spp. do not reach north to Colima, and
5 spp. do not reach south into Central America.

49 spp. (63%) occur in the Pacific states of southern Mexico (south of Colima), of which,
7 spp. do not reach north to Colima and
3 spp. do not reach south into Central America.

55 spp. (70%) occur in Central America, all of which extend into continental Mexico and all but 11 of which extend into the West Indies.

46 spp. (58%) occur also in the West Indies.

A study of the above summary shows that 63 of the species and varieties, or 80% of the non-endemic flora of the archipelago, occur also on the peninsula of Lower California or in the coastal states of the Mexican mainland north and east of the islands; in other words on the nearest continental masses. Of this group, 38 of the species occur also in the West Indies

and hence range widely and have demonstrated their ability to cross ocean barriers. Since wind and ocean-currents are favorable, it seems, consequently, not improbable that some, if not all, of this group of species, may have gained the islands from the continent across the intervening ocean.

There remain, however, 16 species, or 20% of the non-endemic flora, which do not occur in the Pacific states of Mexico north of Colima. Of this number, *Cyperus, Hippomane* and *Ipomoea* are present in southern Mexico and are also widely distributed in the West Indies. Their presence on our islands is no cause for surprise. The *Hippomane,* particularly, being a seaside tree, is generally recognized as using ocean-currents in its dissemination. The others, with means less clear, have demonstrated their faculties for reaching islands. In a similar class is the *Physalis.* This is a weedy plant, distributed widely in the West Indies, but apparently rare on the continent. The four species just mentioned worry us little as to just how they attained our islands, for they seem capable of doing it, as they have shown in their success at similar tasks elsewhere. Of the remaining 12, out of the total 16 non-endemic species not present in western or peninsular Mexico, all present much more difficult and even quite imposing problems in distribution. The *Psidium* shows direct relations with the Galapagos Islands. The *Aristida* has relations in the interior of northern Mexico reminiscent of the relationships shown by the very striking insular endemic species of *Teucrium* and *Nicotiana.* The *Sophora,* not otherwise known on the Pacific side of America, is a widely distributed shore-plant of the West and East Indies. As a well known sea-disseminated plant it must have come from the West Indies, somehow crossing Central America, or from Polynesia across the Pacific on the Reverse Equatorial Drift to land on Clarion Island. There finally remain among the puzzling non-endemics, 3 ferns, 2 orchids and the *Sporobolus, Rhamnus, Oreopanax* and *Forestiera.* These latter 9 seem to indicate West Indian, southern Mexican or Central American affinities best discussed in connection with the endemic flora of the island.

The endemic flora of the Revillagigedos, as stated above, consists of 37 species and subspecies, or 31% of the entire identified flora of the archipelago. There are no endemic genera nor are any of the species sufficiently aberrant to have

merited even special subgeneric recognition. Most of the endemic species, however, are very distinct from the relatives off the islands, some of them to such a degree that their precise specific relationships are quite obscure. The list of the insular endemics, with an indication of their occurrence among the islands and some notes on their relationships, is given in the following table:

NAME	Socorro	San Benedicto	Clarion	RELATIONSHIP
1. Cheilanthes peninsularis, var. insularis	×	....	×	Peninsular
2. Paspalum longum	×	....	....	Caribbean
3. Cyperus duripes	×	×	×	Relations obscure; probably Mexican
4. Stenophyllus nesioticus	×	×	?×	Relations obscure; West Indian or Central American
5. Pleurothallis unguicallosa	×	....	....	West Indian
6. Peperomia chrysolepida	×	....	....	Southern Mexican and northern Central American
7. Peperomia socorronis	×	....	....	As above
8. Phoradendron townsendi	×	....	....	Weak species; relations from Nayarit to Central America and West Indies
9. Calliandra socorrensis	×	....	×	Weak species; relations in western Mexico
10. Bursera nesopola	×	....	....	Weak species; relations peninsular
11. Croton masonii	×	....	....	Relations very obscure, probably southern Mexican or Central American
12. Acalypha umbrosa	×	....	....	Peninsular
13. Euphorbia anthonyi	×	×	....	Relations obscure; probably Mexican
14. Euphorbia anthonyi, var. clarionensis	....	....	×	As above
15. Ilex socorroensis	×	....	....	West Indian
16. Meliosma nesites	×	....	....	Costa Rican
17. Triumfetta socorrensis	×	....	....	Relations obscure; probably southern Mexican or Central American
18. Sida nesogena	×	....	....	Weak species; western Mexican
19. Hypericum eastwoodianum	×	....	....	Relations very obscure; probably southern Mexican or Central American
20. Psidium socorrense	×	....	....	Relations on Socorro and Galapagos Islands
21. Bumelia socorrensis	×	....	....	Relations obscure; Mexican
22. Ipomoea halierca	?	....	×	Southern Mexican
23. Teucrium townsendii	....	....	×	Northern and eastern Mexican
24. Teucrium affine	×	....	....	As above

NAME	Socorro	San Benedicto	Clarion	RELATIONSHIP
25. Teucrium affine, var. dentosum	....	×	....	As above
26. Nicotiana nesophila	×	....	....	Northeastern Mexican
27. Nicotiana stocktoni	?	....	×	As above
28. Cestrum pacificum	×	....	....	Weak species; relative from Nayarit to Central America
29. Guettarda insularis	×	....	....	Weak species; relatives from Sinaloa to Colima, Yucatan and West Indies
30. Borreria nesiotica	×	....	×	Relations obscure; tropical American
31. Vernonia littoralis	×	....	....	Guatemalan and southern Mexican
32. Brickellia peninsularis, var. amphithalassa	×	....	×	Peninsular
33. Eupatorium pacificum	×	....	....	Southern Mexican
34. Erigeron socorrensis	×	....	....	Relations very obscure; Mexican or even Galapagean
35. Erigeron crenatus	....	×	....	As above
36. Coreopsis insularis	×	....	....	Southern Mexican
37. Perityle socorrosensis	×	×	×	Peninsular

A study of this enumeration of the insular endemics shows that 5 of them *(Cheilanthes, Bursera, Acalypha, Brickellia* and *Perityle)* have relations on the peninsula of Lower California and that an additional 5 *(Phoradendron, Calliandra, Sida, Cestrum* and *Guettarda)* have relations in western Mexico. None of these 10 (27% of the total endemics) are exceptionally strong species, the most of them in fact being weak species and worthy of scarcely more than the rank of endemic insular varieties. The two species and the variety of *Teucrium* form a distinctive island group most nearly related to forms now occurring in northern and eastern Mexico and adjacent United States. The two species of *Nicotiana* are also immediately related and form a very distinct island group related most closely to habitally very dissimilar plants of northeastern Mexico.

The 15 plants just mentioned are northern or eastern in affinities. The remaining 22 are of uncertain relationship or are southern, Galapagean or West Indian in affinities. Of these there are 6 *(Peperomia* spp., *Ipomoea, Vernonia, Eupa-*

torium and *Coreopsis)* which have clear relationships in southern Mexico or Central America. The *Meliosma* is evidently related to a Costa Rican species. Three species, *Paspalum, Pleurothallis* and *Ilex,* have clear West Indian affinities. The *Psidium* is related to one common to the Galapagos and the Revillagigedos. The two curious shrubby species of *Erigeron* may also show a Galapagean relationship or may belong with four plants *(Cyperus, Euphorbia* sp. et var. and *Bumelia)* that have puzzling and obscure, although probably Mexican, affinity. To conclude the grouping of the endemics there are 5 very well-marked species, *Stenophyllus, Croton, Triumfetta, Hypericum* and *Borreria,* which, while of puzzling relationship, can at least be said to have no relations north or east of the islands. Their relations are no doubt obscure ones in southern Mexico or Central America.

With the exception of the species of *Nicotiana* and *Teucrium,* whose relations, it should be recalled, are not on the peninsula, or on the west coast of Mexico nearest the islands, the insular species of northern and eastern affinity are much less differentiated than those having their relatives on the continent to the southward or in the West Indies. Those endemics with close relatives on the peninsula and on the adjacent Mexican mainland are, I believe, more recent arrivals and, hence, younger than those much more differentiated species that have southern affinities. The southern types and those with affinities in northeastern Mexico are the old elements in the flora.

The data just given indicate the floristic relations of the Revillagigedos with the continent. A brief consideration should now be given to the relations with other islands and archipelagos. Those nearest the Revillagigedos are the Tres Marias Islands which rise from depths of less than a 1000 meters only 50-60 miles off the coast of Nayarit and to the northwest of Cape Corrientes in Jalisco. The most recent enumeration of the flora [Eastwood, Proc. Calif. Acad. Sci. ser. 4, 18: 442-468 (1929)], lists 324 vascular plants, of which only 19 are considered endemic. Although some of the species are peculiar to the islands and to the adjacent mainland, most of them are widely distributed in the American tropics. There are only 23 species common to the Tres Marias and the Revillagigedos, practically all of them being widely dispersed tropi-

cal ones. Only *Zanthoxylum insulare* is of any particular phytogeographic significance. This plant is known only from Socorro, Maria Madre, Jamaica and from northern and western South America. It represents, I believe, one of the old elements in our flora. There is absolutely no indication that the Tres Marias were ever directly connected with the Revillagigedos.

North of the Revillagigedos and far off the coast of Lower California lie Alijos Rock, a barren bird rock, and Guadalupe Island [cf. Eastwood, loc. cit. 394-420], an island with distinctly Californian, rather than tropical affinities. Clipperton Island, lat. 10° 17′ S and long. 109° 13′ W, far to the south of the Revillagigedos, is a low coral islet quite devoid of higher plants [cf. Snodgrass & Heller, Proc. Wash. Acad. Sci. 4: 501-504 (1902)]. Cocos Island, lat. 5° 32′ N and 87° 00′ W, well to the west of Panama, is a small, wet tropical island with a rank vegetation. Its known flora consists of about 100 species,[2] of which about 10 are endemic. The only species known to be common to Cocos and the Revillagigedos are *Setaria geniculata, Caesalpinia crista* and *Ipomoea pes-caprae*. They are all widely dispersed tropical species, two of them being strand plants.

There are about 21 species of the Revillagigedo flora present in the Galapagos Islands. Practically all of them are widely-ranging, more or less weedy, tropical species. The only noteworthy plants are *Psidium galapageium* and *Scaevola plumierii*. The significance of their distribution is quite obscure. Possibly the Socorro and the Galapagos *Psidium* have been derived from a common, now extinct ancestral stock on the mainland, but even so the reasons for the sole persistence of the unmodified descendants on the far separated Revillagigedos and Galapagos is still a problem. The West Indian *Scaevola plumierii* is known on Pacific shores only at the tip of the peninsula of Lower California, on Clarion Island, and in the Galapagos. The shrubby *Erigeron* species of the Revillagigedos much suggest those of the Galapagos but I suspect that the similarity is due to similar responses of related mainland stocks to a similar insular climate.

---

[2] Based upon a consideration of the list given by Stewart, Proc. Calif. Acad. Sci. ser. 4, 1: 375-404 (1912), and upon a manuscript flora of the island kindly made available to me by Prof. B. L. Robinson.

From the facts given, it becomes obvious that the Revillagigedos do not have a flora that has a strong affinity with that of any other island or archipelago. The species shared with other islands are overwhelmingly of the widely distributed, weedy, tropical sort. The Revillagigedos and the Galapagos islands, although very distantly separated, do share several species that suggest a relation of the floras. The climate on both archipelagos is arid. This common possession of a dry insular climate may, possibly, offer a partial explanation for the occurrence of those species which suggest a direct floristic relation between the archipelagos. In any case I do not believe that they have ever been directly connected by land.

ORIGINS OF THE FLORA

There are two theories used in accounting for the composition of isolated insular floras. One maintains that winds, ocean currents and animals are completely effective in populating such islands with plants; the other that these means are at most only partially effective, and that consideration of all elements in insular floras generally indicates that they have had a previous period of migration and usually also of change and development on contiguous land-masses which have now disappeared. The former, or oceanic theory, accepts most island floras as rather recent, and treats of them in a geography in which ocean depths and shore lines are essentially as they are found today. The latter, or continental theory, tends to give insular floras considerable age, and looks for their early history in a time when the surface features of the earth were somewhat different from what they are at present. It involves the change from elevated land to deep ocean-bottom and frequently tends to ignore the geologists in its frantic effort to build land-bridges or continents for the overland dispersal of certain species which the opposing theory blithely leaves for hurricanes, tidal waves and well-fed but misdirected birds. These contrasting theories can be and are pushed to incautious extremes by their sponsors, extremes that show very clearly the great divergence of opinion that exists regarding the abilities of most plants to disseminate successfully over broad tracts of ocean. It is, however, this lack of general agreement, this challenge of an unsolved problem, that gives the study of in-

sular floras its particular fascination. Eventually we may hope to have a consensus of opinion regarding the means by which ordinary flowering plants have generally reached remote islands. This, however, can only be attained after a minute inquiry into the composition of a great number and variety of insular florulas, and only after a final judicial consideration of the implications involved in each. The floristics of the Revillagigedos are, hence, partial data for an unsolved botanical problem. Deductions and speculations based upon them not only aid us in the attempt to determine the probable history of the island and its flora, but may also give some clues to the efficacy of the debated means of plant dispersal.

As ocean currents and over-sea winds have played at least a minor role in populating most isolated archipelagos, it is desirable to examine into these forces and to determine, if possible, what part they have played in forming the flora of the Revillagigedos.

These islands are situated at the east end of the great North Equatorial Drift and are hence bathed by waters coming from the north as well as by some from the south. The well known Californian Current comes southeastward along the coast of Lower California and continues in large part to about the latitude of our islands, where under the force of the northeast trade winds it turns and becomes the beginning of the North Equatorial Drift. An eastern portion of the Californian Current tends to continue down the coast of the Mexican mainland. This latter part, strongest in the spring, is generally weak. When subjected to the southerly winds prevailing off Central America and southern Mexico in the summer, it tends to become uncertain or even reversed. There results a weak, seasonal, northwestern movement of water off Central America and southern Mexico that has sometimes been called the Mexican Drift. At its height it is uncertain and complicated by eddies. It is never so strong nor so clearly directed as the Californian Current is to the north of the islands. As far as can be determined, it pushes weakly northward towards the vicinity of the Revillagigedos only during the summer months and hence would be a factor in the northward dispersal of potential island plants only, if at all, during that brief period of the year. The Californian Current, being stronger and continuous, however, offers a possible, perennial means of trans-

port from Lower California and from the Mexican mainland lying immediately off to the east and northeast. I have no doubt that it has carried strand plants from that quarter, and possibly some of the plants from the coastal plains as well.

Data regarding the directions of winds in the region about the Revillagigedos are only of the most general sort. These are consistent, however, in attributing to the region winds prevailing from the northeast, north and northwest, and show that only in summer is there even a noteworthy proportion of breezes from the south or southeast. The islands are frequently visited also by the small but very violent cyclonic storms that harry the west coast of Mexico. Although accompanied by extremely violent winds these hurricanes are probably of no aid in plant dispersal since they originate at sea (usually at about lat. 15° N) and moving northwestward either parallel the coast, or move from the sea northeastward over the land. They might aid in the dissemination of plants within the archipelago, but would be vastly more effective in transporting island plants to the mainland, rather than *vice versa*. It seems, therefore, that if winds are to be considered as a means of dispersal that the emphasis must be placed on the trades from the north and northeast, for these, like the ocean currents, would place the sources of dissemination for potential island plants on continental areas nearest the islands and in exactly those areas which now have the greatest number of species in common with the islands.

Although 80% of the non-endemic flora present on the islands also occur to the north and east on the nearest continental masses, in exactly those areas in which the plants could have taken advantage of the most favorable currents and winds for transportation to the islands, and even although 27% of the endemic flora on the islands find their closest relatives in exactly the same region in which their ancestors may have had offered similar facilities for transportation, it does not necessarily follow that these species must all have come by currents or wind, or that, granting this, that the remainder of the flora must have reached the islands by similar transoceanic means. I am willing to admit that perhaps a good half of the non-endemic flora has reached the islands from across the ocean and, with little doubt, from the nearest parts of the continent. As will be explained, however, I believe that even

some of the widely distributed non-endemic species may have reached the islands by other than oceanic means. The species which I am inclined to admit as most probably of transoceanic dissemination are chiefly the widely spread weedy ones, and particularly those broadly distributed in the West Indies where their range shows that they can get over ocean barriers and from island to island most successfully. There have, no doubt, been even some of the characteristic western Mexican species that have been able to follow these weedy types and also reach the islands.

After admitting, however, that a large proportion of the flora may have gained the islands across the ocean from the nearest land, there still remain some species whose presence on the islands is not so easily accounted for. These species are chiefly from Socorro. They include the most differentiated of the island endemics and most of such types as the epiphytes, the shade-loving mesophytes and the forest-trees. These plants either do not occur or do not have their immediate or even close relatives on the adjacent parts of the continent. Their affinities, such as can be determined, are much more distant, lying in southern Mexico, in Central America, or in the West Indies. They are characteristically plants of middle altitudes inland, away from the sea, and are not suitable for oceanic dispersal. They are not weedy types. Several of them very clearly have their nearest relations far away in the West Indian Region, while others, off the islands, are known only from east (on the wetter side) of the continental divide. Some of them grow in the mountains from Vera Cruz and Oaxaca south into Central America. One has its relations in Costa Rica. The most striking of these plants and the ones which indicate this southern affinity most clearly are *Polystichum, Adiantopsis, Asplenium, Sporobolus, Paspalum, Cattleya, Epidendrum, Pleurothallis, Peperomia* spp., *Rubus, Rhamnus, Ilex, Meliosma, Oreopanax, Forestiera, Vernonia* and *Eupatorium*. Also to be associated with these just mentioned, since they are probably of the same floristic group, are those very distinct endemics of quite uncertain, although general southern relationship such as, *Stenophyllus, Cyperus, Euphorbia, Croton, Triumfetta, Hypericum, Psidium, Bumelia, Ipomoea, Borreria, Erigeron* spp., and *Coreopsis*. These latter species in their strong differentiation, which quite obscures their precise

relationship among their congeners, suggest antiquity. They form a remarkable contrast with those endemics which have immediate affinities on the adjacent continent and which, in still having their relationships with their parents obvious and in not having developed any strong specific traits, show themselves to be of rather recent origin. Those species with clear but geographically distant, southern relationships and those with obscure general southern affinity are quite different from the weedy types or from the obviously peninsular or northwestern Mexican forms which might have reached the island by wind or waves. The lack of means of these species of southern affinity for contact with their scattered relatives, the distance by which they are now separated from them, and the notable degree in which some of them have become differentiated from their relatives on the mainland, suggest that they reached the islands long ago when alignments of land and the climatic conditions were quite different from those of the present time. In fact, I believe they represent an old floristic element and are relics of an early, now impoverished mesophytic, or even humid flora that formerly existed on or near the present islands.

A theory involving a relic flora on the islands assumes an effective, probably a complete, land route for the migration of the island flora in the distant past, subsequent isolation permitting marked development and change in plastic species, and finally decimation of the flora through physiographic changes and in more recent history through competition with more adaptable immigrants. This theory would demand a body of land which would either include all our present islands or would lie at least contiguous to the present island of Socorro and have continental connections off to the east or southeast. Practically all of the possible plant-relics are restricted to Socorro. This I believe is a topographic accident and that there is not necessarily any phytogeographic significance in their lack on the smaller and less lofty Clarion and San Benedicto. Like much of western North America the climate of the Revillagigedos is doubtless becoming more arid. Its larger size, greater moisture and diversity of conditions over Clarion and San Benedicto are probably the prime reasons why the relics have found a final haven on Socorro. It is only in the protected cañons and on the moist upper slopes of Socorro that

stenoclimatic relics of an earlier mesophytic flora could be expected to persist.

There being a suspicion that a large land-mass formerly occupied the general vicinity of the Revillagigedos, it is natural that evidence either for or against it should be sought in bathymetric data. Depth-measurements in this part of the Pacific are not so numerous as could be wished for, but are sufficient to give us the general idea of the submarine topography which we need. A study of the 3000-meter depth-contour shows that it lies generally well within 100 miles of the shore along practically the whole west coast of Mexico and Central America. It crosses the mouth of the Gulf of California in a northwest-southeast line that continues the prevailing trend of the peninsular and central and southern Mexican coast-lines. Although the 3000-meter contour may follow the coast line rather closely, the 4000-meter contour does not. In fact it departs from it most conspicuously. Coming down from the north the 4000-meter line, passing well to the seaward of Guadalupe Island (lat. 29° 00′ N) and a little west of Alijos Rock (lat. 24° 57′ N), continues south until southwest of Clarion[3] where it swings well eastward to nearly 100 miles southeast of Socorro. It then sweeps northeastward to within 100 miles of the Tres Marias Islands where it abruptly doubles back and continues southeastward within 100 miles of the Mexican coast. About opposite Acapulco, however, this depth-line swerves abruptly southwestward, away from the coast and towards the open sea. The Revillagigedos Islands, accordingly, lie on a large submarine plain (3000-4000 meters deep) situated just to the west and south of Lower California and on one separated from the coast of Central America and middle and southern Mexico by a vast tract of very deep water.

Concerning this great submarine plain upon which the Revillagigedos are located, there are a number of significant features. Its western limits are quite independent of continental shore lines. The largest part of it is that southern portion containing the islands. Its southern corner lies over 600

[3] The charts indicate that soundings of 130-145 meters depth have been made around lat. 20° N and long. 120° W, some 300 miles WNW of Clarion. This is the Allaire Bank. Its position, which falls roughly in the east-west axis of the Revillagigedos, suggests that it might be a far westerly peak of the archipelago which is now submerged. It is separated from Clarion by depths of over 4000 meters.

miles to the west of Jalisco on the Mexican mainland. The southern border of the plain appears to parallel the general east-west axis of the archipelago. This border and axis, if projected eastward, would strike about the state of Jalisco and, perhaps not as a mere coincidence, tend to line up with the southern margin of the Mexican plateau. The northern swing of the 4000-meter line between Socorro and the Tres Marias lines up with the trough of the Gulf of California. In short, it seems from these bathymetric data that the Revillagigedo Islands might well represent peaks of a submerged land-mass which formerly extended east and west and connected with the Mexican mainland in Jalisco or Colima and that in the diastrophism that formed the Gulf of California it was separated from the mainland and subsequently sunk.

Such a theory is quite consistent with what is known of the geological history of the western states of Mexico. Deposits show that the most active part of this coast has been that in and around the Gulf of California. The peninsula of Lower California has been particularly active, having had periods of extensive subsidence and flooding in the Eocene, the Miocene and the Pliocene. At the close of the Tertiary the peninsula and the adjacent areas were subjected to tremendous fracturing and down-faulting. Except that the Isthmus of Tehuantepec subsided and was covered by the sea in late Miocene and early Pliocene, the area in the coastal states of Mexico south of Nayarit has been above the sea since the beginning of the Tertiary and for all we know perhaps has even extended further to the westward. Mountain-making forces were active at the close of the Tertiary in our coastal area and were particularly energetic in Jalisco where a line of great upheavals on an east-west axis now forming the south end of the Mexican plateau, brought high land near the coast and probably caused the hump on the coast line that is terminated by Cape Corrientes. At present the whole coast seems to be rising.

The Revillagigedos lie, accordingly, to the south of an unstable region where tectonic forces have been active over a long period and to the west of land that has, over the same period, continued above the sea and may possibly have even extended further west. As evidenced by the paralleling of the northwest-southeast coast lines of the mainland and the two shores of the peninsula the islands are separated from the con-

tinent by several great lines of probably late Tertiary faulting. In alignment they strongly suggest a continuation of the line of Tertiary uplift and vulcanism that determines the southern end of the Mexican plateau. In fact, the site of the Revillagigedos may well represent a portion of the continental margin, much less stable than the peninsula to the north, that was elevated and connected with middle western Mexico during the relatively quiet history of that section in mid-Tertiary and some that was subsequently disconnected and finally entirely subsided when crustal equilibria were disturbed by mountain-making forces on the mainland and by the tremendous upheavals and down-faultings that shaped the peninsula and Gulf of California at the close of the Tertiary. What is more, this theory not only accounts for important details in plant and animal distribution, but also accounts particularly well for the granitic rocks of Roca Partida, the central islet of the Revillagigedos, and accommodates readily the continental origin that has been suggested for them by Hanna, Science n. s. 62: 491-2 (1925) and Pan Amer. Geologist 48: 17 (1927).

Assuming, if not actually accepting the theory, that there was formerly a large mass of land rising from the waters in which the Revillagigedos are now located, one naturally wonders what connection, if any, it may have had with the peninsula of Lower California. The fact that the present archipelago has a long axis that presents a very broad angle to that of the peninsula and one more in line with certain structural axes on the mainland suggests that they belong to different oreogenic systems and have had different histories and hence, perhaps no direct land connection. Plant distribution, however, gives additional evidence. The large number of species common to the peninsula and the islands are chiefly of the widely distributed weedy types efficient in oceanic dispersal. The insular plants conspecific with otherwise strictly peninsular species are xerophytic ones, as are also the weakly differentiated insular endemics of peninsular affinities and, like them, give every evidence of recent arrival, probably by oceanic means. The relic flora on the islands is a mesophytic or even a moist tropical one of southern affinity and shows no species, with the possible exception of the *Sphacele,* in common with the peninsula. Had there been some, it seems inconceivable that they would fail to persist in the conditions, much more favorable

than on the islands, found in the moist meadows and cañons of the mountains at the peninsula-tip, a region which has not been submerged in Tertiary or more recent times. The *Sphacele* which grows on the summit of Socorro and in the higher parts of the mountains of southernmost Lower California does seem to be an exception. It is an old species with only distant relatives, and one which had no doubt wandered far before it made its last stand in three such strangely selected localities as Hawaii, Socorro and the tip of Lower California. I am inclined to believe, however, that it reached the island and peninsula from a common source on the mainland that has now disappeared. It might, of course, have reached the island from Lower California over the sea, but in any case I do not believe it was by a direct overland route. Such a theory falls of its own weight when attempts are made to explain how only this plant and no others of many species give any evidence of having availed themselves of such an opportunity for advantageous migration. The evidence from plant distribution, therefore, seems to be definitely against the assumption of any former bridging connection of the peninsula with the vanished land mass to the south.

As there are good reasons for believing that the old land mass that preceded the present Revillagigedos could not have been connected with the peninsula of Lower California its connections with the continent must have been through the mainland of Mexico. Indeed, I believe we may visualize it, in times before the extensive diastrophism of the Pliocene, as projecting westward from what is now the states of Jalisco and Colima, or possibly from even somewhat further south. It was at this period when a moister climate permitted the more northern and western extension of the floras now found on the mountain slopes of Vera Cruz, Oaxaca and Chiapas and in Central America and the West Indies, that the land mass must have received directly the first members of the flora and fauna[4] which now linger, more or less modified and in de-

[4] A number of the land-snails on the islands, like the plants have affinities in southern Mexico. The only native land vertebrates on the islands, two lizards (*Uta* spp.) and a snake (*Masticophis* sp.), are clearly related to species, not in lower California, but in the coastal states of the mainland of western Mexico. The lizards have relatives in Jalisco and Colima and northward. Ortenburger, Mem. Univ. Michigan Mus. 1: 144 (1928), in his monograph of the racers definitely concludes that the island snake is immediately derived from one now occurring along the coast from Sonora to Guerrero and possibly Michoacan.

pleted numbers on the crests of the isolated, ocean-ringed, volcanic peaks which now form the Revillagigedos. It was on this old land mass, after its separation from the mainland, that the strongly differentiated insular endemics were able to develop in isolation, and so eventually change. With them, no doubt, were some of the widely distributed weedy species which, having arrived early, probably had no need to demonstrate their abilities for oceanic dispersal in order to reach the islands. The subsidence and diminishing of the land and the tend towards increasing aridity which followed the Tertiary must have been very destructive to the original flora and fauna. Inadaptable stenoclimatic species must have disappeared in large numbers. Even today, indeed, the margin by which many of the island species are able to persist must be very slight. A reduction, for example, of half the height of Socorro would probably result in a reduction, in similar proportion, of the number of species in the entire archipelago. What is more, the reduction would be in those moisture-requiring species which are chiefly old elements in the flora. The islands today are dominated by those species of the older flora which were plastic enough to develop successful xerophytic forms and by the adaptable immigrants which have arrived from over the sea in more recent times. The future flora, if conditions continue with the same trend, will doubtless be made up chiefly of the weedy, readily dispersed, successful plants of wide distribution and will become more and more of an oceanic type.

ACKNOWLEDGMENTS

For the great privilege of working over the Revillagigedo plants obtained on the California Academy of Sciences expedition of 1925, I am indebted to Dr. Barton Warren Evermann, Director of the Museum of the Academy, and to the Curator of Botany, Miss Alice Eastwood. To Dr. W. R. Maxon I am indebted for the loan of critical material from the islands, chiefly collections by Townsend, now preserved in the United States National Herbarium. I am also under great obligation to Prof. W. A. Setchell and Dr. E. B. Copeland

for the loan of a large number of critical Revillagigedo plants from the Brandegee Herbarium, now a part of the general collections at the University of California. Various specialists have also assisted me. The ferns have been determined by Mr. C. A. Weatherby, the orchids by Mr. Charles Schweinfurth, certain grasses by Mrs. Agnes Chase and Prof. A. S. Hitchcock, the Peperomias by Prof. W. Trelease and the Eupatorieae by Prof. B. L. Robinson. Mr. Paul C. Standley very kindly gave me the benefit of his extensive knowledge of the Mexican and Central American plants by examining several puzzling specimens. Through the kindness of Captain John Ramsbottom, Keeper of the Dept. of Botany of the British Museum (Nat. Hist.), I have had available a copy of those parts of Barclay's manuscript journal that concern the islands. Mr. A. W. Anthony, most kindly, has supplied me with data regarding his own important expedition to the islands.

The value of this paper and the pleasure I have had in preparing it have been greatly enhanced by the very friendly and extremely helpful responses I have had to my requests for assistance. I am consequently very grateful to those I have mentioned above. It is a pleasure to again, now publicly, acknowledge my appreciation of and gratitude for the valued assistance they have given me.

INTRODUCTION TO THE CATALOGUE

In the following catalogue I have enumerated and discussed each species of vascular plant known from the Revillagigedo Islands. The determinations of all species have been carefully verified and the nomenclature, when necessary, revised. For all species and subspecies first described from the islands I have given complete synonymy. For the widely distributed species, however, I have given synonyms only when convenience or when precision required it. Under the proper species I have listed all names, whether correct or not, that have been applied to the island flora. References to every mention of Revillagigedo plants that I have encountered in floras or monographs have also been included. Special care has been given to this bibliographic work and I believe that few

if any of the rare references to the Revillagigedo flora have been missed. The nomenclature used is in accord with the International Rules. In the decapitalization of certain specific names and in the omission of the Latin diagnosis for new species I have departed from the prevailing and what I consider the best botanical practice. This was reluctantly done in order to conform with the editorial policies of the Academy.

I have cited all collections examined. These include all but a small percentage of those ever made on the islands and represent all the species ever reported from them. My concern has been, of necessity, chiefly with the problems of distribution, relationship and taxonomy of the species. I regret most keenly that I have been able to give so little regarding the selection of habitats, ecological relations, variations, abundance, growth-habit, flower-color, etc. of the various plants of the islands. Very little is known about these interesting and important details, since, in the excitement of pursuing plant-kinds, the collectors on the islands, who should have assembled such data, have usually forgotten to observe and make note of the vegetation. I have given notes on the general distribution of most species. Emphasis in these notes has been given to the range in Mexico, Central America and the West Indies and particularly to those sections of these areas which might be significant in determining the original source of the island plant. No attempt has been made to state the complete range of species extending into South America or the Old World.

CATALOGUE OF THE SPECIES

PSILOTACEÆ

1. **Psilotum nudum** (L.) Griseb.

Psilotum nudum Griseb. Abh. Ges. Wiss. Göttingen **7**: 278 (1857).

Collected by Barkelew (no. 218) on Socorro. Widely distributed in the tropics.

POLYPODIACEÆ[5]

2. **Polystichum muricatum** (L.) Fée

Polystichum muricatum Fée, Gen. Fil. 278 (1852).

Growing in the forested cañons towards the summit of Socorro where it has been collected by Mason (nos. 1630, 1677). It has a stout trunk-like base, 2.5-3 dm. tall and forms a widely spreading plant 9-12 dm. high. Barkelew (no. 227) also collected it on Socorro. The island plants seem much more fibrillose on the under surface of the pinnae than in most material from the mainland. The species ranges from southern Mexico through Central America to Venezuela and occurs, also, in Jamaica and Haiti.

3. **Asplenium formosum** Willd.

Asplenium formosum Willd. Sp. Pl. **5**: 329 (1810).

Material of this species was collected by Mason on Socorro on the north-facing wall of a cañon near Grayson Cove (no. 1615) and among rocks, in soil and on tree-trunks in shaded places or on north-facing rock wall from 300-1200 meters alt. on the east slope of the island (no. 1631). The insular material collected differs from the typical form in its brown rachis and rather less divided pinnae, in these respects approaching *A. carolinum* Maxon of the Galapagos Islands, although lacking the second row of sori characteristic of that species. *Asplenium formosum* is very widely distributed in the American tropics.

[5] The determinations and the systematic and distributional notes for this family have been contributed by Mr. C. A. Weatherby.

4. **Asplenium potosinum** Hieron., var. **incisum** Hieron.

Asplenium potosinum, var. *incisum* Hieron. Hedwigia **60**: 248 (1919).

Collected on a dry stream bank in the fog-belt near the summit of Socorro by Mason (no. 1670). Barkelew (no. 215) also obtained the variety on the island. It has heretofore been known only from the Mexican state of San Luis Potosi. The insular material seems quite typical. The species is a critical segregate of that variable and puzzling assemblage that formerly passed as *A. lunulatum*, a group that ranges in Central America, in southern and eastern Mexico, the West Indies, etc.

5. **Adiantopsis radiata** (L.) Fée

Adiantopsis radiata Fée, Gen. Fil. 145 (1852).

Present in the dense forests near the summit of Socorro, where it was found growing in soil along dry stream beds by Mason (no. 1632). The species is known from the West Indies, eastern and southern Mexico and from Venezuela to Paraguay. It is either absent or very rare on the Pacific Coast.

6. **Pteridium caudatum** (L.) Maxon

Pteridium caudatum Maxon, Proc. U. S. Nat. Mus. **23**: 631 (1901).

Collected on Socorro by Barkelew (no. 216) and Mason (no. 1662). Mason reports that it is very common on the higher parts of the island. It grows 3-15 dm. tall in the brush but in the forests has stipes 2 m. long and attains a total height of 4.5-6 m. The species occurs in Florida, the West Indies, tropical Mexico and Central America.

7. **Polypodium polypodioides** (L.) Watt

Polypodium polypodioides Watt, Canad. Nat. ser. 2, **13**: 158 (1867).

Collected by Mason (no. 1642) near the summit of Socorro, where it occurred as a climbing epiphyte on mossy tree-trunks both in dense forest and in more open formations. Barkelew (no. 236 in pt.) also found it on the island. The species is very widely distributed in the warmer parts of America.

8. **Polypodium pulchrum** Mart. & Gal.

Polypodium pulchrum Mart. & Gal. Mém. Acad. Brux. **15**: 41, t. 8, f. 2 (1842).

Growing in soil and on tree-trunks in the shade of the forests near the summit of Socorro where it was obtained by Mason (no. 1633). Barkelew (no. 236 in pt.) also collected it on the island. This species ranges from central Mexico south to Costa Rica. It is a close segregate of the wide spread *P. plumula* H. & B., distinguished principally by its broad and usually pale rhizome-scales, and perhaps is no more than a variety of that species.

9. **Cheilanthes peninsularis** Maxon, var. **insularis** Weatherby

Cheilanthes peninsularis, var. *insularis* Weatherby, Amer. Fern Journ. **21**: 25 (1931). *C. wrightii* of Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1891); Brandg. Zoe **5**: 28 (1900).

This variety is endemic to the archipelago. It has been collected on Socorro by Townsend, Anthony (sine no.) and Mason (no. 1616). Mason's collection, which is the type material, came from a very dry north facing rock wall above Grayson Cove at an altitude of about 300 m. It has also been found by Mason (no. 1571) on Clarion, where he reports it as locally abundant in the brush just below the crest of the hills. Typical *C. peninsularis* is confined to central and southern Lower California.

GRAMINEÆ

10. **Eragrostis ciliaris** (L.) Link

Eragrostis ciliaris Link, Hort. Berol. **1**: 192 (1827).

Collected by Barkelew (no. 224) and Mason (no. 1640) on Socorro. The latter got it on a mud-wash on the plateau. It is very widely distributed in the tropics.

11. **Eragrostis diversiflora** Vasey

Eragrostis diversiflora Vasey, Contr. U. S. Nat. Herb. **1**: 285 (1893); Hitchc. Contr. U. S. Nat. Herb. **17**: 365 (1913).

Collected on San Benedicto by Anthony (sine no.), Barkelew (no. 172) and Mason (nos. 1681, 1681a). Mason reports that it is common there in scattered bunches. Off the island it is known only from a very few collections in Sinaloa and Colima.

12. **Jouvea pilosa** (Presl) Scribn.

Jouvea pilosa Scribn. Bull. Torr. Bot. Cl. **23**: 143 (1896); Hitchc. Contr. U. S. Nat. Herb. **17**: 384 (1913).

This species frequents the coastal sands from southern Lower California south to Nicaragua. It has been collected on Socorro by Barkelew (no. 183) and Mason (no. 1610).

13. **Sporobolus argutus** (Nees) Kunth

Sporobolus argutus Kunth, Enum. Pl. **1**: 215 (1833).

Growing on beach-sand and about a vernal pool near Sulphur Bay on Clarion where it was collected by Mason (no. 1569). Widely distributed in the warmer parts of America.

14. **Sporobolus purpurascens** (Sw.) Hamilton

Sporobolus purpurascens Hamilton, Prodr. Ind. Occ. 5 (1825).

Collected near the craters at the summit of Mt. Evermann by Mason (no. 1663). The species has a very disrupted range, being known only from southeastern United States, Cuba, Jamaica, Mexico (Vera Cruz), Guatemala, Costa Rica and several South American countries. The determination has been verified by Mrs. Chase.

15. **Aristida pansa** Woot. & Standl.

Aristida pansa Woot. & Standl. Contr. U. S. Nat. Herb. **16**: 112 (1913).

A common plant on the middle slopes of the south side of Clarion, where it was collected by Mason (no. 1586). It also grows on Socorro, Mason (no. 1649) having collected it on the grassy alluvial flats near Benner Cove. The material from Clarion has been determined by Prof. Hitchcock. He reports that although it shows some minor differences from the continental plant that these are not sufficiently important to justify the treating of the insular plant as distinct. *Aristida pansa* is otherwise known only from Arizona, New Mexico, Texas, Durango and San Luis Potosi. It represents, therefore, the only non-endemic member of the Revillagigedo flora that has a distribution suggestive of the specific relationships of the endemic island species of *Nicotiana* and *Teucrium*.

16. **Eriochloa acuminata** (Presl) Kunth

Eriochloa acuminata Kunth, Enum. Pl. **1**: 72 (1833).

Collected by Anthony (sine no.) and Mason (nos. 1581, 1587) on Clarion where it is reported as a common grass. It grows from sea-level to the crest of the island but is especially common and covers large areas near the summit. The species is practically confined to Mexico. It ranges from Chihuahua and southeastern California southward, chiefly on the Pacific slope, to Oaxaca. Determined by Mrs. Chase.

17. **Paspalum longum** Chase, n. sp.

A robust perennial in large clumps; culms simple, erect, about 8 dm. or more tall, overtopped by the leaves, subcompressed, glabrous; nodes glabrous, none exposed; sheaths elongate, overlapping, the lower pinkish, papillose-pilose along the margin toward the summit, otherwise very smooth, rounded on the back, with tawny prophylla as much as 1 dm. long, the upper sheaths subcompressed; ligule firm-membranaceous, 3mm. long, with long stiff hairs back of it; blades erect-ascending, folded toward the base and narrowed to the width of the sheath, flat or nearly so above, 7-10 dm. long, 8-10 mm. wide, with a long-attenuate, subinvolute tip, the midnerve thick throughout, the upper surface and margin of the blades scabrous, the lower surface smooth, the margin at the base papillose-ciliate with long hairs, the blade much exceeding the panicle; panicle tawny, short-exserted or partly included, the rather slender compressed axis 12-18 cm. long; racemes 9-13, nodding or loosely curled in age, the lower 8-12 cm. long; rachis about 1 mm. wide, densely pubescent at base and minutely so on the upper surface throughout, the margin scabrous; spikelets in pairs on angled pedicels, rather crowded, 2.8-2.9 mm. long, 2 mm. wide, depressed plano-convex and slightly unsymmetrical, broadly ovate-elliptical, obtuse to subacute; glume and sterile lemma equal, rather thin and fragile, very minutely papillose under a lens, 3-nerved; fruit about 2.5 mm. long and 1.6 mm. wide, obovate-elliptic, stramineous, minutely papillose-striate.

Type: No. 186603, Herb. Calif. Acad. Sci., collected May 7, 1925, by H. L. Mason (no. 1648) on a grassy flat north of Benner Cove, Socorro Island.

"This species belongs in the group *Virgata*. In the three overmature specimens examined (all Mason's no. 1648), the leaves are much longer than the culm. In this the species differs from all the others of the group. It appears to be most allied to *Paspalum arundinaceum* Poir. of the Greater Antilles, Guatemala [Atlantic side], and French Guiana. From that it differs in the very thick midnerves of the blades, the slightly larger, flatter spikelets and in the fragile texture of the sterile lemma and palea. A cotype is in the U. S. National Herbarium, no. 1449808."

18. **Setaria geniculata** (Lam.) Beauv.

Setaria geniculata Beauv. Ess. Agrost. 51 and 178 (1812).

Growing at the edge of hot springs in the craters near the summit of Mt. Evermann, where material in very mature condition was collected by Mason (no. 1664). A variable species ranging very widely in the warmer parts of America.

19. **Cenchrus myosuroides** HBK.

Cenchrus myosuroides HBK. Nov. Gen. et Sp. **1**: 115, t. 35 (1816); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890); Brandg. Zoe **5**: 27, 28 (1900); Hitchc. Contr. U. S. Nat. Herb. **17**: 268 (1913); Hitchc. & Chase, Contr. U. S. Nat. Herb. **22**: 53 (1920).

Collected on San Benedicto by Anthony (no. 370), Barkelew (no. 171) and Mason (no. 1682). Mason notes that it is common there on flats and on crater-bottoms where it forms meadow-like growths 15 dm. tall. On Socorro the species has been collected by Townsend, Barkelew (no. 202) and Mason (no. 1604). Mason notes that it grows 9-24 dm. tall on Socorro and that it is common there both on the alluvial deposits near sea-level and on the adjacent hillsides. The species is very widely distributed in the warmer parts of America.

20. **Sorghastrum nutans** (L.) Nash

Sorghastrum nutans Nash in Small, Fl. Southeast. U. S. 66 (1903); Hitchc. Contr. U. S. Nat. Herb. **17**: 211 (1913).

Collected on Socorro by Anthony (no. 401). The species extends from the United States into Mexico where it has been collected at various points on the west coast.

21. **Heteropogon contortus** (L.) Beauv.

Heteropogon contortus Beauv. ex R. & S. Syst. **2**: 836 (1817); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890); Brandg. Zoe **5**: 28 (1900); Hitchc. Contr. U. S. Nat. Herb. **17**: 212 (1913).

On Socorro this species has been collected by Townsend and by Mason, the latter obtained it above Grayson Cove (no. 1619) and near Cape Rule at the south end of the island (no. 1647). Mason notes that the species covers much of the upper half of the mountain on the west side of the island. The species is very widely distributed in the warmer parts of America.

CYPERACEÆ

22. **Cyperus ligularis** L.

Cyperus ligularis L. Amoen. Acad. **5**: 391 (1759).

Collected by Mason (no. 1678) on Socorro on a low flat at the east point of Braithwaite Bay. Widely distributed in tropical America, on the Pacific coast extending north at least to the Tres Marias.

23. **Cyperus duripes** Johnston, n. sp.

A coarse plant springing from a short hard rhizome that becomes over a centimeter thick; leaves numerous, stiffish, ascending, apparently equalling or surpassing the inflorescence; leaf-bases becoming as much as 3 cm. broad, brownish, eventually breaking down into numerous fine brownish fibers; leaf-blades becoming 8-16 mm. broad, firm, not transversely lineate, lucent above, opaque beneath, margins finely very weakly and obscurely denticulate, revolute, vascular strands fine, numerous and crowded; culms 4-10 dm. tall, towards the summit smooth sulcate and decidedly angulate; base of culms very woody, obscurely trigonous, usually covered with brown fibers, commonly developing some strict coarse buds or immature shoots; leaves of involucre 9-12, becoming 1-4 dm. long, similar to the cauline ones in texture, etc.; rays of inflorescence 9-12, unequal, 15-30 mm. long, bearing a single spike or a very crowded group of 2-3 or even a congested secondary umbel of 3-7 spikes; spikes cylindrical, dark brown, the terminal principal ones ca. 8 mm. thick and 1-1.5 cm. long, the

lateral ones shorter and proportionately stouter, sessile and usually divergent; spikelets numerous, congested, ca. 4 mm. long, ca. 1 mm. broad, turgid but somewhat laterally compressed; basal persistent glumes sessile, 1.5-2 mm. long; fructiferous glumes 2, elliptical-oblong, 3.5-4 mm. long, ca. 12-ribbed, brown-dotted; anthers 1.7-2 mm. long, ca. 0.3 mm. broad, base retuse, apex contracted into a subulate appendage 0.5 mm. long; style 1-1.4 mm. long, producing 3 branches 2-2.4 mm. long; mature fruit unknown.

Type: No. 200908, Herb. Univ. Calif., collected May 25, 1897, by A. W. Anthony (sine no.) on **Clarion Island.**

Anthony's collection above cited, which shows the inflorescence and flowers, is clearly the same species as the sterile material collected on Clarion by Mason (no. 1590). According to Mason the plant forms great rank growths in loose soil on the north slopes along the crest of the island. Material collected on Socorro by Anthony (no. 400) is conspecific. An immature specimen by Barkelew (no. 173), labeled as from San Benedicto, is probably the same. The species is endemic to the islands. It is to be noted, however, that the material from Socorro and San Benedicto tends to have simple umbels, is decidedly less robust and seems to be less conspicuously lignescent and hence, perhaps, might be separable from the Clarion form. The new species belongs to the section *Mariscus* and to the general group of *C. ligularis* although evidently distinct from that particular species. Its exact relations are obscure. From *C. ligularis* it differs in its fewer flowered pale spikelets, in its very much firmer foliage, which is lucent above, has much less scabrid margins and lacks evident cross-partitions, and finally in its very woody more or less fibrous culm-bases and rhizomes. It is a plant on hillsides, not of coastal marshes.

24. Cyperus aff. brunneus Sw.

Overly mature specimens of a species suggesting in gross habit *C. brunneus* Sw. and one probably closely related to it, have been collected on Socorro by Barkelew (no. 196) and Mason (no. 1651). The latter obtained it on sea-cliffs near Benner Cove. The spikelets seem to be stouter and have more closely imbricated scales, but otherwise the Socorro plant is

very like the West Indian material of *C. brunneus*. A few collections of that species have been made in southern Mexico.

25. **Scirpus robustus** Pursh, var. **paludosus** (Nels.) Fernald

Scirpus robustus, var. *paludosus* Fernald, Rhodora **2**: 241 (1900).

Growing on the margins of pools behind the dunes on Clarion where it has been collected by Mason (no. 1580). The plant grows 1-2.5 dm. tall. The variety is known from northwestern Mexico and western United States.

26. **Stenophyllus nesioticus** Johnston

Stenophyllus nesioticus Johnston, Univ. Calif. Pub. Bot. **7**: 438 (1922). *Fimbristylis sp.* Brandg. Zoe **5**: 27–28 (1900); ? Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890).

Collected on San Benedicto by Anthony (no. 317, type; 371) and Mason (no. 1687), on Socorro by Barkelew (no. 225) and Mason (no. 1650), and, if the label is to be fully trusted, also on Clarion by Anthony (sine no.). Mason found it occasional in scattered patches in a cañon on San Benedicto. On Socorro it grew on sea-cliffs and travertine deposits at Benner Cove. The collections from San Benedicto and Clarion are quite similar, having the spikes in a dense head as originally described. The material from Socorro, however, frequently develops spikes 6-15 mm. long. In their arrangement these can be described only as umbellate. I assume that the specimens from Socorro, reported by Vasey & Rose, loc. cit., as *Fimbristylis,* are probably this form. Townsend's specimens, however, could not be located in the National Herbarium. *Stenophyllus nesioticus* is related to *S. junciformis* (HBK.) Britt., and related forms of the West Indies and Central America. Although the precise relationship is not clear, it can be said that they are not Mexican.

COMMELINACEÆ

27. **Commelina virginica** L.

Commelina virginica L. Sp. Pl. ed. 2, **1**: 61 (1762). *Tradescantia* sp. Brandg. Zoe **5**: 27 (1900).

An immature specimen obtained on Clarion by Anthony (sine no.) is apparently referable to this very wide-spread and variable species.

ORCHIDACEÆ

28. **Pleurothallis unguicallosa** Ames & Schweinf.

Pleurothallis unguicallosa Ames & Schweinf. Proc. Biol. Soc. Wash. **43**: 195 (1930).

An epiphytic species found in the forests on the higher portions of the east slope of Socorro by Mason (no. 1628, type). The species is endemic. Its closest relative is *P. wilsoni* Lindl., a species known only from Cuba, Jamaica, Haiti, Porto Rico, and Guadeloupe in the West Indies.

29. **Cattleya aurantiaca** (Batem.) P. N. Don

Cattleya aurantiaca P. N. Don, Florist Journ. 185 (1840); Ames & Schweinf. Proc. Biol. Soc. Wash. **43**: 195 (1930).

Found by Mason (no. 1643) growing on branches of *Bumelia* on the east slope of Socorro. Otherwise known only from southern Mexico south to Costa Rica.

30. **Epidendrum rigidum** Jacq.

Epidendrum rigidum Jacq. Enum. Pl. Carib. 29 (1760).

Collected on Socorro by Barkelew (no. 233). Ranging from southern Florida and eastern Mexico southward into northern South America. Apparently unknown from the Pacific slope of Mexico, Salvador or Guatemala. I am indebted to Mr. Schweinfurth for the determination of this and the two preceding orchids.

PIPERACEÆ

31. **Peperomia chrysolepida** Trelease, n. sp.

A rather small creeping- or stoloniferous-assurgent forking succulent herb; stems slender, 1-2 mm. thick, rooting from many nodes, terete, usually branching from the rooted nodes, glabrescent; leaves about 4 at a node, round- or subquadrate- or ovate-elliptical, obtuse at both ends, 7-15 mm. long, 5-8 mm. wide, glabrous, glossy, trinerved, impressed punctulate; petiole 1-2 mm. long, more or less puberulent; spike terminal, 2-3 cm. long, ca. 2 mm. thick, rachis with anastomosing hairy ridges; peduncle slender, scarcely 1 cm. long, short hispid; bracts round-peltate, orange-dotted; ovaries subovoid, attenuate; stigma apical.

Type: No. 3999023, Herb. U. S. Nat. Mus., collected in 1903 by F. E. Barkelew (no. 228) on **Socorro Island.**

Found growing in moss on trees in the forests on the upper slopes of Socorro by Mason (no. 1629). Concerning this and the following species Prof. Trelease writes, "Neither of them, so far as I can see, is identical with any published species, but both are closer to Mexican and Guatemalan species than to anything else I know; neither is very closely comparable with South American forms; and both are endemic American types (even though the Old World *reflexa* seems to contradict this idea)."

32. **Peperomia socorronis** Trelease, n. sp.

A moderate sized caespitose, somewhat branched erect glabrous, epiphytic herb; stems 2-3 mm. thick, somewhat scurfy-exfoliating, 1-2 dm. tall; leaves alternate, elliptic, subacute at both ends, 2-3 cm. broad, 3-6 cm. long, drying thin but dull and 3-5(-7)-nerved, glabrous; petioles scarcely 5 mm. long; spikes terminal or occasionally also from the upper axils, some 2 mm. thick and 10 cm. long, rather loosely flowered; peduncles 10-15 mm. long; bracts round-peltate; berries subglobose, slightly mucronate; stigma subapical.

Type: No. 186616, Herb. Calif. Acad. Sci., collected May 8, 1925, by H. L. Mason (no. 1653), near the summit of **Mt. Evermann, Socorro Island.**

Growing on tree-trunks, chiefly in decaying knot-holes, in moist forests at the lower edge of the fog-belt where it obtains moisture from the fog sufficient to carry it through the dry season. It occurs associated with *P. chrysolepida.* Both species are endemic to Socorro.

MORACEÆ

33. **Ficus cotinifolia** HBK.

Ficus cotinifolia HBK. Nov. Gen. et Sp. **2**: 49 (1817); Standley, Contr. U. S. Nat. Herb. **20**: 19 (1917). *F. tecolutensis* of Brandg. Zoe **5**: 28 (1900).

Collected on Socorro by Anthony (no. 395), Barkelew (no. 178) and Mason (no. 1607). According to Mason the plant forms a tree becoming 6 m. in height and 15-30 m. in spread.

Aerial roots are commonly produced. It occurs scattered over slopes where it forms conspicuous dark green masses among the dense pallid growth of *Croton*. On drier flats, along with *Psidium* and *Zanthoxylum*, it is the dominant tree in somewhat of a forest community. Because of the shade offered by the broad spread and dense foliage of the trees of this species, they are favorite gathering places for the numerous sheep that run wild on the island. The species ranges widely in Mexico. On the Pacific Coast it extends from Lower California and Sonora south into Central America.

LORANTHACEÆ

34. **Phoradendron townsendi** Trelease

Phoradendron townsendi Trelease, Gen. Phoraden. 112, t. 162 (1916); Standley, Contr. U. S. Nat. Herb. **23**: 226 (1922). *Ph. rubrum* of Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890); Brandg. Zoe **5**: 27 (1900).

Known definitely only from Socorro where it has been collected by Townsend (type), Anthony (sine no.), Barkelew (no. 177), and Mason (nos. 1620, 1622). Mason reports that it is parasitic on *Dodonaea* and *Guettarda*, and that it is particularly common on the west side of the island. The species is a very critical one. I believe it is rather doubtfully separable from that one of the Mexican mainland which Trelease has treated chiefly as *Ph. commutata* Trel., but which I suspect might well be accepted as *Ph. rubrum* (L.) Griseb. In short, I have accepted *Ph. townsendi* as a very questionable endemic. In any case, however, the plant has very close relatives in southern Mexico, adjacent Central America, and in the West Indies.

ARISTOLOCHIACEÆ

35. **Aristolochia brevipes** Benth.

Aristolochia brevipes Benth. Pl. Hartw. 15 (1839); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890); Brandg. Zoe **5**: 27 (1900).

Collected on San Benedicto by Anthony (fide Brandg. loc. cit.), Barkelew (no. 169) and Mason (no. 1680). The last mentioned found it trailing on ash-slopes on the north side of the island. Townsend, Anthony (sine no.), and Barkelew (no.

193) found it on Socorro. The species frequents dryish situations and has been collected in most parts of Mexico, although most often in the northwestern parts.

AMARANTHACEÆ

36. **Iresine celosia** L.

Iresine celosia L. Syst. ed. 10, **2**: 1291 (1759).

A weak, slender suffruticose plant found by Mason (no. 1565) growing through the brush on Clarion where he reports it as common. The inflorescence on the Clarion specimens is more compact, the stems more distinctly fruticulose and the root stronger and more persistent than is usual in this species. I believe these to be mere ecological responses in this variable species. It is widely distributed through the warmer parts of America.

NYCTAGINACEÆ

37. **Boerhaavia caribaea** Jacq.

Boerhaavia caribaea Jacq. Obs. Bot. **4**: 5, t. 84 (1771). *B. ixodes* Standley, Contr. U. S. Nat. Herb. **13**: 423 (1911). *Boerhaavia* sp. Brandg. Zoe **5**: 27 (1900).

Of this extremely variable and very widely distributed species, collections have been made on Socorro by Anthony (sine no.), Barkelew (no. 205) and Mason (nos. 1603, 1674). It is said to be rather common on the island. Mason (no. 1592) also collected it on the summit ridge of Clarion.

AIZOACEÆ

38. **Sesuvium portulacastrum** L.

Sesuvium portulacastrum L. Syst. ed. 10, **2**: 1058 (1759); Brandg. Zoe **5**: 27 (1900)

This succulent plant grows in brackish marshes or in localities near the sea throughout most of the American tropics. It is rare or at least is very rarely collected along the west coast of Mexico. It has been collected on Clarion by Anthony (sine no.) and Mason (no. 1576). The latter found it growing along the beach and on the cliffs above it.

PORTULACACEÆ

39. **Portulaca pilosa** L.

Portulaca pilosa L. Sp. Pl. 445 (1753); Vasey & Rose, Proc. U.S. Nat. Mus. **13**: 146–7 (1890); Brandg. Zoe **5**: 27 (1900).

Collected on Socorro and Clarion by Townsend. Mason (no. 1584) found it on Clarion and only along the hills east of Sulphur Bay, where it occurs on the slopes from beach to crest. In his collections the plant has formed a very loosely branched suffruticose caudex. The leaves are very fleshy and obtuse, being rather compressed botuliform in shape. The material from Socorro represents a much more slender and apparently less persistent plant. The differences, however, are probably ecological in origin. The species ranges widely in the American tropics.

CRUCIFERÆ

40. **Lepidium lasiocarpum** Nutt.

Lepidium lasiocarpum Nutt. ex T. & G. Fl. No. Amer. **1**: 115 (1838); Brandg. Zoe **5**: 27 (1900).

This herb has been collected on Clarion by Anthony (no. 405) and Mason (no. 1589). Mason notes that it grows in crevices on shaded cliffs and along the summit ridge of the island. The species grows in western United States and northern Mexico.

ROSACEÆ

41. **Rubus** sp.

Material representing this genus was obtained by Mason (no. 1654) in cañons towards the summit of Socorro. The plant represented is a large shrub with stems that often climb to a height of 15 m. The collections lack flowers, fruit and even an old inflorescence. They appear to represent, however, a species related to those of southern Mexico and adjacent Central America. As far as can be judged from imperfect material, the closest relation seems to be *R. schiedianus* Steud.

42. **Prunus capuli** Cav.

Prunus capuli Cav. Anal. Hist. Nat. Madrid **2**: 110 (1800).

Collected by Mason (no. 1635) on the east slope of Socorro where it forms large bushy pyramidal trees 3-5 m. tall. The material from Socorro generally has the leaf-blades a little more prominently toothed and proportionately somewhat broader than in the common continental form but otherwise seems quite like it. The species is found from Lower California and Sonora southward through Central America to Peru.

LEGUMINOSÆ

43. **Calliandra socorrensis** Johnston

Calliandra socorrensis Johnston, Contr. Gray Herb. **70**: 71 (1924). *Anneslia socorrensis* Britt. & Rose, No. Am. Fl. **23**: 64 (1928). *Calliandra* spp. Brandg. Zoe **5**: 27 (1900).

Two unnumbered collections of this plant were made on Socorro by Anthony. One, with leaflets 10-19 mm. long, probably came from a sheltered locality, the other, with leaflets 3-11 mm. long, from a more exposed situation. The latter collection was made the type. Mason has collected on Clarion (no. 1566) a plant obviously conspecific with these from Socorro. It is given as a shrub about a meter tall. The specimens of it are distinctly shrubby and in this regard much suggest the type, which probably also came from a shrub of similar size. No flowers of this species have ever been collected. Its fruits are known only from legumes that are old and battered. All the specimens have uniformly 2-yoked pinnae, each of which bears 4-6(-7) leaflets. The species is related to *C. formosa* (Kunth) Benth., and particularly to those forms of it that Britton & Rose, loc. cit. 68, have referred to *Anneslia gracilis* (Mart. & Gal.) Britt. & Rose. The relation of the island plant to that of western Mexico is very close. It stands as a questionable endemic. Only when good collections of it have been obtained will it be possible to decide its status definitely. I should not be surprised if it proves to be no more than an insular phase of *C. formosa*.

44. **Calliandra** sp.

A shrub collected by Mason (no. 1661) in the thickets near the crest of Socorro. It grows 15 dm. tall. The collections are fragmentary, consisting of only a few leafy twigs and some old fruits, but are sufficient to prove it different from *C. socorrensis,* the larger leaves having 3 pairs of pinnae each bearing 9-12 leaflets. It is closely related to and perhaps is no more than an island form of the widely ranging and very variable *C. portoricensis* (Jacq.) Benth. The leaflets are 3-6 mm. broad and 1-1.5 cm. long and hence are rather broad for the species.

45. **Caesalpinia crista** L.

Caesalpinia crista L. Sp. Pl. 380 (1753). *Guilandina socorroensis* Britt. & Rose, No. Am. Fl. **23**: 338 (1930). *C. bonducella* of Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Anthony (no. 417) and Mason (no. 1567), whence probably also came the collection by Barkelew (no. 207) that has been labeled as from Socorro. Barkelew's collection is the type of *Guilandina socorroensis.* Except that the island plant is somewhat less thorny than is usual in the species, it is quite like the common forms of this pantropic strand-plant. In stipules and bracts it is in no way aberrant. It will be noticed, furthermore, that the description of these structures given by Britton & Rose in their key is not in agreement with that found in their formal diagnosis. The latter is correct. The island plant is obviously a mere trivial form of *C. crista.* Mason notes that it is a straggling shrub, branched from the base and becoming 6-12 dm. tall. On the Pacific side of America the species ranges from Sinaloa in Mexico south to Ecuador. It is known from the Tres Marias, Revillagigedo, Cocos and Galapagos islands.

46. **Sophora tomentosa** L.

Sophora tomentosa L. Sp. Pl. 373 (1753); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146 (1890); Brandg. Zoe **5**: 27 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 435 (1922).

This pantropic strand-plant, generally distributed in the West Indian region, is known from the Pacific side of America only from the Revillagigedos. It has been collected

on Clarion by Townsend, Anthony (no. 404) and Mason (no. 1562). The collection made by Barkelew (no. 246) and labeled as from Socorro is probably another example of the confused data in his set of plants. I believe that Barkelew's collection also came from Clarion. Mason reports that the plant is rather common on Clarion, growing in the dense brush near the ocean, along the beach and on the low hills directly behind it. It is a shrub from a woody base and grows 2-12 dm. tall.

47. **Canavalia apiculata** Piper

Canavalia apiculata Piper, Contr. U. S. Nat. Herb. **20**: 566 (1925). *Erythrina* sp. Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146 (1890); Brandg. Zoe **5**: 27 (1900). *C. obtusifolia* of Brandg. Zoe **5**: 27 (1900).

A very close relative and perhaps no more than a phase of the pantropic strand-plant, *C. maritima* (Aubl.) Thon., which it apparently replaces on the west coast of Mexico. Off the continent it has been collected only on Clarion where it has been obtained by Townsend, Anthony (no. 405) and Mason (No. 1552). It is abundant on Clarion growing along the beach and well up on the slopes. Mason noted, but did not collect it, at Grayson Cove on Socorro.

48. **Phaseolus lunatus** L.

Phaseolus lunatus L. Sp. Pl. 724 (1753).

Collected on Socorro by Mason (no. 1668) who reports it as abundant and as draping profusely the bushes near the summit of the island. The species is very widely dispersed through tropical America.

49. **Phaseolus atropurpureus** DC.

Phaseolus atropurpureus DC. Prodr. **2**: 395 (1825). *Phaseolus* sp. Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146 (1890); Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Townsend, Anthony (no. 414) and Mason (no. 1550). The collection made by Barkelew (no. 248), labeled as from Socorro, probably also came from Clarion. According to Mason the plant is found everywhere on Clarion, either trailing on the ground or climbing over

rocks. It is most abundant, however, along the beaches and on the lower hills just behind them. The species occurs in most parts of Mexico and extends into northern Central America.

50. **Rhynchosia minima** (L.) DC.

Rhynchosia minima DC. Prodr. **2**: 385 (1825); Brandg. Zoe **5**: 27 (1900).

Known on the islands only from a collection made on Socorro by Anthony (sine no.). The species is very widely distributed through tropical America, extending northward to southern Lower California, Sonora, Texas and Florida.

51. **Galactia striata** (Jacq.) Urban

Galactia striata Urban, Symb. Ant. **2**: 320 (1900).

Specimens, showing leaves and ripe fruit, of what is almost certainly this species were collected by Mason (no. 1563) on Clarion. The plant is reported as a very abundant vine that had almost completely dried up and gone in late April when the specimens were taken. *Galactia striata* grows on the Tres Marias and is widely distributed in southern Mexico, Central America and the West Indies.

ZYGOPHYLLACEÆ

52. **Tribulus cistoides** L.

Tribulus cistoides L. Sp. Pl. 387 (1753); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146–7 (1890); Brandg. Zoe **5**: 27 (1900).

Collected on Socorro by Townsend, Anthony (no. 393), and Barkelew (no. 200), and on Clarion by Townsend, Anthony (no. 410), and Mason (no. 1554). On Clarion Mason notes that it is abundant near the sea, growing on beaches, dunes and sea cliffs. The species is very widely distributed through the warmer parts of America.

RUTACEÆ

53. **Zanthoxylum fagara** (L.) Sargent

Zanthoxylum fagara Sargent, Gard. & Forest **3**: 186 (1890). *Z. pterota* HBK.; Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Anthony (fide Brandg. loc. cit.) and Mason (no. 1575). A tough thorny shrub which on

Clarion is usually scattered, although at times forms almost impenetrable thickets. The species is very widely distributed in the warmer parts of America, mostly in semiarid situations.

54. **Zanthoxylum insulare** Rose

Zanthoxylum insulare Rose, No. Am. Fauna **14**: 79 (1899); Wilson, No. Am. Fl. **25**: 189 (1911); Standley, Contr. U. S. Nat. Herb. **23**: 534 (1923). *Zanthoxylon* sp. Brandg. Zoe **5**: 27 (1900).

This species has been found on Socorro by Anthony (no. 394), Barkelew (no. 187), and Mason (no. 1636). Mason found it on the east slope of the island and reports that it is a climbing shrub with leaves that are dark and glossy green above and lighter colored beneath. The leaflets on the Socorro material occur in 5-9 pairs. The most common numbers, however, are 7-9. The species has been found only in Jamaica, Tres Marias Islands, and Socorro, and in northern and western South America. It is perhaps too closely related to *Z. culantrillo* HBK., a species which ranges from Central America to Peru and which in turn is rather close to certain species of Brazil.

BURSERACEÆ

55. **Bursera nesopola** Johnston, n. sp.

A small tree 2.5-6 m. tall; twigs red-brown, somewhat lucent, at first very sparsely and obscurely pubescent but later becoming quite glabrous; leaves usually clustered at the ends of branches or short lateral spurs, simple; blade elliptical or oblong-ovate, 2-3.8 cm. long, 1.5-2.3 mm. wide, chartaceous, apex obtuse, base obtuse to obliquely shallow-cordate, margin finely crenate, midrib evident, producing 6-7 evident parallel veins on each side, secondary venation usually obscure; upper leaf-surface slightly vernicose, sparsely and usually obscurely hispidulous, slightly glandular; lower leaf-surface more conspicuously (usually brownish) hispidulous, particularly on the veins and midrib, paler, opaque, somewhat glandular; petiole about one-fourth length of blade, 5-10 mm. long, hispidulous, unwinged; inflorescence slender, surpassing the leaves, 3-5 cm. long, loosely 3-7-flowered, racemose, finely pubescent; pedicels ascending, 3-5 mm. long; calyx sparsely hispidulous, ca. 2 mm.

thick at base, lobes erect cuneate 1.5-2 mm. long; petals elliptical ovate, 2-2.5 mm. long, 1.3 mm. wide, sparsely hispidulous outside; filaments subulate, ca. 0.8 mm. long, glandular-pulverulent; anthers ca. 1 mm. long; ovary glabrous; submature fruit obliquely and somewhat irregularly obovoid or pyriform, 7-9 mm. long, glabrous.

Type: No. 186618, Herb. Calif. Acad. Sci., collected May 3, 1925, by H. L. Mason (no. 1609), at Benner Cove on **Socorro Island.**

This species, which Mason found occurring as scattered trees on drier slopes at the south end of Socorro, is obviously related to *B. rhoifolia* (Benth.) Johnston, a plant widely distributed over the southern parts of Lower California and adjacent Sonora. It differs from the peninsular relative in having a very much sparser rather obscure pubescence, subvernicose upper leaf-surfaces, and very elongate inflorescences.

EUPHORBIACEÆ

56. **Croton masonii** Johnston, n. sp.

Shrub 3-25 dm. tall; bark rough, deciduous; twigs pallid, copiously stellate-tomentose, eglandular, the trichomes consisting of a well developed erect or ascending axis and numerous short appressed radiate branches; leaves ovate to lance-ovate, 1.5-3.5 times as long as broad, 2.5-7 cm. long, 1.5-4 cm. broad, broadest below the middle, not at all lobed, palmately 5-costate at base although practically pinnate in venation, lacking laminar or petiolar glands, base rounded or somewhat truncate, apex acute or acuminate, margin denticulate, upper surface with impressed ribs and veins and green or somewhat grayish with a fine stellate pubescence, under surface densely white stellate-tomentose with prominent ribs and primary veins and prominulent secondary veins; petiole 5-20 mm. long, a fifth to a sixth the length of the blade, pallid with a stellate tomentum; stipules subulate, caducous, pallid and tomentose, 3-5 mm. long; inflorescence usually terminating short leafy branchlets, racemose, usually 6-12 cm. long, a centimeter or less thick, bisexual, rarely branched towards the base; bracts linear, 3-5 mm. long; *staminate flowers* usually 25-70 in each raceme; pedicels 3-5 mm. long; buds subglobose ca. 2 mm. thick, white

stellate tomentose; calyx cut two-thirds to base into 5 triangular-ovate lobes; petals 5, surpassing the calyx, ca. 3.5 mm. long, ca. 1.3 mm. wide, oblanceolate, obtusish, inner face evidently simple-villous especially below the middle, outer face somewhat stellate; stamens 10-15, ca. 3 mm. long, villous especially towards the base; glands 5 on the edge of the villous receptacle opposite the sepals; *pistillate flowers* 1-20, replacing the staminate flowers towards the base of the racemes, subsessile; buds angulate, ovoid with an obtuse or truncate apex, ca. 2.5 mm. long, stellate-tomentose inside and out; petals represented by glands or very rarely with one or more developing and becoming 1.5-2 mm. long and linear with a lacerate or villous margin; calyx lobed to well beyond the middle, the sinus somewhat plicate; calyx-lobes 5, somewhat oblong, thickish, acute, decidedly accrescent and persistent at maturity, becoming 4-5 mm. long and evidently embracing the fruit; ovary ovoid-globose, ca. 1.5 mm. thick, densely stellate; capsule 3-celled, 6-8 mm. long, stellate tomentose, apex obtuse or truncate; styles 3, each 2 mm. long and parted to the base, the divisions each forked at their middle, stellate on the outer face; seeds 4-5 mm. long.

Type: No. 186600, Herb. Calif. Acad. Sci., collected May 5, 1925, by H. L. Mason (no. 1637) on the east slope of **Socorro Island.**

This very distinct endemic of Socorro has the general facies of the widely distributed Mexican *C. cortesianus* HBK., but differs not only in such details as having the upper surface of the palmately ribbed leaves stellate rather than glabrous but also in the striking and important development of having the calyx of the female flowers persistent, strongly accrescent and eventually quite embracing the fruit. In fact the persistent, conspicuously accrescent calyces of *C. masonii* distinguish it quickly and decisively from all but a very small number of the American species of this large genus, none of which seem very closely related to it. Although the relations of the island plant are obscure, in general they seem to be with the species of southern Mexico and adjacent Central America. The plant grows in dense pure stands over all the south slope of Socorro, extending from sea-level up to the plateau where its upper limit is abruptly marked. It forms almost inpenetrable thickets

over large areas and was one of the most trying plants for the members of the recent expedition since it was necessary to fight a passage through its stands in order to get anywhere on the island from the anchorage. Collections of it have been made on Socorro by Anthony (sine no.), Barkelew (no. 180) and Mason (no. 1637). It is reported as "*Croton* sp." by Brandegee, Zoe **5**: 27 (1900).

57. **Acalypha umbrosa** Brandg.

Acalypha umbrosa Brandg. Erythea **7**: 7 (1898) and Zoe **5**: 27 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 630 (1923); Pax & Hoffm. Pflanzenr. [Heft 85] Fam. 147, pt. 16, pg. 124 (1924).

Known only from Socorro where it has been collected by Anthony (no. 375, type), Barkelew (no. 206), and Mason. Mason obtained it (no. 1623) near Grayson Cove, where on the burned-over area it formed a common small bush 4.5-6 dm. tall, and later (no. 1660) recollected it near the summit of the island. The species seem to be polygamo-dioecious. Most of the material seems to have axillary inflorescence consisting of a few pistillate flowers borne on the peduncle of the dense elongate spike of staminate flowers. Although this condition seems to prevail, I found that some specimens (in one case a single branch of a prevailingly staminate specimen) tend to be predominately if not exclusively pistillate. These forms have axillary spikes of 10-25 pistillate flowers and, apparently late in the season, develop a distinctly terminal pistillate spike also. A similar variation on the arrangement of the pistillate and staminate flowers is to be observed in *A. californica* Benth. That latter species, which is chiefly peninsular, is probably the closest relation of *C. umbrosa*.

58. **Hippomane mancinella** L.

Hippomane mancinella L. Sp. Pl. 1191 (1753); Brandg. Zoe **5**: 28 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 649 (1923).

Collected on Socorro by Anthony (no. 388), and Mason (no. 1625). At Grayson Cove the tree is said to be locally abundant and to form a small grove back of the shore. There are many interesting and conflicting reports regarding the

poisonous qualities of this plant, cf. Standley, loc. cit. Mr. Mason's observations in this connection are of some interest. The plant has been reported as producing very severe dermatitis. The poisonous qualities of its fruit have been repeatedly emphasized. Dermatitis was produced on a member of the Academy expedition who came in contact with the juice of a crushed leaf. The wood, however, was used as fuel and the shade of the trees was enjoyed, yet no other case of dermatitis developed. Sheep were noted to eat the leaves and parakeets to break open the fruits and eat the seeds. With this example some of the party ate the seeds and found them to have a flavor suggestive of that of black walnuts. The species frequents coasts and is widely distributed in the West Indian region. Along the Pacific Coast it is known from Socorro and the Galapagos Islands and on the mainland from southernmost Mexico to Ecuador.

59. **Euphorbia californica** Benth.

Euphorbia californica Benth. Bot. Voy. Sulphur 49 (1844); Brandg., Zoe **5**: 27 (1900).

Collected on Clarion by Anthony (no. 413), and Mason (no. 1564). Mason notes that it is a rather succulent shrubby plant 5-10 dm. tall, scattered abundantly in the brush over the island. It was in leafless condition the last of April when he collected it. The plant also grows in the coastal region of Sinaloa, Sonora, and southern Lower California.

60. **Euphorbia incerta** Brandg.

Euphorbia incerta Brandg. Proc. Calif. Acad. Sci. ser. 2, **3**: 171 (1891) and Zoe **5**: 27 (1900).

Collected on Socorro by Townsend, Anthony (no. 399), and Barkelew (no. 244). The species is known only from a relatively few scattered stations. It has been collected in the general vicinity of La Paz, Lower California, and at Mazalan, Sinaloa, and on the Tres Marias and Revillagigedo islands. It appears to grow chiefly, if not exclusively, in sands along the sea shore.

61. **Euphorbia anthonyi** Brandg.

Euphorbia anthonyi Brandg. Erythea **7**: 7 (1898) and Zoe **5**: 27 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 602 (1923). *E. clarionensis* Brandg. Erythea **7**: 7 (1898) and Zoe **5**: 27 (1900). *Chamaesyce deppeana* Millsp. Pub. Field Mus., Bot. **2**: 409 (1916); Johnston, Contr. Gray Herb. **68**: 87 (1923).

Although there has been some attempt in the past to distinguish specifically the material from each of the islands in the archipelago, my attempts to do so have been quite unsuccessful. There do appear to be certain tendencies that are correlated with certain islands, but these seem too indefinite or too trivial to justify, certainly at this time, the dignifying of them by specific recognition. I have accordingly placed all the material from the islands, of this general relationship, under *E. anthonyi.* Specimens have been collected on Clarion by Townsend, Anthony (no. 406, type of *E. clarionensis),* and Mason (no. 1556); on San Benedicto by Anthony (no. 369, type of *E. anthonyi),* Barkelew (no. 174), and Mason (no. 1688); and on Socorro by Townsend, Barkelew (nos. 204, 204a), and Mason (nos. 1600, 1671). The collections from Clarion and San Benedicto show little variation and seem very much alike except that those from Clarion have distinct narrow white petaloid appendages on the involucre-glands, whereas those from San Benedicto quite lack them. As the material from Socorro also lacks appendaged involucre-glands, the form from Clarion may for convenience be distinguished as **E. anthonyi** var. **clarionensis** (Brandg.), comb. nov. The material assembled from Socorro is very variable. Some of it (Barkelew 204 and Mason 1600) is as robust and has quite the same habit as that from San Benedicto. The Socorro plants, however, tend to be more slender, possibly in response to more favorable conditions found on that island. Some of these forms (Townsend, Barkelew 204a and Mason 1671) approach in habit the fruticulose forms of *E. hypericifolia* L. Indeed I am inclined to believe that *E. anthonyi,* which is endemic to the archipelago, was probably derived from that species or some other closely related one belonging to the same plexus of puzzling ill defined species. These latter are found throughout the warmer parts of America.

It is to be hoped that future collectors on the islands will watch this *Euphorbia* for variations and that they will prepare

more than a single collection from each island. Our knowledge of its habit of growth and of its selection of habitats is very meagre. Mason notes that on Clarion it is "common among the brush" and that it assumes "shrubby proportions away from the sea" and becomes prostrate along the beach. On San Benedicto he reports it as a common shrubby prostrate plant. Nothing is noted regarding its habit, habitats, abundance or variation on Socorro.

AQUIFOLIACEÆ

62. **Ilex socorroensis** Brandg.

Ilex socorroensis Brandg. Univ. Calif. Pub. Bot. **4**: 90 (1910); Standley, Contr. U. S. Nat. Herb. **23**: 675 (1923).

The type of this very distinct endemic was collected on Socorro by Barkelew (no. 179). Mason (no. 1634) found the species on the east slope of Socorro where it becomes arborescent, reaches 6 m. in height and forms dense thickets. The flowers are given as white and 4-5-merous. The species has no obvious relations in Mexico or Central America and seems, in fact, to be rather evidently related to *I. repanda* and its immediate relatives in the West Indies.

SAPINDACEÆ

63. **Cardiospermum halicacabum** L.

Cardiospermum halicacabum L. Sp. Pl. 366 (1753). *C. palmeri* Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 147 (1890); Brandg. Zoe **5**: 27 (1900).

Of this widely distributed and very variable vine of the tropics a glabrous form has been collected on Clarion by Mason (no. 1591) and a densely pubescent form has been collected on Socorro by Townsend, Anthony (no. 379), Barkelew (no. 203), and Mason (no. 1645). The pubescent form of Socorro is similar to plants of the peninsula and of the mainland of Mexico that have been referred to *C. palmeri* Vasey & Rose, and to *C. corindum* L. These plants I believe are mere phases of the variable and very widely ranging *C. halicacabum*. It is interesting, however, that Socorro and Clarion have different forms. The plants on these islands are

quite similar in leaf-outline, shape of fruit, etc. They differ merely in that one is densely pubescent, almost velvety, whereas the other is quite glabrous.

64. **Sapindus saponaria** L.

Sapindus saponaria L. Sp. Pl. 367 (1753). *Sapindus* sp. Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146 (1890); Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Townsend, Anthony (sine no.), and Mason (no. 1561). Mason reports that it grows there behind the beach about a vernal pool and that it forms a large thicket used by the Blue-faced Booby as nesting sites. As many as ten nests were frequently found in a single plant. It is the largest shrub on the island growing to a height of 2-3 m. The species is widely distributed in the warmer parts of America.

65. **Dodonaea viscosa** Jacq.

Dodonaea viscosa Jacq. Enum. Pl. Carib. 19 (1760); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146, 148 (1890); Brandg. Zoe **5**: 27 (1900).

This shrub, which is very widely distributed in the warmer parts of America, has been collected on Socorro by Townsend, Anthony (no. 390), and Mason (no. 1621) and on Clarion by Townsend, Anthony (no. 412), and Mason (nos. 1551, 1577). A collection by Barkelew (no. 188), labeled as from San Bendicto, probably also came from Clarion or Socorro. According to Mason the shrub grows on Clarion at the summit of sea-cliffs where its dark green color makes it a very conspicuous plant against the prevailing gray color of the mass of the vegetation on the island.

SABIACEÆ

66. **Meliosma nesites** Johnston, n. sp.

Tree becoming 20 m. tall; branchlets pale, terete, sparsely brownish hispidulous and somewhat glandular, becoming glabrate; axillary buds brown with a dense pubescence; leaves alternate, firmly chartaceous; blades oblanceolate, 10-18 cm. long, 3-6 cm. broad, broadest above the middle and then con-

tracted towards both ends, glabrous or very sparsely and obscurely pubescent along the veins and in the vein-axils beneath, apex acuminate, base cuneate, margin somewhat crisped but quite entire, upper surface dark green; beneath paler, somewhat lustrous, midrib prominent and producing 9-13 veins on each side, veins prominent, arcuately ascending, arching to 2-4 mm. from the leaf-margin, tertiary and even finer veining evident and reticulate; petioles 8-11 mm. long, upper half slender, glabrous, smooth and very narrowly winged, lower half coarse thickened, paler and somewhat pubescent; panicle axillary, 5-13 cm. long, sparsely and divaricately branched, sparsely brownish-hispidulous and somewhat glandular, lower branches 5-15 or becoming as much as 25 mm. long; pedicels ca. 1 mm. long; sepals 1-1.5 mm. long, glandular-ciliate, orbicular-ovate, apex obtuse with a rounded tip, base broad and somewhat auriculate, the 3 inner sepals slightly the largest and broadest; petals and androecium unknown; disk cupulate, ca. 0.6 mm. high, bearing 5-10 oblong glandular teeth, closely investing the lower three-fifths of the ovary; ovary 2-celled, studded with short appressed glandular hairs; style ca. 1.5 mm. long, about once and a half the length of the ovary; fruit purple, on pedicels 2-4 mm. long; carpels obliquely subglobose, ca. 12 mm. in diameter, usually only one developing from each flower, becoming glabrous.

Type: No. 186617, Herb. Calif. Acad. Sci., collected May 5, 1925, by H. L. Mason (no. 1627) on the east slope of Socorro Island.

This species is most closely related to *M. idiopoda* Blake of Costa Rica, from which it differs in its more elongate leaves, sparse spreading pubescence on the stems and leaves, better developed and deeper floral disk, long style, and glandular-strigose ovary. Along with *M. idiopoda* it finds its relatives in the Costa Rican *M. glabrata* (Liebm.) Urban and *M. tonduzii* Donn. Sm. and in the north Panamanian *M. panamensis* Standley. *Meliosma nesites* is, accordingly, an outlying member of a group that centers in Costa Rica. A few species of the genus extend from the Caribbean islands and from Central America into the extreme southern parts of Mexico. These Mexican species, however, do not appear to be immediately related to our island plant.

RHAMNACEÆ

67. **Rhamnus discolor** (Donn. Sm.) Rose

Rhamnus discolor Rose, Contr. U. S. Nat. Herb. **8**: 51 (1903).

To this species of Central America and southernmost Mexico I refer material collected by Mason (no. 1667) on rocky forested slopes near the summit of Socorro. This material is very similar to that of the type-collection of *R. discolor* made in Guatemala, the chief differences being that the island plants have glabrate stems, slightly larger leaves that are glabrous above, slightly larger flowers, and decidedly hairy ovaries. The continental plants of *R. discolor,* however, are very variable in these as well as other characters so that the Socorro plants fall well within the gamut of variation well known and now accepted for the species.

68. **Karwinskia humboldtiana** (R. & S.) Zucc.

Karwinskia humboldtiana Zucc. Abh. Akad. Wiss. München **2**: 351 (1832); Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Anthony (sine no.), and Mason (no. 1588). The latter notes that it is a large shrub or small tree, up to 4.5 m. tall. The species is a variable one and is found in most parts of Mexico.

TILIACEÆ

69. **Triumfetta socorrensis** Brandg.

Triumfetta socorrensis Brandg. Erythea **7**: 1 (1898) and Zoe **5**: 27 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 745 (1923).

An endemic of Socorro originally collected and described from material obtained by Anthony (no. 378). The only other collections are by Barkelew (no. 197) and Mason (no. 1672). The latter obtained it near Grayson Cove where he notes that it is abundant in the area burnt over by the castaway Grayson. The plant is a shrub 1-1.5 m. tall. The species is a very distinct one. Its immediate relationships are quite uncertain although they lie probably with some of the species of southern Mexico or northern Central America.

MALVACEÆ

70. **Abutilon californicum** Benth.

Abutilon californicum Benth. Bot. Voy. Sulphur 8 (1844).

A rather mature specimen from Socorro collected by Barkelew (no. 184) seems to be referable to this Lower Californian species.

71. **Sida hederacea** (Dougl.) Torr.

Sida hederacea Torr. ex Gray, Mem. Am. Acad. Sci. ser. 2, 4: 23 (1849).

Forming large grayish patches about a dried pool back of the beach on Clarion where it was found by Mason (no. 1558). Widely distributed in saline or alkaline soils in western United States but somewhat less commonly in Mexico where it extends, apparently through the eastern parts of that country, south to Oaxaca. On the Pacific coast of Mexico it is rare or absent for I have seen no material from south of Lower California.

72. **Sida rhombifolia** L.

Sida rhombifolia L. Sp. Pl. 684 (1753).

Collected by Barkelew (no. 232) on Socorro. The species is generally distributed through the warmer parts of America.

73. **Sida nesogena** Johnston, n. sp.

Slender strictly branched shrub up to 8 dm. tall; stems sparsely stellate, copiously short glandular-villous; leaves ovate to lance-ovate, 1.5-3.5 cm. long, 10-18 mm. wide, palmately 5-costate, densely glandular-stellate, even velvety when young, irregularly serrate, frequently somewhat 3-lobed, paler beneath, apex acute or somewhat acuminate, base rounded or cordate; petioles 5-15 mm. long, slender, sparsely stellate, glandular-villous; flowers axillary, solitary or grouped in short-pedunculate few-flowered cymose clusters, borne along the upper parts of the stem and together forming an elongate leafy panicle 1-2 dm. long; mature calyx glandular-villous, 4-5 mm. long, angulate, cut to beyond the middle; lobes ascending, acute to shortly acuminate; corollas orange-yellow;

carpels 5, nearly 3 mm. long, inner face reticulate and glabrous; back of carpels convex, thickened on the margins and down the middle, obscurely glandular, armed (particularly along the thickened midpart) with short coarse antrorse usually falcate hairs; sterile parts of carpels obliquely ovate or narrowly deltoid, well developed, not united, armed with numerous short stiff antrorse hairs, apex acute or obtusish, not beaked; seeds dark brown, smooth, glabrous, ca. 1.3 mm. long.

Type: No. 186605, Herb. Calif. Acad. Sci., collected May 4, 1925, by H. L. Mason (no. 1613) among brush and coarse grass at about 160 m. alt. in the hills back of Grayson Cove, **Socorro Island.**

This species, which is known only from the overly mature collection cited above, is related to both *S. glutinosa* Commers. and *S. glabra* Mill. From *S. glutinosa* it differs in having unappendaged carpels, orange-yellow corollas, and an indument on stems, pedicels, petioles and calyces which is almost exclusively glandular-villous and only sparsely stellate. From *S. glabra* it differs in its conspicuous and quite copious glandular indument, and coarsely short-hairy carpels. On the whole I am inclined to believe that *S. nesogena* is closest to *S. glabra*, particularly to the form from western Mexico described as *S. alamosana* Wats. The island plant, however, differs so strikingly in the amount, kind and distribution of its pubescence that I am quite unwilling to assign it to that species even as a variety. The carpels of *S. nesogena* are provided with short stout antrorse hairs. I have found no similar development in either *S. glabra* or *S. glutinosa*.

74. **Gossypium hirsutum** L.

Gossypium hirsutum L. Sp. Pl. ed. 2, 975 (1763). *G. barbadense* of Brandg. Zoe **5**: 27 (1900).

A collection of this cotton, showing flowers and fruit, has been made on Socorro by Anthony (sine no.). The species is widely distributed in tropical America. It is cultivated but is not uncommon in the wild or semi-wild state. Nothing being on record regarding the conditions under which Anthony collected it on Socorro, I have questionably accepted it as part of the indigenous flora rather than a recent man-assisted adventive.

STERCULIACEÆ

75. **Melochia pyramidata** L.

Melochia pyramidata L. Sp. Pl. 674 (1753); Brandg. Zoe **5**: 27 (1900).

Material of this species has been collected on Clarion by Anthony (no. 408) and Mason (no. 1560) and, if we are to believe the label, also on Socorro by Barkelew (no. 247). Mason found it growing abundantly along the bottoms of dry gulches. The species is very widely distributed in the tropics.

76. **Waltheria americana** L.

Waltheria americana L. Sp. Pl. 673 (1753); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146–7 (1890); Brandg. Zoe **5**: 27 (1900).

Collected on Socorro by Townsend, Anthony (no. 381), Barkelew (no. 222) and Mason (no. 1646). On Clarion collections have been obtained by Townsend, Anthony (sine no.) and Mason (no. 1557). On Socorro Mason obtained his material at Bathurst Bay and notes that the plant is of "general distribution on the west side of the island where mixed vegetation prevails". He notes that on Clarion it is abundant on seacliffs and that a less common depressed form is prevalent on the beach. The species is generally distributed in Mexico and in other warmer parts of the World.

GUTTIFERÆ

77. **Hypericum eastwoodianum** Johnston, n. sp.

A glabrous perennial becoming much branched and decidedly fruticose, 2-5 dm. tall, usually rather strict; stems erect or ascending, at first green and quadricostate but with age becoming more or less terete and developing a smooth russet bark that on the oldest parts becomes broken and rough; leaves decidedly elongate, 6-12 times as long as broad, except below the inflorescence usually 2 or more times the length of the internodes, margins revolute, upper surface green and under high magnification regularly papillate-tessellate, under surface glaucous, sparsely pellucid-punctate and with an evident midrib but no veins, apex acute or obtusish, blade contracted in the lower third of its length to a rather narrow sessile base,

the larger leaves on the main stems becoming 2.5-3 cm. long and 3-6 mm. wide but those on the twigs and younger parts (which form most of the foliage) 1-2 cm. long and ca. 2 mm. wide although appearing narrow because of their revolute margins; inflorescence terminal, a dichasial cyme with ascending or even strictly ascending branches, simple or less commonly compound, 5-30-flowered; peduncles 1-2 cm. long; bracts linear, acute, 5 mm. long or less; pedicels slender, strictly ascending, 2-4 mm. long; sepals at anthesis ca. 4 mm. long, strictly ascending, herbaceous, more or less evidently 3-7-nerved, slightly unequal, larger ones broadly oblanceolate or oblong, acute, ca. 1.5 mm. wide, in age somewhat accrescent and becoming as much as 5 or even 6 mm. long; petals oblanceolate, ca. 6 mm. long or possibly a little longer, apex rounded; stamens free, 40-50; ovary at anthesis ovoid-ellipsoid, 2 mm. long, surmounted by 3 slender styles ca. 1.5 mm. long; capsule attenuate, 4-4.5 mm. long, scarcely if at all surpassing the calyx.

Type: No. 186606, Herb. Calif. Acad. Sci., collected May 4, 1925, by H. L. Mason (no. 1614) from sheltered places on cliff-faces at Grayson Cove, **Socorro Island.**

This species has been collected also on Socorro by Barkelew (no. 229). The exact relations of this insular endemic are uncertain. It falls into the subsection *Spachium* of Keller, E. & P. Nat. Pflanzenf. ed 2, 21: 181-2 (1925), and in the group in his synopsis numbered $a\beta III\,2^{\times\times}$. It is particularly well marked by its very short, scarcely if at all exerted capsules, shrubby habit and abundant foliage. These characters and its more abundant stamens separate it from *H. canadense* L., *H. chilense* Gay and *H. caespitosum* C. & S., to which it works out in the key to the section *Brathys* given by Keller, Bull. Herb. Boiss. ser. 2, 8: 180 (1908). The specific distinctness of this plant of Socorro was long ago recognized by Miss Alice Eastwood, as shown by the unpublished manuscript name under which Barkelew's collections have been distributed. The name she selected, however, is no longer available since it has appeared in botanical literature applied to a very different plant of Corsica. I find it hence eminently fitting as well as a great pleasure to associate the name of my kind and very good friend with this well marked species.

CACTACEÆ

78. **Opuntia** sp. vel spp.

Although one of the flat-jointed species of this genus is the most notorious plant of Clarion, where its abundant growth makes almost impassable large areas on the south side of the island, no specimens of it have been collected and preserved for study. The same species or one of similar habit is also known from Socorro. On the latter island, however, the cactus patches are apparently less extensive. Accounts of Socorro have scarcely any mention of them. No cactus has been reported from San Benedicto. While the island Opuntias may represent species known from Lower California or the Mexican mainland, it is more probable that they represent one or more endemic species that are, hence, undescribed and unnamed. It is to be hoped that future collectors on the islands will obtain good specimens of these conspicuous plants. The slabs of the cactus if split longitudinally may be dried like an ordinary plant. Needless to say flowers and fruit should also be preserved. Good photographs of the whole plant and of a flowering slab would materially assist in making the determination in this excessively large and difficult genus.

COMBRETACEÆ

79. **Conocarpus erecta** L.

Conocarpus erecta L., Sp. Pl. 176 (1753); Brandg. Zoe **5**: 27 (1900).

Collected on Socorro by Anthony (no. 397) and Barkelew (no. 242). This widely dispersed American strand-tree ranges on the Pacific coast from southern Lower California south to Ecuador and the Galapagos Islands.

MYRTACEÆ

80. **Psidium galapageium** Hook. f.

Psidium galapageium Hook. f., Trans. Linn. Soc. London **20**: 224 (1847).

Doubtfully to this species, which has been considered endemic to the Galapagos Islands, I refer material collected near Grayson Cove on Socorro by Mason (no. 1676). It is a tree 3-9 m. tall, growing on the forest border scattered in groves

of *Ficus* and *Bumelia*. The lanceolate or oblanceolate leaves are 3-5.5 cm. long and 11-19 mm. broad and are acute at both ends. Both surfaces are minutely brownish pilose. The twigs are also brownish pilose, usually rather copiously so and slightly glandular. The Galapagos plants are rather variable in the amount and distribution of their pubescence but some forms are exceedingly similar to the Socorro plants in this regard. In most of the Galapagos material the leaves are slightly less elongate. The leaf-texture, however, is quite similar to that found in our plants. The length position and indument of the peduncles, the size shape and position of the flower-buds, as well as the apically slightly free sepal-tips are quite alike in both the Socorro and Galapagos specimens. Unless both the Galapagos and Socorro plants represent insular modifications of some small-flowered, small-leaved continental plant that I have failed to recognize, I see no other course than to indicate a direct specific relationship between the guavas of these far-separated archipelagos. No pubescent, small-flowered, small-leaved species of *Psidium* has been reported from Mexico or Central America.

Probably conspecific with Mason's collections are those made on Socorro by Anthony (no. 396) and Barkelew (sine no.). Their material is very much more mature. There are completely developed fruits but no buds or flowers. The foliage is matured and partly deciduous. As far as can be compared the collections of Anthony and Barkelew differ from those of Mason chiefly in having the indument on the firmer leaves almost all deciduous, a difference which is almost certainly associated with their advanced state of maturity.

81. **Psidium socorrense** Johnston, n. sp.

Shrub 3-12 dm. tall; branches subterete, rather copiously brownish short-pilose; leaves ovate-oblong to ovate-elliptic, about twice as long as broad, 4-5.5 cm. long, 15-30 mm. broad, pellucidly punctate, distinctly brownish pilose on the midrib and veins but elsewhere sparsely pubescent, apex acute or short acuminate, base rounded or obtuse, margins slightly revolute, above dark green with weakly impressed veins, secondary venation obscure, petioles usually ca. 5 mm. long; peduncles ascending, solitary in the axils, one-flowered, 1-1.5

cm. long, brownish pilose; flower buds becoming 9 mm. long, ca. 4.5 mm. thick, subsessile; bracteoles 2, linear, 3-4 mm. long, ca. 0.5 mm. wide, caducous; calyx before anthesis completely closed, the apex apiculate; sepals concave, suborbicular, ca. 5 mm. long, subcoriaceous, inner surface distinctly glandular strigose, the tips not free in the bud; petals white, concave, obovate, 5-6 mm. long, 4 mm. wide, prominently gland-dotted, apex rounded, margin more or less definitely antrorse-ciliate; stamens 3-4 mm. long, glabrous; anthers 0.75 mm. long; staminal disk puberulent; style ca. 5 mm. long, below the middle sparsely appressed long-villous; stigma small; ovary pubescent, 3-celled; fruit glabrate, purple, obovoid or globular ovoid, 13-15 mm. long, 11-12 mm. thick, producing several seeds in each cell; seeds angular and compressed, ca. 5 mm. long.

Type: No. 186614, Herb. Calif. Acad. Sci., collected May 5, 1925, by H. L. Mason (no. 1639) on the east slope of **Socorro Island.**

This interesting shrub is very closely related to *P. galapageium* and perhaps may be only a phase of it differing in its much broader leaves, slightly less dense eglandular indument, villous style, more definitely ciliate petals and distinctly united sepal tips. In *P. galapageium* the tips of the sepals in the mature bud are distinctly free, but in *P. socorrense* they are united to form a terminal mucronate tip for the unopened bud. According to Mason *P. socorrense* is abundant in pure open stands on the plateau of Socorro. It seems to be confined to level areas.

ARALIACEÆ

82. **Oreopanax xalapense** (HBK.) Decsne. & Planch.

Oreopanax xalapense Decsne. & Planch. Rev. Hort. ser. 4, **3**: 108 (1854).

Collected on Socorro by Barkelew (no. 230) and Mason (no. 1626). Mason reports that it is a slender tree 3-4.5 m. tall growing in a forested valley near the summit of Mt. Evermann. The plant grows in the shade of larger trees. Off the island it is known in southern Mexico (Jalisco) and south into Guatemala.

SAPOTACEÆ

83. **Bumelia socorrensis** Brandg.

Bumelia socorrensis Brandg. Zoe **5**: 106 (1901); Standley, Contr. U. S. Nat. Herb. **23**: 1118 (1924). *Bumelia* sp. Brandg. Zoe **5**: 27 (1900).

Collected on Socorro by Anthony (sine no.; type), Barkelew (no. 190) and Mason (no. 1638). Mason notes that it is a large beautiful dark-green tree 6-12 m. tall. It grows scattered on rocky outcrops near the summit of the island but gets its best development along the forest border. The flowers are white and fragrant. The fleshy dark blue drupes have a slightly milky juice and are very sweet and palatable. They are a source of food for thousands of birds on the island, being particularly relished by the parakeets and pigeons. The affinities of the species are quite uncertain.

OLEACEÆ

84. **Forestiera rhamnifolia** Griseb.

Forestiera rhamnifolia Griseb. Cat. Pl. Cub. 169 (1866).

Material, representing either this species or a very closely related endemic one, has been collected on Socorro by Barkelew (no. 220) and Mason (no. 1657). It is said to be a small tree and to grow near the summit of the island. Barkelew's collections are sterile and Mason's have only blighted fascicles of staminate flowers. As far as comparisons can be made, however, the Socorro plant seems quite inseparable from *F. rhamnifolia,* a species known only from the West Indies and from a collection on the mainland near Vera Cruz, Mexico. The plant consequently belongs with *Adiantopsis, Paspalum, Sporobolus, Pleurothallis* and *Ilex* as part of the clear-cut Caribbean element in the Socorro flora. It is to be hoped that the next collector on the island will make particular effort to procure good flowering and fruiting material of this very interesting plant.

ASCLEPIADACEÆ

85. **Metastelma** sp.

Apparently referable to this genus is a collection made on Socorro by Barkelew (no. 217). The material, however, is ex-

cessively mature having lost not only all flowers and fruit but almost all its leaves as well. Until better material is collected the identity of the species must remain unknown. In gross habit the plant suggests various species of Mexico.

CONVOLVULACEÆ

86. **Ipomoea triloba** L.

Ipomoea triloba L. Sp. Pl. 161 (1753).

Collected by Mason (no. 1644) at Bathurst Bay on Socorro. The plant grew near the beach in a cactus patch where it was protected from the ravages of sheep. The material is very mature, but except that the peduncles are shorter than is common in the species, seems to be clearly referable to *I. triloba*. The species is widely distributed in warmer parts of America.

87. **Ipomoea pes-caprae** (L.) Sweet

Ipomoea pes-caprae Sweet, Hort. Suburb. Lond. 35 (1818).

This pan-tropic strand-plant has been collected on Socorro by Anthony (sine no.), Barkelew (no. 194) and Mason (no. 1673). The latter found it at Grayson Cove where it is said to be not uncommon. On San Benedicto, Mason (no. 1686) found it only on the north slope of the island and well up on the ridge. On Clarion he (no. 1559) found it common on the beaches and developing stems 10-15 m. in length. The plant is very widely distributed on beaches through most of the tropics. On the Pacific side of America it extends from Lower California and Sonora south to Ecuador. It occurs on all the islands off that coast.

88. **Ipomoea cathartica** Poir.

Ipomoea cathartica Poir. Encyc. Suppl. **4**: 633 (1816); Brandg. Zoe **5**: 27 (1900).
Ipomoea sp. Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146 (1891).

One of the conspicuous plants on Clarion where it has been collected by Townsend, Anthony (no. 403 in pt.) and Mason (no. 1568). Most of the collected material represents the glabrous form of this variable species. Anthony's collection,

however, which consists of a mixture of *I. halierca* and *I. cathartica*, shows (at least in the specimens at the Gray Herbarium) two forms of the latter, i. e. the common glabrous form as well as a strigose form (or possibly even a hybrid-cross with *I. halierca)* not obtained by other collectors on the island. There yet remains for consideration a collection made by Barkelew (no. 245). At the Gray Herbarium and the National Herbarium this is also a mixture consisting of *I. halierca* and the ordinary glabrous form of *I. cathartica*. It is labeled as from Socorro. As both of these species are common and very conspicuous plants on Clarion where Barkelew is known to have collected and since neither of them has been collected by others on Socorro, I am of the opinion that these morning glories, along with a number of other collections of Barkelew, really came from Clarion and were somehow mislabeled. Mason notes that *I. cathartica* is common throughout the brush on the island. The corolla is given as being bright blue when fresh.

89. **Ipomoea halierca** Johnston, n. sp.

A strong perennial; stems trailing or clambering, only weakly twining, the older parts becoming shrubby, the younger leafy stems pallid with a dense almost velvety indument of soft spreading or antrorse hairs 0.5-1 mm. long; leaves alternate; petioles ca. 2 mm. thick, 2-5 cm. long, very densely and antrorsely villous; leaf-blades very firm and thickish, decidedly cordate, entire or rarely shallowly and broadly 3-lobed, 3-5 cm. broad, 3.5-6 cm. in greatest length, evidently 8-10 palmate-nerved, covered with a dense and more or less distinctly velvety indument of soft pallid somewhat appressed hairs, usually with a silky luster particularly beneath, apex broadly acute and frequently somewhat acuminate, base rounded off abruptly into the conspicuous open ca. 1 cm. deep sinus; peduncles axillary, 1.5-6 cm. long, villous, simple and umbellately 1-4-flowered or frequently umbellately branched with umbellately 1-3-flowered secondary peduncles, erect or ascending, 5-30 mm. long; bracts firm, oblanceolate, 0.7-1.5 cm. long, caducous; pedicels erect, 8-20 mm. long; sepals broadest just above the base, firm or subherbaceous,

somewhat canescent with a fine short soft appressed pubescence; three outer sepals lanceolate to quite broadly lanceolate, 5-10 mm. wide, 15-20 mm. long, acute or acuminate; two inner sepals narrowly lanceolate, 3-4 mm. wide, equalling or slightly shorter than the outer ones; corolla blue, drying rose-purple, funnel-form, 6-7.5 cm. long and with a limb about as broad, glabrate or sparsely short-pilose outside, glabrous within; lobes semicircular, ca. 3 cm. broad; tube short, included in the calyx, ca. 6 mm. long, ca. 4 mm. thick at the base, ca. 6-7 mm. thick at summit; throat well developed, gradually expanded; filaments affixed in the tube, strongly ciliate at the base, unequal, the two longest 2-2.5 cm. long; anthers ca. 4 mm. long, affixed in the sinus of their deeply sagittate base; capsules 3-celled, glabrous, strongly depressed, 8-9 mm. long, ca. 1.2 mm. thick, surmounting the strongly reflexed calyx-lobes; seeds dull black, very obscurely puberulent.

Type: No. 186610, Herb. Calif. Acad. Sci., collected April 26, 1925, by H. L. Mason (no. 1553) back of the beach near Sulphur Bay, **Clarion Island.**

This species has been collected also on Clarion by Anthony (no. 403, in pt.). In addition to this, there is a collection by Barkelew (no. 245, in pt.). The Barkelew collection is labeled as from Socorro, but as I have intimated in the discussion under *I. cathartica,* I am of the opinion that it actually came from Clarion. On Clarion, according to Mason, the plant grows above the beaches and climbs over bushes and cactus and is very showy because of its large blue flowers. The species is treated in the monograph by House, Annals N. Y. Acad. Sci. **18**: 201 (1908), as *I. villosa* R. & P., the collections of Anthony and Barkelew being cited under that name. I am unable to agree with House, however, that our island plant is referable to *I. villosa,* a species based upon material collected in the Amazon head-waters of north-central Peru. Although it is perhaps generally related to them, I am also unable to place it with the Hawaiian *I. insularis* Choisy, the Australian *I. congesta* R. Br. or the Brazilian *Pharbitis rosea* Choisy, the species which House cites as synonyms of *I. villosa*

R. & P. The material from the Revillagigedos is distinguished by its coarse weakly twining habit, rather heavy leaf-texture, very copious soft velvety more or less lucent indument, its oblanceolate bracts, etc. I am inclined to believe that *I. halierca* is probably derived from *I. mutabilis* Lindl. of southern Mexico, a species which differs in its more slender more twining habit, narrower more attenuate sepals, and narrower as well as longer bracts, in addition to having leaves which are copiously pubescent only beneath.

90. **Cressa truxillensis** HBK.

Cressa truxillensis HBK. Nov. Gen. et Sp. **3**: 119 (1819). *C. insularis* House, Bull. Torr. Bot. Cl. **33**: 315 (1906). *C. cretica* of Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Anthony (no. 409) and Mason (no. 1582) and, if his label is to be trusted, on Socorro by Barkelew (no. 252). Mason obtained it at Sulphur Bay where it grew on the dried bed of a vernal pool from which it extended out onto the dunes. The species ranges from western United States south to northern Sinaloa and the tip of Lower California and then reappears in Peru and Chile.

BORAGINACEÆ

91. **Cordia brevispicata** Mart. & Gal.

Cordia brevispicata Mart. & Gal. Bull. Acad. Brux. **11**[2]: 331 (1844). *C. socorrensis* Brandg. Erythea **7**: 5 (1898) and Zoe **5**: 27 (1900).

This shrub has been collected on Socorro by Townsend, Anthony (no. 384, type), Barkelew (no. 182) and Mason (no. 1599). Mason's material was collected on slopes near the bottom of a cañon near Benner Cove. He notes that, except on the south side of the island, where it was confined to cañon-bottoms, the shrub is a common one on the brushy slopes. The species is generally distributed in dryish situations over most of western Mexico extending from Lower California to Salvador.

92. Tournefortia hartwegiana Steud.

Tournefortia hartwegiana Steud. Nom. Bot. ed. 2, **2**: 693 (1841).

Collected on Socorro by Barkelew (no. 191) and Mason (no. 1602). Mason collected his material at Benner Cove and notes that the corollas are white when fresh and that they darken quickly when bruised. It was found on north-facing hills in rather dry situations and was not uncommon. The species ranges from Lower California and Sonora south to Oaxaca.

93. Heliotropium curassavicum L.

Heliotropium curassavicum L. Sp. Pl. 130 (1753); Brandg. Zoe **5**: 27 (1900).

Collected on Socorro by Anthony (no. 398) and Barkelew (no. 243) and on Clarion by Mason (no. 1570). On Clarion it was found forming a distinct zone of vegetation about the bed of a vernal pool back of the beach. The species is very widely distributed in saline or alkaline soils throughout most of tropical and subtropical America.

VERBENACEÆ

94. Verbena litoralis HBK.

Verbena litoralis HBK. Nov. Gen. et Sp. **2**: 276, t. 137 (1818).

Obtained on Socorro by Anthony (no. 380), Barkelew (no. 231) and Mason (no. 1612). The last mentioned found it near Grayson Cove where it was an annual or biennial 3-10 dm. tall and had bluish white flowers. The species is very widely distributed in the warmer parts of America.

95. Lantana involucrata L.

Lantana involucrata L. Amoen. Acad. **4**: 319 (1756); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890); Brandg. Zoe **5**: 27 (1900).

Known on the islands only from a collection made on Socorro by Townsend. This shrub is widely distributed in tropical America.

LABIATÆ

96. **Teucrium townsendii** Vasey & Rose

Teucrium townsendii Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146 (1890); Brandg. Zoe **5**: 27 (1900).

This species, endemic to Clarion, was the first of the peculiar Revillagigedo *Teucria* to be described. It was first collected by Townsend but subsequently has been obtained by Anthony (no. 416) and Mason (nos. 1573, 1583). The latter collected two forms, an erect one on the hills west of Sulphur Bay (no. 1573) and a prostrate and more succulent one "due to maritime exposure" on the summit of the hill just east of Sulphur Bay (no. 1583). Although good corollas were not collected their color is noted as white.

The species of *Teucrium* on the Revillagigedos are close and critical ones. The final treatment of them must await the time when carefully collected flowering material has been obtained from all the islands. At present we must judge them by their gross habit, vegetative characters, and fruiting structures. While a study of these seems to indicate the presence of a recognizable form on each of the three islands it has not yielded any particularly reliable diagnostic characters nor any that are quite decisive. Consequently it seems not improbable that future study will show the relations among the several insular forms is varietal rather than specific. However, until the flowering material needful for the solution of this matter has been assembled, it seems best to follow past usage and continue to recognize the Clarion and Socorro plants as distinct species.

The island species of *Teucrium* are clearly insular derivatives of the variable *T. cubense* L., a species which ranges in northern and eastern Mexico, the West Indies and southern parts of the United States, and which on Cedros Island, off the middle of western Lower California, has given rise to *T. glandulosum* Kellogg, another insular species much suggesting our plants. Although the Revillagigedo species seem most like the one on Cedros Island, I believe that the similarity is due, not to immediate relationship but merely to

similarity in responses of the same stock to isolation under an equitable arid insular climate. Our plants have departed much more from *T. cubense* than has the plant on Cedros. *Teucrium cubense* is apparently absent from the southern half of Lower California and Sonora and from the states of western Mexico to the south.

97. **Teucrium affine** Brandg.

Teucrium affine Brandg. Erythea **7**: 6 (1898) and Zoe **5**: 27 (1900).

This species is known only from the type-collection made on Socorro by Anthony (no. 385). Good flowering material has not been obtained. It differs from *T. townsendii* in its much more slender, more elongate leaves, its generally more slender and loosely branched habit and in its perhaps slightly smaller less rugose nutlets the summit of which produces longer and more conspicuous trichomes.

98. **Teucrium affine** Brandg., var. **dentosum** Johnston, n. var.

Lower than typical *T. affine* and having leaves that are usually quite evidently toothed and nutlets that are quite lacking in apical trichomes.

Type: No. 186607, Herb. Calif. Acad. Sci., collected May 11, 1925, by H. L. Mason (no. 1685) on **San Benedicto Island.**

Collections of this endemic form of San Benedicto have been made by Barkelew (no. 170) and Mason (no. 1685, type). No material in good flower was obtained. It is obviously most closely related to *T. affine* of Socorro, having the loose habit and narrow leaves of the species. In lacking trichomes at the apex of its nutlets the variety differs from both the Socorro and Clarion plants.

99. **Sphacele hastata** Gray

Sphacele hastata Gray, Proc. Am. Acad. **5**: 341 (1862).

Very mature material of what most certainly seems to be this species was collected by Mason (no. 1658) in openings in the forest near the summit of Socorro. The collector notes it

as a "foul smelling" plant 3-12 dm. tall. It is an extremely interesting addition to the known flora of the archipelago. It appears to be quite like the plant from the mountains of the Cape Region of Lower California which Brandegee, Proc. Calif. Acad. Sci. ser. 2, 3: 164 (1891), accepted as *S. hastata*. Previous to Brandegee's discovery, the species, which is a very distinct and well marked one, was considered endemic to the mountains of Maui, one of the Hawaiian Islands, and of particular interest since it was the only extra-American member of its genus. The species has been accepted as one of the American elements in the Hawaiian flora. No doubt seems to have been cast on its natural occurrence on Maui. Brandegee seems to have thought that the species might have been introduced through the agencies of man into Lower California from Hawaii since there were a few ranches in the mountains not far from the places in which he found the plant. It seems extremely improbable, however, that the horticultural enthusiasm of the owners of these small montane cattle-ranches would be sufficiently developed to warrant us in assuming that this rankly smelling bush from the mountains of a mid-Pacific island was deliberately introduced as an ornamental by them. Brandegee reported it from two mountain ranges. Observations made forty years later by Jones, Contr. W. Bot. 15: 152 (1929), show the plant still to persist in the same region and to be still a conspicuous member of the flora there. With the discovery of *S. hastata* on the rarely visited Socorro Island and particularly on its summit, which is very difficult of access, I believe that we may now accept it as indigenous in America, for certainly the human factor is quite eliminated in accounting for its presence on Socorro. I believe that we have in the peninsular and new insular station remnants of a past, more general dispersal of the species in America, where it almost certainly evolved, and consequently relics of the original American stock that produced the seeds which, by some fortuitous circumstance, were transported to the Hawaiian Islands.

SOLANACEÆ

100. **Physalis angulata** L.

Physalis angulata L. Sp. Pl. 183 (1753). *P. aequata* of Brandg. Zoe **5**: 27 (1900).

Collected on Clarion by Anthony (no. 411). A species widely distributed in the tropics of the World. In America known only from southeastern United States, the West Indies, Central America and South America.

101. **Physalis** sp.

Collected on Socorro by Townsend and reported by Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 148 (1890), as possibly representing the Lower Californian *P. glabra* Benth. I do not believe it is related to the peninsular species. The relations of the plant seem to be, in a general way, among the native small-flowered species of Central America and southern Mexico, although not particularly close to any of them. When adequate material of this plant is collected I believe it will prove to be an insular endemic. Except that the leaves are quite cordate at the base and have the broad blades noticeably repand it might pass as the very glabrous form of *P. lagascae* var. *glabrescens* Schulz, Urb. Symb. Ant. **6**: 147 (1909), which has been cited from Mexico. The island plant is an interesting one and it is to be hoped that complete and generous collections will be obtained of it.

102. **Solanum madrense** Fernald

Solanum madrense Fernald, Proc. Am. Acad. Sci. **35**: 558 (1900).

Growing on the dry rocky slopes along the forest border near the summit of Socorro. Mason (no. 1659) notes that it is a shrub 5-45 dm. tall and that it is not common. The flowers are given as large and white. The specimens collected are in mature fruit and agree closely with *S. madrense*, a species which ranges, primarily on the Pacific slope, from Sonora south into Central America.

103. **Nicotiana nesophila** Johnston, n. sp.

Plant with a grayish indument of short soft hairs, only moderately viscid; stems 3-8 dm. long, erect or ascending, usually simple, tending to be somewhat woody towards the base; leaves gradually but distinctly reduced up the stem, ovate to elliptical, apex broadly acute to somewhat obtuse, base obtuse to broadly acute and more or less oblique, margins coarsely and irregularly crenate and occasionally even irregularly lobulate, usually somewhat crisped; petioles half or almost as long as the blades, slender, margined for their length by inconspicuous (0.5-1 mm. wide) wings which are distinctly dilated (to 1-2 mm. width) just above the petiole-base and then continue as herbaceous decurrent (1-1.5 mm. wide) leaf-bases for a few centimeters down the stem; lower leaves with blades 7-12 cm. long and 4-6.5 cm. broad, borne on slender petioles 5-8 cm. long; upper leaves (produced just below the inflorescence) 2-3 cm. long and 1-2 cm. broad, borne on petioles 1-2 cm. long; inflorescence terminal, copiously flowered, loosely branched, a short-cylindrical or obconic panicle 6-9 cm. thick; bracts linear to lance-linear, 5-15 mm. long, 1-2 mm. broad; calyx at anthesis cylindrical, 8-10 mm. long, 2.5-3 mm. thick, abruptly rounded at the base, more or less definitely 10-costate, lobes erect linear 2 mm. long; pedicels 1-4 mm. long, erect; calyx at maturity slightly accrescent but greatly distended by the ovoid fruit, borne on thickened erect or ascending pedicles that are 3-10 mm. long; corolla ca. 5 cm. long; tube very slender, 3-4 times the length of the calyx, 3.5-4 cm. long, 1.5-2 mm. thick; throat ca. 3 mm. thick, ca. 5 mm. long; limb white, broadly funnelform, ca. 2 cm. in diameter, with 5 broad lobes 4-5 mm. long, sinus broad and open; filaments affixed in the throat, ca. 0.7 mm. long, glabrous; anthers ca. 2 mm. long, included in the throat; stigma clavate, strongly compressed; style and ovary glabrous; capsule ovate, 5-6 mm. thick, 8-10 mm. long, almost completely invested by the distended calyx-tube, 2-celled, 2-valved; seeds very numerous, ca. 0.5 mm. long, roughened with fine narrow contorted anastomosing ridges and consequently distinctly but irregularly alveolate.

Type: No. 186608, Herb. Calif. Acad. Sci., collected May 3, 1925, by H. L. Mason (no. 1596) in alluvial sands at mouth of a valley near Benner Cove, **Socorro Island.**

This very distinct species has been collected also on Socorro by Barkelew (no. 199). It is obviously related to *N. stocktoni* Brandg. of the Revillagigedos but differs decisively in its much less viscid indument of paler shorter hairs, in its inconspicuously rather than very conspicuously winged petioles, and in its narrower more elongate leaf-blades which are obtuse or broadly acute rather than strongly cordate or reniform at the base. The new species has also more strongly crenate leaf-margins. Although the relationship of the two island plants is clear, their relations outside of the archipelago are quite obscure. In many details, however, they suggest *N. repanda* Willd. and particularly so in the form of the corolla. That species is a small annual with a quite different inflorescence, habit, indument, etc., etc. It ranges in Texas and northeastern Mexico.

104. **Nicotiana stocktoni** Brandg.

Nicotiana stocktoni Brandg. Erythea **7**: 6 (1898) and Zoe **5**: 27 (1900). *N. clarionensis* Clausen, Zeitschr. f. ind. Amstamm.- u. Vererbungslehre, Supplementband **1**: 549 (1928); East, Bibliogr. Genetica **4**: 249 and 251 (1928), nomen.

This remarkable species, first obtained on Anthony's expedition, was based upon material labeled as collected by Stockton (no. 382) on Socorro Island. Collections, however, which match in detail those obtained by Stockton have been obtained by Mason (no. 1585) from among the rocks of an old lava flow on the landward side and towards the summit of the hills just east of Sulphur Bay on Clarion. As both Barkelew and Mason have collected the distinct, although closely related *N. nesophila* on Socorro and since it seems rather unlikely that two such closely related species could resist hybridization and retain so successfully their identity on a single island, I believe that Stockton probably obtained the original material of *N. stocktoni* on Clarion rather than on Socorro as has been accepted. If this is the case, then *N. nesophila* is endemic to Socorro and *N. stocktoni* to Clarion. Future collectors on the

islands should watch the tobaccos closely with the object of ascertaining whether or not the two species occur on a single island and if not the identity of the species characteristic of each island. Mason reports that *N. stocktoni* was rare on Clarion. He found only a single colony. In this, the plants were not abundant although they were reproducing well, since numerous seedlings were observed.

According to a letter received from Prof. R. E. Clausen, the material which he studied and reported upon under the name of *N. clarionensis* was some raised from seed obtained on Clarion by Mason. As Mason's plants from Clarion have been directly compared in detail with the type-specimens of *N. stocktoni* and found to be unquestionably conspecific, the name *N. clarionensis* consequently falls into the synonymy of Brandegee's species. The binomial, *N. clarionensis,* has appeared only in genetical literature, and there only as a bare name. Dr. Clausen writes that his work on the plant has indicated a close relationship with *N. repanda,* as shown by the fact that the diploid chromosome number is 24 in both, that they produce fully fertile F_1 hybrids and that nearly, if not completely regular conjugation and distribution of chromosomes occurs in the F_1 hybrids.

105. **Cestrum pacificum** Brandg.

Cestrum pacificum Brandg. Erythea **7**: 6 (1898) and Zoe **5**: 28 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 1281 (1924).

The type of this species was collected on Socorro by Anthony (no. 391) where subsequent collections have been made by Barkelew (no. 221) and Mason (no. 1652). Mason notes that it is a large shrub or small tree becoming 8 m. in height. It grows in the forested area near the summit of the island and is not very common. The berries are purple. The island plant is very closely related to *C. lanatum* Mart. & Gal. which ranges from Nayarit southward into Central America, and may be no more than an insular phase of that species with shorter corollas.

ACANTHACEÆ

106. Elytraria squamosa (Jacq.) Lindau

Elytraria squamosa (Jacq.) Lindau, Anal. Inst. Fis. Geogr. Costa Rica **8**: 299 (1896). *E. tridentata* Vahl; Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 149 (1890); Brandg. Zoe **5**: 27 (1890).

Collected on Socorro by Townsend, Anthony (no. 392) and Mason (no. 1641). The last mentioned reports that it is frequent on the plateau of the island in rather barren soils. It is a very widely distributed plant in the American tropics and reaches north to Arizona, Texas and Florida.

RUBIACEÆ

107. Chiococca alba (L.) Hitchc.

Chiococca alba (L.) Hitchc. Rep. Mo. Bot. Gard. **4**: 94 (1893).

With some doubt I refer to this widely distributed species material collected on Socorro by Barkelew (no. 201) and Mason (no. 1611). Barkelew's collections are sterile, while Mason's are in mature fruit and have what seems to be blighted buds. These buds suggest that the corolla is decidedly shorter and stouter, and has much less elongate lobes than in the continental plants. Hence it is that good flowering material of the island plant must be obtained before its precise relation with *C. alba* can be determined. We can, however, confidently state that its closest relations are with that species. Mason notes that the plant on Socorro frequents shady cañons and dense forests where it often ascends trees even to a height of 20 m. and from them hangs in festoons clear to the ground. The corollas are noted as being white and as rapidly fading to brown or black. *Chiococca alba* is very widely distributed in the warmer parts of America. Along the Pacific coast it ranges north to Sonora and southern Lower California.

108. Guettarda insularis Brandg.

Guettarda insularis Brandg. Univ. Calif. Pub. Bot. **10**: 416 (1924). *G. elliptica* of Standley, Contr. U. S. Nat. Herb. **23**: 1384 (1926).

Endemic to Socorro where it has been collected by Anthony (no. 377), Barkelew (no. 179) and Mason (no. 1608). It is given as a shrub or small tree 1-6 m. tall and as frequenting

cañons on dry slopes and the forest border on moister ones. The bark is smooth and "at length deciduous in patches". The fruit is a fleshy drupe with a purple exocarp and with a thick bony ellipsoidal or decidedly obovoidal endocarp 12-14 mm. long and 7-8 mm. thick. The species is obviously related to *G. elliptica* Sw., a species to which Standley has reduced it, but appears to have larger corollas and much larger and more elongate fruit. *Guettarda elliptica* is primarily a West Indian species but has been reported by Standley from Mexico where it is given as occurring in Yucatan and from Sinaloa to Colima. The affinities of our island species are consequently to the westward, on the mainland of Mexico.

109. **Borreria nesiotica** Robinson

Borreria nesiotica Robinson, Proc. Am. Acad. Sci. **45**: 409 (1910). *Spermacoce* sp. Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 146, 148 (1890); Brandg. Zoe **5**: 27 (1900).

A very well defined species which is known only from Socorro and Clarion islands. The type, which was collected by Anthony, is labeled as from "Socorro or Clarion Is." Barkelew (no. 208) obtained it on Socorro, while Mason (nos. 1572, 1574) found it only on Clarion. Townsend got it on both islands. The corolla, according to Mason's notes, is white or pink. The immediate relationships of the species are quite obscure. Robinson compared it with *B. verticillata* (L.) Mey. but it seems no more closely related to that species than to *B. laevis* (Lam.) Griseb., a species which it also resembles in habit. Both of the species mentioned are widely distributed in tropical America.

110. **Galium mexicanum** HBK.

Galium mexicanum HBK. Nov. Gen. et Sp. **3**: 337 (1819).

Collected on Socorro by Anthony (no. 386), Barkelew (no. 210) and Mason (no. 1655). Mason obtained his material near the summit of the island and notes it as a "climbing perennial". On the mainland the species ranges from central Mexico southward into northern Central America. Although Anthony's collections have been distributed bearing an un-

published herbarium name by Brandegee, it, like the other collections from the island, falls readily into the species to which I have referred it.

GOODENIACEÆ

111. **Scaevola plumierii** (L.) Vahl

Scaevola plumierii Vahl, Symb. Bot. **2**: 36 (1791); Brandg. Zoe **5**: 28 (1900); Standley, Contr. U. S. Nat. Herb. **23**: 1400 (1926).

Although Brandegee, loc. cit., reported this species from Socorro, the collections by Anthony (no. 387) which he distributed are clearly indicated on a printed label as being from Clarion. As the plant has a number which falls in a block of numbers which are all from Clarion I am accepting that island as the source of the *Scaevola*. This strand-plant is widely distributed in the West Indies but has a very disrupted and erratic distribution on the adjacent continents. It is not known from the west coast of the American mainland. The only Pacific stations are the Galapagos, the Revillagigedos and the tip of the peninsula of Lower California.

COMPOSITÆ

112. **Vernonia littoralis** Brandg.

Vernonia littoralis Brandg. Erythea **7**: 3 (1898) and Zoe **5**: 27 (1900); Blake in Standley, Contr. U. S. Nat. Herb. **23**: 1414 (1926). *Eremosis littoralis* Gleason, No. Am. Fl. **33**: 100 (1922).

Known only from Socorro where the type was collected by Anthony (sine no.). Mason (no. 1656) found it in the dense forest near the summit of the island where it clambered to a height of 15 m. and produced its conspicuous pendent flowering branches from the tree-tops. The corollas are said to be white or pink. The leaves vary from oblong-ovate through elliptical to ovate-orbicular, from entire to distinctly sinuate and from acute to rounded with an abrupt obtusish acumination. The leaf-blade becomes as much as 10 cm. broad and 12 cm. long. The affinities of the species are with *V. shannoni* Coult. and *V. heydeana* Coult. of Guatemala and southern Mexico.

113. **Eupatorium pacificum** Robinson, n. sp.

Fruticose, shortly pilose; stems erect or more often curved-ascending, branched above, subterete, brown; pith white; internodes 3-10 cm. long; hairs short, spreading, slender and attenuate, nodulose; leaves opposite, slender-petioled, deltoid-ovate, acuminate, spreadingly dentate but entire towards the broadly cordate or subcordate base, green on both sides and at first sight apparently glabrous, but in fact slightly puberulent on the nerves and veins, beneath somewhat paler, delicately reticulate (the veinlets immersed), membranaceous, 2.5-9 cm. long, 2-7 cm. wide; teeth of the limb 1.5-3 mm. high, 2-6 mm. broad at base, subacute to obtuse or rounded; petiole spreadingly hirtellous, 1-5 cm. long; corymbs composite, opposite-branched, leafy-bracted; heads about 40-flowered; phyllaries subequal, lanceolate-linear, acute, 2-3-seriate, loosely imbricate, at maturity about 5 mm. long, the outer ones densely but very shortly hairy; corollas white, smoothish; the proper tube slender, 2 mm. long; throat narrowly campanulate, 1-1.3 mm. high; achenes black, sharply angled, slightly lucid, 1.5-2 mm. long, slightly pointed at both ends, often hispidulous on the angles; pappus-bristles about 20, white, delicate, scarcely roughened, almost equalling the corolla.

Type: No. 186613, Herb. Calif. Acad. Sci., collected May 8, 1925, by H. L. Mason (no. 1666) near the summit of **Socorro Island.**

Mason's collections are overly mature, having shed nearly all their florets, but are obviously conspecific with immature material collected by Barkelew (sine no.) also on Socorro. The species appears to be endemic. In many respects it is similar to *E. pazcuarense* HBK. and *E. conspicuum* Kunth & Bouché, both of southern Mexico. From the former it differs in its much greater lignescence and in its more deltoid-ovate distinctly cordate leaves, which are 3-nerved from the very base. From the latter it may be readily distinguished by its somewhat coarser and more spreading pubescence and shorter petioles as well as by its leaf-blades, which are nerved from the very base, much less toothed towards the base, and not disposed to be decurrent on the petiole.

114. **Brickellia peninsularis** Brandg., var. **amphithalassa** Robinson, n. var.

Leaves subdeltoid-ovate or almost orbicular, scarcely longer than wide, more firmly membranaceous than in the typical variety, or even subcoriaceous, very finely and densely puberulent-hirtellous on both sides, peduncles for most part 8-24 mm. long; corollas yellowish, scarcely nigrescent in drying.

Type: No. 186615, Herb. Calif. Acad. Sci., collected April 26, 1925, by H. L. Mason (no. 1555) on **Clarion Island.**

Collections of this plant made by Anthony on Socorro and Clarion were reported by Brandegee, Zoe **5**: 27 (1900), as *Brickellia* sp. It has also been collected on Socorro by Barkelew (no. 198) and Mason (no. 1598). On Clarion, Mason (no. 1555) reports that it is the dominant cover and gives a grayish aspect to the hillsides. It is a shrub 6-15 dm. tall, branched from the base, and very brittle. The variety is endemic to the archipelago, differing from the typical form of southern Lower California in its proportionately broader leaves, finer and denser pubescence of the foliage, somewhat longer peduncles, and paler florets. In Prof. Robinson's monograph of the genus, Mem. Gray Herb. 1: 108 (1917), it is mentioned as a peculiar form of *B. peninsularis.* Blake, Contr. U. S. Nat. Herb. **23**: 1483 (1926), reports it from Socorro under the name, *Coleosanthus peninsularis* (Brandg.) Blake.

115. **Erigeron socorrensis** Brandg.

Erigeron socorrensis Brandg. Erythea **7**: 4 (1898) and Zoe **5**: 27 (1900); Blake in Standley, Contr. U. S. Nat. Herb. **23**: 1499 (1926), in pt.
Erigeron sp. Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 148 (1890).

This slender shrub is known only from Socorro, where the type was collected by Anthony (no. 376) and other collections have been obtained by Townsend, Barkelew (nos. 189, 214) and Mason (no. 1618). Mason's collection is from the dry slopes above Grayson Cove. The relations of this species are clearly with the endemic of San Benedicto, *E. crenatus,* but beyond that they are extremely vague. The shrubby species of *Erigeron* on the Revillagigedos, like the shrubs on Juan Fernandez, Galapagos and Bermuda islands, belong to the section *Cacnotus,* a section containing many ill-defined and rather

weedy species that are widespread in temperate and tropical America. The species of the section *Caenotus* are notorious for the difficulties they present to classification. This, due to their variability and lack of distinctive characters, will probably always remain a problem. In any case, the group is now in such hopeless confusion that any attempt to discuss their phylogeny must be wasted time. It does seem significant, however, that the common weedy species of the section *Caenotus*, even when clearly annual, do show a distinct tendency to produce hard and more or less woody stems. It is likely, therefore, that their shrubby insular relatives have continued and accentuated this tendency under an equitable frostless insular climate and consequently unbroken growing season. I do not believe that the shrubs on the various archipelagos are directly related, but rather, that in each case they have developed on the island from probable annual stock derived from the nearby mainland. As there is no species of the section native to Lower California, I believe we may eliminate the peninsula as a possible source of the species on the Revillagigedos. It seems most probable that their ancestors came from southern Mexico, where a number of possible relatives now exist.

116. **Erigeron crenatus** Eastwood, n. sp.

A small low shrub 1-4 dm. tall, usually producing several coarse branches from near the base, younger parts finely villose or strigose but at length becoming glabrate in age; stems distinctly woody, becoming as much as 3 dm. long and 2-5 mm. thick, erect or usually ascending, very densely clothed for several centimeters below the apex with the ascending functional leaves and below these with the deflexed tardily deciduous old ones, the older parts roughened by the indurate persistent bases of fallen leaves; leaves dark green when fresh but drying grayish, oblanceolate or spatulate and frequently quite broadly so, somewhat coriaceous, costate but only obscurely veined, 5-15 mm. broad, 4-6.5 cm. long, broadest just below the obtuse or rounded apex and then gradually contracted into the slender petiole which forms 1-2 cm. of their total length, margins entire to crenate or lobulate-crenate, narrowly revolute and perhaps somewhat thickened; inflorescence a corymbose panicle, usually projecting only a few centimeters

from the rosulate cluster of crowded leaves, usually compound, being formed of a group of simple panicles springing from adjacent leaf-axils or reduced lateral shoots; heads 3-4 mm. high, 4-5 mm. thick, on sparsely bracteolate peduncles 3-15 mm. long, frequently inclined; tegules (except for the few short outer ones) narrowly lanceolate, the back somewhat glandular in texture, the margins hyaline; achenes flattened, thick-margined, sparsely strigose; pappus barbellate ca. 1.7 mm. long; ray-florets glabrous, white, very numerous, 2-3-seriate, pistillate, scarcely if at all surpassing the hermaphroditic disk-florets; style 1.2 mm. long, glabrous; style-branches 0.5 mm. long, ca. 0.1 mm. broad, appendages very short; disk-florets numerous, 2.5 mm. long, sparsely pubescent or glabrous, tube ca. 0.7 mm. long, lobes triangular and ca. 0.5 mm. long.

Type: No. 186604, Herb. Calif. Acad. Sci., collected May 11, 1925, by H. L. Mason (no. 1683) in loose ashy soil on **San Benedicto Island.**

This species is known only from San Benedicto where it has been collected by Barkelew (no. 176) and Mason (no. 1683). It is obviously related to *E. socorrensis,* the endemic species of Socorro, but differs not only in its low habit of growth but in being coarser and larger in all its parts. The plant of Socorro is a slender loosely branched shrub becoming 12 dm. tall and has much smaller very conspicuously less crowded paler leaves and a more slender more open inflorescence of smaller heads. Although these differences are largely matters of degree, they serve to distinguish the plants found on the two islands. The plants from Socorro and San Benedicto each have a very characteristic aspect. The two species may be recognized instantly at a glance. Blake, Contr. U. S. Nat. Herb. 23: 1499 (1926), refers to the San Benedicto plant under *Erigeron socorrensis.*

117. **Gnaphalium attenuatum** DC.

Gnaphalium attenuatum DC. Prodr. 6: 228 (1837).

A single plant of this species was collected by Mason (no. 1665) near the hot springs close to the summit of Socorro. The species is known otherwise from central Mexico south into Central America.

118. **Coreopsis insularis** (Brandg.) Blake

Coreopsis insularis Blake, Proc. Am. Acad. Sci. **49**: 340 (1913). *Leptosyne insularis* Brandg. Erythea **7**: 5 (1898) and Zoe **5**: 28 (1900).

Endemic to Socorro where the type was obtained by Anthony (no. 394) and subsequent collections have been made by Barkelew (no. 223) and Mason (no. 1624). A loosely branched perennial with elongate shrubby stems which grows "in patches from sea-level up". The linear leaf-lobes in the fresh condition are succulent, terete and pungent. The rays are yellow. Although very distinct, the species is probably most closely related to *C. pinnatisecta* Blake of Oaxaca and Puebla in southern Mexico.

119. **Viguiera deltoidea** Gray, var. **townsendii** Vasey & Rose

Viguiera deltoidea, var. *townsendii* Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 148 (1890); Brandg. Zoe **5**: 28 (1900); Blake, Contr. Gray Herb. **54**: 90 (1918); Blake in Standley, Contr. U. S. Nat. Herb. **23**: 1544 (1926).

This very ill-defined variety was originally based upon material collected on Socorro by Townsend. It has subsequently been collected there by Anthony (no. 389) Barkelew (no. 181) and Mason (nos. 1601, 1606). According to Mason, who collected it at Benner Cove, it is an erect or scandent shrub which is occasional on the drier slopes of the island. The island plant is most obviously related to *V. deltoidea* var. *chenopodina* Blake of Lower California. I am by no means certain that var. *townsendii* and var. *chenopodina* are really separable or are practicable taxonomic units or that they are much more than mere extreme xerophytic phases of the species, the type of which came from Cape San Lucas.

120. **Perityle socorrosensis** Rose

Perityle socorrosensis Rose, Bot. Gaz. **15**: 118, t. 13, f. 9 (1890); Vasey & Rose, Proc. U. S. Nat. Mus. **13**: 148 (1890); Brandg. Zoe **5**: 27, 28 (1900); Rydb. No. Am. Fl. **34**: 16 (1914).

The type and original collection of this species was made on Socorro by Townsend. Anthony (no. 383), Barkelew (no. 192) and Mason (nos. 1605, 1605a) have subsequently recol-

lected it there. Mason's material came from Benner Cove. Material from San Benedicto has been obtained by Anthony (no. 372), Barkelew (no. 175) and Mason (no. 1684). On Clarion, where Mason notes that it is a shrubby perennial, it grows on sandy beaches almost to the water's edge as well as on the steep sea-cliffs. Collections from Clarion have been made by Anthony (no. 415) and Mason (nos. 1578, 1579). The plant varies somewhat in the size of its succulent leaves, apparently in response to its environment. There is also interesting variation in the development of pappus. The material from Clarion tends to be awnless or to have only a single awn, that from San Benedicto and Socorro generally having 1-2 awns developed. As in most species of *Perityle* of this relationship the marginal flowers, from plant to plant, vary conspicuously in the degree of development of ligule. The relationship of the species is clearly with *P. crassifolia* Brandg. of southern Lower California.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 3, pp. 105-128, plate 1 DECEMBER 18, 1931

III

THE GENUS POGOGYNE

BY

JOHN THOMAS HOWELL

Assistant Curator, Department of Botany

INTRODUCTION

Purpose.—The present study of the genus Pogogyne was begun when certain collections made by the writer on the plains of the San Joaquin Valley were not nicely determinable, although in treatments of the genus the species seemed rather definitely limited on comparative morphologic characters. And, the genus being small, it quickly appeared that here would be an admirable occasion for acquiring an experience in the study of species by a statistical method, coupled with, and governed by, the usual morphologic method. So a critical study of the genus Pogogyne was undertaken in order to determine more definitely the range of variation within the several species and to develop, if possible, by a statistical study of diagnostic criteria, quantitative data for the limitation of the species.

The statistical method employed in this work is of a primary sort, *i. e.*, the collection of quantitative data with a development of simple and evidently useful ratios and collations. Some, primarily interested in the fullest exploitation of a series of numerical compilations, will perhaps argue that this simple use of numerical facts cannot be properly called a statistical method, especially in view of the later complexities

developed in the field of biometry. But, as has been pointed out by Hall and Clements (Carnegie Inst. Publ. no. 326: 20, —1923), at this early stage of the use of statistical methods in flowering plant taxonomy the simplest uses of the figures furnish all the information now desirable, and a fuller development of them can follow later when such deductions will attain to more immediate usefulness and value. In the following presentment these simple data have been of primary importance in determining specific limits and drawing diagnoses, and in several instances tabulations are given to illustrate the value and the manner of compilation and comparison. Always, however, these facts have been used with a basic regard for the associated morphologic characters as determined by herbarium studies and field observations.

History.—The genus Pogogyne was first described by Bentham in 1834 in his monographic study of the Mint Family, Labiatarum Genera et Species. Three species were described, all having four perfect anthers, and the genus was placed in the tribe Melissineæ. In 1849, Bentham in Plantae Hartwegianae described the first species now characterized by sterile upper stamens, *P. zizyphoroides*, but he appears to have overlooked this stamen character for no account of it is given in his diagnosis and he states that the species is related to *P. parviflora*, a species with four fertile stamens. Torrey in the Botany of the Pacific Railroad Reports (1856) first described the total deficiency of the upper stamens in the type description of *P. serpylloides* which he placed, with question, in the genus Hedeoma. Gray in 1867 transferred Torrey's species to the genus Pogogyne, indicating a subgenus, Hedeomoides, characterized by only two fertile stamens, and in 1876 in the Botany of California, gave the first complete description of the genus as thus modified. Briquet in Die Natürlichen Pflanzenfamilien (1896) accepts two genera as representing the complex: first he reverts to Bentham's original concept of the genus Pogogyne, and then raises Gray's subgenus Hedeomoides to generic rank. Greene in the Manual of the Bay Region Botany (1894) and Jepson in the Flora of Western Middle California (1901) and in A Manual of the Flowering Plants of California (1925) follow the arrangement of Gray.

In the present work Gray's broader concept of the genus Pogogyne has been followed, two subgenera being recognized. Although Briquet's treatment is in keeping with the interpretation of generic limits that are based on staminal characters in certain sections of the Labiatæ, it seems obvious that his recognition of two genera here results in an artificial arrangement. The relatively wide separation of related units and the juxtaposition of relatively unrelated units in the sequence developed would seem to indicate this. On the other hand the two groups here accepted as subgenera show close relationship as shown by habit, leaves, inflorescence, and (aside from the stamen character) floral organs; and, moreover, the geographic distribution and physiological similarity of the species within the two groups also point to their very close relation.

Relationships.—Pogogyne belongs to the tribe Satureineæ of the Labiatæ as the family is treated by Bentham and Hooker and by Gray, and, by Briquet to the Stachyoideæ-Melissinæ, a smaller tribe identical with part of the Satureineæ. This latter is mainly characterized by 2-lipped, 10–15-nerved calyx, 2-lipped corolla, 2 or 4 stamens with the upper pair shorter and with anthers 2-celled. Within the tribe, Pogogyne is most nearly related to Hedeoma, and less closely, to Satureia.

In a family as intricate as the Labiatæ it is hazardous even to surmise the probable phylogeny of only a small part but in the case of Pogogyne morphologic and distributional evidence contribute facts that indicate a very possible line of development worthy of discussion. As stated above Pogogyne is related both to Hedeoma and to Satureia, probably through derivation from a common ancestral stock. Such a primitive group would be marked by such characters as perennial habit, simple inflorescence, unmodified calyx, and four fertile stamens, the upper pair smaller and tending to abort. Such a plexus might be considered similar to the large and complex genus Satureia as defined by Briquet (1896) which is marked by most of the characters just mentioned. It seems probable that due to some distributional or genetic arrangement a section of this original stock diverged and gave rise to the phylo-

genetic line that later developed the genera Hedeoma and Pogogyne, a line characterized by tendencies to annual habit, abbreviated inflorescence, and staminal reduction. The remainder of the complex can be considered as having maintained the old characters with only minor modifications, forming the modern genus Satureia and related genera.

In the Pogogyne-Hedeoma line, Hedeoma appears to be the older type with more numerous and more widely dispersed species, and with plants usually perennial, inflorescence noncongested, and calyx-lobes nearly undifferentiated. Although one subgenus of Pogogyne maintains the extra primitive character of four fertile stamens, a character not found in the rest of the Pogogyne-Hedeoma line, the annual habit, the involved inflorescence, and the bilabiate calyx in Pogogyne appear to be derived. These characters together with the relatively restricted distribution of the fewer species and the unusual physiological requirements for growth suggest a more highly specialized and lately evolved group in Pogogyne than in Hedeoma.

Within the genus Pogogyne there are two views to explain the possible origin and relationship of the two subgenera. Either they are two parts of a single line of development, a simple linear arrangement, or they represent two diverging lines from a common basal type. The latter view seems the more plausible in view of available morphologic and distributional evidence. In the subgenus Eupogyne, *P. douglasii* appears to be the least modified, *P. abramsi* marking a transition in habit and flower to *P. nudiuscula*. In the subgenus Hedeomoides the wide-spread species *P. serpylloides* appears less specialized than *P. zizyphoroides* both physiologically and morphologically, though the two are very nearly related. The little-known *P. tenuiflora* of Guadalupe Island probably represents a line of development originating near *P. serpylloides* but widely divergent from it, due perhaps to long-continued geographic isolation. A prototype of wide distribution similar to *P. tenuiflora* would probably be employed as an intermediate link between the subgenera by those who would have all the species of Pogogyne arranged in a linear sequence of development.

Distribution and Ecology. — Floristically, the genus Pogogyne is strictly Californian; at no place does a species extend beyond the limits of the California flora, and, at appropriate altitudes, the species pervade the area as completely as any group of Californian plants. The area here assigned to the California flora is somewhat enlarged over the province outlined by Jepson (Man. Fl. Pl. Calif. 1, 1925), and extends from middle western Oregon south to Mt. San Pedro Martir in northern Lower California and from the Cascade-Sierran crest west to the Pacific Ocean. In addition, the insular areas off the coast of California and Lower California are here considered a part of the California province as has been proposed recently by Mason in discussing the California Coast Range forest (Carnegie Inst. Publ. no. 346: 142, —1927). A remarkable feature of the distribution of the genus Pogogyne is how nearly coextensive it is with the province thus outlined. *Pogogyne zizyphoroides* extends north into southern Oregon, *P. serpylloides* occurs in northern Lower California, and *P. tenuiflora* is found on Guadalupe Island off Lower California where it is endemic. In life zones the species are best developed in the Lower and Upper Sonoran zones but *P. douglasii* and *P. serpylloides* also occur in the lower part of the Transition Zone.

The species of Pogogyne are generally characteristic of hollows in low valley lands inundated during the rainy season, the plants maturing after the ponds have dried and the summer heat has begun. *Pogogyne serpylloides* is partly an exception, for although it is sometimes found in the dried beds of former pools, it is more abundant on moist hillsides. In the sequence of floral societies characteristic of the rain pools of the Sacramento and San Joaquin valleys, Pogogyne occurs in the final or next to the final assemblage. As the water recedes from the bed of the pool, *Downingia bicornuta, D. ornatissima, Allocarya stipitata,* and *Mimulus tricolor* are most abundant on the moist or freshly dried bottoms. At this time Pogogyne develops vegetatively, sometimes beginning to bloom. In late spring and early summer when the beds of the pools are parched by the first drying heat, the more hydrophilous flora gives way to a society in which Pogogyne is conspicuous.

Navarretia leucocephala and *N. nigelliformis* reach maturity at this time, and *Lythrum hyssopifolia, Boisduvalia glabella,* and *Psilocarphus globiferus* are in flower or fruit. *Pogogyne douglasii minor* and *P. zizyphoroides* are the species frequently represented in this society. *Eryngium vaseyi,* a perennial which generally reaches maturity even later after most of these plants have passed, is sometimes a member of this late society. In Coast Range and Sierra Nevada valleys species of Pogogyne are also found in low areas, maturing generally during the summer; and in the vicinity of San Diego *P. nudiuscula* and *P. abramsi* blossom and fruit in the rain-pools on the elevated coastal plains at the end of the rainy season.

Acknowledgments.—The following study was undertaken and carried out at the California Academy of Sciences, and to Miss Alice Eastwood, Curator of Botany, the writer is indebted for the opportunity to do this work. The author also appreciates the opportunity afforded by the officers of other herbaria to borrow and study further material. These herbaria together with the symbol used in the citation of specimens are: Herbarium of the California Academy of Sciences (CA), Gray Herbarium of Harvard University (G), Herbarium of the University of Oregon (O), Herbarium of Pomona College (Po), Dudley Herbarium of Stanford University (St), Herbarium of the University of California (UC).

TAXONOMIC TREATMENT

Pogogyne Benth., Lab. Gen. et Spec. 414 (1834); Bentham *in* DeCandolle, Prodromus 12: 243 (1848); Bentham and Hooker, Genera Plantarum 2, pt. 2: 1190 (1876); Gray *in* Brewer and Watson, Bot. Calif. 1: 596 (1876); Gray, Syn. Fl. N. Am. 2, pt. 1: 364 (1878); Greene, Man. Bay Reg. Bot., 289 (1894); Howell, Fl. NW. Amer., 551 (1901); Jepson, Fl. West. Mid. Calif., 461 (1901); Jepson, Man. Fl. Pl. Calif., 873 (1925).

Annual herbs of spring and summer with numerous punctate glands, the glandular secretion with an aromatic or rank

odor; stems 0.25–4.5 dm. long, assurgent to strictly erect, simple or branched, glabrous or frequently with a fine retrorse pubescence; leaves suborbicular to oblanceolate-spathulate and linear, simple, entire or obscurely to saliently serrate, obtuse or acute, attenuate below into a short petiole, the margin of the upper leaves becoming bristly-ciliate; floral bracts 2 below each flower, shorter to longer than the calyx, spathulate to oblanceolate and linear, generally entire, the margin conspicuously and sometimes densely bristly-ciliate; flowers numerous, congested in axillary cymules and appearing verticillate, or rarely the flowers solitary or few in the lowest axils, the lower clusters frequently discrete, the upper crowded and the inflorescence becoming spicate-capitate; calyx 15-nerved, the tube slender-campanulate, 1–5 mm. long, punctate-glandular, glabrous or pubescent or rarely hirsute; calyx-lobes linear-deltoid, acute, disposed in two sets, glabrous or hairy or hirsute, the margins generally ciliate, the lower lip 2-lobed, 2–8 mm. long, the upper lip 3-lobed, 1.5–5 mm. long; corolla 2.5–20 mm. long, tubular-funnelform, lavender to purple, the palate frequently mottled with pale yellow, pubescent and sometimes glandular without, pubescent or glabrous within, 2-lipped, the upper lip nearly plane, entire, the lower lip 3-lobed; stamens erect under the upper lip of corolla, 4 or 2 with fertile, 2-celled anthers, the anthers and filaments more or less hairy, the lower pair of stamens always fertile, the upper pair shorter, fertile or sterile or obsolete, the sterile stamens when present simple or capitellate; style about equalling the corolla, more or less hairy below the branches; style-branches unequal to subequal, glabrous; nutlets 1–2.5 mm. long, narrow- to rotund-obovate, hairy and sometimes glandular on the rounded apex, light to dark brown, concolorous or mottled.

KEY TO SUBGENERA AND SPECIES

a. Corolla 9–20 mm. long; four stamens fertile, lower pair 3.5–6 mm. long; style rather densely hairy 2–6 mm. below style-branches; style-branches unequal to nearly equal.....Subgenus Eupogogyne

b. Floral bracts and calyx-lobes conspicuously hirsute, bristly-ciliate.

c. Inflorescence 1–3 cm. broad; calyx-tube 3–4 mm. long, (2–3 mm. long in subspp.); lower calyx-lobes 2–4 mm. longer than upper (except in subsp. *parviflora*); style 13–20 mm. long; north of the Tehachapi region.....1. *P. douglasii*

cc. Inflorescence 0.4–0.8 cm. broad; calyx-tube 2 mm. long; lower calyx-lobes 1 mm. longer than upper; style 12 mm. long; San Diego.....2. *P. abramsi*

bb. Floral bracts and calyx-lobes glabrous or subglabrous; inflorescence 1–1.5 cm. wide; calyx-tube 3–4 mm. long; San Diego.....3. *P. nudiuscula*

aa. Corolla 2.5–12 mm. long; upper pair of stamens sterile, sometimes deficient; lower pair fertile, 0.5–2 mm. long; style sparsely hairy to 1 mm. or less below style-branches (except in no. 6); style-branches generally unequal.....Subgenus Hedeomoides

d. Corolla tubular, 2.5–8 mm. long; style hairy 1 mm. or less below style-branches.

e. Stems prostrate or spreading, slender (except in subsp.); calyx-tube 1–2.5 (or 3.5) mm. long; corolla 2.5–5 mm. long; rudiments of upper stamens present or lacking; nutlets 1 mm. long.....4. *P. serpylloides*

ee. Stems erect or suberect, generally robust, calyx-tube 2.5–5 mm. long; corolla 4–8 mm. long; rudiments of upper stamens present; nutlets 1.7–2.5 mm. long.....5. *P. zizyphoroides*

dd. Corolla tubular-salverform, 12 mm. long; style hairy 3 mm. below style-branches.....6. *P. tenuiflora*

Subgenus **Eupogogyne** J. T. Howell, subgen. nov.

Pogogyne Benth., Lab. Gen. et Spec. 414 (1834).
Pogogyne Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 304 (1896).

1. **Pogogyne douglasii** Benth., Lab. Gen. et Sp. 414 (1834)

Stems erect or suberect, 0.5–4.5 dm. tall, glabrous to puberulent, simple or becoming branched near the base, the branches

spreading and assurgent; leaf-blade 1–2 cm. long, 0.2–1.5 cm. wide, slender-oblanceolate to oblong and elliptic, mostly obtuse, margin entire or coarsely serrate, glabrous, attenuate below to a broad petiole; floral bracts linear to oblanceolate, pungently acute to obtuse, equalling or exceeding the calyx, margin conspicuously bristly-ciliate; inflorescence densely flowered, congested-capitate and short to long-oblong, or the whorls in the lower axils discrete; lower calyx-lobes 3–8 mm. long, the upper lobes 2–5 mm. long, the margins ciliate; calyx-tube 2–4 mm. long, glabrous or the nerves pubescent; corolla 0.9–2 cm. long, lavender to purple, the palate of the lower lip frequently mottled with pale yellow, the outside of the corolla more or less pubescent; stamens fertile, the anthers and upper part of filaments hairy, the lower pair of stamens 3.5–6 mm. long, the upper pair 1–3 mm. long; style 0.8–2 cm. long, somewhat exceeding the corolla, hairy 2–6 mm. below the branches; style-branches equal or unequal; nutlets 1–1.7 mm. long, obovate, dark to light brown.

Low areas in the foothills and valleys: Butte County south to Kern and San Luis Obispo counties, California.

The original publication of the genus Pogogyne was accompanied by the descriptions of three species based on specimens collected by Douglas in California, *P. douglasii, P. multiflora,* and *P. parviflora.* The three were differentiated on relative lengths of floral bracts and flowers, of calyx-tubes and calyx-teeth, and of stamens and corollas. After a careful study of numerous collections it is believed that these three species of Bentham are parts of a single variable specific unit and they are here accepted as constituting the species *P. douglasii. Pogogyne parviflora* which is rather clearly marked by the relative length of calyx-tube and lower calyx-teeth and which occupies a distinct geographic area is here treated as a subspecies. The characters which Bentham used to separate *P. douglasii* and *P. multiflora* (the relative lengths of floral bracts and flowers, and of corollas and stamens) have been found to intergrade and vary to such a degree that the latter species is here considered a synonym of *P. douglasii.*

KEY TO SUBSPECIES OF *P. douglasii*

a. Lower calyx-teeth 1.5–2.5 times as long as the calyx-tube.

b. Calyx-tube 3–4 mm. long; corolla 15–20 mm. long; style hairy 4–6 mm. below the branches; plants robust, frequently branched ..... *1a. typica*

bb. Calyx-tube 2–3 mm. long; corolla 9–14 mm. long; style hairy 2–3 mm. below the branches; plants of low stature.

c. Plants branched, pale with close white pubescence and numerous white bristles ..... *1b. ramosa*

cc. Plants simple, green or the floral bracts frequently purplish-tinged ..... *1c. minor*

aa. Lower calyx-teeth 1–1.5 times as long as the calyx-tube ..... *1d. parviflora*

1a. **Pogogyne douglasii typica** J. T. Howell, nom. nov.

Pogogyne douglasii Benth., Lab. Gen. et Sp. 414 (1834).

P. multiflora Benth., *loc. cit.*

P. douglasii var. *multiflora* (Benth.) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 304 (1896).

Stems generally robust, 2–4.5 dm. tall, simple or branched; bracts of the inflorescence oblanceolate or linear, green; inflorescence dense and spicate or the lower floral whorls distinct, mostly 2–3 cm. broad; length of lower calyx-lobes 1.5–2.5 times the length of the calyx-tube; calyx-tube 3–4 mm. long, glabrous or somewhat pubescent; corolla 15–20 mm. long; style hairy 4–5 mm. below the style-branches.

Foothills and valleys of the Coast Ranges and Sierra Nevada from Lake and Butte counties south to Kern and San Luis Obispo counties.

The type localities of both *P. douglasii* Benth. and *P. multiflora* Benth. are given in the original publication as "in California septentrionali."

Collections. California: Kelseyville, Lake Co., *Blankinship in 1927* (CA); Leesville, Colusa Co., *Heller 12387* (CA, G, St); Calistoga, Napa Co., *Eastwood 4626* (CA, G); Pope Valley, Napa Co., *J. T. Howell 4278 and 4370* (CA); Ala-

meda, Alameda Co., *Kellogg & Harford 730* (CA); Walnut Creek, Contra Costa Co., *Elmer 4320* (CA, Po, St, UC); Pajaro Hills, Monterey Co., *Chandler 441* (UC); San Simeon Bay, San Luis Obispo Co., *Palmer 351* (UC); Santa Margarita Valley, San Luis Obispo Co., *Summers in 1882* (UC); near Chico, Butte Co., *Palmer 2078* (Po); Nelson, Butte Co., *Heller 11390* (CA, G, St, UC); Wawona, Mariposa Co. *Eastwood in 1923* (CA); near Bootjack, Mariposa Co., *J. T. Howell 6678* (CA); Raymond, Madera Co., *Eastwood 12521* (CA); Fresno Flats, Madera Co., *Hall 1552* (UC); Big Sandy Creek, Fresno Co., *McDonald in 1915* (CA); California, *Douglas* (G); California, *Hartweg 1914* (G).

The Douglas collection cited above is undoubtedly a part of the type collection of *P. multiflora* Benth. since the floral bracts are mostly shorter than the flowers and the stamens are exserted. The collection, *Hartweg 1914,* is listed in Plantae Hartwegianae as *P. multiflora* by Bentham, but in the specimen in the Gray Herbarium the stamens are not conspicuously exserted.

The following specimens from the plains of southern and eastern Solano Co. exhibit intermediate characters between subsp. *typica* and subsp. *minor:* Vanden Station, *Heller 5594* (G, St); Elmira, *Baker 2899* (G, Po, UC); Benicia, *Abrams 5746* (St). In habit and foliage these plants resemble low forms of subsp. *typica* and in amount of hairiness on the style the specimens are like subsp. *typica.* In length of calyx and corolla the plants are generally nearer subsp. *minor* though occasionally exceptions occur. Here they are placed as non-typical forms of subsp. *typica.*

As plants of *P. douglasii* pass from youth to maturity and old age, they become branched from the base, the cauline and larger floral leaves drop off, and the corolla is notably reduced. This change is well shown by comparing two collections made from the same pool-bottom near Pope Valley, Napa Co., in May *(J. T. Howell 4278)* and in July *(J. T. Howell 4370).* If field evidence were not available to show the later development of the plants, such extreme types as *Bolander 2667* from Lake Co. (UC) and *Brewer 855* from Napa Valley (UC) might be treated as new forms.

An attempt was made to segregate the forms of subsp. *typica* in the Sierran foothills from those in the Coast Ranges. The more slender inflorescence, the narrower floral bracts, and the more abundant hairs of the floral bracts and calyx-lobes are noticeable characters of the Sierran plants but these characters varied just enough in plants on both sides of the Great Valley that, in too many instances, the erection of a critical line of division between the forms would have been arbitrary.

1b. **Pogogyne douglasii ramosa** J. T. Howell, subsp. nov.

Stem slender, assurgent, 1–1.5 dm. tall, white-hairy especially above, branched at or above the base; bracts of the inflorescence oblanceolate to linear, green, densely white-ciliate on the margins and puberulent on the surfaces; inflorescence more or less interrupted-spicate, 1–1.5 cm. broad, ovate to lanceolate; length of lower calyx-lobes 2 times the length of the calyx-tube; calyx-tube 2–3 mm. long, nerves white-bristly; corolla 11–13 mm. long, conspicuously hairy outside; style hairy 3 mm. below the style-branches.

Dried beds of winter pools in the San Joaquin Valley.

Type: no. 171693, Herb. Calif. Acad. Sci., collected by J. T. Howell (no. 2004), **near Merced, Merced Co., Calif.** Only one other collection has been seen, that of Rattan at Live Oaks, San Joaquin Co., Calif., in 1880 (St).

1c. **Pogogyne douglasii minor** J. T. Howell, subsp. nov.

Stems 0.5–1 (or rarely 2) dm. tall, very slender, simple; bracts of the inflorescence narrowly linear to acicular, acerose-pointed, green or frequently purplish, the margins densely white-ciliate; inflorescence short-capitate, 1–2 cm. broad; length of the lower calyx-lobes 1.6–2.5 times the length of the calyx-tube; calyx-tube 2–2.5 mm. long, white-hairy; corolla 9–14 mm. long; style hairy 2–3 mm. below style-branches.

Depressions on low clay hills bordering the Sacramento and San Joaquin valleys from Tehama Co. south to Madera Co.

Type: no. 171692, Herb. Calif. Acad. Sci., collected by J. T. Howell (no. 4211), **near Merced, Merced Co., Calif.**

Other collections. California: eight miles south of Vina near Pine Creek, Tehama Co., *Heller 11334* (CA, G, St, UC); Glenn Co., *L. E. Smith in 1916* (CA); Folsom, Sacramento Co., *Hannibal in 1918* (St); Raymond, Madera Co., *Cummings in 1896* (G).

The collection from Poso Creek Valley in the foothills of the southern Sierra Nevada, *Dudley 543* (St), intergrades with subsp. *typica*. In technical characters of length of calyx-tube and hairiness of style it agrees with subsp. *minor* but in other characters it resembles more diminutive aspects of subsp. *typica*.

1d. **Pogogyne douglasii parviflora** (Benth.) J. T. Howell, comb. nov.

Pogogyne parviflora Benth., Lab. Gen. et Spec. 414 (1834).

Stems rather slender, 2–3 dm. tall, simple or generally branched; bracts of the inflorescence oblanceolate to linear, mostly green; inflorescence dense and capitate, 1–2 (or 2.5) cm. broad; length of lower calyx-lobes 0.75–1.5 times the length of the calyx-tube; calyx-tube 2.5–4 mm. long, glabrous or somewhat hairy; corolla 11–15 mm. (or 17) mm. long; style hairy 4 mm. below the style-branches.

Low places in Coast Range valleys of Sonoma, Mendocino, and Lake counties.

Pogogyne parviflora Benth. was first collected by Douglas "in California septentrionali."

Collections. California: Sherwood Valley, Mendocino Co., *Dudley in 1899* (St); between Willits and Laytonville, Mendocino Co., *Abrams 5817* (St); Kelseyville, Lake Co., *Blankinship* (CA); Batchelor Valley, Lake Co., *Rattan in 1883* (St); between Cotati and Santa Rosa, Sonoma Co., *Eastwood 10620* (CA); Santa Rosa, Sonoma Co., *Heller 5642* (G, Po, St); Mark West, Sonoma Co., *Bolander 3901* (UC).

The plant represented by plate no. 5886 of Curtis' Botanical Magazine is probably *P. douglasii parviflora* and not *P.*

TABLE 1—SHOWING VARIATION IN CERTAIN SPECIES OF POGOGYNE

LOCALITY (all in California)	Herbarium	Lower calyx-lobes, length	Upper calyx-lobes, length	Calyx-tube, length	Ratio of lower calyx-lobe to calyx-tube	Corolla, length	Bearded part of style, length
Pogogyne douglasii typica.		*mm.*	*mm.*	*mm.*		*mm.*	*mm.*
Leesville	CA 25661	7	4	4	1.75	16	5
Calistoga	CA 25660	6	3	4	1.50	18	4
Walnut Creek	CA 25662	6	4	3	2.00	16	5
Alameda	CA 25652	6	4	4	1.50	18	5
Pajaro Hills	UC 25587	6	4	4	1.50	15	4
San Luis Obispo	UC 104540	8	4	4	2.00	15	5
Nelson	CA 25657	5	3	3	1.66	16	5
Wawona	CA 25655	6	4	3	2.00	16	5
Raymond	CA 128084	5	2	3	1.66	18	4
Big Sandy Creek	CA 25659	5	2	3	1.66	18	5
Average		6.0	3.4	3.5	1.72	16.6	4.7
Pogogyne douglasii minor.							
Vina	CA 25656	5	2	2	2.50	14	3
Glenn County	CA 25654	4	2	2	2.00	13	3
Merced	CA 171692	5	2	2.5	2.00	14	3
Poso Creek	St 23744	5	3	2	2.50	15	3
Average		4.7	2.2	2.1	2.25	14	3
Pogogyne douglasii parviflora.							
Ukiah	UC 25591	4	3	4	1.00	15	4.5
Kelseyville	CA 165111	3	2	3	1.00	13	4
Mark West	UC 25594	4	3	3	1.33	11	4
Cotati	CA 25653	4	2	4	1.00	17	4
Average		3.7	2.5	3.5	1.08	14	4.1

douglasii as named, for the length of the lower calyx-lobes equals the length of the calyx-tube.

2. **Pogogyne abramsi** J. T. Howell, spec. nov.

Stems 0.5–2 dm. tall, simple and erect or branched and suberect to diffuse; leaf-blade 0.5–1.5 cm. long, 0.1–0.5 cm. wide, oblong to linear-oblanceolate, entire or frequently saliently toothed, pubescent or glabrous, narrowed below to a short petiole, the petioles and margins of the upper leaves conspicuously bristly-ciliate; floral bracts white-ciliate, narrowly linear, pungently acute, equalling the calyx or shorter; flowers in slender terminal spike or the lower whorls somewhat distinct; calyx-tube 2–2.5 mm. long, densely white-hairy on the veins outside; lower calyx-lobes 3–4 (or 6) mm. long, the upper lobes 2–3 (or 5) mm. long, all about 0.5 mm. broad at base, the margins hairy and bristly-ciliate, the veins hairy; corolla 10–12 mm. long; lower stamens 4–4.5 mm. long, sparsely hairy, upper stamens 1–2 mm. long, fertile, glabrous; style 12 mm. long, hairy 2–4 mm. below the branches; style-branches unequal to nearly equal; nutlets 1–1.5 mm. long.

Depressions on the mesas and "sandy flats inundated during rains," western San Diego Co.

Type: no. 162150, Herb. Calif. Acad. Sci., collected by Abrams (no. 3446), on **mesa north of San Diego, San Diego Co., Calif.**

Other collections. California: mesa north of San Diego, *Abrams 3446* (G, Po, St); mesas north of San Diego, *Chandler 5346* (St, UC); near San Diego, *Hall 3924* (St, UC); vicinity of San Diego, *Spencer 127* (G, UC); Linda Vista, *T. S. Brandegee in 1894* (UC); clay soil of dried rain-pools, 11 miles northeast of San Diego, *J. T. Howell 6636* (CA, G, O, Po, St, UC).

Distinguished in appearance and marked by several excellent characters, the plant here described seems amply distinct from *P. nudiuscula* to be given specific recognition. All specimens save one that have been examined are labelled "*P. nudiuscula*" yet no diagnosis of that species describes the unusual charac-

ters of the present plant. Undoubtedly it would have received early recognition if its distribution were not so nearly coextensive with that of *P. nudiuscula*. But there are no "intermediates," the two species being more easily separable than certain forms of the long-recognized species, *P. serpylloides* and *P. zizyphoroides*. In habit *P. abramsi* is more slender and the character of vesture marks it at once. The leaves are frequently lobed and the floral bracts are very narrow and pungent. The calyx of *P. abramsi* is smaller in all parts than is the calyx of *P. nudiuscula*, while the corolla and style are generally longer in the latter. The stamens are fertile in both species but in the present species both pairs are shorter than the corresponding pairs in *P. nudiuscula*.

Little is known of the field relationships of *P. nudiuscula* and *P. abramsi* but it is evident from collections in the herbaria that the two species do not grow together, for they have never been mixed in a single collection and no collector has noted the variation which would be so conspicuous if the plants were associated. Further field work might reveal a physiological barrier which separates the two besides determining more accurately the distribution of each.

The following field notes accompany the last of the specimens cited above: tube of the corolla slender, widening into the campanulate throat; the upper lip of the limb cucullate, the lobes of the lower lip reflexed; limb and throat rich rosy-purple, tube white; middle lobe of lower lip with central yellow area spotted with deep purple; lateral lobes of lower lip with a median line of similar purple but with no yellow; the two lower stamens and the style exserted and curved from under the upper lip.

3. **Pogogyne nudiuscula** Gray, Bot. Cal. 1: 597 (1876).

Stems 1–3 dm. tall, simple to much-branched, suberect or somewhat spreading; leaf-blades 0.5–1.5 cm. long, 0.2–0.5 cm. wide, ovate to oblong, obtuse or acute, subentire, glabrous, narrowed below to petiole 0.2–0.5 cm. long; floral bracts oblanceolate to oblong-linear, glabrous or with few marginal

hairs, equalling the calyx or shorter, or the outermost sometimes exceeding the calyx; flowers in distant axillary whorls or the upper whorls capitate-congested; calyx-tube 3–4 mm. long, conspicuously veined, glabrous or very sparsely hairy; lower calyx-lobes 3–5 mm. long, the upper lobes 2–4 mm. long, all lobes 1 mm. broad at base, the margins of the lobes glabrous, rarely thinly ciliate; corolla 11–14 mm. long, sparsely hairy outside, lavender; lower pair of stamens 5–6 mm. long, upper part of filaments hairy, upper stamens 2–3 mm. long, fertile, glabrous; style equalling or slightly exceeding the corolla, 11–15 mm. long, hairy to 1.5–4 mm. below style-branches; style-branches nearly equal; nutlets 1.5 mm. long.

On the mesas of western San Diego Co. near San Diego, the region of the type locality.

Collections. California: San Diego, *Cleveland in 1874* (type, G); San Diego, *Greene in 1902 (Baker distribution no. 1655)* (CA, G, Po, UC); San Diego, *Dunn in 1891* (CA, UC); mesas near San Diego, *Chandler 5345* (UC, St); Mission Valley, San Diego, *T. S. Brandegee in 1894* (UC); East San Diego, *Spencer 548* (G, Po); University Heights on "hog wallows," *Alderson 998* (St).

Subgenus **Hediomoides** Gray, Proc. Amer. Acad. 7: 386 (1867).

Hediomoides (Gray) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

4. **Pogogyne serpylloides** (Torr.) Gray, Proc. Amer. Acad. 7: 386 (1867).

Stems numerous from the base and diffusely spreading, or rarely simple and suberect, 0.25–2.5 dm. long; leaf-blade oblongish to ovate and broadly elliptic, obtuse, entire or minutely crenulate or obscurely serrulate, 0.2–1.2 cm. long, 0.1–0.8 cm. wide, narrowed below to a petiole 0.1–0.7 cm. long; floral bracts spathulate to linear-oblanceolate, equalling or exceeding the calyx, margins somewhat ciliate-pubescent; flowers in dis-

crete axillary whorls or the upper whorls congested and the inflorescence becoming capitate; calyx-tube 1–3.5 mm. long, nerves thinly pubescent; lower calyx-lobes 2–4 mm. long, the tips spreading in fruit, the upper lobes 1.5–3 mm. long, the margins of the lobes ciliate; corolla lavender or lilac, hairy or glabrous without, 2.5–5.5 mm. long; lower pair of stamens fertile, 0.5–1.5 mm. long, the upper pair sterile with or without rudiments of anthers, or both upper stamens entirely lacking; style included in or equalling the throat of corolla, 2–4 mm. long, lightly hairy below branches; nutlets rotund-ovate, dark brown, mottled or not, 1–1.3 mm. long.

Hillsides and low valley lands: Sierra Nevada foothills from Eldorado Co. to Mariposa Co.; Coast Ranges from Humboldt Co. to San Luis Obispo Co., east to Lake and San Benito cos.; northern Lower California.

KEY TO SUBSPECIES OF *P. serpylloides*

a. Stems slender and spreading; whorls of the inflorescence discrete.....*4a. typica*

aa. Stems more stiffly erect, few-branched; whorls of inflorescence approximate, forming oblong, capitate spike.....*4b. intermedia*

4a. **Pogogyne serpylloides typica** J. T. Howell, nom. nov.

Hedeoma (?) serpylloides Torr., Pac. R. R. Rep. 4: 123 (1856).
Pogogyne serpylloides (Torr.) Gray, Proc. Amer. Acad. 7: 386 (1867).
Hediomoides serpylloides (Torr.) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

Plants generally much-branched from the base, the stems flexuous and spreading, or rarely in undeveloped diminutive plants, the stem simple but slender; flowers in distinct axillary whorls, the whorls rarely congested and capitate in small plants.

Sierra Nevada and Coast Range hills from northern California to northern Lower California.

"Hillsides, Martinez" is the type locality of *Hedeoma serpylloides* Torr.

Collections. California: New York Ravine, Eldorado Co., *K. Brandegee in 1907* (UC); near Copperopolis, Calaveras Co., *Davy 1391* (Po, UC); Mokelumne Hill, Calaveras Co., *Blaisdell* (CA); New York Falls, Amador Co., *Hansen 447* (St, UC); French Flat, Tuolumne Co., *Williamson 53* (CA, Po, St); Cathay Valley, Mariposa Co., *Eastwood 4332* (CA, G); Butler Valley on Mad River, Humboldt Co., *Tracy 2621 and 2622* (UC); Rowes, Mendocino Co., *Chandler 1060* (UC); Ukiah, Mendocino Co., *Kellogg and Harford 728* (CA, G); Kelseyville, Lake Co., *Blankinship in 1923* (CA); Pope Creek Canyon, Napa Range, Napa Co., *J. T. Howell 6113* (CA); Healdsburg, Sonoma Co., *Rattan in 1877* (St); Martinez, Contra Costa Co., *Bigelow in 1854* (type collection, G); Bald Peak, Contra Costa Co., *J. T. Howell 4747* (CA, G, O, Po, St, UC); Berkeley Hills, Alameda Co., *Eastwood in 1907* (CA); Oakland, Alameda Co., *Jones 2833* (CA, Po, St); Fort Point, San Francisco, *Kellogg and Harford 729* (CA, G); Arroyo Mocho, Alameda Co., *J. T. Howell 1802* (CA); near Stanford University, Santa Clara Co., *Baker 543* (G, Po, St, UC); between Gilroy Spring and Madrone Spring, Santa Clara Co., *Dudley 4154* (CA, St); Tres Pinos River 5 miles above Pacaines, San Benito Co., *Abrams and Borthwick 7807* (Po, St); Monterey Co., *Abbott* (CA); Cambria, San Luis Obispo Co., *Eastwood 13596* (CA). Lower California: near San Quintin, northern Lower California, *Orcutt 1361* (G, UC).

Unlike the other species of the genus, this form is not so nearly confined to low places where pools form during winter rains, but rather appears to be more abundant on slopes of hills near protecting thickets and brush. Only two collections that have been examined carry the record that the specimens were collected on the beds of former pools. Although there is considerable variation noted in the size and aspect of plants in this variety, such variation is believed to be due entirely to edaphic and climatic influences.

TABLE 2—SHOWING VARIATION IN CERTAIN SPECIES OF POGOGYNE

LOCALITY	Herbarium	Lower calyx-lobes, length	Upper calyx-lobes, length	Calyx-tube, length	Corolla, length	Lower stamens, length	Nutlets, length
Pogogyne serpylloides.		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Kelseyville, Calif.	CA 165110	2.5	2	2.5	5	1.5	1.2
Oakland, Calif.	CA 25679	2.5	1.5	2.5	5.5	1	1.2
Monterey Co., Calif.	CA 25677	3.5	2.5	1.5	3.5	1	1.1
Cambria, Calif.	CA 140011	3	2	1	3	1	1
Mokelumne Hill, Calif.	CA 25680	4	3	2	4	1	1.3
French Flat, Calif.	CA 25678	3	2.5	1.5	4.5	1	1.1
Cathay Valley, Calif.	CA 25673	3	2	2	5	1	0.9
San Quintin, Lower Calif.	UC 25599	4	3	2	3.5	0.5	1.1
Average.		3.2	2.3	1.9	4.2	1.0	1.1
Pogogyne zizyphoroides.							
Central Point, Oregon.	CA 171656	6.5	5	2	5	1.5	1.6
Oroville, Calif.	CA 25668	6	4	3	8	2	2.2
Willows, Calif.	CA 25665	4	3	4	7	1	1.8
Suisun, Calif.	CA 25664	4.5	3.5	3.5	5	1.5	2
Byron Springs, Calif.	CA 145271	4.5	3.5	2.5	4	1	1.7
Coyote, Calif.	St 134508	5.5	3.5	2.5	6	1.5	2
Merced, Calif.	CA 171690	2.5	1.5	2.5	5	2	2
White Rock, Calif.	UC 25604	5	4	3	7	1	1.8
Average.		4.8	3.5	2.9	5.9	1.4	1.9

4b. **Pogogyne serpylloides intermedia** J. T. Howell, subsp. nov.

Plants few-branched from the base, the stems rather stiffly erect, rarely spreading; flowers in approximate whorls, the inflorescence oblong-capitate, rarely 1 of the lower whorls distinct.

Sierra Nevada foothills and Coast Ranges of central California.

Type: no. 25672, Herb. Calif. Acad. Sci., collected by Guirado (no. 714), at **San Juan, San Benito Co., Calif.**

Other collections. San Juan, San Benito Co., *Guirado 714* (G, UC); Livermore, Alameda Co., *Jepson in 1891* (UC); Live Oaks, San Joaquin Co., *Rattan in 1880* (St); St. Lawrence, Eldorado Co., *Jones in 1882* (Po); California, *Andrews* (G).

In this subspecies the more apparent characters that separate *P. serpylloides* and *P. zizyphoroides* find a definite transition from one species to the other. In an adequate collection of the two species a series can be arranged passing by every intergrade of habit, foliage, and flower from typical specimens of *P. serpylloides* to specimens of *P. zizyphoroides.* The following series can be arranged from the specimens of these species found in the Herbarium of the California Academy of Sciences: (1.) Oakland Hills, *Goldsmith;* (2.) Monterey County, *Abbott;* (3.) Mokelumne Hill, *Blaisdell;* (4.) San Juan, *Guirado;* (5.) Suisun, *Eastwood;* (6.) Merced, *J. T. Howell;* (7.) Willows, *Eastwood;* (8.) Oroville, *Heller.* This sequence passes by gradual intergrades from plants with habit typical of *P. serpylloides* (1 to 3) to plants typical of the more robust habit of *P. zizyphoroides* (5 to 8). In this series the intermediate form from San Juan (4) with its stricter habit and compact inflorescence, resembles the less robust aspects of *P. zizyphoroides,* but it is definitely referable to *P. serpylloides* on the size-character of the nutlets. Because of the approximation of this form to *P. zizyphoroides* while yet maintaining the one essential characteristic of *P. serpylloides,* it

has seemed proper to treat it as a distinct subspecies. Although plants constituting subsp. *intermedia* are very distinctive in appearance, it has been difficult to separate it from subsp. *typica* because of the nature of variations in the latter, especially in the more diminutive specimens which are very frequently unbranched and bear single capitate flower-clusters. It is interesting that there are apparently no quantitative data by which subsp. *typica* and subsp. *intermedia* can be separated; but this might be expected since only a single quantitative character is available for the adequate separation of the species *P. serpylloides* and *P. zizyphoroides*.

Andrews' specimen of *P. serpylloides intermedia* in the Gray Herbarium is labelled in Gray's hand-writing "*P. zizyphoroides* var. *magis evoluta*."

5. **Pogogyne zizyphoroides** Benth., Pl. Hartw. 330 (1849).

Hedeomoides zizyphoroides (Benth.) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

Stems simple or branched, 0.5–2 dm. tall, erect or somewhat spreading; leaf-blade ovate to oblong or broadly elliptic, 0.4–1.5 cm. long, 0.2–1 cm. wide, glabrous or the margins minutely scaberulous, obtuse, entire, narrowed below to a broad petiole 0.2–0.7 cm. long, the petioles of the upper leaves frequently ciliate-margined; floral bracts equalling or exceeding the calyx, spathulate to slender-oblanceolate, conspicuously ciliate on the margins; flowers in dense heads or the lower whorls distinct from the terminal capitate cluster; calyx-tube 2.5–5 mm. long, glabrous or nearly so, rarely the nerves somewhat bristly; lower calyx-lobes 2.5–6 mm. long, the upper lobes 1.5–4 mm. long, the middle upper lobe frequently 0.5–1 mm. shorter than the two lateral upper lobes, the margins and nerves of the lobes bristly-hairy; corolla lavender, 4–8 mm. long; lower pair of stamens fertile, 1–2 mm. long, the upper pair sterile and present as club-shaped rudiments; style 3–7 mm. long, lightly hairy below branches; nutlets obovate, dark brown, 1.6–2.5 mm. long.

Dried beds of vernal pools in clay soil, frequently alkaline in character: Jackson Co., Oregon; plains and low bounding hills of the Sacramento and San Joaquin valleys, Butte Co. south to Mariposa and Merced cos.; occasional in valleys of the Coast Ranges in the San Francisco Bay region.

Pogogyne zizyphoroides Benth. was first collected "in valle Sacramento" by Hartweg.

Collections. Oregon: Central Point, Jackson Co., *Howell 777* (CA, G, O); road to Goldhill, Jackson Co., *Henderson 12383 and 12400* (CA, O). California: California, *Hartweg 1915* (type collection, G); hills 8 miles north of Oroville, Butte Co., *Heller 11275* (CA, G, St, UC); Willows, Glenn Co., *Eastwood 10204* (CA); 4 miles east of Williams, Colusa Co., *Ferris 544* (St); Suisun, Solano Co., *Eastwood 10407* (CA); Byron Springs, Contra Costa Co., *Eastwood 14443* (CA); above Niles, Alameda Co., *Jones in 1882* (Po); Coyote Station, Santa Clara Co., *Congdon in 1881* (St); Merced, Merced Co., *Eastwood 4406* (CA); Merced plains, Merced Co., *J. T. Howell 998* (CA); White Rock, Mariposa Co., *Congdon in 1903* (UC). The present disposition of the Oregon collections of this species is discussed in Madroño 2: 20 (1931).

Comparing the tables of measurements for *P. zizyphoroides* and *P. serpylloides* it is seen that there is an overlap in all data except the length-measurements of the nutlets. In all specimens studied this size-character has been found adequate for the definite quantitative separation of the two species. It will be noted, however, that in all the other sets of data, the sizes of floral structures are larger on the whole and in averages for *P. zizyphoroides* and that it is only in few exceptional cases of both species that the observed overlap occurs. Because of this overlap these data have not been available as diagnostic characters, but the differences shown by the averages strengthen the conclusion that *P. zizyphoroides* and *P. serpylloides* are two distinct specific entities. The apparent interrelation of the two species is treated further in the discussion of *P. serpylloides intermedia*.

6. **Pogogyne tenuiflora** Gray, Proc. Amer. Acad. 11: 100 (1876).

Plate 1.

Hediomoides tenuiflora (Gray) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

Stems erect, 1 dm. tall; leaves obovate, obtuse, the margins slightly bristly or glabrous, with pair of salient teeth; floral bracts linear to oblanceolate, finely ciliate, pungent, about equalling the calyx; calyx-lobes finely ciliate, the lower lobes 6 mm. long, the upper lobes 5 mm. long, nerves of calyx puberulent; corolla 12 mm. long, tubular-salverform, pubescent without; lower pair of stamens fertile, 3 mm. long, upper pair sterile, capitellate, 2 mm. long; style hairy 3 mm. below branches, the branches unequal.

Pogogyne tenuiflora Gray is known only from the type collection made in 1875: Guadalupe Island, Lower California, *Palmer 65* (G).

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 4, pp. 129-134 DECEMBER 18, 1931

IV

A GREAT BASIN SPECIES OF PHYSOCARPUS*

BY

JOHN THOMAS HOWELL

Assistant Curator, Department of Botany

It was on the crest of the Panamint Range where one looks eastward down to the alkaline sink of Death Valley and westward beyond the Argus Mts. to the highest summits of the Sierra Nevada, that the present study was begun. There, clinging to clefts and crevices of a rocky ledge and forming a densely and rigidly branched shrubby growth, was found a form of the Basin species of Physocarpus, *P. alternans*. The following diagnoses and key present the variations found in this species through the extent of its range and describe as new the forms which have been found in California.

Physocarpus alternans is most nearly related to the *P. monogynus* complex of species which is found mainly in the Rocky Mt. region from British Columbia to Colorado and New Mexico, a group of species characterized by carpels two or three and by stamens nearly alike. From this group *P.*

*The symbols used to indicate the herbaria where material has been studied are as follows:

CA, Herbarium of the California Academy of Sciences,
Po, Herbarium of Pomona College,
St, Dudley Herbarium of Stanford University,
UC, Herbarium of the University of California.

alternans is easily separated on morphologic and distributional grounds and in a manner more decisive than most of the species in the genus are separated. The solitary carpel at once marks the species and the character of the stamens alone would have specific value. Besides these two characters the species is distinctive for the relative density of pubescence on nearly all parts, the small leaves, and the few-flowered, compact corymbs. In geographic distribution this species appears to replace all other species in the Great Basin area of western Utah, Nevada and California, and, although Rydberg in his treatment of the genus credits *P. (Opulaster) monogynus* to Nevada, no specimens have been seen from Nevada to confirm this statement. For these reasons the species *P. alternans* is considered adequately distinct. And since the species has never been placed in the genus Physocarpus, the necessary combination is given as new.

Physocarpus alternans (Jones) J. T. Howell, comb. nov.

Neillia monogyna var. *alternans* Jones, Zoe 4:42, 1893.

Low densely branched shrub, 2–5 ft. high; sterile shoots of the season stellate-pubescent and rarely glandular, the bark on older stems brown or later greyish-white, shreddy; petioles 0.2–1 cm. long, sometimes glandular; leaf-blades 0.3–1.5 cm. long, rounded to rhonboidal, cordate, generally 3-lobed, the lobes doubly crenate, more or less pubescent above and below; inflorescence umbellately corymbose, terminal, 3–6-flowered; floral bracts linear and linear-lanceolate to oblong and oblanceolate, laciniate, sometimes glandular-fimbriate; pedicels 0.3–1 cm. long, densely stellate-pubescent; hypanthium stellate, 3–4 mm. wide; sepals hairy, white or pink-margined, ovate, acutish to obtuse; petals white (or becoming pink), rounded, 3–4 mm. long; stamens about 20, the filaments alternating short and long, the long with somewhat dilated bases; follicle solitary, densely stellate, about 5 mm. long.

Distribution: mountains of the Great Basin from central Utah westward through Nevada to southeastern California.

Habitat: crevices of rocks and cliffs in the Transition and lower Boreal zones (from upper Artemisia-Piñon Belt to Limber Pine Belt) of desert mountains, 6000 to 9000 ft.

KEY TO THE SUBSPECIES OF *P. alternans*

a. Inner surface of hypanthium glabrous.
  b. Upper surface of leaves slightly pubescent or nearly glabrous.....*a. typicus*
  bb. Upper surface of leaves densely pubescent.....*b. panamintensis*
aa. Inner surface of hypanthium with ring of hairs near top....*c. annulatus*

a. **Physocarpus alternans typicus** J. T. Howell, nom. nov.

Neillia monogyna (Torr.) Greene var. *alternans* Jones, Zoe 4: 42, 1893.
Neillia alternans Jones, Zoe 4: 43, 1893, as a synonym.
Opulaster alternans Heller, Catalogue N. Amer. Pl. ed. 2, 5, 1900.
Neillia opulifolia (L.) Wats. var. *alternans* Rydberg (not Jones), N. Amer. Fl. 22: 245, 1908, as a synonym.
Neillia opulifolia (L.) Wats. var. *pauciflora* Wats., Bot. King's Explor. 80, 1871 in part, according to Rydberg in N. Amer. Fl. 22: 245, 1908; not *Spiraea pauciflora* Nutt. in T. & G., Fl. N. Amer. 1: 414, 1840, nor *Spiraea opulifolia* L. var. *pauciflora* (Nutt.) T. & G., Fl. N. Amer. 1: 414, 1840.

Petioles 0.5–1 cm. long, rarely shorter, sparsely to densely pubescent; leaf-blade 1–1.5 cm. long, or sometimes 0.5 cm. long, slightly hairy above or nearly glabrous, the hairs mostly forked, or trifid to stellate, usually not blurring the color of the leaf; stipules not glandular-margined or rarely, the subulate tip laciniate; floral bracts oblong-lanceolate to oblanceolate, generally laciniate; pedicels 0.5–1 cm. long, glandular; hypanthium glabrous within.

Collections. Utah: Provo, Wasatch Mts., *L. N. Goodding 1159* (UC); Provo, Wasatch Mts. at 6000 ft., *M. E. Jones 5613c* (UC). Nevada: Duck Creek at 7300 ft., Schell Creek Mts., *M. E. Jones in June 30, 1893* (type collection, Po); Morey Peak at 6–7000 ft., *C. A. Purpus 6367* (UC); Highland Peak, *C. A. Purpus in 1898* (UC); one mile south of Cave Creek P. O., Ruby Mts., *H. L. Mason 4770* (CA); Bunker Hill, Toyabe Range, *Kennedy 4226* (St).

b. **Physocarpus alternans panamintensis** J. T. Howell, subsp. nov.

Shrub 1–3 ft. high; branchlets stellate-pubescent and glandular; petioles 0.2–0.5 cm. long, glandular and densely pubescent; leaf-blade 0.3–0.5 cm. long, densely stellate-pubescent above, the color of the leaf obscured by the felt-like covering; stipules slender to broad-deltoid, glandular-margined and hairy; floral bracts linear to linear-lanceolate, hairy, generally entire; pedicels 0.3 cm. long or less, hairy, glandular; hypanthium glabrous within.

Type: no. 171685, Herb. Calif. Acad. Sci., collected by J. T. Howell (no. 3942), about 150 yards north of **saddle between Johnson and Surprise canyons, el. 8500 ft., Panamint Range, Inyo Co., Calif.**

This subspecies is distinguished from subsp. *typicus* and subsp. *annulatus* by the dense, felt-like pubescence which covers the upper leaf-surface as well as the lower. Other distinctive characters which meet in subsp. *panamintensis* but which are sometimes found in the other subspecies, singly or in pairs, are the very short petioles, the small leaf-blades, the linear or linear-lanceolate floral bracts, the very short pedicels, and the numerous red glands which are found on the branchlets, petioles, and margins of stipules and bracts. It should be noted here that the small leaf-blade and short petiole which are so distinctive and uniform in the present subspecies are roughly paralleled in the specimen of the type collection of subsp. *typicus* which has been examined. While size of leaf is believed to be nearly constant in the present subspecies, it would appear from a study of the more eastern material that in subsp. *typicus* leaf-size is variable to a considerable degree even on single plants.

The density of pubescence of the upper leaf-surface is selected as the diagnostic character from these other variables because variation in density of pubescence is more closely and definitely correlated with the geographic distribution of the

species in the Great Basin. The specimens collected by Goodding and by Jones at Provo in central Utah, and the collections from eastern Nevada by Mason in the Ruby Mts. and by Jones in the Schell Creek Mts. show the upper leaf-surface weakly pubescent to nearly glabrous, the color of the leaf scarcely toned by the scanty vesture. More southern collections in Nevada made by Purpus on Morey Peak and on Highland Peak show a marked increase in the amount of pubescence and the color of the leaf is somewhat affected by the more numerous hairs. Still further south and west at the southwestern limit of distribution of the species, the present subspecies is found in which the pubescence of the upper leaf-surface is felt-like and the color of the leaf is largely obscured by the dense covering.

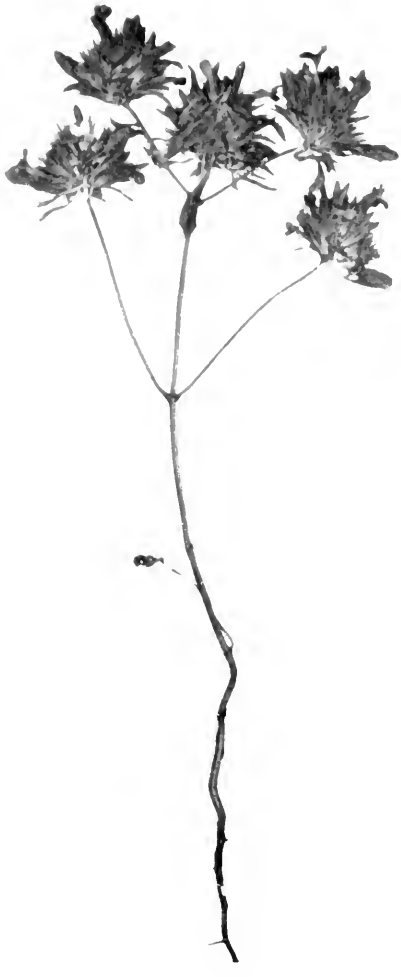
c. **Physocarpus alternans annulatus** J. T. Howell, subsp. nov.

Petioles 0.2–0.4 cm. long, glandular and densely pubescent; leaf-blade 1–1.5 cm. long, stellate-hairy, the color of the leaf slightly blurred; stipules deltoid-lanceolate, not subulate or laciniate, glandular-margined; floral bracts linear-lanceolate, glandular; pedicels 0.3–0.4 cm. long, densely stellate and somewhat glandular; hypanthium with conspicuous hairy ring in upper part just below insertion of stamens.

Type: no. 171686, Herb. Calif. Acad. Sci., collected by V. Duran (no. 1682), **Wyman Creek, White Mts., el. 8500 ft., Inyo Co., Calif.**

The ring of hairs in the hypanthium which marks subsp. *annulatus* appears to be lacking in all other forms of the genus Physocarpus. This character because of its variance from the usual generic type of glabrous hypanthium might be held specific in value, but a study of the other characters of the plant shows it to be too closely related to *P. alternans* to be considered a specific segregate. As noted in the above diagnosis there are minor variations of density of pubescence, dis-

position of glands, and sizes of petioles, leaf-blades, and pedicels which also tend to separate this subspecies from subsp. *typicus*, but there is also some variation in these characters in subsp. *typicus* so they can be considered only secondary in value. In character of the density of pubescence on the upper leaf-surface, subsp. *annulatus* most closely resembles the specimens of subsp. *typicus* collected in southern Nevada by Purpus than those collected further north and east in eastern Nevada and Utah.



Guadalupe Island, off Lower California.
Coll. EDWARD PALMER, M.D., 1875.
No. 65

Pogogyne tenuiflora Gray; n. sp.

Pogogyne tenuiflora Gray; type specimen, × 1.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, NO. 5, pp. 135-160 DECEMBER 18, 1931

V

NEW SPECIES OF PLANTS FROM WESTERN NORTH AMERICA

BY

ALICE EASTWOOD

Curator, Department of Botany

INTRODUCTION

The species described in the following pages have come to the herbarium of the California Academy of Sciences from the collections of the author and the contributions of many correspondents and friends. A few have been in the collection many years, some even antedating the great fire and saved among the rescued types.

To our herbarium the late Mrs. Blanche Trask sent her best collections from the islands off the coast of California and other localities in southern California. Some of the types are among her collection.

Mrs. A. L. Coombs, for many years before her death, collected interesting plants from out-of-the-way places where she and her husband spent their vacations.

Mr. E. Roy Weston, while stationed at Bakersfield, collected for our herbarium in the surrounding region and especially in the little explored Greenhorn Mountains. He added many species not before represented in our collection as well as the species herein described as new.

Mr. J. August Kusche, while off on entomological expeditions, always collects plants as well, and has sent interesting plants from arctic North America, Hawaiian Islands, California, and Arizona.

Other friends to whom we are indebted are mentioned in the descriptions.

1. **Calochortus westoni** Eastwood, new species

Bulb ovoid; leaf single, 1.5 to 2 dm. long, about 1 cm. wide, glaucous, acuminate; umbel sessile, with several flowers; bracts generally 2, papery, lanceolate-acuminate, the longest about 5 cm., sometimes surpassing the pedicels; flowers with buds ovate-acuminate, veined; sepals ovate, 1.5 cm. long, 7 mm. wide, mucronate; nectary at base purple; petals ovate-lanceolate, with a distinct broad claw, hairy over the inner surface and along the margin, surpassing the sepals, white with a narrow, purple, curved line above the gland and purple dots below on the claw; gland curved, covered with short crisped hairs; stamens with filaments broadening to the base, about as long as the acuminate, pink anthers; pistils with recurving stigmas; pods elliptical, 2 cm. long, 1 cm. wide, drooping.

Type: no. 145955, Herb. Calif. Acad. Sci., collected by E. Roy Weston, May, 1927, in the **Greenhorn Mountains, Kern County, Calif.**, at the saddle on the summit above Shirley Meadows from which the snowdrifts had been gone but a short time. This species is related to *Calochortus elegans* Pursh, from which it differs in the absence of peduncle, calyx gland smaller, flowers more numerous in the umbel (5-7).

This species is named for E. Roy Weston who collected the type specimen and who has contributed many valuable specimens to the herbarium.

2. **Fritillaria striata** Eastwood, new species

Bulb deep-seated, of thick, roundish scales; lowest leaves generally whorled, pale green, glabrous, somewhat undulate, oblanceolate, about 1 dm. long, 1–3 cm. wide; upper leaves linear-lanceolate, diminishing to the bracts; flowers one to

several, drooping from the summit of erect lengthening pedicels, very fragrant; perianth with the divisions conniving to form a tube, tips spreading, pale pink, with close striate dotted darker lines, tube obtusely angled at base by the prominent oblong nectaries within; divisions oblanceolate, obtuse, 2–3 cm. long, about 1 cm. wide, the spreading tips edged with crisp pubescence; stamens with thick filaments narrowing upwards, pink-mottled, shorter than the perianth tube; styles lengthening with age, connivent, stigmas not spreading, ovary obtusely lobed.

Type: no. 145549, Herb. Calif. Acad. Sci., collected by E. Roy Weston, May, 1927, on **Rattlesnake Grade, Greenhorn Mountains, Kern County, Calif.** The species is also represented in the Academy Herbarium by the following collections: herb. no. 153092, collected by Mrs. H. C. Harter, February 26, 1928, in the foothills adjacent to Lindsay, Tulare County, Calif.; herb. no. 145634, collected by Mrs. G. Earle Kelley, March 13, 1927, in Fraser Valley, near Strathmore, Tulare County, Calif., growing in grain fields. It is related to *F. pluriflora* Torr., differing in shape and coloring of the flowers, the conspicuous nectaries and the connivent stigmas.

3. **Iris pinetorum** Eastwood, new species

Minutely puberulent throughout; stems several from a slender, scaly rootstock about 5–6 cm. thick; sterile shoots with leaves becoming 4 dm. long, 5 mm. wide, surpassing the slender stems, pale green, tapering at apex to a long point; flowering stems simple, clothed with 2–3 lanceolate-attenuate leaves sheathing at base, the free part slightly spreading, 2–3 cm. long; sheath valves spreading, 2-flowered, similar to the cauline leaves, inner white-membranous; flowers pale yellow, tinged or veined with lilac, on spreading pedicels 5–30 mm. long; perianth tube 15 mm. long, very slender, outer divisions oblanceolate, about 6 cm. long, 1 cm. wide near the top, tapering to a long claw, inner divisions shorter and narrower; anthers yellow, 13 mm. long, emarginate at base and apex;

style branches 3.5 cm. long, 2 mm. wide, with emarginate divisions 2 cm. long; capsule broadly oblong, 2 cm. long and about 1 cm. wide. The parts of the flowers spread widely open.

Type: no. 171935, Herb. Calif. Acad. Sci., collected by the author (no. 14454), June 11, 1927, at **Forest Lodge, near Greenville, Plumas County, Calif.** It was common, growing under the pines. In its narrow leaves and slender floral parts it resembles *I. tenuissima* Dykes, but the spathe valves are unlike those of that species. It might be considered a variety of *I. californica* Leicht., but its widely spreading and very slender floral parts separate it from that species.

4. **Eriogonum covilleanum** Eastwood, new species

Annual, simple or branching from the base and trichotomously or dichotomously repeatedly branching above with slender, glabrous, gracefully curving branchlets, 1.5–3 dm. tall; leaves orbicular subcordate or truncate above the cuneate base, upper surface often red and almost glabrous, lower white-tomentose with the veins beneath often red and prominent, petioles slender 1–5 cm. long according to the size of the plant; bracts 3, glabrous, subulate, obtuse; flowers in sessile involucres at the forks and scattered along the filiform curving stems, involucres glabrous with 5 dark veins, the margin entire, slightly white-ciliate; flowers 2 mm. long, urceolate with rounded base, the divisions of the perigonium elliptical, the apex truncate or slightly emarginate, pink or white with darker midvein, puberulent on midvein and at base, stamens not exserted.

Type: no. 171936, Herb. Calif. Acad. Sci., collected by the author, April 26, 1925, on the road from the summit of **Mount Hamilton** to **Livermore, Calif.**, growing on cliffs along the road where *Mentzelia lindleyi* was abundant and beautiful. It is named in honor of Dr. Frederick Vernon Coville who invited the author to accompany him on a trip into that region while investigating species of *Ribes*. It is related to *E. vimineum* Dougl., differing from any of the allies of that species in the shape of the flowers and the peculiar puberulence.

5. **Eriogonum tenuissimum** Eastwood, new species

Annual, branching from the base and above with many filiform branches, repeatedly forking to form subglobular plants 2–4 dm. high, lightly arachnoid or glabrous; leaves all radical, oblong-oblanceolate with obtuse apex and tapering base; margin slightly woolly-ciliate, somewhat undulate or entire, pale green, the upper surface glabrous, the lower arachnoid, petioles dilated at base, as long as the blades, together 4–8 cm.; bracts at the nodes 3, deltoid-acuminate, woolly on the margins, appressed to the stems; flowers on capillary divaricately spreading pedicels 1–1.5 cm. long, blooming from almost the very base; involucres glabrous, about 1 mm. long, narrowly turbinate, tapering at base, obtusely 4-toothed, 1–4 flowered; flowers soon turning red, the divisions hairy externally, oblong, the outer twice as large as the inner; ovary shortly stipitate, ovate-acuminate, 3-winged and conspicuously exserted. The plants are somewhat monœcious as some of the flowers have stamens and abortive ovaries while those with exserted ovaries have abortive stamens.

Type: no. 139858, Herb. Calif. Acad. Sci., collected by the author (no. 13897), May 5, 1926, at **Cholame, San Luis Obispo County, Calif.** It was common on the hills across the creek from the station. It belongs to the subgenus Ganysma. *Eriogonum hirtiflorum* Gray has exserted ovaries but has sessile involucres and stipitate glands.

6. **Eriogonum pulchrum** Eastwood, new species

Low branching woody shrub about 1 dm. high, white-tomentose throughout; stems leafy, terminated by a corymb 1–3 cm. wide; leaves linear, sessile, 5–10 mm. long, tomentose on both sides, the lower revolute and furrowed, fasciculate; peduncles from almost none to 2 cm., bracts triangular-acuminate subtending the branches and involucres; involucres sessile except some in the forks, about 2 mm. long, tomentose, turbinate with 4–5 small red teeth, about 6-flowered; flowers pink-tinged becoming deep rose; perigonium contracted at base on short scarcely exserted pedicels, outer divisions spreading, orbicular above the short claw, base subcordate, apex trun-

cate or slightly emarginate, 2 mm. wide, inner divisions erect, oblong, ½ as wide; filaments hairy at base; ovary ovate-acuminate, 2 mm. long, minutely scabrous-puberulent.

Type: no. 161957, Herb. Calif. Acad. Sci., collected by the author (no. 15746), October 21, 1928, near the **Meteor Crater, near Cañon Diablo, Arizona.** This is related to *Eriogonum microthecum* Nutt., and may be included under one of the varieties of that species. It is, however, quite different from the type as described.

7. **Eriogonum lanosum** Eastwood, new species

Stems many from a woody leafy caudex, densely white-tomentose throughout, 1.5 to 3 dm. high; leaves all at base, blades oblong to suborbicular, thick, tomentose on both sides, 1–2.5 cm. long, a little less wide, apex rounded, base truncate to subcordate, margin undulate, petioles 2–4 cm. long, broad and sheathing at base; inflorescence cymosely paniculate, shorter than the stem, 5–10 cm. across, bracts very small, subulate; involucres turbinate, sessile, 2 mm. long with 5 short, red-tipped teeth, and about 10 flowers on pedicels 1–2 mm. long; outer divisions of perigonium orbicular, 2 mm. wide, white with red midnerve and red claw 1 mm. long, inner divisions oblong, less than 1 mm. wide; stamens with red-purple anthers and hairy filaments; ovary acuminate, 2 mm. long, minutely scabrous-puberulent.

Type: no. 161958, Herb. Calif. Acad. Sci., collected by the author (no. 15747), October 21, 1928, at the **Meteor Crater, near Cañon Diablo, Arizona.** It belongs to the Section Corymbosa Bentham, which contains many closely related species.

8. **Arenaria kuschei** Eastwood, new species

Stems stiff, erect, leafy, branching from a woody base, glabrous, glaucous, about 15 cm. high; leaves 1–3 cm. long, pungent, margin ciliate-serrulate almost to the apex, clasping and somewhat swollen at base, surpassing the nodes; inflorescence glandular, cymosely congested, pedicels 2–5 mm. long,

bracts similar to the leaves but broader and shorter; sepals very glandular, ovate, aristate, 7 mm. long; petals white, obovate, entire, narrowed at base, surpassing the sepals; stamens included with 5 large yellow glands at base; styles connivent about as long as the globular ovary.

Type: no. 169243, Herb. Calif. Acad. Sci., collected by J. August Kusche, July 12, 1929, at **Forest Camp, Mohave Desert, Calif.** It is related to *A. macradenia* Watson, differing chiefly in the congested, glandular inflorescence.

9. **Anemone adamsiana** Eastwood, new species

Rootstock slender, light brown, horizontal, 3 cm. long, 4 mm. in diameter; flowering stems solitary with or without radical leaf when in flower, this leaf when present similiar to the involucral leaves; petioles 1–2 cm. long, striate, broad at the clasping bases, somewhat pubescent with appressed hairs, leaflets sessile, the terminal rhomboid, 3-cleft above the middle, the divisions irregularly crenate, obtuse or mucronate, lower part entire, lateral leaflets unequal-sided, the inner margin entire almost to the apex, the outer crenate from about the center, variable in size, from pubescent on the veins to glabrous; peduncles surpassing the leaves, pubescent; flowers from bright rose to pale pink or white; sepals elliptical to obovate about 1 cm. long and 5 mm. wide, veins free; stamens about 40, filaments white, about 5 mm. long, broadening at the curving base and below the anther; anthers 5 mm. long; akenes appressed white-pubescent; style glabrous curved, head of fruit on a curved peduncle.

Type: no. 88154, Herb. Calif. Acad. Sci., collected by the author (no. 70), April 24, 1907, on **French Hill** near **Adams Station** on the **Waldo-Crescent City road, Del Norte County, Calif.** Specimens were collected again, March 29, 1928, at the same locality. It also grows along the road near Adams Station, and at the lower altitude the flowers are paler in color. It is related to the blue-flowered *A. oregona,* but differs not only in the color of the flowers but also in the foliage.

10. **Anemone adamsiana** var. **minor** Eastwood, new variety

This is similar in every respect except that the radical leaves are fully developed at the time of flowering and are similar to the stem leaves.

Type: no. 88199, Herb. Calif. Acad. Sci., collected by the author (no. 153), April 29, 1907, on **Gasquet Mountain, Del Norte County, Calif.**

11. **Anemone oligantha** Eastwood, new species

Rootstock dark brown, horizontal or branched; flowering stem solitary without radical leaves when flowering, slender, striate, slightly puberulent, with hood-like papery scales at base; leaves of the involucre with petioles 5–10 mm. long, the terminal leaflet petiolulate, rhomboidal 15 mm. long, 8 mm. wide, lower half entire, upper irregularly crenate; lateral leaflets obliquely rhomboidal, similar but narrower, all leaflets with appressed hairs on the veins of both surfaces; peduncles 15–20 mm. long, generally not surpassing the leaves, appressed hairy; sepals white, oblong, obtuse, 3–5 mm. long, 2 mm. wide, veins free; stamens yellow, about 20, filaments 3–4 mm. long, scarcely surpassing the head of akenes, anthers elliptic, 5 mm. long; akenes on short stipes, somewhat pubescent, style curved at apex.

Type: no. 88197, Herb. Calif. Acad. Sci., collected by the author (no. 158), April 30, 1907, at **Monumental** near Anderson's on the Waldo-Crescent City road, **Del Norte County, Calif.** This is the smallest-flowered anemone on the Pacific Coast and perhaps is related to *A. lyallii* Gray.

12. **Delphinium apachensis** Eastwood, new species

Perennial from a woody branching root; stems 4–6 cm. tall, simple or branching, somewhat woolly pubescent; radical leaves generally wanting when plant is in bloom, the withered ones on long petioles with blades 5-divided, 3 cm. wide the divisions 2–3, obtusely lobed, cauline leaves with narrower, simpler divisions; racemes of principal stem 1–5 dm. long or

less, of the lateral branches 3–5 cm. long; bracts linear, shorter than the pedicels, bractlets 2, close to the flower; flowers 2 cm. across, the spur straight or curved, 1 cm. long, sepals azure-blue, 3-veined, oblong, 5 mm. long, 4 mm. broad, a woolly spot on the back near the obtuse apex; petals white, shorter than the sepals, woolly, claw 5 mm. long; stamens with brown anthers and broad membranous connivent filaments; follicles erect, pubescent, veiny; seeds with loose cellular coats, black-spotted.

Type: no. 167759, Herb. Calif. Acad. Sci., collected by the author (no. 17144), May 12, 1929, along the road near **Apache Lodge, Roosevelt Dam, Arizona.** Another specimen from Fish Creek grade, near the summit, was collected April 19, 1917; it is no. 89143, Herb. Calif. Acad. Sci.

13. **Dicentra nevadensis** Eastwood, new species

Glabrous and glaucous, growing in colonies from root-stocks; leaves radical, tripinnately dissected, the blades about 9 mm. long, 8 cm. broad on petioles 5–7 cm. long, the principal divisions with petiolules 1–1.5 cm. long, ultimate divisions with linear, acuminate lobes 1 mm. wide and callous apex; scapes 1–2 dm. high, surpassing the leaves; inflorescence cymosely paniculate, the ochroleucous flowers on filiform pedicels 5–10 mm. long, about equaling the linear-attenuate bracts; sepals ovate-lanceolate, acuminate, 8 mm. long, 2 mm. wide at base, margin irregularly serrate or entire; outer petals ochroleucous with spreading and darker tips, inner with exserted limb, white tinged with pale yellow; ovary lanceolate 5 mm. long, style 7 mm. long with 3-parted stigma.

Type: no. 187724, Herb. Calif. Acad. Sci., collected by Miss Enid Larson, July 7, 1931, on **Alta Peak Trail, Sequoia National Park, Calif.** It is represented by another specimen from Sequoia National Park collected by Mrs. Charles Derby, July 5, 1929, at an altitude of 10,000 feet, and by a specimen collected by Mr. C. L. Fox, July, 1923, near the big rock as one enters Mineral King, Tulare County, Calif. The species is represented in the Gray Herbarium by a collection of W. H. Brewer in 1864, no. 2793. The same is in the U. S. Na-

tional Herbarium, also a collection of Coville and Funston, on the Death Valley Expedition at Mineral King, August 1, 1891, no. 1410. Another specimen in the National Herbarium was collected by George B. Grant at Alta Meadows, July 4, 1902. This pale-flowered Dicentra not only differs from *D. formosa* in the color of the flowers, but also in the more finely dissected leaves; the flowers are smaller than those of *D. formosa* and more constricted below the spreading tips.

14. **Dicentra oregana** Eastwood, new species

Perennial from thick, branching, scaly rootstocks; leaves glabrous and glaucous, ternately compound with the divisions pinnately dissected, ultimate segments confluent, laciniately dentate, blade 6–10 cm. long and broad, petioles 1–2 dm. long, dilated at base; scapes naked, 2–3 dm. high, striate; inflorescence terminal, nodding, paniculate with the flowers closely clustered on filiform pedicels, bracts and bractlets filiform to linear-attenuate; sepals oblong-lanceolate, acuminate, striate, 6 mm. long, 2.5 mm. wide; corolla ovate-cordate, exterior petals ochroleucous with short spreading tips, inner with the exserted limb rose color; ovary smooth, shorter than the style.

Type: no. 81304, Herb. Calif. Acad. Sci., collected by the author (no. 149), May 5, 1907, on the **Waldo-Crescent City road,** on the Oregon side of the boundary monument, growing on gravelly banks along the roadside near **Telephone Point.** In the Gray Herbarium the species is represented by a specimen collected on the Illinois River, Oregon, by Volney Rattan in 1879. In the U. S. National Herbarium it is represented by a specimen collected by Thomas Howell at Waldo, Oregon, June 4, 1884, no. 3424. Another specimen in the Herbarium of the California Academy of Sciences was collected by L. F. Henderson on the trail to Tennessee Pass near the top, three miles from Kerby, southern Oregon, April 20, 1926. The latter is a more robust plant than the type but the flowers are similar. Not only in the color of the flowers but in the pallid foliage, this species presents a quite different appearance from any of the numerous forms of the variable *Dicentra formosa.*

15. **Mahonia amplectens** Eastwood, new species

Shrub 3–6 dm. high or perhaps more; leaves 7-foliate, glaucous, veiny; leaflets suborbicular, 3–5 cm. wide, sessile except the terminal one, the cordate bases of the lateral ones overlapping, the marginal spiny teeth 5–10 mm. apart; petioles about 4 cm. long. This was neither in flower nor fruit, but the leaves are so unlike any other species that it is quite distinct.

Type: no. 81281, Herb. Calif. Acad. Sci., collected by Mrs. Blanche Trask (no. 66), November, 1904, in **Santa Rosa Mountains, San Bernardino County, Calif.**, near the **Garnet Queen Mine**, growing along a small stream. It was among the specimens saved from the great fire of 1906.

16. **Streptanthus coombsæ** Eastwood, new species

Annual, simple or branching, glabrous; radical leaves wanting; cauline lanceolate, 1–3 cm. long, entire, obtuse, sagittately clasping at base; racemes ebracteolate with flowers on erect pedicels, 2–5 mm. long; sepals not united, purplish with white margins, lanceolate, the two larger 8 mm. long, 2 mm. wide at the saccate base, the two inner narrower; petals about 1.5 cm. long, the claw a little shorter than the narrow, linear, purple blade with crisped, white margins; longer stamens in two pairs, united to the anthers, filaments 8 mm. long, the 2 shorter separate, 6 mm. long; pod wanting, but ovary glabrous, linear, 7 mm. long, stigma capitate, ovules winged.

Type: no. 171937, Herb. Calif. Acad. Sci., collected by Mrs. A. L. Coombs, July, 1913, on **Williamson River, southern Oregon.** Its affinities are with the Section Euclisia, but differs from all described species.

17. **Streptanthus dudleyi** Eastwood, new species

Annual, almost glabrous, simple or branching above; radical leaves wanting; cauline leaves lanceolate, obtuse, glabrous except a few hairs along the midrib and margins, largest leaves 5.5 cm. long, 1.5 cm. wide, margins entire, sinuate or sinuate-dentate, upper leaves smaller and entire; flowers white, race-

mose; pedicels spreading or erect, 5 mm. long, slightly hairy with branching hairs; sepals separate but connivent at base, almost equal, lanceolate, 4 mm. long, 1.5 mm. wide at base, greenish with white margins; petals 8 mm. long, linear, the narrow blades with crisped undulate white margins; stamens separate, anthers green, sagittate; pods erect, 5 mm. long, 1 mm. wide with style 1 mm. long, tipped with a capitate stigma; seeds winged.

Type: no. 171933, Herb. Calif. Acad. Sci., collected by Chester Dudley, February 24, 1929, on the headwaters of **Bitterwater Creek, San Benito Co., Calif.** This species belongs to the section which includes *S. heterophyllus* Nutt. Among other differences are pubescence, shape of leaves, erect pods and evident style.

18. **Streptanthus sanhedrensis** Eastwood, new species

Biennial, glabrous and glaucous, branching chiefly from the base; leaves of the first year orbicular, about 2 cm. across, cuneate at base, crenate along the upper margin, often tinged with rose, petioles about as long as the blades; lower cauline leaves obovate, sessile at the clasping base; upper leaves orbicular and obtuse or ovate and acute, auriculate clasping at base, entire; racemes ebracteolate, pedicels 5 mm. long, receptacle broad; flowers white with the outer sepals saccate at base, inner flat, tips recurving, about 8 mm. long, 5 mm. wide at base; petals 11 mm. long, the blades oblong, obtuse; shorter stamens with sagittate anthers as long as the filaments, 2 longest stamens as long as the petals; immature pods flat, spreading, tipped by a 2-lobed sessile stigma.

Type: no. 128829, Herb. Calif. Acad. Sci., collected by the author (no. 12928), May 22, 1925, on the trail from **Dashiel's** to **Mt. Sanhedrin, Calif.**, growing amid rocks. This species belongs to the group of which *S. cordatus* Nutt. is the type.

19. **Sedum gertrudianum** Eastwood, new species

Corm round or fusiform 1–2 cm. long, 1 cm. in diameter; stems 1 to several, less than 1 dm. high, simple, slender, red-dotted throughout and somewhat farinose; radical leaves oblanceolate, tapering to petioles, together 1–2.5 cm. long, fleshy, 2–4 mm. wide, lower cauline leaves subopposite, upper alternate, lanceolate, obtuse, clasping at base, fleshy, red-dotted and minutely puncticulate; inflorescence terminal; flowers about 5 on a 2-branched inflorescence, pedicels 1–2 mm. long, bracts and sepals similar to the upper leaves but smaller; petals white with red midveins, lanceolate, acute, 1 cm. long; stamens half as long as the petals, anthers red, turning black; pistils spreading, styles pointed, as long as the filaments; fruit immature.

Type: no. 171934, Herb. Calif. Acad. Sci., collected by the author (no. 15112), May 16, 1928, along the bluffs of **Morro Bay, San Luis Obispo County, Calif.** It was almost concealed by the grass amid which it grew. The species is named in honor of Miss Gertrude Sinsheimer, companion and hostess of the author on the trip. It is related to *Sedum blochmanæ* Eastwood *(Hasseanthus blochmanæ* Rose) and *Hasseanthus kessleri* Davidson. It is much smaller than the former but has flowers the same color. *Hasseanthus kessleri* Davidson is figured on plate XVIII, Bull. S. Calif. Acad. Sci., XXII, p. 72. While it also is one of the white-flowered species and smaller than *S. blochmanæ, S. gertrudianum* differs in habit, surface of leaves and stems, length of filaments, and color of anthers.

20. **Dudleya murina** Eastwood, new species

Caudex branching from a thick root; leaves linear-acuminate, farinose, reddish, the largest 10 cm. long, less than 1 cm. wide at base, tapering to a fine point, rounded or keeled along the back, slightly concave on the front; flowering stems several, about 2 dm. high, reddish and farinose; lower cauline leaves lanceolate-attenuate, 3 cm. long, upper, ovate, clasping, spreading, diminishing upwards to the small bracts; inflorescence a laxly-spreading panicle, pedicels 1–4 mm. long; calyx

divided to the base, the divisions lanceolate, acute, 5 mm. long, half as long as the corolla; petals connivent to 5 mm. with tips spreading, acute, pale yellow or almost white, keeled and irregularly striped with red; filaments 5 mm. long, anthers oblong, yellow 1 mm. long; immature follicles connivent with red ribs and long styles.

Type: no. 157346, Herb. Calif. Acad. Sci., collected by the author (no. 15128a), May 19, 1928, growing on serpentine rocks along the road up **Cholla Creek, San Luis Obispo County, Calif.** The mouse-color of the plant gives it its name.

21. **Amorpha emarginata** Eastwood, new species

Shrub 1–3 dm. high, branches ribbed, sparingly pubescent and glandless; leaves 1–2 dm. long; leaflets about 6 pairs, obovate with emarginate apex and cuneate base 1–2 cm. long, 1–1.5 cm. wide, reticulate, lower surface with a few scattered hairs, margins sub-crenate, a few glands on the upper surface and between the marginal teeth; stipules brown-membranous, linear-lanceolate, about 4 mm. long, hairy at tip; petiolules 2 mm. long; racemes narrow, longer than the leaves, bracts similar to the stipules; pedicels about 2 mm. long; calyx cuneate, ribbed, 5 mm. long, 4 short teeth triangular, fifth a little longer and narrower, gland-tipped; petals dark purple; ovary glabrous, slightly curved.

Type: no. 81280, Herb. Calif. Acad. Sci., collected by the author (no. 8745), May 19, 1919, at **Fish Creek, Apache Trail, Arizona.** This has leaves unlike other known species and a very small calyx with short teeth.

22. **Aralia arizonica** Eastwood, new species

Older foliage glabrous except for some hairs on the rhachis and veins of the lower surface, leaflets thin, green, ovate-acuminate, obliquely cordate at base, margin setosely doubly-serrate, lateral leaflets 15 cm. long about 10 cm. wide on petiolules 2–4 cm. long, terminal leaflets 3-divided or with divisions more or less confluent; leaves subtending the inflorescence tripinnately compound, leaflets lanceolate, puberulent

with short curly hairs; umbels paniculate, densely tomentose-puberulent with curled hairs, bracts small, attenuate; calyx turbinate about 1 mm. long, the triangular divisions as long as the tube; pedicels 1–2 mm. long with a hairy ring at the base of the calyx; petals obtuse, striate-nerved; style in bud divided almost to the base.

Type: no. 147267, Herb. Calif. Acad. Sci., collected by J. August Kusche, June 26, 1929, in **Cave Creek Cañon, Chiricahua Mountains, Arizona.** This is a tall species probably related to *A. californica* Watson and *A. racemosa* L. It differs from these in the peculiar leaf-margins. The teeth are much deeper than those of *A. californica* and setosely tipped. The immature minute flowers do not coincide with either. The more recently described *A. bicrenata* Woot. & Standl. has the leaf margins bicrenate according to the description, so cannot be confused with this.

23. **Arctostaphylos imbricata** Eastwood, new species

Low spreading shrub, bark deciduous but not glossy and rather rough, dark brownish red; young branches clothed with short and long viscid hairs; leaves oblong-ovate, cordate, almost sessile, and so closely placed as to be imbricated, green and glabrous, except for some viscid hairs on the lower part of the midrib, 2–3 cm. long, 1–2.5 cm. wide, entire or slightly serrate at base, apex acute; flowers in dense racemes or panicles shortly pedunculate or almost sessile at the ends of the branchlets; bracts similar to the leaves, but diminishing upwards, more viscid, hairy and ciliate, surpassing the pedicels; bractlets orbicular; pedicels 2–3 mm. long, viscid with gland-tipped hairs; sepals orbicular, cucullate, 1–5 mm. long, glandular and ciliate; corolla broadly urceolate, 3 mm. wide, glabrous externally but villous within; stamens 2 mm. long, filaments dilated at the hairy base, anther appendanges 1 mm. long surpassing the anther, ovary somewhat glandular-pubescent; fruit globose, 6 mm. in diameter, with the sepals persistent and deflexed.

Type: no. 38777 (flowers), no. 38776 (fruit), Herb. Calif. Acad. Sci., collected by Mrs. Marion L. Campbell and Mrs.

Ernest Meiere, who collected flowering specimens, February 15, 1915, and fruiting specimens June of the same year, on **San Bruno Hills** in **San Mateo County, Calif.** This is related to *Arctostaphylos andersoni* Gray, from which it is most noticeably distinguished by the much shorter, densely imbricated leaves and the compact flower clusters with shorter flowers.

24. **Asclepias giffordi** Eastwood, new species

Stem stout, densely white-tomentose throughout; leaves shortly petioled, oblong, 1–1.5 dm. long, 4–5 cm. broad, undulate, apex and base obtuse; umbels on stout peduncles 5–10 cm. long, the upper shorter, many flowered, pedicels lax, angled, 2–3 cm. long, densely tomentose; sepals lanceolate, obtuse, 4–6 mm. long, 2 mm. wide, externally tomentose, interiorly glabrous; divisions of the corolla pale yellow, oblong, obtuse, incurved, 8 mm. long and half as wide, tomentose externally, glabrous within; corona surpassing the anther column with obtuse apex and horn exserted over the anther column and covering it, base with nipple-like appendages, anthers emarginate at base of wings; ovary glabrous, fruit unknown.

Type: no. 81308, Herb. Calif. Acad. Sci., collected by E. W. Gifford, July, 1913, near **Tuolumne, Calif.** The species is named in honor of the collector. It is unlike the other related species of California in that the corona surpasses the anther column, and in the notched anther wings.

25. **Gentiana copelandi** Eastwood, new species

Stems decumbent, 2–3 from a perennial root and a rosulate cluster of oblong-spatulate to suborbicular leaves with broad sheathing petioles, the largest including the petiole 5 cm. long and 2 cm. broad; cauline leaves 3–4 pairs, connate-clasping at base, broadly petiolate or sessile, the uppermost 5–10 mm. broad and distant from the flower 5–10 mm.; divisions of the calyx oblong, acute, about as long as the cuneate tube, 2–3 mm. broad, separated by a membranous truncate sinus 2 mm. broad; corolla dark purple, broadly funnelform, 4–5 cm. long, lobes ovate, acute or mucronate, greenish tinged in bud, ap-

pendages triangular with narrow linear-attenuate laciniæ varying in different flowers; stamens inserted on the throat of the corolla, with filaments dilated at base and decurrent on the corolla-tube, anthers linear, 3–4 mm. long; stipe as long as the ovary which tapers at both ends, lobes of the stigma connivent; seeds winged.

Type: no. 81306, Herb. Calif. Acad. Sci., collected by the author (no. 2037), August 30, 1912, near the foot of **Mt. Eddy, Siskiyou County, Calif.** It grew in a meadow along the trail. The species is named in honor of Dr. Edwin Bingham Copeland, who first collected it September 7, 1903, no. 3875, distributed by C. F. Baker, no. 81307, Herb. Calif. Acad. Sci. It is related to *Gentiana newberryi* Gray, but has much broader leaves and dark purple flowers.

26. **Convolvulus tridactylosus** Eastwood, new species

Prostrate and trailing, gray-tomentose throughout; leaves three parted, cuneate at base, the divisions widely spreading, the middle from ovate-triangular to narrower, about 2 cm. long, 4–10 mm. wide, mucronate, lateral divisions oblong, obtuse, 1–2 cm. long, 5–10 mm. wide: petioles flexuose, the lowest 5 cm. long, diminishing upwards; flowers solitary in the leaf axils on peduncles shorter than the petioles, erect or curving; corolla white with pink bands terminated at the apex by a tuft of tomentum, bracts subtending the calyx lanceolate, acute, equaling or shorter than the elliptical mucronate sepals, these tomentose externally, glabrous within; anthers narrow-sagittate 5 mm. long, filaments shorter than the style, inserted above the base of the corolla; stigma lobes linear, 1–2 mm. long.

Type: no. 158703, Herb. Calif. Acad. Sci., collected by the author (no. 15202), June 5, 1928, on the mountains near **Covelo, Mendocino County, Calif.**

This species belongs to the group of which *C. villosus* Gray is the type. It differs in the shape of the leaves which are like three outspread fingers; also in the bracts subtending the calyx. The type description of *C. villosus* has been followed in the comparison.

27. **Convolvulus linearilobus** Eastwood, new species

Glabrous, pale green, intricately twining; leaves 3–lobed, the middle lobe linear-acuminate, 3–6 cm. long, 2–5 mm. wide, lateral lobes basal, spreading horizontally and curving downwards, 5–15 mm. long, 1–3 mm. broad, petioles 15–20 mm. long; flowers solitary on long slender axillary peduncles, some 15 cm. long, bracts 5–20 mm. from the calyx, opposite or alternate, varying in length, linear and sometimes slightly sagittate at base; sepals unequal, oval, obtuse and tipped with a dark brown mucro; corolla white, almost 3 cm. long, and as wide across the top; anthers narrow, linear-sagittate, surpassing the stigma which is nearly 2 mm. long.

Type: no. 167170, Herb. Calif. Acad. Sci., collected by the author (no. 17264), May 15, 1929, along the road near the **Mercury Mine, Mazatzal Mountains, Arizona.**

This species is near *C. luteolus* Gray, differing from other species in that aggregate by the peculiar leaves, distinguished by the extremely long narrow linear lobes and the divaricate basal shorter ones. The leaves are not at all sagittate or hastate.

28. **Nemophila evermanni** Eastwood, new species

Low spreading annual, hispid with white spreading hairs, deflexed on the stems and peduncles; leaves 1–2 cm. long, petiole half as long as the 3–9-lobed blade, divisions oblong obtuse, generally entire, ciliate and with finely pustulate hairs on the surface, about 5 mm. long; peduncles slender, surpassing the leaves; divisions of the calyx lanceolate-deltoid 5 mm. long, the appendages linear, 2 mm. long or shorter; corolla blue with white center, about 2 cm. across, the lobes rounded, basal appendages oblong, half free, 2 mm. long, ciliate; stamens with filaments equaling the styles, 4 mm. long, anthers purple-brown, sagittate, 1 mm. long; pistil with styles divided almost to the hairy base, ovary hispid; capsule 15 mm. long, and almost as wide, subtended by the enlarged calyx, nodding; seeds not ripe.

Type: no. 171874, Herb. Calif. Acad. Sci., collected by Dr. Barton Warren Evermann, April 20, 1915, at **Walker Basin, Kern County, Calif.**

This species is related to *N. insignis* Benth., from which it is conspicuously distinguished by the large capsule and the different appendages at the base of the corolla. The capsule is similar to that of *N. macrocarpa* Eastwood, but the plant differs in habit, pubescence, color of the flowers, and shape of the corolla-appendages.

29. **Mimulus grantiana** Eastwood, new species

Annual about 5 cm. high with filiform purple branches, chiefly from the base, somewhat glandular-puberulent; cotyledons often persistent, spatulate, the blade as long as the petiole, together 5 mm.; succeeding leaves even from the base irregularly pinnatifid with obtuse lobes, opposite and clasping, about 5 mm. long with internodes 1 cm. long; flowers on filiform peduncles drooping in bud, erect in fruit on horizontally spreading peduncles lengthening to 2 cm.; calyx in fruit purple, 5-ribbed and with short acute or obtuse equal teeth, slightly glandular-puberulent; corolla with tube surpassing the calyx by about 2 mm. broadening abruptly to a limb 1 cm. in diameter almost entire, crimson above, darker below, and spotted with yellow in the throat; ovary oblong-lanceolate shorter than the calyx, the style surpassing it by 6–8 mm. slightly glandular-puberulent above and tipped by the broad, generally purple, stigma.

Type: no. 22715, Herb. Calif. Acad. Sci., collected by the author (no. 9442), April 23, 1920, at **Campo, San Diego County, Calif.**, growing in sandy soil amid the brush.

The species is named in honor of Dr. Adele Lewis Grant, who has so well monographed this difficult genus in Annals of the Missouri Botanical Garden. This lovely little Mimulus seems nearest to *M. gracilipes* Robinson, Proc. Am. Acad. 26: 176, differing most noticeably in the peculiarly lobed leaves in which it also differs from all other related species.

30. **Githopsis latifolius** Eastwood, new species

Branching with weak, slender, erect stems from the axils of the leaves, scabrous on the somewhat obscure angles; leaves scattered, sessile with broad base, elliptical to ovate, obtuse, lowest about 2 cm. long, 1.5 cm. wide, entire, upper leaves smaller; flowers terminal, sessile, subtended by short bractlets; sepals lanceolate-acuminate, entire, 1 cm. long, 2 mm. wide, equaling the open-campanulate corolla; corolla dark blue, 1 cm. across with broad obtuse lobes; ovary slender, scabrous on the ribs.

Type: no. 171875, Herb. Calif. Acad. Sci., collected by Mrs. A. L. Coombs, September, 1912, at **Big Meadows, Plumas County, Calif.**

This species differs from all other species of Githopsis in the broad leaves and the open-campanulate corolla.

31. **Hieracium occidentale** Eastwood, new species

Perennial, stem 4 dm. high, purplish, glabrous throughout, except the involucre and adjacent stems; radical leaves oblanceolate, tapering to a margined petiole, entire or minutely callous-denticulate, 10–15 cm. long, 1–3 cm. wide, apex obtuse; cauline similar but sessile, smaller and diminishing upwards; heads loosely panicled at the summit of the stem on long slender peduncles; heads 1 cm. high, flowers white; inner bracts of the involucre linear with green, glandular-puberulent midribs and paler, somewhat membranous margins, outer shorter, narrower, spreading, and with a few marginal hairs; pappus tawny, akenes immature.

Type: no. 150330, Herb. Calif. Acad. Sci., collected by the author (no. 14583), June 14, 1927, at **Forest Lodge**, near **Greenville, Plumas County, Calif.**

This species differs from *H. albiflorum* to which it seems most closely allied, by the absence of the hairy pubescence of that common and widely distributed species.

32. **Baccharis arizonica** Eastwood, new species

Shrubby, upwardly branching with many slender, 4-angled, viscid branches, becoming 1–2 m. high; leaves linear, bract-like on the flowering branchlets, 2–5 mm. long; inflorescence paniculate; lower heads pedunculate on branchlets, ultimate heads sessile; staminate heads globular, involucral scales in 4–5 ranks, outer ovate, obtuse, narrowly white-margined, green-tipped; inner narrowly lanceolate with narrow, fimbriate margins; heads about 30-flowered, pappus equaling or surpassing the flowers, the tips broadened and hairy; tube of corolla half as long as body; stamens exserted; receptacle flat; pistillate heads campanulate, scales of the involucre in 5–6 series, outer green, white-margined, inner lanceolate, fimbriate, pappus copious white, becoming 1 cm. long; akenes glabrous, striate.

Type: no. 160939 (♂) no. 160938 (♀), Herb. Calif. Acad. Sci., collected by the author (staminate no. 15833, pistillate no. 15832), near **Roosevelt Dam, Arizona,** at **Packard** on the road to **Payson.** The following specimens are also in the Academy Herbarium from Arizona: Fish Creek, Apache Trail, October, 1929, also Roosevelt Lake, October 30, 1929, collected by the author; junction of Pantave and Rincon creeks, Blumer 3998, and bank of Santa Cruz River, Blumer 4042, both collections near Tucson; Soldier Cañon, Santa Catalina Mountains, Forest Shreve 5118; Tucson, John I. Carlson. Very young examples were collected by the author (nos. 6144 & 6144a) at Phoenix, April 18, 1917. These specimens have linear oblanceolate leaves 2–3 cm. long and 1–2 mm. wide, generally acute and tapering to the base.

This species has been confused with *B. sarothroides* Gray, but it differs in having larger heads and white, rather than tawny, pappus.

33. **Aplopappus illinitus** Eastwood, new species

Stems erect, pale yellow, slightly floccose, with branches erect and very leafy; leaves fasciculate, terete, incurving, 1–2 cm. long, acuminate, glandular-punctate and pale green; heads radiate, narrowly paniculate at summit of main stems; involu-

cre about 5 mm. high, bracts in 3 series, pale with green keels, slightly floccose, margins ciliate becoming squarrose at the acute tops, the outer merging into the upper leaves; ray flowers 4–5, fertile, disk-flowers 8–10, pale yellow with slender, glandular tube longer than the campanulate limb; stamens and stigmas exserted; pappus tawny, barbellate, equalling the corolla; akenes sparingly pubescent with short spreading hairs.

Type: no. 171902, Herb. Calif. Acad. Sci., collected by Mrs. Alvina Buttle near **Warners Springs, San Diego County, Calif.**

This species is near *Haplopappus propinquus* Blake, differing in the radiate heads, sparingly hairy akenes, the more viscid stems, and leaves with the conspicuous, gummy, varnish-like exudation.

34. **Aplopappus traskæ** Eastwood, new species

Shrub with tomentose stems 3–4 dm. high, branching above in a paniculate inflorescence; leaves oblong-lanceolate, tapering at base to a short petiole, apex obtuse, 3-6 cm. long, 2 cm. wide, upper surface green and glabrous except in the youngest leaves, lower lightly tomentose, finely reticulate, margin serrate, sometimes entire, especially the lower part; heads subsessile at the ends or short branchlets or on short pedicels, when solitary, about 1 cm. high, 5 mm. wide; bracts in 5 series, glabrous and chartaceous with a tuft of white tomentum at the apex, or glabrous throughout with a dark spot at apex; disk flowers about 12, slightly pubescent, 5.5 mm. long, the stigmas exserted; rays few, shorter than the pappus; pappus fuscous, equalling the disk corolla; akenes ribbed with upwardly appressed hairs.

Type: no. 581, Herb. Calif. Acad. Sci., collected by Mrs. Blanche Trask June, 1903 (no. 292), on **San Clemente Island, Calif.** It was among the specimens saved from the great fire.

The species is related to *Hazardia cana* (Gray) Greene, and *H. detonsa* Greene, differing from both in the smaller heads, bicolored leaves and the almost glabrous bracts of the involucre. It has been compared with the type of *H. detonsa* and

specimens of *H. cana* from Guadalupe Island, the type locality. Both specimens are in the Herbarium of the California Academy of Sciences.

35. **Eucephalus bicolor** Eastwood, new species

Suffrutescent, lower part of stems with scale-like leaves, upper part leafy and with paniculately branching inflorescence, tomentose, becoming glabrate, 4–9 dm. high; leaves green and glabrous on upper surface, densely white-tomentose on lower, oblong, elliptical to lanceolate, apex acute to obtuse, sessile at the rounded base, 3-nerved at base, 2–6 cm. long, 5–20 mm. wide, margin undulate or entire; bracts similar to leaves but smaller; heads in an open panicle on slender bracteate stems; involucres turbinate, 1 cm. long with bracts in 4–5 ranks, the lower small, the upper linear-oblong, more or less tomentose, carinate with green or red midnerve, the apex red, margin ciliate; rays purple, linear 1 cm. long; pappus tawny, barbellate, slightly dilated at apex about equalling the slender tubular disk flowers, these striate with 5 short teeth, akenes pubescent.

Type: no. 2940, Herb. Calif. Acad. Sci., collected by the author (no. 2214), September 14, 1912, on **French Hill, Calif.**, above **Adams Station** on the road from Crescent City to Grants Pass. Another specimen was collected near Adams Station, August 11, 1923. Two specimens collected on the Gasquet Mountain road above Patrick Creek have smaller leaves and more contracted panicles.

This species differs from *E. tomentellus* Greene in the rayed heads and the densely white pubescence of the lower leaf surface.

36. **Eucephalus glandulosus** Eastwood, new species

Suffrutescent, glandular-scabrous throughout, branching above the base with short weak branches, sometimes terminated by solitary heads, leafy above, 4–5 dm. high; leaves ovate-oblong to lanceolate, 3–6 cm. long, 1–2 cm. wide, reticulated 3-nerved from base, apex acute, base rounded sessile, margin entire;

heads rayless, solitary or few terminating short branchlets; involucre 1 cm. high, bracts in 4 series, green or red with acuminate apex; akenes hairy chiefly below the tawny pappus.

Type: no. 171599, Herb. Calif. Acad. Sci., collected by the author (no. 2152), September 11, 1912, on the trail from the **Illinois River** near **Waldo, Josephine County, Oregon,** to **Black Butte** near the **California boundary.**

This species is related to *E. glabratus* Greene, differing in the glandular-scabrous pubescence which extends to the upper leaf surface and the involucres.

37. **Erigeron kuschei** Eastwood, new species

Perennial herb from slender creeping rootstocks, 1-1.5 dm. high; radical leaves oblanceolate to spatulate, tapering to a long margined petiole, blade 1–2 cm. long, 5–10 mm. wide, with a few scattered hairs along the margin and toward the obtuse apex; cauline leaves ovate to linear-oblong, sessile by a broad base, sparsely hairy; heads solitary on almost naked peduncles; involucral bracts equal in two series, hairy at base, red-tipped and margined, linear, 5 mm. long; disk 1 cm. broad, yellow; rays about 50, sterile, white, 8 mm. long, 1–2 mm. broad; pappus equalling the disk flowers, sparse, simple; akenes (immature) flat, sparsely hairy.

Type: no. 147118, Herb. Calif. Acad. Sci., collected by J. August Kusche, July, 1927, at **Cave Creek Cañon, Chiricahua Mountains, Arizona,** at an altitude from 6–8,000 feet. A second collection was made in the same place and at about the same time, smaller in every way, but otherwise similar to the type, no. 147117, Herb. Calif. Acad. Sci.

38. **Eriophyllum rixfordi** Eastwood, new species

Perennial, branching from a woody caudex with simple stems about 3 dm. high, densely white-woolly throughout; leaves oblanceolate, the lower tridentate at apex, upper entire or serrate, acute, about 3 cm. long, 1 cm. wide; heads singly terminating the stems, globose, 2 cm. in diameter with involucral bracts densely white-woolly, the free part triangular

acute; rays few, linear-lanceolate, 1 cm. long, 5 mm. wide, entire, veined; disk flowers numerous, corolla 5 mm. long, glandular, the limb short with reflexed divisions; pappus scales lanceolate, fimbriate, unequal, the longest equalling the tube of the corolla, the others half as long; akenes dark brown, strongly 4-angled, puberulent.

Type: no. 700, Herb. Calif. Acad. Sci., collected by Mr. G. P. Rixford on the **south side** of **Shaft Rock Mountain**, near **Hilt, Siskiyou County, Calif.**

39. **Laphamia arizonica** Eastwood, new species

Loosely branching from the base and paniculately above, glabrous, except the puberulent peduncles and involucres; leaves opposite, scattered, trifoliate on slender petioles much longer than the blades; leaflets small, orbicular, the upper often 3-lobed, the lateral generally entire; heads 1 cm. in diameter, involucral bracts linear attenuate, in one series, keeled at base; rays white, oblong-orbicular 3-crenate at apex; disk-flowers 4 mm. long, the throat more than twice the tube, glandular-puberulent, divisions 4, deltoid; akenes of both ray and disk flat, glabrous with ciliate margins; pappus-bristle 1, barbellate, equalling the throat of the corolla.

Type: no. 17375, Herb. Calif. Acad. Sci., collected by the author (no. 8753), May 18, 1919, at **Fish Creek** on the **Apache Trail, Arizona.** Specimens were collected also at Horse Mesa Dam, May 21, 1929.

40. **Laphamia saxicola** Eastwood, new species

In dense clumps from a perennial root, glabrous; leaves all opposite, bipinnately dissected with filiform divisions and long rhachis; heads terminating short branchlets, about 1 cm. in diameter, many flowered; bracts of the involucre in a single series, linear-attenuate, 7 mm. long, scaberulous, 2-ribbed, keeled at base; rays yellow, toothed at apex, fertile; disk-flowers glandular-puberulent, slender, tube shorter than the throat, together 4 mm. long; akenes flat, puberulent, callous-

margined and shortly ciliate, awn single, equalling the corolla, stamens and style exserted.

Type: no. 167470, Herb. Calif. Acad. Sci., collected by the author (no. 17401), May 22, 1929, near the **Roosevelt Dam** on the road to **Fish Creek, Apache Trail, Arizona.**

This intricately branched and leafy species grew in clumps a foot or so in diameter on the side of steep banks along the road. It differs from all known species in the remarkably dissected leaves.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 6, pp. 161-263, plates 2-18 JANUARY 8, 1932

VI

THE DIATOMS OF SHARKTOOTH HILL, KERN COUNTY, CALIFORNIA

BY

G. DALLAS HANNA, *Curator*
Department of Paleontology
California Academy of Sciences

Sharktooth Hill is located on the north side of Kern River in Sec. 25, T. 28S., R. 28E., M. D. M. It is shown on the U. S. Geological Survey's topographic map (Caliente Sheet) as an unnamed hill 642 feet high, and seven miles in an air line, northeast of Bakersfield.

The hill marks the westernmost exposure of Miocene rocks in this particular section. The uppermost layer near the top of the hill contains many marine shells, not well preserved. A few feet below this lies the stratum so prolific in bones and teeth of marine mammals and fishes. Because of the abundance of teeth of sharks in the layer, the hill has received the name indicated above. Below the layer containing the vertebrates there are shales extending to the base of the hill. The uppermost layers of these shales are somewhat sandy and contain few preserved fossils in this particular exposure. Fur-

ther below, however, and about 30 feet below the bone layer there are pale-buff, diatom-shales containing ash as the chief impurity. Diatoms are present in great abundance and perfection of preservation. Some of the material may well be classed as an impure diatomite. The total thickness of the zone at this point cannot be determined because the base is obscured but the same layer in well sections not distantly removed has been found to have a thickness of 100 to 200 feet. The constituent organisms vary little from the base to the top. Besides diatoms, the shales contain silicoflagellates, sponges and radiolarians; these groups have not been carefully studied, as yet.

The geologic relationship of the Sharktooth Hill exposure has been presented in another paper[1] and it will suffice here to repeat that the formation belongs to the Temblor, middle Miocene as defined by Dr. F. M. Anderson.[2] The layer of bones referred to and the stratum of marine shells immediately overlying, constitute the type locality of "Zone C" of that author. We now know that beneath the beds here considered there are approximately 2500 feet of strata also classed as Temblor and even this does not include extreme basal Miocene of other sections.

The diatoms herein described have been exceedingly helpful in determining the stratigraphic relationship of this particular horizon and the Temblor formation in general. The same assemblage of common species in approximately the same relative abundance occurs at many places on the east side of the San Joaquin Valley both in surface outcrops and in well samples. One of these localities has been studied in detail and many of the records are incorporated herein. This exposure is found on the west side of Cottonwood Creek a few miles to the eastward of Sharktooth Hill. (See below for exact locality data.) It seemed desirable to add these records to offset any tendency the reader might have to consider these fossils purely local and transitory in their occurrence.

---

[1] Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 19, no. 7, 1930, pp. 65-83.
[2] Proc. Calif. Acad. Sci., ser. 4, vol. 3, 1911, pp. 81-94.

The other records from near-by localities are omitted because of space limitations. It may be stated, however, that this layer has been identified in a north-south direction for about 20 miles on the east side of the great valley.

On the west side of the valley the horizon occurs widely distributed. It is especially accessible and well preserved to the right of the road leading from Coalinga to Oil City in Fresno County and immediately on top of the sandstone formation called "Vaqueros Reef" in some reports.[3] Here, the age of the diatomite has been listed as "Monterey" or "Santa Margarita" and the stratum was once called the "indicator bed."

Many excellent exposures occur in the coast ranges but the individual species cannot be recorded here without an undue expansion of the present paper. Each of these localities should receive separate study.

The diatoms of this particular horizon in California have not heretofore been critically studied. However, at least once before the Temblor has furnished a collection, which eventually fell into the hands of Tempere and Peragallo in Paris. Presumably the sample was collected in the search which was made for the source of the original float material noted in literature as "Santa Monica." Samples from many places and several zones were thus taken and sent to Europe under the name of this town where no fossil diatoms occur. Tempere & Peragallo's[4] list in which the Temblor records are found is somewhat difficult to interpret because they appear also to have incorporated some lots of upper Miocene species. In order to be certain of the determination, the California Academy of Sciences purchased in Paris a part of the original sample and slides have been made for comparison. These contain such highly distinctive forms as *Annellus californicus, Cymatogonia amblyoceras, Raphidodiscus marylandicus,* etc., and upper Miocene distinctive species are lacking. The sample probably came from the Santa Monica Mountains and certainly is equivalent in age to the material studied herein; this

[3] Arnold & Anderson, U. S. Geol. Surv. Bull. 398, 1910, pp. 81-82.
[4] Diat. du Monde Entier, Ed. 2, 1908, pp. 60-62.

has been proved by means of other samples in the Academy collection from the same region, which were taken by experienced geologists and accurately located, stratigraphically.

To find the equivalent of this Temblor stratum elsewhere than in California it is necessary to go far but the correlation can be made with almost equal certainty. Early in the study, numerous species were noted which appeared to be very close to or identical with forms heretofore well known from the Miocene diatom deposits of Virginia, Maryland and New Jersey. In Maryland these deposits have been placed in the Calvert formation. Appeal was made to Dr. Remington Kellogg for material for use in comparison and he very kindly furnished me with a sample from Dunkirk, Calvert County, Maryland, collected by Dr. F. W. True. This has been of great help in determining critical species.

A careful analysis of age relationships of many American Miocene formations has been made by Dr. W. P. Woodring.[5] In this he placed the Calvert formation in the middle Miocene (p. 93). The Temblor was placed in the same part of the column (p. 97). It is believed that the present study has proved the equivalence in age of that part of the Calvert formation which contains the diatom deposits and the upper part of the Temblor as exposed on Kern River and elsewhere in California. The Calvert has been independently correlated with the Tortonian of the European standard section upon the basis of the plants and marine mammals by Berry[6] and Kellogg,[7] respectively. The latter has suggested from a subsequent study,[8] however, that both the Calvert and upper Temblor may be Helvetian and since Woodring's correlation of them with the Bowden (and Tortonian) was admittedly not positive the following table was proposed in my paper on the Geology of Sharktooth Hill. It has been shown recently that the Santa Margarita is merely a sandy phase of upper Monterey[8a]

[5] Woodring, Miocene mollusks from Bowden, Jamaica. Pt. 2. Gastropods and discussion of results. Carnegie Inst. Washington, Publ. 385, 1928, pp. 1-108.
[6] Berry, U. S. Geol. Surv. Prof. Ppr. 98 F, 1916, pp. 61-70.
[7] Kellogg, Bull. Geol. Soc. America, vol. 35, 1924, pp. 763-764.
[8] Kellogg, R. Carnegie Inst. Washington, Publ. 346, art. 1, 1927, p. 5.
[8a] Barbat & Weymouth, Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 21, 1931, pp. 25-36, pls. 4, 5, 2 text figs.

and since this is almost certainly Sarmatian in age, there is left to represent the Pontian in California, several borderline formations, the age of which has heretofore been somewhat doubtful. Some of these are: Reef Ridge formation; Harris [grade] diatomite; Intermediate zone of Newport, Malaga Cove and Los Angeles Basin generally. Most of these have not been well defined, paleontologically.

CORRELATION OF CALIFORNIA AND EUROPEAN MIOCENE

SECTION	EUROPEAN STAGES	CALIFORNIA FORMATIONS
Upper	Pontian	Santa Margarita
Miocene	Sarmatian	Upper Monterey
Middle	Tortonian	Lower Monterey
Miocene	Helvetian	Upper Temblor
Lower	Burdigalian	Lower Temblor (Pyramid Hill Fauna)
Miocene	Aquitanian	Vaqueros

Attention is called to the fact that the correlation of the Sharktooth Hill exposure is made by means of identity of specialized and short range species. No further comment is necessary except to add that some of the same species of diatoms should be found in strata of the same age which are suitable for their preservation, wherever found, if due consideration be given to the life processes and wide geographic range of present-day forms of these small organisms. It is significant to note that many species recorded herein have likewise been found in Italy by Forti[9] in strata which he stated to be middle Miocene.

The literature pertaining to diatoms contains some very important papers dealing with the middle Miocene, elsewhere in the world, particularly the West Indies, east America, Spain,

[9] Forti, A. Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913.

Italy and Hungary. In each of these localities there are some species which have been found in the Temblor. Here again samples have been available for comparison; some of these were obtained from generous correspondents and others were purchased as a part of the Tempere collection.

The use of these various collections has made the task of identification of species less burdensome and it is believed greater accuracy has thus been obtained than would otherwise have been possible. However, as in most other groups of fossils, there are certain genera of diatoms which are in taxonomic chaos and in these cases the species-names chosen may eventually prove to have been the wrong ones. Fortunately, however, this remark does not apply to most of the distinctive and abundant Temblor fossils. In order that these may be sifted from the less important ones the following list is given.

Most distinctive and important Temblor diatoms

*Actinocyclus ehrenbergii Ralfs
*Actinoptychus halionyx Grunow
*Actinoptychus kernensis Hanna
*Annellus californicus Tempere
*Biddulphia angulata Schmidt
*Coscinodiscus apiculatus Ehrenberg
*Coscinodiscus convexus Schmidt
*Coscinodiscus fulguralis Brun
Coscinodiscus meditatus Hanna
*Cymatogonia amblyoceras (Ehrenberg)
*Cymatosira andersoni Hanna
*Eupodiscus antiquus Cox
*Hyalodiscus frenguellii Hanna
*Navicula kernensis Hanna
Navicula mimicans Hanna
Perrya innocens Hanna
*Raphidodiscus marylandicus Christian
Rattrayella inconspicuua (Rattray)
*Rhaphoneis obesa Hanna
*Sceptroneis caduceus Ehrenberg
Stephanogonia polyacantha Forti
Stictodiscus kittonianus Greville
*Surirella tembloris Hanna
*Triceratium spinosum Bailey
Xystotheca hustedti Hanna
*Zygoceros (?) quadricornis Grunow

Not all of the above species are equally abundant, of course, but those marked with an asterisk (*) can usually be found in properly cleaned material after a few minutes search. Some of them are dominant in this Temblor horizon wherever found and are not known from upper Miocene strata; these are the most valuable marker-species. Since this paper is intended to be as exhaustive as possible for the deposit concerned, it naturally contains some forms which are either too rare or of

too long geologic range to be useful in correlation or age determination at this time.

The present paper is based primarily on material from Sharktooth Hill but some records are incorporated from the locality on Cottonwood Creek a few miles to the east. Also there are a few *Rhaphoneis* listed from an exposure near Round Mountain. These three localities are entered in the records of the California Academy of Sciences as follows:

Locality 1063. A series of seven samples of diatomaceous shales from NE¼, Sec. 13, T. 29S., R. 29E., M. D. M., on the west side of Cottonwood Creek, Kern County, Calif.; G. D. Hanna and F. M. Anderson, Colls., April, 1927.

Locality 1068. A series of five samples of diatomaceous shales from the southeast side of Sharktooth Hill, Sec. 25, T. 28S., R. 28E., M. D. M., Kern County, Calif., G. D. Hanna, Coll., April, 1927.

Locality 1187. Diatomaceous ashy shale from Sec. 13, T. 28S., R. 28E., M. D. M., east side of 1340 Hill, about one mile west of Round Mountain, Kern County, Calif.; G. D. Hanna, Coll., April, 1927.

The last and any other locality records used have been considered for the sole purpose of elucidating the flora of the Sharktooth Hill strata and its equivalent elsewhere.

In preparing the collection for study the various species have been selected from strewings and mounted individually under measured covers. Synthetic resin (hyrax) has been used entirely as a mountant because this can now be procured practically without color, soluble in the usual solvents of balsam and possessing a refractive index of about 1.80. Moreover, test slides have not shown the slightest sign of deterioration in over four years. No known natural resin approaches this material in ease of manipulation and superior optical properties.

1. **Actinocyclus ehrenbergii** Ralfs

Plate 2, figs. 1, 2, 3

Actinocyclus ehrenbergii RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 834. —VAN HEURCK, Syn. Diat. Belgique, 1880-1882, p. 215, pl. 123, fig. 7.—RATTRAY, Journ. Quekett Micr. Club, ser. 2, vol. 4, 1890, p. 171.—WOLLE, Diat. N. America, 1890, pl. 85, fig. 9.

This large and handsome species is exceedingly abundant in the deposit on Sharktooth Hill. It is likewise widely distributed in beds of the same age. In an extension of the Sharktooth Hill horizon to the southeast a few miles a layer was found in which practically nothing else exists. Slides made from this particular sample are marvelous when the mounts are made in highly refractive resin; under low powers the play of prismatic colors is scarcely excelled by crystalline substances viewed with polarized light.

The references cited above are important but form an insignificant portion of the total literature on the species. Indeed, it is so variable that Rattray was obliged to use nine pages to cite the synonymy known to him in 1890. Ehrenberg conceived the idea of naming every individual he found with a different number of rays from any known to him and by careful search and great industry he was able to find the range extending from three to 120. This action stands as one of the greatest blunders in the study of diatoms. Rather than try to disentangle such a complex situation Ralfs renamed the entire mass, *Actinocyclus ehrenbergii* and the justice of this procedure has not been questioned by diatomists.

The species is exceedingly common in the Calvert formation of Maryland and Virginia and specimens from there formed the basis of a large number of Ehrenberg's names. By direct comparison, I am not able to detect any noteworthy difference between Maryland and California specimens. Authors have had much difficulty in distinguishing *A. ehrenbergii* from *A. ralfsii* (W. Smith). Some (as Grunow and Lagerstedt) have gone so far as to advocate their union and this may yet have to be done. In general the bright, hyaline, radial spaces are double in *ehrenbergii*, single in *ralfsii* but the character is apparently not constant.

2. **Actinoptychus halionyx** Grunow

Plate 2, fig. 4

Actinoptychus splendens halionyx GRUNOW in VAN HEURCK, Syn. Diat. Belgique, 1880-1882, pl. 119, fig. 3.—WOLLE, Diat. N. America, 1890, pl. 92, fig. 12.

"*Actinoptychus glabratus* GRUNOW?" SCHMIDT, Atlas Diat. pl. 153, 1890, fig. 12; "Peru Guano."

Actinoptychus solisi HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, 1926, p. 123, pl. 12, figs. 1-3.

The mottled appearance of alternating segments in the Sharktooth Hill specimens is very similar to that shown in Ravet's photograph, reproduced by Van Heurck. His figure does not show the conspicuous hyaline areas at the outer ends of the non-maculate segments, so obvious in the photograph shown herewith, but this is believed to be due to a different focus of the microscope in the two cases. I am not able to find intergradation between these diatoms and the living, non-maculate *A. splendens* and therefore consider *halionyx* a distinct species. It seems now that *A. solisi* is a form of *halionyx* having somewhat bolder markings than usual.

3. **Actinoptychus janischii** Grunow

Plate 3, fig. 1

Actinoptychus janischii GRUNOW in VAN HEURCK, Syn. Diat. Belgique, 1880-1882, pl. 122, fig. 6; "Guano from Peru."—PANTOCSEK, Beit. Kennt. Bacill. Foss. Ungarns, pt. 1, 1886, p. 61, pl. 16, fig. 143; Hungarian Miocene deposits.—SCHMIDT, Atlas Diat. pl. 153, 1890, figs. 8-10, 21.

As Grunow pointed out, the most remarkable feature of this diatom is the fact that all segments are almost in a plane. Janisch is supposed to have found the diatom in Guano from Peru but until this report is corroborated it had best be held in doubt in view of the abundance of the species in Miocene deposits. It is fairly common at Sharktooth Hill but more so at some other localities stratigraphically equivalent such as 1063, on Cottonwood Creek a few miles east.

4. **Actinoptychus kernensis** Hanna, new species

Plate 3, figs. 2, 3

Valve large without undulations in the marginal zone; segments 12 (in holotype; not less than 8 nor more than 14 have been seen); segments are gentle undulations not separated by sharp flexures or dark or light radial lines (in some specimens the undulations of the segments scarcely perceptible); border striated; marginal zone very wide and marked with a coarse uneven reticulation, the radial arrangement being most perfect; irregular radial lines cover the disk (except for the hyaline central area), with cross lines forming a network; disk also covered with fine beads as in *A. splendens* and many other *Actinoptychus;* spines are scattered irregularly around the margin, without any definite number relation to the segments. Diameter (holotype), .1680 mm.; paratypes, .132, .089, and .060 mm.

Holotype: No. 3142; *paratypes:* Nos. 3143-3145 Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

Schmidt[19] figured a specimen from "Bolivia Guano" without name, which resembles the present form more than any other but when examined in detail there are many important structural differences. *A. vulgaris* is somewhat similar but the central hyaline area radiates outwardly, more or less, in alternating segments in that form; moreover, the boundaries of the segments are sharper defined, the marginal zone bears large hyaline areas as in *A. halionyx* shown herewith, and there is usually a mottled appearance to the valve under low powers.

[19] Atlas Diat. pl. 132, 1888, fig. 5.

5. **Actinoptychus perisetosus** Brun

Plate 4, figs. 1, 2

Actinoptychus perisetosus Brun, Le Diatomiste, vol. 2, no. 16, 1894, p. 73 pl. 5, fig. 9; Japanese deposits.

Brun described this species as very variable and abundant in the fossil deposits of Japan. The Sharktooth Hill specimens do not agree with his figure in every minute detail but it is believed that the differences are inconsequential. The three large spines shown in his figure are more slender than they appear in ours but this is partly due to the fact that they are not all in perfect focus in the photographs. The species is very abundant in all collections made from the stratum on Sharktooth Hill and its equivalent at other places in that region.

The species bears superficial resemblance to the very abundant *A. undulatus* of many Miocene deposits but the lightly marked segments of the present form do not appear to be typical of *undulatus*. Nevertheless it seems probable that *perisetosus* is merely one of the many named variations of that long lived species.

6. **Actinoptychus thumii** Schmidt

Plate 4, figs. 3, 4

Actinoptychus stella thumii SCHMIDT, Atlas Diat. pl. 90, 1886, figs. 4, 5.—PANTOCSEK, Beit. Kennt. Bacill. Foss. Ungarns, pt. 1, 1886, p. 63, pl. 8, fig. 65.—FORTI, Atti R. Ist. Veneto Sci. Lett. Art. vol. 72, pt. 2, 1913, pl. 15, figs. 6, 7; [as form *fenestrata*].

Schmidt's specimens came from "Szent Peter" in Hungary and "Tegel von Brünn," both probably middle or lower Miocene deposits. The Sharktooth Hill specimens are very close indeed and although Schmidt's figures indicate possible intergradation in his material I have observed no such tendency in the collection now being studied and therefore prefer to hold *thumii* distinct from *stella*. The form is probably a forerunner of the huge *grundleri* and its allies of later Miocene time. In the photographs herewith, the three blunt spines are not well shown because of the great depth of the diatom; some portions necessarily are out of focus because of the high magnification required to show the details of sculpture.

7. **Actinoptychus undulatus** (Bailey)

Actinocyclus undulatus BAILEY, Amer. Journ. Sci. vol. 42, 1842, pl. 2, fig. 11. —Kützing, Bacill. 1844, p. 132, pl. 1, fig. 24.

Actinoptychus undulatus (BAILEY), RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 839, pl. 5, fig. 88.—SCHMIDT, Atlas Diat. pl. 1, 1874, figs. 1–4, 6.—VAN HEURCK, Syn. Diat. Belgique, 1881, pl. 22 *bis*, fig. 14; pl. 122, figs. 1–4.—MANN, Cont. U. S. Nat. Herb. vol. 10, pt. 5, 1907, p. 272.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, 1926, p. 124, pl. 12, fig. 4.—HANNA, Journ. Paleon. vol. 1, no. 2, 1927, p. 108.

In view of the uncertainty regarding the limits of variation of *A. undulatus* I am obliged to record it from the Sharktooth Hill deposit. The name may be used in too broad a sense but until a revision of the group is made, identification cannot be made with certainty.

8. **Annellus californicus** Tempere

Plate 4, figs. 5-9

Annellus californicus TEMPERE, in TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1908, p. 60; "Santa Monica, Calif."—AZPEITIA, Asoc. Esp. Prog. Cien. vol. 4, sec. 3, Cien. Nat. pt. 2, 1911, pp. 149-237, "Montemayor, Fernán-Núñez," Spain.

Annellus TEMPERE, TAYLOR, Notes on Diatoms, 1929, pp. 119, 180, 236, pl. 1, fig. 28.

This species is exceedingly common in the deposit exposed on Sharktooth Hill (Loc. 1068) and in many other places where the equivalent of this same series of strata is found. These other localities are widely distributed in California, some of them being: "North of Coalinga, immediately above the Temblor Reef Beds" (called "Vaqueros Reef" erroneously in U. S. Geological Survey Bulletins 398 and 603); "Smuggler's Cove, Santa Cruz Island, Calif."; near Point Dume, Los Angeles County, Calif.

The last mentioned locality may be the one from which Tempere's original material came although he gave it as from "Santa Monica." Definite proof of this statement can probably never be had and an analysis of the situation requires that we begin with the celebrated piece of float picked up a few

miles south of Santa Monica.[11] When it was learned that the parent bed from which the float block had drifted was not in the immediate vicinity of Santa Monica a very great deal of search was made for it. California microscopists apparently examined every known outcrop of diatomaceous earth in the southern part of the state in their endeavor to supply the desires of students elsewhere for more material like the original find. Evidently those not thoroughly trained in the study of these organisms thought they had found the source bed whenever they found a stratum with well preserved fossils. In this manner the "Santa Monica float block" has been reported to have come from places all the way from Newport to Santa Maria. Unquestionably some of these amateurs distributed samples under the label "Santa Monica" which actually came from far from there, their motive being the sincere belief that they had the original source of the famous float.

Tempere's *Annellus* was found in only one of several samples (no. 112 of his collection) which he had under the locality "Santa Monica." It is certain that the genus was not represented in the original block and has not since been found in strata of known equivalent age. But now, that it has been found in many widely scattered places in the upper part of the Temblor, and often in abundance, it may be assumed with safety that Tempere's sample came from a locality of the same age. The nearest place to Santa Monica where such a deposit is located, so far as I have been able to determine, is near Point Dume, Los Angeles County. Several years ago Mr. Douglas Clark, geologist for the Southern Pacific Company, gave me a sample from there and *Annellus* was found in it soon after.

The genus is one of the most distinct among the diatoms. Tempere's original description, quoted below, is very inadequate and he never published a figure. "Valve á silice repliée sur ellemême sous form d'anneau tubulaire recouvert de grosses ponctuations régulièrement disposées. Diamétre de la valve: 70 à 15 μ; largeur: 30 à 40 μ. Pas rare dans le no. 112." This brief description is certainly insufficient to make the genus or species recognizable were it not for the striking

[11] See Hanna, Bull. Amer. Assoc. Petrol. Geol. vol. 12, no. 11, 1928, pp. 1109-1110, for an account of this.

form of the organism. Even so, I hesitated to adopt the name until after I had secured some of Tempere's original, cleaned material and from it made mounts of the form in question. There can be no doubt now as to what he had and I chose a specimen from his collection for illustration herewith. The structural details are given in the sectional drawing.

The genus appears to be as closely related to *Melosira* as any other. Such an open cylinder as this is otherwise unknown in the Diatomaceæ and a first thought may be that something is missing on one end. However, this cannot be because among hundreds which have been handled I have never found one that could not be strung, bead-like, on the glass hair of the mechanical finger. The collections in which the genus occurs contain nothing which could in any way be presumed to be detached caps, or partitions.[12]

This strange and striking organism had a short existence, geologically, and for this reason and because of its abundance when found it forms a valuable marker fossil of middle Miocene strata, the Temblor. It has not been found in lowermost diatomaceous shales near Coalinga, California (the Kreyenhagen of authors), and has also not been found any place in the type section of the Monterey. In the lower portion of this latter, however, where it might occur, the diatoms are not preserved.

9. **Arachnoidiscus manni** Hanna & Grant

Plate 5, fig. 1

Arachnoidiscus manni HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 2, 1926, p. 125, pl. 12, figs. 7-9.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 109, pl. 17, fig. 5.

Arachnoidiscus ornatus montereiana SCHMIDT, Atlas Diat. pl. 73, 1882, figs. 7-9. (Not *A. ehrenbergii montereyana* SCHMIDT, Atlas Diat. pl. 68, 1881, fig. 2.)

Arachnoidiscus ornatus montereianus, HANNA & GAYLORD, Bull. Amer. Assoc. Petrol. Geol. vol. 9, no. 2, 1925, pl. 5, fig. 2.

---

[12] The genus has recently been illustrated by Taylor, Notes on Diatoms, 1929, pl. 1, fig. 28, the locality being given as "Sta. Maria., Cal.", probably an error for "Santa Monica, Calif." Taylor failed to place the group definitely in his outline of the classification of diatoms on p. 119.

At one time it was thought that this species could be differentiated with a fair degree of constancy but after handling many hundreds, this now seems doubtful. Evidently Schmidt had reason for separating the fossil form from California Miocene from *A. ornatus* Ehrenberg but whether this was sufficient or not remains to be determined. It is to be noted that Ehrenberg did not figure *ornatus* and the first illustrations were given by Ralfs.[13] With these as a basis for determination it is found that most California fossils are heavier marked and the concentric divisions extend from margin to central area. The species *nicobaricus* of Ehrenberg[14] has usually been referred to *ornatus* as a synonym and it is found to be a much lighter marked form than specimens from California. The problem is further complicated by the fact that some of the early diatomists received both living and fossil material from "Monterey" and in their publications they did not differentiate. The living form is very common there and Mr. W. M. Grant has an abundance of specimens. On direct comparison with the fossils from the same place the differences noted above seem to be constant. However it seems possible that when a more thorough study shall have been made it will be necessary to reduce the number of names to one—*ornatus*.

The species is very rare in the Sharktooth Hill deposit.

10. **Asterolampra rotula** Greville

Plate 5, fig. 2

Asterolampra rotula GREVILLE, Trans. Micr. Soc. London, vol. 8, n. s. 1860, p. 111, pl. 3, fig. 5; "Monterey, California."—RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16. 1889, p. 195.—WOLLE, Diat. N. America, 1890, pl. 93, fig. 10.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1404.

The imperfect specimen referred to this Monterey species is the best that could be found in the Sharktooth Hill deposit. It is rare and no other representative of the genus or of *Asteromphalus* appears to be present.

---

[13] In Pritchard, Hist. Infus. Ed. 4, 1861, p. 842, pl. 15, figs. 18-21.
[14] Mikrog. 1854, pl. 36 (not 30) fig. 35.

11. **Aulacodiscus brownei** Norman

Plate 5, fig. 3

Aulacodiscus brownei NORMAN in RALFS in PRITCHARD, Hist. Brit. Inf. Ed. 4, 1861, p. 844.—SCHMIDT, Atlas Diat. pl. 36, 1876, figs. 15, 16; pl. 105, 1886, fig. 6.—RATTRAY, Journ. Roy. Micr. Soc. 1888, p. 341.—WOLLE, Diat. N. America, 1890, pl. 88, fig. 10.—DE TONI, Syl. Alg. vol. 2, pt. 3, 1893, p. 1093.

This two spined *Aulacodiscus* was described from the upper Miocene at Monterey, California, where it is not uncommon. De Toni listed it as living and the similar, *A. probabilis* Schmidt, occurs in the Cretaceous of Simbirsk, Russia. The recent records may be taken with doubt owing to the circumstances of their collection and the specimen here being recorded may not be the same as those from Monterey because it shows some considerable differences in details. However, I do not have sufficient material to warrant separation at this time and it seems best to consider it the same. It was not found in the material from Sharktooth Hill but occurred at Loc. 1063 (C. A. S.) on Cottonwood Creek, a few miles to the east in a stratigraphically equivalent stratum.

12. **Auliscus bonus** Hanna, new species

Plate 5, figs. 4, 5

Valve small, almost circular, slightly convex, eyespots two with a few coarse punctæ on top; central area almost circular, hyaline; margin with a row of short semi-cellules, continuing inwardly as coarse, rugose, radial riblets. Diameter .0422 mm.

Holotype: No. 3155, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 C. A. S. on the southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

A. cælatus Bailey is much larger than this little diatom and has much longer marginal markings; however the two are believed to belong to the same portion of the genus. The two figures shown are opposite valves of the same frustule and the different focus is obtained to show the characters of marginal

and central area. No very close relative has been found in the literature although it displays no very striking or unusual details.

13. **Auliscus suppressus** Hanna, new species

Plate 5, fig. 6

Valve minute, circular, almost flat; border broad and heavy; two large "eyes" close to border; central circular space hyaline; disk with irregularly arranged, coarse, sparse, large beads; in addition a series of fine curved lines spread out from each "eye" and the sides are irregularly marked with lines and dots roughly radial in arrangement. Diameter, .0321 mm.

Holotype: No. 3156, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

The species is probably allied to *A. loczyi* Pantocsek[15] Beit. from Hungarian Miocene but the available figures of that species do not show the fine lines mentioned. It is true that they can be seen only under favorable conditions, that is, by use of high aperture and mounting media of high refractive index. However, we cannot merely assume that the markings are present on *loczyi* when they are not shown.

The species is exceedingly small and apparently rare.

14. **Biddulphia angulata** Schmidt

Plate 5, figs. 7, 8

Biddulphia angulata SCHMIDT, Atlas Diat. pl. 141, 1889, figs. 7, 8; Nottingham, Maryland.—WOLLE, Diat. N. America, 1890, pl. 6, fig. 7.

Odontella angulata (SCHMIDT), DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 869.

The diatoms here referred to *angulata* agree more closely with the figures of that species than any other of which illustrations have been found. There are some slight differences in details but hardly more than the specimens themselves display.

[15] Beit. Kennt. Foss. Bacill. Ungarns, pt. 3, 1893, pl. 5, fig. 82.

The species is fairly common in the finer washings of the Sharktooth Hill deposit but they are almost always fractured or deformed by pressure.

15. **Cladogramma conicum** Greville

Cladogramma conicum GREVILLE, Trans. Micr. Soc. London, vol. 13, 1865, p. 97, pl. 8, figs. 1, 2.

A few specimens of a very convex *Cladogramma* were mounted from the lighter washings of material from Loc. 1063 on Cottonwood Creek, Kern County, Calif. *C. californicum,* as usually found in upper Miocene deposits, is a much flatter diatom.

16. **Coscinodiscus æginensis** Schmidt

Plate 5, fig. 9

Coscinodiscus æginensis SCHMIDT, Atlas Diat. pl. 113, 1888, figs. 13, 14.—RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16, 1889, p. 489.—DE TONI, Syl. Algarum, vol. 2, pt. 3, 1894, p. 1288.

Coscinodiscus apiculatus californica GRUNOW in SCHMIDT, Atlas Diat. pl. 113, 1888, figs. 13, 14.

Schmidt stated in the explanation of his plate 113 that Grunow called his diatom *"C. apiculatus californica"* but he was unable to associate the form with *apiculatus.* This view seems to be correct; the name *"californica"* even as a subspecies is not desirable because of the prior *"Coscinodiscus californicus"* of O'Meara.

The specimens found in the Sharktooth Hill deposit have a slightly smaller central hyaline area than Schmidt's figure but otherwise the resemblance is so close that indentification is believed to be warranted.

17. **Coscinodiscus apiculatus** Ehrenberg

Plate 6, fig. 1

Coscinodiscus apiculatus EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 77; Mikrog. 1854, pl. 18, fig. 43.—GRUNOW, Denk. Akad. Wiss. Wien, vol. 48, no. 2, 1884, p. 75.—SCHMIDT, Atlas Diat. pl. 64, 1877, figs. 5-10.—WOLLE, Diat. N. America, 1890, pl. 86, fig. 9.

There is some confusion in the published figures of *apiculatus* and *perforatus* and it may be that they cannot be separated in a large series. Both were described from Miocene deposits of Maryland or Virginia and have often been reported together. Typical *apiculatus* is abundant and usually well preserved in the Sharktooth Hill deposit and strata of equivalent age in other places in the same region.

18. **Coscinodiscus convexus** Schmidt

Plate 6, figs. 2, 3; plate 7, fig. 1

Coscinodiscus convexus SCHMIDT, Atlas Diat. pl. 60, 1877, fig. 15; Barbados.—RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16, 1889, p. 104.—DE TONI, Syl. Algarum, vol. 2, sec. 3, 1894, p. 1271.

In the Sharktooth Hill deposit, the diatoms believed to be this species are much larger than those from Barbados but in other respects there is general agreement. Sometimes a specimen does have a rather imperfect central rosette, as the smaller figure herewith shows, and the absence of this is one of the distinguishing features of *convexus*. However, the diatom is far more convex than are such doubly marked species as *C. asteromphalus*. The convexity is so great that in the specimens photographed the margin is completely out of focus.

19. **Coscinodiscus fulguralis** Brun

Plate 7, fig. 2

Coscinodiscus fulguralis BRUN, Mem. Soc. Phys. Hist. Nat. Genève, vol. 31, pt. 2, no. 1, 1891, p. 21, pl. 21, fig. 6; "Sendai" Japan, fossil deposit.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1264.

This is a very delicate species and a perfect specimen was not found in the Sharktooth Hill deposit although it is abundant there. It is very large, almost flat and consistently has smaller beading than *C. gigas* Ehrenberg or *C. diorama* Schmidt to both of which it is related. There is some doubt as to the age of the diatoms reported from Japan and it seems very probable that some of the deposits may be as old as

Eocene while others are as young as Pliocene. On the authority of Schlumberger, Brun gave the latter age but this is extremely unlikely for all the material he described; there are too many extinct genera and species. Only in rare instances such as the present is a trace of the Japanese flora found in the California Temblor deposits.

20. **Coscinodiscus lineatus** Ehrenberg

Plate 8, figs. 1 2, 3

Coscinodiscus lineatus EHRENBERG, Abh. Akad. Wiss. Berlin, 1838, p. 129; 1841, p. 371, pl. 1, III, fig. 20, pl. 3, VII, figs. 7, 8.—EHRENBERG, Mikrog. 1854, pl. 18, fig. 33, pl. 22, fig. 6, pl. 35 A, XVI, fig. 3, XVII, fig. 7.—VAN HEURCK, Syn. Diat. Belgique, 1880-1881, p. 217, pl. 131, fig. 3.—SCHMIDT, Atlas, Diat. pl. 59, 1877, figs. 27-32.

This species is very abundant in the Sharktooth Hill deposit and strata of equivalent age elsewhere in the same general region. The specimens appear to belong to the typical species without a trace of marginal spines, originally described from east American Miocene deposits. The rows of beads often deviate from a true geometric 60° arrangement.

There is a temptation to call all circular diatoms with this true arrangement of the beads in three series of straight lines, *C. lineatus,* and undoubtedly a considerable number of erroneous determinations have thus been made. Even *Stephanopyxis lineatus* with the high marginal spines has been referred to *Coscinodiscus.* In spite of these difficulties the Temblor material here being considered appears to be indistinguishable from that from Calvert County, Maryland, supplied to me by Dr. Kellogg. I am not so certain that what has been called *lineatus* from the California upper Miocene deposits is that species in every case. The records in the literature indicate that the species is a very persistent one extending from "Eocene" of Denmark to the present time. Before accepting this as final a careful examination needs to be made of the group.

21. **Coscinodiscus marginatus** Ehrenberg

Plate 8, figs. 4, 5

Coscinodiscus marginatus EHRENBERG, Abh. Akad. Wiss. Berlin, 1841, p. 142. —EHRENBERG, Mikrog. 1854, pl. 18, fig. 44; pl. 33, XII, fig. 13; pl. 38B, XXII, fig. 8.—SCHMIDT, Atlas Diat. pl. 62, 1877, figs. 1-5, 9, 11, 12.—WOLLE, Diat. N. America, 1890, pl. 112, fig. 8.—MANN, Cont. U. S. Nat. Herb. vol. 10, no. 5, 1907, p. 253, pl. 49, fig. 2.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, 1926, p. 139, pl. 15, fig. 5.

This heavy, coarsely marked diatom seems to have persisted through, unchanged from the middle Miocene to the present time. Many varietal names have been proposed for some of the variations encountered and they serve more to emphasize the need of a broad specific definition rather than any taxonomic need. Unless some of the variants prove to be reasonably constant through some geologic period of time or in a certain geographic area they have little value. The species reached its greatest development in the upper Miocene and certain layers of diatomite in California of this age are composed of it almost exclusively. In the middle Miocene, as at the Sharktooth Hill locality, the form is rare and constitutes an insignificant portion of the diatom flora; no large specimens were found, but otherwise those studied do not differ from upper Miocene forms.

22. **Coscinodiscus meditatus** Hanna, new species

Plate 9, fig. 1

Valve circular, almost flat, border narrow; beads largest nearest center where they are very sparse, decreasing in size slightly toward margin; marginal zone of about one-third radius covered with small beads arranged in close set radial rows, about every fourteenth row projecting much farther toward the center than the others. Diameter, .0541 mm.

Holotype: No. 3170, Mus. Calif. Acad Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

This very striking species is common in the Sharktooth Hill deposit and at other localities in the vicinity where the

same horizon is exposed. However, the silex seems to be brittle because unbroken specimens are hard to find. Only one species of diatom has apparently been described which bears a reasonably close resemblance; this is *Actinocyclus rotula* Brun[16] from a fossil deposit in Japan. That species has the short marginal rows of beads set diagonally to the radials and there are conspicuous spines at the marginal ends of the radials; moreover *rotula* is a true *Actinocyclus* with the conspicuous marginal bead; the California species does not possess a trace of this feature.

23. **Coscinodiscus monicæ** Grunow

Plate 9, fig. 2

Coscinodiscus janischii monicæ GRUNOW, Denk. Akad. Wiss. Wien, vol. 48 no. 2, 1884, p. 76.

Coscinodiscus monicæ GRUNOW, RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16, 1889, p. 115.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1278. —SCHMIDT, Atlas Diat. pl. 63, 1877, fig. 10 (without name; named in Fricke's Index, 1902).

The group of diatoms to which this species belongs is exceedingly difficult to differentiate. The beads are without secondary markings and the size seems to vary considerably. Schmidt's figure to which reference is here made has the central large beads separated from each other while in the specimen figured from Sharktooth Hill they touch. Otherwise the two are in close agreement.

24. **Coscinodiscus novozealandicus** Grove

Plate 9, fig. 3

Coscinodiscus superbus HARDMAN var. *novo-zelandica* GROVE in RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16, 1889, p. 459, pl. 16, pt. 2, fig. 15.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1208.

"*Coscinodiscus superbus* HARDMAN MS (*Cestodiscus*) var. *novæ zelandiæ* GROVE" in SCHMIDT, Atlas Diat. pl. 163, 1891, fig. 8; "Troublesome Gulley, Oamaru" New Zealand; pl. 148, 1890, fig. 7, [named on pl. 153, 1890].

---

[16] Mem. Soc. Phys. Hist. Nat. Genève, vol. 31, no. 1, 1891, p. 6, pl. 17, fig. 5.

This species has been reported heretofore only from Oamaru, New Zealand strata of "Miocene" or "Oligocene" age; it is common in the Sharktooth Hill deposit. I can see no reason to associate the form as a subspecies with *C. superbus* from Barbardos (originally placed in the genus *Cestodiscus)*, because the two appear specifically different; specimens from both Barbados and Oamaru have been examined to determine this point. The New Zealand and California diatoms appear closer related to *C. elegans* than *superbus*. The genus *Cestodiscus* was founded on a *Coscinodiscus* with minute marginal spines and this is generally considered to be an unsound basis as Mann[17] has pointed out. Because of the heavy border, the small spines do not show distinctly in the photograph herewith but they are located at the ends of the main radial rows of beads. Under ordinary circumstances I believe in no alteration of a species- or genus-name from the original spelling of the author but in this case it seems best to correct the obvious error.

25. **Coscinodiscus oculus-iridis** Ehrenberg

Plate 9, fig. 4

Coscinodiscus oculus-iridis EHRENBERG, Abh. Akad. Wiss. Berlin, 1839, p. 147. —EHRENBERG, Mikrog. 1854, pl. 18, fig. 42; pl. 19, fig. 2.—SCHMIDT, Atlas Diat. pl. 60, 1877, fig. 17; pl. 63, figs. 4, 6-9; pl. 113, 1888, figs. 1, 3-5, 20.

How best to treat the diatoms belonging to the group centering about *C. oculus-iridis* is a problem very difficult to solve. There are many variants with which to contend and often it is impossible to form an accurate picture from the imperfect illustrations. In the present case, the diatoms of the Sharktooth Hill deposit are large and handsome but not very common. The beads forming the central rosette are always larger than those of the disk and the size of the hyaline space enclosed varies from nothing to that shown in the accompanying figure. The valves are decidedly more convex than are some living forms which have been referred to the species.

[17] Cont. U. S. Nat. Herb. vol. 10, pt. 5, 1907, p. 246.

26. **Coscinodiscus pacificus** Grunow

Plate 10, fig. 1

Coscinodiscus oculus-iridis pacifica GRUNOW, Denk. Akad. Wiss. Wien, vol. 48, no. 2, 1884, p. 77.

Coscinodiscus pacificus GRUNOW in RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16, 1889, p. 563; [name for pl. 60, 1877, fig. 13, of Schmidt's Atlas Diat.].—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 2, 1926, p. 142, pl. 16, fig. 1.

Coscinodiscus radiatus Ehrenberg is a common and widely distributed diatom with a long geologic range. Normally it has no central rosette of large beads and the beading of the disk does not form perfect radial rows; no secondary markings are visible on the beads with ordinary dry lenses. *C. oculus-iridis,* on the other hand, has the central rosette and almost perfect radials, but still lacks secondary beading. Between these two extremes there is almost perfect intergradation and several of the intergrades have received names, *C. pacificus* being one of them.

27. **Coscinodiscus symbolophorus** Grunow

Coscinodiscus symbolophorus GRUNOW, Denk. Akad. Wiss. Wien, vol. 48, no. 2, 1884, p. 82, pl. 4, figs. 3-5.—RATTRAY, Proc. Roy. Soc. Edinburgh, vol. 16, 1889, p. 492.—SCHMIDT, Atlas Diat. pl. 138, 1889, figs. 1-3. —DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1230.

Symbolophora; many species names of EHRENBERG; see MANN, Cont. U. S. Nat. Herb. vol. 10, pt. 5, 1907, p. 256.

This name of Grunow's has been generally accepted to include a very considerable number of names coined by Ehrenberg and included in his genus *"Symbolophora."* It appears to be impossible to disentangle the complicated synonymy the latter created and Grunow's action was undoubtedly the best to take. Most of Ehrenberg's names were founded on diatoms found in the Miocene of Virginia and Maryland and since then the species under one name or another has been reported from many fossil localities, widely distributed. The group apparently first appeared in the upper Cretaceous. It is very common in the Sharktooth Hill deposit and strata equivalent in age elsewhere in California.

28. **Cyclotella kelloggi** Hanna, new species

Plate 10, figs. 2, 3, 4

Valve flat, circular with a distinct border and a marginal zone crossed with heavy rounded radiating costæ; about every third to every fifth rib shorter than the remainder or broken into a few beads; remainder of disk covered with sparse, irregularly arranged but relatively large rounded beads. Diameter (holotype), .0392 mm.; (paratype no. 3176) .031+ mm.; (paratype no. 3177) .031.

Holotype: No. 3175; *paratype:* No. 3176, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California;** Temblor, middle Miocene. *Paratype:* No. 3177, from a depth of 4156 feet in Federal Exploration Company, Kinsella Well No. 1, Loc. 1221 (C. A. S.), Sec. 15, T. 22S., R. 24E., M. D. M., northwest of Bakersfield, Kern County, California; Miocene, possibly higher than Temblor.

Some figures of *C. transylvanica* Pantocsek, resemble this species in a general way but all differ in important details.[18] A closer species appears to be *C. calæ* Azpeitia[19] from the Miocene of Spain, but it likewise differs greatly in detail so that direct comparison scarcely seems necessary.

The species is very rare in the Sharktooth Hill deposit but has been found in abundance in a stratum of younger age a few miles out in the San Joaquin Valley. A nearly perfect specimen from there is figured herewith in order to make more complete the available information on the species. This latter individual has the marginal ribs somewhat shorter than those in the Sharktooth Hill specimens but this is believed to be due to the size of the disk; in other details it agrees very well with those from Sharktooth Hill. Specimens have been prepared from the type Monterey where they are not rare.

The species is named for Dr. Remington Kellogg in recognition of his work on the marine, vertebrate fossils of Sharktooth Hill.

---

[18] See Fricke in Schmidt, Atlas Diat. pl. 223, 1900, fig. 21—Pantocsek, Beit. Kennt. Foss. Bacill. Ungarns, pt. 3, 1893, pl. 11, fig. 177.

[19] Assoc. Espaňona Prog. Cien. Cong. Zargoza, vol. 4, pt. 2, 1911, p. 200, pl. 1, figs. 5, 6.

In some respects this form resembles *"Cestodiscus (pulchellus* var.?) *hirtulus"* Grunow[20] from the Miocene of Trinidad. From the drawing, however it appears that the center of that species is provided with about seven angular spines and the occasional dark bars on the marginal zone may be spines. Both Rattray and De Toni put *hirtulus* under *Coscinodiscus* so it very likely bears no actual relationship to the present form.

29. **Cymatogonia amblyoceras** (Ehrenberg)

Plate 10, fig. 5

Triceratium amblyoceras EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 88.—EHRENBERG, Mikrog. 1854, pl. 18, fig. 51.—BRIGHTWELL, Quart. Journ. Micr. Sci. vol. 1, 1853, p. 250, pl. 4, fig. 14.—RALFS in Pritchard, Hist. Infus. ed. 4, 1861, p. 857.—WOLLE, Diat. N. America, 1890, pl. 77, fig. 3.—DE TONI, Syl. Algarum, vol. 2, sec. 3, 1894, p. 970.

Triceratium amblyoceras nankoorensis GRUNOW, Reise S. M. F. *Novara*, Bot. vol. 1, 1867, p. 103.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 971.

Schuettia (?) *amblyoceras* (EHRENBERG), DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, pp. 1393, 1396.

Actinoptychus amblyoceras (EHRENBERG), SCHMIDT, Atlas Diat. pl. 1, 1874, fig. 25; pl. 155, 1890, fig. 13.—PANTOCSEK, Beit. Kennt. Diat. Foss. Ungarns, pt. 1, 1886, p. 60, pl. 13, fig. 110.—WOLLE, Diat. N. America, 1890, pl. 85, fig. 5.

Valve triangular, gently undulatory with a strong spine at one side of the bisector of each angle and close to the margin; sides gently concave; surface divided into six equal parts by lines formed by junction of lines of beads; these beads arranged in three sets of rows at 60° to each other; border very narrow; marginal area depressed and marked by finer beading than the disk.

	Measurements	
	Length of one side	Rows of beads in .01 mm.
No. 3178	.090 mm.	13
No. 3179	.1010 mm.	14
No. 3180	.1124 mm.	14
No. 3181	.0562 mm.	12

[20] Van Heurck, Syn. Diat. Belgique, 1880-2, pl. 126, fig. 3.

Plesiotypes: Nos. 3178-3181, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

This beautiful diatom is abundant in the Sharktooth Hill deposit and elsewhere in California in strata of equivalent age.

Because of the absence of a hyaline central area it was at first thought that the Sharktooth Hill specimens could be specifically separated from the east American *amblyoceras;* in the latter the central area is well developed. Examination of numerous collections from California shows that the area is not uniformly closed and may even be as large as in Maryland specimens. No other difference was noted which might be of use in separating the diatoms from the two coasts.

Three aberrant species have been reported living in tropical seas but the genus is best known from the fossil from Maryland and a fossil one from Hungary. None have been reported from upper Miocene or later deposits so far as my search of the literature has disclosed. The species have been assigned to various genera. They are obviously related to *Actinoptychus* but differ in failing to possess definite radial rays. Formerly they were put in *Triceratium* because of their shape but this disposition was certainly faulty. De Toni[21] created the genus *Schuettia* for the group but, as Van Heurck[22] pointed out, Grunow[23] had already proposed the name *Cymatogonia.* Since neither of these two names has come into general use it seems best to adopt the earlier; fortunately similar procedure throughout the genera of diatoms has thus far not proved acceptable.

30. **Cymatosira andersoni** Hanna, new species

Plate 10, fig. 6

Ovate, flat, border heavy, ends roundly pointed, sides gently curved; surface with large round beads, rather irregularly arranged but the central ones are nearly in longitudinal rows;

[21] Syl. Algarum, vol. 2, sect. 3, 1894, p. 1395.
[22] Treat. Diat. 1896, p. 496.
[23] Bot. Centralbatt, vol. 15, no. 10, 1883, p. 299.

center always with a hyaline area; in edge view the diatoms grow in a chain somewhat looser than *Rhabdonema* but closer than in *Cymatosira lorenzianum*. Length, .0340 mm.; width, .010 mm.; 10 beads in .01 mm.

Holotype: No. 3182, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

Very few species of *Cymatosira* have been discovered and this one differs radically from any of them. It is exceedingly abundant in the Sharktooth Hill deposit and its stratigraphic equivalent elsewhere in the same general region. The species seems to be closest to *C. biharensis* Pantocsek[24] from the Miocene of Hungary. Two fossil species from Japan, *debyi* and *japonica* Brun & Tempere,[25] are further removed.

The species is named for Dr. F. M. Anderson, long associated with the California Academy of Sciences and the original describer of the Temblor formation.

31. **Denticula lauta** Bailey

Plate 11, fig. 1

Denticula lauta BAILEY, Smith. Cont. Knowl. vol. 7, 1855, p. 9, figs. 1, 2. (Feb. 1854).—VAN HEURCK, Syn. Diat. Belgique, 1881, pl. 49, figs. 1, 2.—WOLLE, Diat. N. America, 1890, pl. 46, fig. 10; pl. 56, figs. 16-17.—CARTER, Amer. Mon. Micr. Journ. vol. 12, no. 5, 1891, p. 97, pl. 1, fig. 19.

Eunotia sancti antonii EHRENBERG, Mikrog. 1854, pl. 33, XIII, figs. 9, 10; San Francisco Bay, Calif.; fossil deposit. (Not. pl. 34 V B, fig. 7, from "St. Antonio, Capverden, Afrika".)

Diatoms referred to this species are not common in the Sharktooth Hill deposit but occasional specimens may be found in the lighter washings. There is a portion of the Miocene higher in the column than this part of the Temblor where

[24] Beit. Kennt. Foss. Bacill. Ungarns, pt. 2, 1889, p. 65, pl. 3, figs. 41, 42.

[25] Mem. Soc. Phys. Hist. Nat. Genève, vol. 30, no. 9, 1889, p. 36, pl. 7, figs. 18*a*, 18*b*, pl. 4, fig. 12.

Denticula is excessively abundant and this portion is thought to be stratigraphically equivalent to the outcrops on San Francisco Bay near Pinole. Bailey's and Ehrenberg's collections were obtained there and both had *Denticula* in abundance. My material from there is similar. Ehrenberg gave several figures from the locality and they are unmistakably the same as Bailey's species which has been accepted generally in diatom literature. The specimen illustrated herewith was illuminated with slightly oblique light giving the impression of asymmetry, as in *Nitzschia;* a true symmetrical arrangement is normal. I have not seen the minute beads shown in figures of some species of *Denticula.*

32. **Dimeregramma scutulum** Hanna, new species

Plate 11, fig. 2

Valve rounded on top, broad in the center, tapering to obtusely rounded ends; sides gently rounded; a zone of marginal beads on each side of the broad central space or pseudoraphe; these lateral zones consist of 23 straight transverse rows of three square beads each, except the rows near the ends which have two and then one; the beads are largest in the center and gradually become smaller toward each end; at each end there is a large roughly semicircular hyaline area. Length, .0330 mm.; width, .0133 mm.; 9 transverse rows of beads in .01 mm. in the center of the valve.

Holotype: No. 3184, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California;** Temblor, middle Miocene.

Only one specimen was found but owing to its small size the species may be more abundant in the finer washings. The literature contains many species of diatoms referred to the genus *Dimeregramma* but in most cases the drawings are on such a small scale that they cannot be identified satisfactorily.

33. **Dossetia lacera** (Forti)

Plate 11, fig. 3

Xanthiopyxis lacera FORTI in TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1909, p. 197; [name only].—FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 69, pt. 2, 1910, p. 1311.—FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1555, pl. 12, figs. 14-18.

This form was first described from the middle Miocene of Marmorita in Italy. It is fairly common in the Sharktooth Hill deposit and equivalent strata in California. The upper Miocene form, *D. temperei* Azpeitia, is generally distributed in the shales of this age in the state; it is a larger and heavier species and is much shorter in proportion to breadth.

The establishment of the genus *Dossetia* for such forms as this, seems to be entirely justifiable.[26]

34. **Eupodiscus antiquus** Cox

Plate 12, figs. 1, 2, 3, 4

Eupodiscus radiatus BAILEY, var. *antiqua* J. D. COX, in Kain & Schultze, Bull. Torrey Bot. Club, vol. 16, no. 8, 1889, p. 209.—WOLLE, Diat. N. America, 1890, pl. 77, fig. 8.

Diatoms here referred to *E. antiquus* are abundant in the deposit on Sharktooth Hill and elsewhere in California in equivalent strata. The species is characterized by a heavy and upturned border zone bearing four post-like pillars. The disk in many cases presents "watch case milling" effect better than the specimen illustrated; again the pattern is less perfect, approaching a radiate or fasiculate arrangement. Neither more nor less than four pillars was observed in several hundred individual valves examined. Because the species is large, common, heavy, usually very well preserved and of exceedingly short geologic range so far as known, it makes a very valuable marker for the horizon in which it is found.

Measurements

Diameter	Beads in .01 mm.
.1426 mm.	3 (Plesiotype No. 3193)
.1820 mm.	2.5 (Plesiotype No. 3194)
.1156 mm.	2.5 (Plesiotype No. 3195)
.200 mm.	3 (Plesiotype No. 3196)

[26] See AZPEITIA, Asoc. Española, Prog. Cien. Cong. de Zaragoza, vol. 4, pt. 2, 1911, pp. 202-203. Also FORTI, last reference cited above.

Plesiotypes: Nos. 3193-3197, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of Sharktooth Hill, Kern County, California; Temblor, middle Miocene.

The available information on *antiquus* is very meager. I cannot find that Cox published anything at all and Kain & Schultze only stated that: "while this species bears a general resemblance to *Eupodiscus radiatus,* the cellules are not radiate nor of equal size, but are much smaller towards the margin. General Cox has noted the same form in the Richmond deposits, and instead of considering it a distinct species, he prefers to consider it merely a variety." They were listing the diatoms from well borings at Atlantic City, New Jersey. Wolle's figure is not very satisfactory owing to his method of drawing. However, he did show a diatom with irregular beading and a heavy marginal zone with four post-like processes and it is probable that he had an authentic specimen. He mentioned Richmond, Virginia and the artesian well at Atlantic City but did not state from which the specimen illustrated came.

I have hesitated to identify the California material with a form so poorly diagnosed and certainly would not do so if there were not so many other things in common between the east and west coast deposits. Specimens from the eastern formations have not been available for comparison. Under such circumstances many taxonomists consider it the best policy to create new names with the risk that these may later become synonyms. This is supposed to cause less confusion in the literature than a misidentification, but in the present case it seems best to take a chance on this. It is extremely unfortunate that no satisfactory, well illustrated monograph of the east American deposits has appeared.

Even the genus *Eupodiscus* is of very doubtful application to either of the species, *antiquus* or *radiatus.* The type of the group is *Tripodiscus argus* Ehrenberg (selected by Boyer, Proc. Acad. Nat. Sci. Philadelphia, vol. 78, 1926 [1927] Suppl. p. 89), and it has been pointed out on more than one

occasion that *radiatus* can hardly be considered congeneric.[27] Boyer even suggested the new genus-name *Baileya* for *radiatus* but unfortunately this had been used long ago for a genus of flowering plants.[28] The latest attempt to rectify matters was by Karsten[29] who proposed *"Eu-eupodiscus"* and cited *radiatus* alone. This is almost an impossible combination and probably was not intended to become a genus-name.

Until some really constructive information can be offered to clear up this nomenclatorial tangle it seems desirable to leave the California diatoms under *"Eupodiscus antiquus."*

35. **Goniothecium rogersii** Ehrenberg

Plate 11, figs. 4, 5, 6

Goniothecium rogersii EHRENBERG, Abh. Akad. Wiss. Berlin, 1841 [1843], pp. 401, 416 (or 128).—BAILEY, Amer. Journ. Sci. vol. 46, 1844, p. 301. —EHRENBERG, Mikrog. 1854, pl. 18, figs. 92, 93.—BRIGHTWELL, Quart. Journ. Micr. Sci. vol. 4, 1856, p. 107, pl. 7, figs. 43-46.

This is a common species in the Sharktooth Hill deposit. Originally it was described from Miocene deposits of Virginia or Maryland supposed to be equivalent in age.

My catalog contains the names of 23 species of *Goniothecium* all but seven being from Ehrenberg's writings. Of these 16, *rodgersii* may be the only valid name and the species has not heretofore been adequately figured. Like many of the diatoms belonging to this general group, great variability is found in the shape and size of the frustules and this fact led Ehrenberg to issue many names without consideration of other factors. The genus is very common in the upper Miocene of California, but numerous specimens examined do not appear to differ specifically from those from the Temblor, illustrated herewith by a representative selection.

---

[27] Mann, A. Cont. U. S. Nat. Herb. vol. 10, no. 5, 1907, p. 278; and Boyer, op. cit.
[28] Harvey & Gray, ex Torrey, in Emory, Notes Mill. Reconnois, 1848.
[29] Karsten, in Engler, Pflanzenfam. Ed. 2, vol. 2, 1928, p. 226.

36. **Hemiaulus polymorphus** Grunow

Plate 11, fig. 7

Hemiaulus polymorphus GRUNOW, Denk. Akad. Wiss. Wien, vol. 48, 1884, p. 66.—GROVE & STURT, Journ. Quek. Micr. Club. vol. 3, ser. 2, 1887, p. 11.—SCHMIDT, Atlas Diat. pl. 143, 1889, figs. 11-13.—PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 2, 1889, p. 83.—WOLLE, Diat. N. America, 1890, pl. 25, figs. 23-25.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 114, pl. 18, figs. 9, 10.

This exceedingly variable diatom is very rare in the deposit on Sharktooth Hill. Indeed, *Hemiaulus* by this time had almost ceased to exist although *polymorphus* was very abundant in Eocene time as represented by the Jutland deposits of Denmark, and the Kreyenhagen shale of California.

37. **Hercotheca mammillaris** Ehrenberg

Hercotheca mammillaris EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 269.—KÜTZING, Sp. Alg. 1849, p. 27.—EHRENBERG, Mikrog. 1854, pl. 33, XVIII, fig. 7.—RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 887, pl. 7, fig. 35.—GRIFFITHS & HENFREY, Microg. Dict. 1875, pl. 43, fig. 31.—WOLLE, Diat. N. America, 1890, pl. 64, figs. 22, 23.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1005.—VAN HEURCK, Treat. Diat. 1896, p. 427, fig. 147.—BOYER, Maryland, Geol. Surv. Miocene, 1904, p. 490.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 114, pl. 18, fig. 11.

It is believed that numerous small oval diatoms with marginal spines found in the lighter washings from Locs. 1063 and 1068 are this species. A critical comparison with specimens from east American lower Miocene has not been made but it is not believed specific differences will be found.

38. **Hyalodiscus frenguellii** Hanna, new species

Plate 11, figs. 8, 9

Valve convex, constructed of heavy silica, thick at the edges; central disk large, almost flat, marked with very fine radial lines; outer zone narrow, covered with fine radial lines of beads; the beads are also arranged in diagonal curved rows meeting at an angle greater than 90°; at irregular intervals the radial rows are thickened producing larger and more conspicuous elongated dots.

Measurements

Diameter	Radial striæ in .01 mm., at inner edge of outer zone
.0968 mm.	21 (Holotype, No. 3190)
.0713 mm.	21 (Paratype, No. 3191)
.0539 mm.	21 (Paratype, No. 3192)

Holotype: No. 3190; *paratypes:* Nos. 3191, 3192, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

This is a heavy species of *Hyalodiscus,* abundant in the Sharktooth Hill deposit. Its dark brown color on dry strewn slides makes it very conspicuous. The finer structure, however, is very difficult to resolve with dry objectives but can be seen with oblique light and 4 mm. apochromatics.

The central area appears rugose under low powers, some specimens showing a series of comparatively large bead-like elevations; the holotype, however, appears to possess an indistinct unevenness which disappears under high magnification.

Two species of *Hyalodiscus* have been recorded from the middle Miocene of the eastern United States, *lævis* and *stelliger.* The new species is not related closely to either of these; nor is it close to *H. reticulatus* Schmidt of the upper Miocene of California.

The species is named for Dr. Joaquin Frenguelli, the celebrated diatomist of the Argentine.

39. **Leudugeria janischii** (Grunow)

Epithemia ? LEUDUGER-FORTMOREL, Diat. Ceylon, Mém. Soc. Emul. St. Brieuc, 1879, p. 183, pl. 9, fig. 87.

Eunotiopsis janischiana GRUNOW, in CLEVE & MÖLLER, Diat. Ex. no. V, 1879, p. 4, no. 257; [name only].

Euodia janischii GRUNOW, in VAN HEURCK, Syn. Diat. Belgique, 1880-1882, pl. 127, figs. 1-4.—WOLLE, Diat. N. America, 1890, pl. 105, figs. 19-21.

Leudugeria epithemioides TEMPERE, Le Diatomiste, vol. 2, 1893, p. 17.

Leudugeria janischii GRUNOW, VAN HEURCK, Treat. Diat. 1896, p. 539, fig. 287.

Leudugeria janischiana GRUNOW, FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1648, (var. *subarcuata* TEMPERE, pl. 27, fig. 4).

A single specimen was found in the collection from Loc. 1063 on the west side of Cottonwood Creek, Kern County,

California. The species is much more common in the upper part of the Miocene, as at Monterey, than in the Temblor. It has been reported living in tropical seas but the records need confirmation.

Forti has given valuable observations on the genus and revived the original spelling of the species-name as written on the slides distributed by Cleve & Möller. It is doubted if many taxonomists will agree that such procedure constitutes publication.

40. **Liradiscus rugulosus** Forti

Plate 12, figs. 5, 6

Liradiscus rugulosus FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1559, pl. 12, fig. 23.

The specimen here referred to Forti's species conforms almost exactly in shape, as does *Liradiscus ovalis* Greville.[30]

The specimen is strongly marked with uniformly scattered spines but lacks the peculiar lines connecting the spines found in *ovalis*. *L. rugulosus* seems also from the figure to be marked only with spines and these appear smaller but the difference does not appear sufficiently great to warrant specific separation. The species appears to be rare in the Sharktooth Hill deposit; only one good specimen was found but since it is a very small form, thorough search of the lighter washings might show that it is more abundant.

Typically, a *Liradiscus* should have the peculiar lines connecting the spines and probably this form should be referred to *Xanthiopyxis* but until more specimens can be studied it seems best not to change genera.

Macrora Hanna, new genus

Valve small, circular; margin heavy, crenulated and marked by large hyaline ovate areas; disk convex and marked by similar, large hyaline areas.

Genotype (monotypic): *Pyxidicula stella* Azpeitia.

[30] See Van Heurck, Treat. Diat. 1896, p. 511, fig. 260.

41. **Macrora stella** (Azpeitia)

Plate 12, fig. 7

Pyxidicula (??) *stella* AZPEITIA, Assoc. Esp. Prog. Cien. Cong. de Zargoza, vol. 4, pt. 2, sec. 3, 1911, pp. 150, 152, 213, pl. 1, fig. 1; Puente-Genil, Córdoba.

This form is rare in the Sharktooth Hill deposit (Loc. 1068) but was occasionally found in the finer washings. It would be overlooked in ordinary mounting procedure unless this be conducted with an objective of shorter focal length than 16 mm.

Azpeitia doubly questioned the placing of the species in *Pyxidicula;* he even expressed doubt as to its being a diatom, thinking perhaps it might belong to the Radiolaria. However, I have had an opportunity to study several specimens in all positions and can state confidently that the organism is a diatom; the huge hyaline areas are not pores. The relationship appears to be with *Stephanopyxis* but there is such radical divergence from all known species of that genus that I feel obliged to propose a new group name for it. The California specimens do not show any difference which can reasonably be used for specific separation, from the one figured from the Miocene of Spain by Azpeitia.

42. **Melosira geometrica** Hanna, new species

Plate 12, figs. 8, 9

Valve circular with heavy margin, disk convex with large beads arranged in hexagonal system, beads largest at center and decreasing regularly toward margin of disk; in zonal view sides are straight and marked with longitudinal rows of very fine beads. Diameter (holotype), .030 mm.; diameter (paratype), .0352 mm.; length, .0139 mm.

Holotype: No. 3200; *paratype:* No. 3201, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.), southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

From the markings on the disk this species might be expected to fall in the genus *Endictya* but members of that

group should have the beading on the girdle similar to or identical with that of the disk; in this form they are very different. It appears to be a true *Melosira* although no very close relative seems to have been described. It is common in the Sharktooth Hill deposit in the finer washings and was thought to be some form of *Stephanopyxis* during preparatory processes but careful handling of many valves with the mechanical finger did not confirm the supposition. In edge view the form was always conspicuous on dry, strewn slides due to the brown prismatic color formed by the fine markings.

43. **Melosira sulcata** (Ehrenberg)

Gallionella sulcata EHRENBERG, Ber. Akad. Wiss. Berlin, 1837, p. 61.—EHRENBERG, Infus. 1838, p. 170, pl. 21, fig. 5.—EHRENBERG, Mikrog. 1854, pl. 18, figs. 1*a-c;* pl. 20, II, fig. 27; pl. 25A, XVII, figs. 11-12.

Melosira sulcata (EHRENBERG), KŬTZING, Bacill. 1844, p. 55, pl. 2, fig. 7.—SCHMIDT, Atlas Diat. pl. 177, 1892, figs. 23-39.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 2, 1926, p. 148, pl. 17, fig. 2.

Diatoms supposed to be this species are exceedingly abundant in the Sharktooth Hill deposit. Many variations (or species) are present, ranging from those with perfectly hyaline disks to those with radiating bars as in *M. sol* and *M. clavigera* and those with rosette centers. An adequate means of separation of these variations has not been proposed; they may all be forms of one plastic species. As the taxonomy of the group stands at present they are useless for correlation in geology.

44. **Navicula kernensis** Hanna, new species

Plate 13, fig. 1

Valve strongly convex, long and slender, ends pointed; raphe surrounded by a lanceolate hyaline area dilated in the center, more on one side than the other; outer zone marked with close set transverse, slightly radial ribs of uneven length, interrupted toward the outer ends by a strong, longitudinal bar upon which there is a thickening where each transverse bar crosses; terminal nodules heavy; central nodule strongly rounded, heavier on one side than the other. Length (holo-

type), .192 mm.; width, .040 mm.; nine striæ in .01 mm.; length (paratype), .220 mm.; width, .0485 mm.; nine striæ in .01 mm.

Holotype: No. 3202; *paratype:* No. 3203, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of **Sharktooth Hill, Kern County, California;** Temblor, middle Miocene.

This heavy and striking species is common in the Sharktooth Hill deposit and its equivalent elsewhere in the same general region. The silica is evidently brittle because perfect specimens are scarce, yet fragments are found on practically every strewn slide.

Search of the literature for a named form to which this could be referred was without avail. Pantocsek described several species, *N. halionata* in particular, from the Miocene of Hungary which are similar in shape and in the possession of bars instead of lines of beads but in every case details are so different from the California specimens that separation must be maintained. Many of the early species to which the California form bears a superficial resemblance are so crudely drawn that recognition of them cannot be at all certain. This pertains particularly to *N. formosa* Gregory[31] which is better illustrated than many others. The resemblance of *kernensis* and *mimicans* to *formosa* is striking; Gregory suspected that the transverse bars were punctate and Boyer[32] has shown this to be the case. Moreover, the descriptions of *formosa* which have been seen indicate that the diatom is smaller and the markings are finer.

Some of the species similar to the present one and *mimicans* have been referred to the group *Caloneis* of Cleve which is now recognized as a distinct genus; in view of the fact that Boyer[33] selected *N. amphisbæna* as the genotype, such reference may not be permissible; further study is necessary to determine this point definitely and in the meantime it is perhaps better to place them in *Navicula.*

---

[31] Gregory, W., Trans. Micr. Soc. London, vol. 4, 1856, p. 42, pl. 5, fig. 6.
[32] Boyer, C. S. The Diatoms of Philadelphia, 1916, pl. 21, fig. 18.
[33] Proc. Acad. Nat. Sci. Philadelphia, vol. 79, 1927, Suppl. p. 306.

45. **Navicula lyra** Ehrenberg

Plate 13, fig. 2

Navicula lyra EHRENBERG, Abh. Akad. Wiss. Berlin, 1841 (1843), p. 419, pl. 1, I, fig. 9*a*.—WOLLE, Diat. N. America, 1890, pl. 16, figs. 6, 9, 14, 26.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 2, 1926, p. 152, pl. 18, fig. 5.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 116, pl. 20, fig. 3.

Navicula lyra recta GREVILLE, Edinburgh, New Phil. Journ. n. s. vol. 10, 1859, pl. 4, fig. 3.—SCHMIDT, Atlas Diat. pl. 2, 1874, fig. 18.—WOLLE, Diat. N. America, 1890, pl. 16, fig. 4.

This beautiful species is rare in the Sharktooth Hill deposit but it is just as well developed as living individuals today. It has had a long life and must be a form especially well fitted to adapt itself to its surroundings. Variation among the specimens mounted from the deposit is not great. No attempt has been made to place the fossils in any of the 35 or more subspecies which have been named because no useful purpose would appear to be served by following a trinomial or polynomial system of nomenclature. Eventually some of these forms may be desirable to meet the needs of geology but it is not felt that that time has yet arrived.

46. **Navicula marina** Ralfs

Plate 13, fig. 3

Navicula marina RALFS, in PRITCHARD, Hist. British Infusoria, Ed. 4, 1861, p. 903; new name for *N. punctulata* W. SMITH, not EHRENBERG.—VAN HEURCK, Syn. Diat. Belgique, 1880-1881, pl. 11, fig. 16.—HANNA & GRANT, Journ. Paleo. vol. 3, no. 1, 1929, p. 96, pl. 13, figs. 6, 7; pl. 14, fig. 1.—Not *N. marina* JANISCH & RABENHORST, Diat. Honduras, 1863, p. 10, pl. 2, fig. 16.

Navicula punctulata W. SMITH, Syn. British Diat., vol. 1, 1853, p. 52, pl. 16, fig. 151; Marine, Poole Bay and Seaford, Sussex, England.—Not *N. punctulata* EHRENBERG, Ber. Akad. Wiss. Berlin, 1842, p. 337; Mikrog., 1854, pl. 16, group 1, fig. 1; pl. 15A, fig. 34; pl. 15B, fig. 14.

Navicula granulata BREBISSON, VAN HEURCK, Syn. Diat. Belgique, 1880-1881, pl. 11, fig. 15.—Not *N. granulata* BREBISSON, in DONKIN, Trans. Micr. Soc., vol. 6, n. s., 1858, p. 17, pl. 3, figs. 19 *a*, *b*.

Navicula schultzei KAIN, Bull. Torrey Bot. Club, vol. 16, 1889, p. 75, pl. 89, fig. 2, Atlantic City, New Jersey, Miocene.

Navicula schultzei mexicana SCHMIDT, Atlas Diat., pl. 244, 1903, fig 5.

Navicula schultzii KAIN, WOLLE, Diat. N. America, 1890, pl. 24, fig. 5.

Navicula schulzii KAIN, CLEVE, Kongl. Sv. Vet. Akad. Handl. vol. 27, no. 3, 1895, p. 45.

Navicula schulzii marylandica CLEVE, Kongl. Sv. Vet. Akad. Handl. vol. 27, no. 3, 1895, p. 45.

Navicula schulzii californica CLEVE, Kongl. Sv. Vet. Akad. Handl. vol. 27, no. 3, 1895, p. 45, pl. 1, fig. 26.

This species is common in the Sharktooth Hill deposit and its equivalent in the same general region. The specimen figured has slightly angulated sides, this being the most common form present, but shape is very variable and some individuals are plain ovate without a trace of angulation.

Measurements

Length	Width	Transverse rows of beads in .01 mm.
.090 mm.	.447 mm.	6 (Plesiotype No. 3205, figured)
.090 mm.	.0428 mm.	7

Finding this species in the Temblor was a surprise because it has already been reported from an Etchegoin, Pliocene, brackish water deposit in the San Joaquin Valley. Under the name *"Navicula schultzei* Kain" it has been reported from Miocene deposits of eastern North America.[34] Cleve added the subspecies, *marylandica,* from the same region and *californica* from California, but they do not appear to be sufficiently distinct for recognition.

47. **Navicula mimicans** Hanna, new species

Plate 13, fig. 4

Valve similar in structure to *N. kernensis* but shorter, broader and with a narrower hyaline zone on each side of the raphe; the transverse bars end inwardly in an almost even line; the lateral longitudinal line is not a bar but a mere thickening in the transverse bars and the line is much more distant from the margin than in *N. kernensis;* the central area is dilated more on one side than the other corresponding to an asymmetric thickening of the central nodule.

---

[34] Kain & Schultze, Bull. Torrey, Bot. Club, vol. 16, 1889, p. 75, pl. 89, fig. 2.—Boyer, Maryland Geol. Surv. Miocene, 1904, p. 487.

Measurements

Length	Width	Striæ in .01 mm.
.1350 mm.	.0345 mm.	9 (Holotype No. 3206)
.0669 mm.	.0223 mm.	11 (Paratype No. 3207)
.1170 mm.	.0340 mm.	9 (Paratype No. 3208)

Holotype: No. 3206; *paratypes:* Nos. 3207, 3208, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

This species is similar in structure to *N. kernensis* but connecting forms do not exist in the formation here being studied, although both are common. *N. mimicans* is always shorter and broader and the longitudinal lateral lines are always closer to the raphe. The measurements given represent the greater part of the range of variation. *N. kernensis* is much the more constant in size. (See under that form for remarks regarding relationships.)

48. **Navicula morricei** Hanna, new species

Plate 13, fig. 5

Valve flat, ovate, ends roundly pointed; transverse rows of beads slightly radial toward ends, interrupted on each side of the raphe by a zone of scattered beads; this zone corresponds in position to the lyre of *N. lyra,* the central nodule being dilated as in that species. Length (holotype), .120 mm.; width, .0580 mm.; 10 rows of beads in .01 mm. in center of valve, nine at ends.

Holotype: No. 3209, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

The species is rare in the locality mentioned and because of the large size and fragile nature of the valves, perfect specimens are difficult to find. Those examined, however, have shown very little variation, either in size, shape, or character of markings.

Species belonging to this same group and sufficiently close to call for careful comparison are: *N. schaarschmidtii* Pantocsek,[35] with more rounded ends, smaller size (.076-.10 mm. long and .04–.048 mm. wide) and finer markings (10.5–12 rows of beads in .01 mm.); *N. neupaurii* Pantocsek[36] with more rounded ends, smaller size (.094 mm. long and .042 mm. wide) and finer markings (12 rows of beads in .01 mm).

The distinctions shown are believed to warrant specific separation of the California form from these. It is not at all unlikely that this species has passed at some time or other under the name *N. prætexta,* since there is a slight superficial resemblance; however, consultation of original sources of information pertaining to that species shows that the usual California upper Miocene forms referred to it have probably been correctly identified.[37] It is possible that the *prætexta* complex forms an intergrading series of variants similar to *N. lyra;* if so then *morricei* merely forms one of the links in the chain but sufficient material has not yet been studied to prove such intergradation.

This handsome diatom is named in honor of Mr. Charles Morrice, a modest and earnest worker whose justly earned fame is narrated in greater detail in the paper on the geology of Sharktooth Hill.[38]

49. **Navicula optima** Hanna, new species

Plate 13, fig. 6

Valve ovate, narrowly rounded at the ends, slightly convex; markings consist of distantly spaced bars, acutely radial, and extending from the raphe to the border except in the central area where three on each side are unequally shortened; this produces an imperfect stauros. Length (holotype), .0411 mm.; width, .0114 mm.; eight bars in .01 mm.

---

[35] Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, p. 28, pl. 14, fig. 121; Miocene, Hungary.

[36] Op. cit. p. 27, pl. 14, fig. 123; St. Peter, Hungary.

[37] See Hanna & Grant, Proc. Calif. Acad Sci. ser. 4, vol. 15, 1926, p. 154 for references to *N. prætexta.*

[38] Hanna, G. D., Proc. Calif. Acad. Sci. ser. 4, vol. 19, no. 7, 1930, pp. 65-83.

Holotype: No. 3210, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.), southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

This minute but boldly marked form bears a strong resemblance to *N. tolmani* Hanna[39] from a still lower portion of the Tertiary section; the present species, however, lacks the tendency toward capitate ends and *N. tolmani* does not have the central bars shortened to produce a stauros.

On account of its small size most of the diatoms of the present species were probably lost in the finer washings during the cleaning processes; consequently it appeared to be rare.

Much uncertainty surrounds the identity of a vast number of the early described species of *Navicula;* lenses were comparatively imperfect and published drawings are on such a small scale that the essential characters cannot be determined therefrom. Moreover, mounting material no better than Canada balsam was known when many of the species were described. Two courses are open to the student of such organisms. One is to use an old name of some species which in general appearance and form somewhat resembles his but the exact characters of which he can only surmise. The other procedure is to describe his material as new and add another name to an already overburdened genus. Neither action is satisfying but the last seems to be the least objectionable of the two in the present case.

50. **Navicula proserpinæ** (?) Pantocsek

Plate 13, fig. 7

Navicula proserpinæ PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 3, p. 79, 1905, pl. 18, 1893, fig. 260; "Bodos, Transylvania," freshwater deposit.

A few specimens of this minute species were found in the Sharktooth Hill deposit. They may belong to an undescribed species but the identification at this time cannot be effected with certainty; the publication of the figure, however, is believed desirable in order to record the presence of such a form

[39] Journ. Paleo. vol. 1, no. 2, 1927, p. 117, pl. 20, fig. 5.

in this middle Miocene formation; it may have an important bearing on the history of the evolution of the genus *Navicula* which may be exclusively a Tertiary to recent group; Boyer[40] has suggested that it began with the lower Miocene.

The species bears a close resemblance to the figure of Pantocsek's *N. proserpinæ,* reported from a freshwater deposit; the few specimens found in the Sharktooth Hill material may have washed into the Miocene sea from a nearby lake or stream because they do not differ radically from many described freshwater forms.

51. **Navicula spectabilis** Gregory

Navicula spectabilis GREGORY, Trans. Roy. Soc. Edinburgh, vol. 21, 1857, p. 481, pl. 9, fig. 10.—SCHMIDT, Atlas Diat. pl. 2, fig. 31, pl. 3, figs. 20-21, 29, 1875.—MANN, Cont. U. S. Nat. Herb. vol. 10, pt. 5, 1907, p. 356.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, 1926, p. 156, pl. 19, fig. 2.

A very few individuals of this species were detected in the collection made at Loc. 1063 (C. A. S.) on the west side of Cottonwood Creek a few miles east of Sharktooth Hill. It and its close relative, *N. lyra,* have lived without much change of structure or form from lower Miocene to the present and for this reason they are practically valueless for correlation purposes. They are very beautiful diatoms, nevertheless.

52. **Omphalotheca caput-medusæ** (Azpeitia)

Hercotheca ? caput-medusæ AZPEITIA, Assoc. Esp. Prog. Cien. Cong. Zaragoza, vol. 4, sec. 3, Cien. Nat. pt. 2, 1911, p. 207, pl. 11, fig. 3; Miocene of Spain.

Diatoms similar to the one Azpeitia figured are present but rare in the Sharktooth Hill deposit (Loc. 1068). It appears that they would better be included under *Omphalotheca* than *Hercotheca* because of the convexity of the valves and the excessively long spines distributed over the valvular surface.

---

[40] Maryland Geol. Surv. Miocene, 1904, p. 488.

53. **Periptera tetracladia** Ehrenberg

Plate 13, fig. 8

Periptera tetracladia EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 270.—KÜTZING, Spec. Algarum, 1849, p. 25.—EHRENBERG, Mikrog. 1854, pl. 33, XVIII, fig. 9.—RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 865, pl. 6, fig. 30.—GRIFFITHS & HENFREY, Microg. Dict. 1875, pl. 43, fig. 66.—VAN HEURCK, Syn. Diat. Belgique, 1880-1882, pl. 83*ter*, figs. 7-9.—PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 2, 1889, p. 74.—WOLLE, Diat. N. America, 1890, pl. 67, figs. 17-19.—CARTER, Amer. Mon. Micr. Journ. vol. 12, no. 6, 1891, p. 121, pl. 2, fig. 35.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1007.—BOYER, Maryland, Geol. Surv. Miocene, 1904, p. 490.—TEMPERE & PERAGALLO, Diat. du Monde Entier, 1908, p. 26.—AZPEITIA, Asoc. Española. Prog. Cien. Cong. Zaragoza, vol. 4, sec. 3*a*, Cien. Nat. pt. 2, 1911, pp. 59, 64, 156, 163, 164, 175.

No two individuals of this form have been seen which are exactly alike and evidently species-boundaries should be interpreted generously. Ehrenberg originally described it from the Miocene of Virginia or Maryland and it has been recognized in several other deposits of the same epoch.

It is fairly common in the lighter washings from the Sharktooth Hill samples; the spines are brittle and often partially or entirely broken off. The frustule is ovate in end view. Probably the most constant features are the shape and the zone of dots on the side of the frustule.

At present we have no means of merging this form with other nondescript "endocystoid" genera although it is possible that too many of these are recognized as valid. Van Heurck[41] placed the group under the much later genus-name *Pyrgodiscus* Kitton, 1885, but the procedure is not warranted even if the rules of nomenclature were not so violently violated.

54. **Perrya innocens** Hanna, new species

Plate 14, fig. 1

Valve very large, extremely thin and delicate, rounded on the sides, tapering abruptly at the ends; a large rounded wrinkle or wave extends longitudinally through the center of the valve; markings consist of a set of transverse bars, rather

[41] Treat. Diat. 1896, index.

coarse and irregularly defined in parts but fairly uniformly spaced and not resolvable into beads; between these major bars which extend almost across the valve there are shorter bars extending inwardly from the inferior margin (on the holotype) unequal distances; the number of these shorter bars between any two major bars is one, two or three, on the same valve: in no instance do they cross the mid-zone; even the major ribs are somewhat poorly and irregularly defined toward the superior margin. Length (holotype), .1860 mm. (original length about .260 mm.); width, .080 mm.; number of major bars in .01 mm. 4 to 5 depending upon the part of the valve upon which the measurement is taken.

Holotype: No. 3213, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of **Sharktooth Hill, Kern County, California;** Temblor, middle Miocene.

The recognition of huge Nitzschias belonging to the group *Perrya* of Kitton is contrary to the views of Van Heurck[42] but is in accordance with the work of H. & M. Peragallo[43] who have given the group careful study. Structurally these forms appear to be too far removed from typical *Nitzschia* to be included in the same genus. The species described above is considerably different from all others in that there is not the slightest indication of the transverse bars breaking up into beads. Also the other described forms do not have the pronounced longitudinal wave shown in *innocens.*

There is considerable evidence to indicate that *Nitzschia* first appeared in lower Miocene strata and the progenitors of the present enormous number of living species were diverse and aberrant forms.

P. innocens is common in the Sharktooth Hill deposit and its equivalent elsewhere in California but the diatoms are so fragile that it is almost impossible to find unbroken specimens in any sample I have cleaned.

---

[42] Treat. Diat. 1896, p. 408, fig. 130.
[43] Diat. Mar. de France, 1900, p. 297, pl. 76, fig. 2.

55. **Plagiogramma truanii** Pantocsek

Plate 14, fig. 2

Plagiogramma truanii PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 2, 1889, p. 62; Bory, Hungary; pt. 3, 1905, p. 87, pl. 15, 1892, fig. 224, pl. 24, fig. 351.—MANN, U. S. Nat. Mus. Bull. 100, vol. 6, pt. 1, 1925, p. 129.

The specimen figured herewith from Sharktooth Hill, Kern County, California (Loc. 1068 C. A. S.) is very close to the one described from the Miocene of Hungary in 1889. The ends of the California form have a slight tendency to become capitate, a character not shown in Pantocsek's figure; also he stated that there were 15 striæ in .01 mm. whereas the present form has 17. These are such minor differences that they can hardly be specific. The form is very rare at the locality mentioned. I doubt if the species can be held distinct from some living forms bearing earlier names but until a careful study shall have been made of the entire group it seems desirable to recognize the fossil form; there seems to be a conflict between two or more of the earlier names.

Raphidodiscus H. L. Smith

Melonavicula CHRISTIAN, Amer. Mon. Micr. Journ. vol. 7, 1886, p. 218; *nomen nudum*.—ANON., Journ. Roy. Micr. Soc. 1890, p. 79.

Raphidodiscus H. L. SMITH in CHRISTIAN, The Microscope, vol. 7, March, 1887, p. 67.—VORCE, "The Affinities of *Raphidodiscus*," The Microscope, vol. 9, no. 5, 1889, pp. 132-137, pl. 6.

Humbugodiscus DEBY, Nuova Notarisia, 1890, p. 240.

Rhaphidodiscus, VAN HUERCK, Treat. Diat. 1896, p. 236, pl. 35, figs. 913 *a*, *b*, text fig. 33. [Name spelled "*Raphidodiscus*" in explanation of pl. 35.]

This very distinct and remarkable form is apparently an excellent marker fossil of middle and possibly lower Miocene deposits the world over. It has been reported from Maryland, Virginia, Trinidad, Hungary and California. The earliest name is *Melonavicula* but this must be considered as a nomen nudum because when the diatom was finally made known with illustrations it appeared as *"Raphidodiscus."* A careful reading of Christian's article shows that he attributed the name to Prof. H. L. Smith. Van Heurck misspelled the name in his Treatise (p. 236) but corrected it in the explanation of his

plate; nevertheless his error has often been repeated. Probably no diatom has been the cause of as much bitter feeling as this. Particularly some European diatomatists deplored the action of Christian and H. L. Smith; Deby went so far as to facetiously rename the genus, *Humbugodiscus!* As it turns out, the critics were in error. Unfortunately Christian's first specimen was lodged inside the rim of a *Melosira* but his figures show he had others which were not.

56. **Raphidodiscus marylandicus** Christian

Plate 14, figs. 3, 4

Melonavicula marylandica CHRISTIAN, Amer. Mon. Micr. Journ., vol. 7, 1886, p. 218; *nomen nudum.*

Raphidodiscus marylandica CHRISTIAN, The Microscope, vol. 7, 1887, p. 66, first fig.—VORCE, The Microscope, vol. 9, no. 5, 1889, p. 132, pl. 6, fig. 5.—WOLLE, Diat. N. America, 1890, pl. 84, fig. 1.—DE TONI, Syl. Algarum, vol. 2, sect. 1, 1891, p. 313.—VAN HEURCK, Treat. Diat. 1896, pl. 35, fig. 913*a*.

Raphidodiscus febigerii CHRISTIAN, The Microscope, vol. 7, 1887, p. 66, 3 figs. —VORCE, The Microscope, vol. 9, 1889, p. 132, pl. 6, figs. 1, 2.—WOLLE, Diat. N. America, 1890, pl. 84, figs. 3, 4.—DE TONI, Syl. Algarum, vol. 2, sect. 1, 1891, p. 313.—VAN HEURCK, Treat. Diat. 1896, pl. 35, fig. 913*b*.

Raphidodiscus christianii GASCOYNE in VORCE, The Microscope, vol. 9, 1889, p. 132, pl. 6, fig. 4.—WOLLE, Diat. N. America, 1890, pl. 84, fig. 2. —DE TONI, Syl. Algarum, vol. 2, sect. 1, 1891, p. 313.

Raphidodiscus bogus WARD in VORCE, The Microscope, vol. 9, 1889, p. 132. Disciform *Navicula*, VAN HEURCK, Treat. Diat. 1896, p. 236, fig. 33; Naparima, Trinidad.

Navicula disciformis PETTICOLAS in VORCE, The Microscope, vol. 9, 1889, p. 132; *nomen nudum.* [Vorce stated that Petticolas had described *R. marylandica* under the above name but I have been unable to find such a description.]

Diploneis microtatos christianii CLEVE, Kongl. Sven. Vet. Akad. Handl. vol. 26, no. 2, 1894, p. 96, pl. 2, fig. 1.—FRICKE, Verz. Schmidt's Atlas Diat. 1903, p. 35.—BOYER, Maryland Geol. Surv. Miocene, 1904, p. 487, pl. 135, fig. 5.

Cocconeis febigerii "BRUN," SCHMIDT, Atlas, Diat. pl. 193, 1894, fig. 58; "Richmond," Va.

The species is common in the Sharktooth Hill deposit and its stratigraphic equivalent elsewhere in California.

Measurements

Length	Width	Transverse rows of beads at dark oval line opposite central nodule in .01 mm.
.0555 mm.	.0515 mm.	13 (Plesiotype, No. 3215, fig'd)
.0480 mm.	.0448 mm.	12 (Plesiotype, No. 3216)
.0315 mm.	.0310 mm.	17 (Plesiotype, No. 3217)
.0382 mm.	.0382 mm.	13 (Plesiotype No. 3218, fig'd)

The synonymy has been worked out in as great detail as possible because the species is believed to be exceedingly important in correlation of geologic formations. It has been found in several localities in California and many places in the eastern part of the United States; the strata in which it has occurred are middle Miocene. A safe inference is that where the species appears the formation is approximately equivalent of the Temblor and Calvert formations in age.

I cannot agree with Cleve and Boyer that the form is merely a variety of *Navicula mikrotatos* Pantocsek.[44] This cannot be unless Pantocsek's figure be hopelessly misdrawn and this seems unlikely. The two undoubtedly belong to the same genus, however.

It likewise does not appear desirable to sink so distinctive a diatom in the great group *Navicula*, or any of its alleged subgenera such as *Diploneis;* it is far more distinctive than some of the admitted genera of Naviculoid diatoms.

In view of the many specific names which have been applied to the form, it seems that to promote stability the rules of nomenclature should be adhered to; this necessitates the adoption of Christian's name *marylandica*. Fortunately this has been most used in the literature.

Specimens from east American localities have been compared directly with these California forms and it does not appear desirable to make a separation. The differences are inconstant and trivial and are more than bridged by the individual variation among specimens from the same stratum.

Boyer[45] made this significant statement regarding the importance of the form from a stratigraphic standpoint: "This *Diploneis*, originally named *Rhaphidodiscus* [sic.] because

[44] Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, p. 27, pl. 9, fig. 80.
[45] Maryland Geol. Surv. Miocene, 1904, p. 488.

when found it had been accidentally enclosed, as was proved later, in the rim of a *Melosira,* is of interest by reason of its orbicular form, although otherwise naviculoid. The *Naviculeæ* appear to be introduced in the Miocene deposits by this genus, several forms of which are rather common, while *Navicula* proper is scarcely seen until a later period."

57. **Rattrayella inconspicuua** (Rattray)

Plate 14, fig. 5; plate 15, figs. 1, 2

Eupodiscus inconspicuus RATTRAY, Journ. Roy. Micr. Soc., vol. 9, 1888, p. 911.—BOYER, Maryland Geol. Surv. Miocene, 1904, p. 498, pl. 135, figs. 6, 7; "Calvert formation, Maryland."

This highly interesting species from east American Miocene deposits is common in the diatomite exposed on Sharktooth Hill, Kern County, California, and equivalent strata elsewhere in the state. It is a fragile diatom but perfect specimens can often be found. The pattern of the large central hexagonal cells decreasing in size toward the margin is a very constant character. Boyer stated that the small marginal ocelli vary from three to 11; I have seen only eight on the Sharktooth Hill specimens. An important feature, however, is the fact that midway between the ocelli there are small blunt spines and this is the most valuable character of *Rattrayella.* It is true that the other known species of the genus, *oamaruensis* and *simbirskianus* are marked on the disk by radiating lines of small beads but in other circular diatoms such differences are not necessarily considered to be of generic value. Under no circumstances can the species remain in *Eupodiscus,* the genotype of which is the very different species, *argus.* Boyer remarked that possibly the form is the variety of *Eupodiscus radiatus* Bailey, called *antiqua* J. D. Cox, but very little is known regarding this subspecies. Certainly *inconspicuua* cannot be left in the same genus with *radiatus* for which the name *Eu-eupodiscus* has recently been proposed. Rattray's remark that the form shows no close affinity to *E. radiatus* is certainly true. I have made comparison with the Oamaru and Simbirsk

Rattrayellas and do not believe the difference in size and character of surface markings sufficient to warrant generic separation.

Rhaphoneis Ehrenberg

EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 74. Genotype (selected by Boyer, Proc. Acad. Nat. Sci. Philadelphia, vol. 78, 1926 (1927), Suppl. p. 190): *Rhaphoneis amphiceros* Ehrenberg, Op. cit.; Mikrog. 1854, pl. 33, XIV, fig. 22 [type figure here selected]; pl. 33, XV, fig. 20; not pl. 18, fig. 82 [=*R. rhombus*].

The species of this genus are in a state of confusion from which they cannot be extricated until a review of all can be made. In the following records an attempt has been made to make the identifications conform to original sources of information. However, there must be some doubt in any present treatment of the group.

Regarding *Rhaphoneis* it is interesting to note that while the three species noted below as occurring rarely in the Sharktooth Hill horizon form a very inconspicuous portion of the finer washings, there is a diatom-bearing zone below this a short distance in which the genus is excessively abundant. The common species in this latter zone, however, are two others not found at the Sharktooth Hill exposure at all. The third species, *amphiceros,* is rare in the lower zone. The best exposure found of this lower zone is on the east side of the hill marked "1340" on the U. S. Geological Survey's topographic sheet, and situated on the west flank of Round Mountain.

58. **Rhaphoneis amphiceros** Ehrenberg

Plate 15, figs. 3, 4, 5

Rhaphoneis amphiceros EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 87.—EHRENBERG, Mikrog. 1854, pl. 33, XIV, fig. 22; XV, fig. 20; not pl. 18, fig. 82.—RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 791, pl. 14, fig. 21.—VAN HEURCK, Syn. Diat. Belgique, 1880-1882, p. 147, pl. 36, fig. 22.—WOLLE, Diat. N. America, 1890, pl. 37, fig. 20.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 2, 1926, p. 165, pl. 20, fig. 8.

I have referred to this species, the largest *Rhaphoneis* of the Sharktooth Hill deposit where it is not common. These fossils are not subject to great variation in shape and are broad in proportion to length, the sides being gently rounded. The beads vary considerably in size, and the transverse rows have a very gentle curve away from the center. This interpretation of Ehrenberg's type species is slightly at variance with his first figure (cited above) in which the sides are somewhat angulated. His next figures are more like mine. The discrepancies are believed to be due to specific differences. The selection here made is in general agreement with that of most later authors although some have called such forms "*R. gemmifera* Ehr." a species which Ehrenberg never figured. The proper interpretation seems to be to make the latter a synonym of *amphiceros*. In selecting the type of the genus Boyer cited all three of Ehrenberg's figures of *amphiceros* thereby failing to definitely fix the species. For this reason and to stabilize the nomenclature I have chosen his last two figures, excluding the first which I have referred to *R. rhombus*. This last is very common in some Pliocene localities in California but I have not yet found it in the deposit here being considered or its equivalent elsewhere. In order to aid in clearing the synonymy of *amphiceros* the notes given below have been made on *rhombus* and their publication at this time would seem to be desirable.[46]

Ehrenberg evidently figured more than one species among his original illustrations of *rhombus*. The one I have selected as type conforms to the usual interpretation although it does not have page priority. His first figures, called *rhombus* (pl. 18, figs. 84, 85), are certainly not rhombic and are not even obtusely angulated on the sides. By the present interpretation of type figures it becomes possible to retain the commonly used names for the diatoms to which they have usually been applied although Ehrenberg certainly had no very clear conception of specific limits in the group.

---

[46] *Rhaphoneis rhombus* EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 87.—EHRENBERG Mikrog. 1854, pl. 33, XIII, fig. 19 [type figure, here selected]; not pl. 18, figs. 84, 85.

Rhaphoneis amphiceros EHRENBERG, Mikrog. 1854, pl. 18, fig. 82.

59. **Rhaphoneis elegans** Pantocsek & Grunow

Plate 15, figs. 5, 6, 7

Rhaphoneis gemmifera elegans PANTOCSEK & GRUNOW in PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, p. 34, pl. 2, fig. 21; pl. 20, fig. 179; pl. 27, fig. 264; pl. 30, fig. 317; "Felso"-Estregály Kékkö, Szakal, Szent-Péter," [Hungary]; "Naparima," [Trinidad Island].

Diatoms referred to this species are very abundant in the zone, outcropping on 1340 Hill just west of the top of Round Mountain, Loc. 1187 (C. A. S.) Kern County, California, Temblor Miocene. However it is less abundant there than *R. parilis*. The long drawn out ends and bold markings are characteristic and the three figures herewith cover practically the entire range of variation seen. Pantocsek's figures include practically the same range and all of his localities are supposed to be Miocene. The association of the name with *gemmifera* is not warranted if Roper's interpretation of Ehrenberg's species be assumed to be correct because intergrading specimens have not been shown to exist; furthermore, the extreme uncertainty regarding the original *gemmifera* would make any identification therewith doubtful.

60. **Rhaphoneis obesa** Hanna, new species

Plate 15, figs. 9, 10

Valve flat, very broad transversely with sides uniformly rounded; ends produced into gracefully tapering, rounded necks; beads in transverse rows curved gently away from the transverse diameter; pseudoraphe narrow but distinct. Length (holotype), .0385 mm.; width, .0180 mm.; 8 rows of beads in .01 mm.; length (paratype), .030 mm.; width, .0181 mm.; 8 rows of beads in .01 mm.

Holotype: No. 3228, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of Sharktooth Hill, Kern County, California; Temblor, middle Miocene.

Paratype: No. 3229, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1063 (C. A. S.) **west side of Cottonwood Creek, Kern County, California;** Temblor Miocene.

The beads in this species are closer together in the rows than in *R. amphiceros;* also the rows have a greater curvature away from the transverse diameter. Moreover, the ends are more produced into narrow necks than in any of the described species of the genus except the one noted below from a slightly lower horizon in the Temblor.

61. **Rhaphoneis obesula** Hanna, new species

Plate 16, fig. 1

Rhaphoneis rhombus EHRENBERG, Mikrog. 1854, pl. 18, fig. 84, 85; Richmond Va. [Not pl. 33, XIII, fig. 19.]

Valve flat, almost as wide as long, sides rounded, ends produced into obtusely rounded apices; beads rather sparse, rows strongly curved away from the transverse axis; pseudoraphe distinct and broad in the center. Length, .020 mm.; width, .0155 mm.; 9 rows of beads in .01 mm.

Holotype: No. 3230, Mus. Calif. Acad. Sci., collected by G. D. Hanna at Loc. 1068 (C. A. S.) on the southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

This exceedingly obese form is very rare at this locality. It may perhaps be an extreme variant of *R. amphiceros* but no specimens were found to lead one to suppose the intergrades exist. The two figures of Ehrenberg cited come closer than any other which has been named.

62. **Rhaphoneis parilis** Hanna, new species

Plate 16, figs. 2, 3, 4

Valve flat, long and slender, tapering gracefully to the ends; sides very obtusely rounded; pseudoraphe practically obliterated; beads uniform in size throughout, rounded and separated uniformly from each other; transverse rows, straight or almost so and placed at right angles to the longitudinal axis.

Measurements

Length	Width	Transverse rows of beads in .01 mm.
.0429 mm.	.010 mm.	7 (Holotype No. 3231)
.0490 mm.	.010 mm.	7 (Paratype No. 3232)
.0344 mm.	.010 mm.	7 (Paratype No. 3233)
.060 mm.	.010 mm.	7 (Longest specimen seen)

Holotype: No. 3231; *paratypes:* Nos. 3232, 3233, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1187 (C. A. S.), on east side of hill marked "1340" on U. S. Geol. Surv. map, **west flank of Round Mountain, Kern County, California**; Temblor, middle Miocene.

This is an exceedingly common species in the stratum outcropping on "1340" Hill. It and the following species constitute a large percentage of all the diatoms in this fairly rich layer.

The figures illustrate about all of the variation noted among hundreds of individuals studied. A few may be a little longer or shorter but the proportions and markings are remarkably constant. I can find no named species in the literature to which these diatoms can be referred with certainty. Some might lump them into the complex assemblage which has gone under the name *gemmifera* Ehrenberg[47] but this procedure appears to be decidedly undesirable. Ehrenberg never figured it and his description might fit many species or even genera. Kützing[48] did not figure it; and Roper[49] apparently identified and figured a Thames River specimen as *gemmifera*. Whether this was correct or not, will probably never be known unless Ehrenberg's original specimen be found. Roper himself did not feel confident of the identification. Under the circumstances it appears necessary to accept his interpretation of Ehrenberg's name and our fossils are certainly not the same as the Thames River one he illustrated. This latter is larger, has curved transverse lines of beads, more beads in the central rows, is less elongate and has a definite pseudoraphe. These differences appear to be so constant that the Temblor diatoms cannot be called Roper's *"gemmifera."*

---

[47] Ehrenberg, Ber. Akad. Wiss. Berlin, 1844, p. 87.
[48] Kützing, Species Algarum, 1848, p. 49.
[49] Trans. Micr. Sci. vol. 2, 1854, p. 75, pl. 6, fig. 7.

63. Sceptroneis caduceus Ehrenberg

Plate 16, figs. 5, 6, 7

Sceptroneis caduceus Ehrenberg, Ber. Akad. Wiss. Berlin, 1844, p. 254.—Bailey, Amer. Journ. Sci. vol. 48, no. 2, 1845, p. 326, pl. 4, fig. 11. "Bermuda tripoli" [Nottingham, Md.].—Ehrenberg, Mikrog. 1854, pl. 33, XVII, fig. 15; Rappahannock, Cliff, Virginia.—(?) Gregory, Trans. Roy. Soc. Edinburgh, vol. 21, 1857, p. 59, pl. 6, fig. 106.—Ralfs in Pritchard, Hist. Infus. Ed. 4, 1861, p. 772, pl. 4, fig. 11.—Grunow, Verh. K. K. Zool. Bot. Gesell. vol. 12, 1862, p. 354.—Carruthers in Gray, Handbook Brit. Fr. Water Weeds or Algæ, 1864, p. 79.—Rabenhorst, Flora Europæa Algarum, 1864, p. 299.—Grunow, Hedwigia, vol. 5, 1866, p. 146.—Van Heurck, Syn. Diat. Belgique, 1880-1882, p. 147, pl. 37, fig. 5.—Pantocsek, Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, pp. 18, 36; St. Peter and Felso-Esztergaly, Hungarian Miocene.—Kain & Schultze, Bull. Torrey Bot. Club, vol. 16, 1889, p. 76; [Atlantic City, New Jersey]; Miocene.—Wolle, Diat. N. America, 1890, pl. 37, fig. 13.—Möller, Lichtdrucktafeln, 1891, pl. 2, row 5, fig. 36; "Nottingham," Md.; pl. 29, row 5, fig. 2, same place.—De Toni, Syl. Algarum, vol. 2, sect. 2, 1892, p. 646.—Van Heurck, Treat. Diat. 1896, p. 331, pl. 10, fig. 399, text fig. 87.—Boyer, Maryland Geol. Surv. Miocene, 1904, p. 489, pl. 135, fig. 12; Calvert formation in Maryland, many localities given.—Peragallo, Diat. Mar. France, 1901, p. 331, pl. 82, fig. 37, pl. 83, fig. 36; Richmond, Va.—Forti, Nuova Notarisia, vol. 19, 1908, p. 131; Bergonzano, Italy.—Tempere & Peragallo, Diat. du Monde Entier, Ed. 2, p. 78, 1908, Atlantic City, New Jersey; p. 117, 1909, "Santa Cruz, Colorado" [probably Santa Ynez, Calif.]; p. 128, 1909, Nottingham, Md.; p. 225, 1910, Bergonzano, Reggio d'Emilio, Italy, Miocene; p. 335, 1912, Patuxtent River, Md.; p. 374, 1913, (Popés Creek, Md.).—Forti, Atti. R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1653; [Separate, "Cont. Diat." XIII, p. 119].

Sceptroneis caduceus abbreviata Forti, Atti. R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1653, pl. 19, fig. 4; "Bergonzano, Rhegii Lepidi" Italy; Middle Miocene.

Styloneis caduceus Ehrenberg, Ber. Akad. Wiss. Berlin, 1845, p. 55. The genus-name is a typographical error according to Ehrenberg, Mikrog. 1854, Exp. pl. 33.

Rhaphoneis hungarica Pantocsek, Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, pp. 17, 34, pl. 3, fig. 30; not pl. 25, fig. 224; "Szakal," Hungary; Miocene; pt. 2, p. 63; Nagy-Kurtos, Hungary, Miocene.

This is one of the most abundant species in the Sharktooth Hill deposit and its stratigraphic equivalent elsewhere in California. There is very great variation in the size and shape of the valves but the size of the bold square markings and the radial beads on the capitate end are remarkably constant.

The records of Gregory (1857) and Van Heurck (1896) showing the species to be living, need confirmation. Tempere & Peragallo (1909) listed it from "Santa Cruz Colorado," a locality which has given a great deal of trouble. Originally it was given as "Santa Suez, California" and it seems that the best interpretation to make is "Santa Ynez, California." Thus far the locality has not been verified as Santa Cruz, city, county or island although much time has been spent in searching for it.[50]

The species has been reported from many east American Miocene localities and from several other places in the world, all of which are supposed to be of approximately the same age. No definite record of it has been found in any upper Miocene locality anywhere. Pantocsek's first figure of *Rhaphoneis hungarica* is undoubtedly a *Sceptroneis* and probably *caduceus* but his second figure is entirely different; his name should be retained for the last.

Ehrenberg's original figure and many specimens from Maryland and Virginia are longer and more slender than the longest shown herewith; however, in a large series there appears to be sufficiently close intergradation to warrant retaining the name for the California material.

64. **Stephanogonia actinoptychus** (Ehrenberg)

Mastogonia actinoptychus EHRENBERG, Abh. Akad. Wiss. Berlin, 1844, p. 269. —EHRENBERG, Mikrog. 1854, pl. 18, figs. 109 *a*, *b;* pl. 33, XIII, fig. 16.

Stephanogonia actinoptychus (EHRENBERG), VAN HEURCK, Syn. Diat. Belgique, 1880-1882, pl. 83ter, figs. 2-4.—PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 2, 1889, p. 76, pl. 13, fig. 221.

Forms supposed to be this species are common in the lighter washings of samples from the Temblor, particularly from Loc. 1063, on the west side of Cottonwood Creek a few miles east of Sharktooth Hill. The genera *Stephanogonia* and *Masto-*

[50] See Hanna, G. D. Journ. Paleo. vol. 4, no. 2, 1930, pp. 182-184, for a more complete account of the difficulties connected with the "Santa Cruz" locality.

gonia have not been adequately differentiated; the early figures are not very satisfactory and a careful study of both groups is needed. The species are most common in middle Miocene strata.

65. Stephanogonia polyacantha Forti

Plate 16, fig. 8

Stephanogonia polyacantha FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1560, pl. 12, fig. 11; [separate, "Cont. Diat." XIII, p. 26, pl. 2, fig. 11]; "Middle Miocene, Marmorito, Alexandria, Piedmont," Italy.

Stephanogonia polyacantha inermis FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1561, pl. 12, fig. 12; [separate, p. 27, pl. 2, fig. 12]; "Middle Miocene, Bergonzano, Reggio d'Emilia," Italy.

Stephanogonia actinoptychus polyacantha TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1909, p. 197; (name only).—FORTI, Atti R. Ist. Veneto, vol. 69, 1910, p. 1310; [separate, "Cont. Diat." XI, p. 62].

Stephanogonia cincta PANTOCSEK, FORTI, Nuova Notarisia, vol. 19, 1908, p. 132. —TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1909, p. 197.—FORTI, Atti R. Ist. Veneto, vol. 69, 1910, p. 1310.—TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1910, p. 225.—Not *Stephanogonia cincta* PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 2, 1889, p. 76, pl. 9, fig. 161; "Nagy-Kürtös, Szakal."

This large and striking species is fairly common in the Sharktooth Hill deposit (Loc. 1068) and on Cottonwood Creek (Loc. 1063). Forti described it from beds of probably equivalent age in Italy. Besides being by far the largest known *Stephanogonia* it is further characterized by the presence of the scattered rounded beads and the absence of pronounced spines around the internal disk. It is very fragile and perfect specimens are difficult to find. Tempere & Peragallo were first to use the name *polyacantha* but without descriptive matter of any kind. Therefore the species must be credited to Forti who claimed it properly.

The outer zone with radial ribs resembles strongly the "veil" of *Coscinodiscus sol,* a living species.

One very large specimen mounted on the same slide as the one figured herewith is .1154 mm. in diameter.

66. **Stephanopyxis lineata** (Ehrenberg)

Plate 16, figs. 9, 10, 11

"*Stephanodiscus? lineatus* (=*Peristephania lin.*?)" EHRENBERG, Mikrog. 1854, pl. 33, XIII, fig. 22; "San Francisco, Calif."

Stephanopyxis ambigua GRUNOW, Denk. Akad. Wiss. Wien, vol. 48, 1884, p. 91.

Peristephania entycha EHRENBERG, Mikrog. 1854, pl. 35B, IV, fig. 14 [?].

Stephanopyxis lineata (Ehrenberg), FORTI, Nuova Notarisia, 1912, p. 83.—FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1547, pl. 11, figs. 21, 23, pl. 12, fig. 3.

Forti deserves credit for resurrection of this important species. Undoubtedly it has been confused with *Coscinodiscus lineatus* because the markings on the disk of the two are similar. The high spines on the margin and the abrupt deflection at that point in the *Stephanopyxis* certainly distinguish them. Ehrenberg's specimen came from a deposit on San Pablo Bay, a portion of San Francisco Bay and I have the species in abundance from there. The age of that deposit has not yet been certainly determined but it is Miocene, and probably somewhat higher in the section than the Sharktooth Hill material yet lower than the type Monterey shale. Ehrenberg's placing of the species in *Stephanodiscus* may have been a slip of the pen; his genus *Peristephania* has not been accepted.

The species is common in the Sharktooth Hill deposit and it is believed that the zonal view here shown for the first time will aid in clearing up the confusion which has surrounded it.

67. **Stictodiscus kittonianus** Greville

Plate 16, fig. 12

Stictodiscus kittonianus GREVILLE, Trans. Micr. Soc. London, n. s. vol. 9, 1861, p. 77, pl. 10, figs. 2, 3.—SCHMIDT, Atlas Diat. pl. 74, 1882, figs. 16, 18.—WOLLE, Diat. N. America, 1890, pl. 75, fig. 9.

Stictodiscus is exceedingly rare in the Sharktooth Hill deposit and only the above species is represented. The very common upper Miocene *S. californicus,* is entirely absent. The original locality for *kittonianus* was "Nottingham Maryland" a deposit which is believed to be very nearly the equivalent of the California Temblor.

68. **Surirella tembloris** Hanna, new species

Plate 16, figs. 13, 14

Valve ovate, slightly pyriform, with a narrow lanceolate central area bordered by a zone of irregular transverse bars: marginal zone with radiating, broad bars on which fine beading is visible under high aperture. Length (holotype No. 3242, .0954 mm.; (paratype No. 3243) .1080 mm.; (paratype No. 3244) .0910 mm.

Holotype: No. 3242; *paratype:* No. 3243. Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1063 (C. A. S.), Sec. 13, T. 29S., R. 29E., M. D. M., west side of **Cottonwood Creek, Kern County, California,** middle Miocene. *Paratype:* No. 3244 from Loc. 1068 (C. A. S.), southeast side of **Sharktooth Hill, Kern County, California;** same formation.

This species is similar to *S. alternans* Schmidt[51] from the Miocene of Richmond, Virginia but this last has a broader central area bounded by a zone of regular, radial, beaded bars.

69. **Triceratium americanum** Ralfs

Triceratium amblyceros EHRENBERG, BRIGHTWELL, Quart. Journ. Micr. Sci. vol. 1, 1853, p. 250, pl. 4, fig. 14; not of EHRENBERG.

Triceratium americanum RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 855. —SCHMIDT, Atlas Diat. pl. 76, 1882, fig. 28; not fig. 3.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 122, pl. 21, fig. 3.

This species is common at Loc. 1063 on Cottonwood Creek, a few miles east of Sharktooth Hill; specimens cannot be separated specifically from those recently reported (1927) from Phoenix Canyon near Coalinga, California, in strata believed to be considerably lower in the Tertiary.

It was stated in my paper cited above that Schmidt figured two forms under the name *americanum,* a coarsely beaded one (his fig. 3) and the one here accepted as *americanum.* It is believed that the coarsely marked specimen is the same as was

[51]Atlas Diat. pl. 211, 1897, fig. 30.

recently named "*Biddulphia jordani*"[32] from Maria Madre Island, Mexico. It so happens that this name is preoccupied by "*Triceratium jordani*" Truan & Witt.[33]

70. Triceratium condecorum Brightwell

Plate 17, figs. 1, 3

Triceratium condecorum BRIGHTWELL, Quart. Journ. Micr. Sci. vol. 1, 1853, p. 250, pl. 4, fig. 12.—SCHMIDT, Atlas, Diat. pl. 76, 1882, fig. 27.—PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, p. 52, pl. 27, fig. 256.—WOLLE, Diat. N. America, 1890, pl. 102, fig. 6.

This small species originally came from "Nottingham Maryland" and has been found widely distributed in Miocene strata elsewhere. The name was originally used by Ehrenberg in 1844[34] according to Chase but essentially as a nomen nudum, and most authors cite the species as of Brightwell who gave the first figure. In most illustrations the sides are shown slightly more convex than the California specimens but since this seems to be a trivial difference and all other details are essentially the same the identification appears to be warranted.

The proposal to place such diatoms as this in which processes are lacking in the angles, in Cleve's genus *Trigonium* has not been adopted by many diatomists. Likewise, the placing of all Tricerati in *Biddulphia* does not appear acceptable. I have accordingly followed general custom and use the name *Triceratium*.

T. americanum Ralfs differs from *condecorum* in having the marginal beads arranged in radial rows. Both species are found fairly commonly in the lighter washings of the Sharktooth Hill deposit and strata of the same age in the same general area.

---

[32] Hanna & Grant, Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 2, 1926, p. 131, pl. 14, fig. 3.

[33] Diat. Jeremie, Hayti, 1888, p. 23, pl. 7, fig. 12.

[34] Ber. Akad. Wiss. Berlin, 1844, p. 272.

71. **Triceratium spinosum** Bailey

Plate 17, figs. 4, 5

Triceratium spinosum BAILEY, Amer. Journ. Sci. vol. 46, 1844, p. 139, pl. 3, fig. 12.—RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 853, pl. 6, fig. 19.—WOLLE, Diat. N. America, 1890, pl. 25, fig. 22; pl. 77, figs. 4, 9, 10; pl. 102, figs. 2, 5.

Triceratium tridactylum BRIGHTWELL, Quart. Journ. Micr. Sci. vol. 1, 1853, p. 248, pl. 4, fig. 3.—SCHMIDT, Atlas Diat. pl. 87, 1885, fig. 12.—WOLLE, Diat. N. America, 1890, pl. 105, fig. 1.

Biddulphia spinosa (BAILEY), BROCKMANN, Abh. Senckenbergischen Naturforschenden Gesellschaft, vol. 41, 1928, pl. 2, fig. 17.

This striking species was first found in Miocene, east American deposits. It is not uncommon in California samples from Sharktooth Hill and equivalent strata elsewhere in that general region.

72. **Triceratium subrotundatum** Schmidt

Plate 17, fig. 2

Triceratium subrotundatum SCHMIDT, Atlas Diat., pl. 93, 1886, fig. 1; Nottingham, Maryland.—WOLLE, Diat. N. America, 1890, pl. 102, fig. 3; pl. 112, fig. 7.—TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1912, p. 331.

Biddulphia (?) *subrotundata* (SCHMIDT), BOYER, Proc. Acad. Nat. Sci. Phila. vol. 52, 1900, (1901) p. 720.—FORTI, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1637, pl. 21, figs. 1, 2, [fa. *italica*]; "Bergonzana, Rhegii Lepidi et Monte Gibbio," Italy.

A large but delicate form without angular processes was found occasionally at Loc. 1063 (C. A. S.), on the west side of Cottonwood Creek several miles east of Sharktooth Hill. A considerable number of imperfect specimens was seen and several were mounted. The only previous records appear to be from the Miocene deposits of eastern North America and from Italy in strata which appear to be approximately equivalent in age to those here being considered. Forti has given an excellent account of the relationship of the species. Boyer stated that except in outline, the species scarcely differed from *Coscinodiscus,* but this is doubtful; affinity seems to be with *T. favus.*

73. **Tropidoneis primoris** Hanna, new species

Plate 17, fig. 6; plate 18, figs. 1, 2

In girdle view, frustule slightly truncate, about three times as long as broad indented at the transverse median line where the central nodule is extended laterally about one-third the distance to the inner margin; ends of valves rounded above; connecting zone narrow with straight sides; markings consisting of transverse rows of beads, uniformly spaced throughout. Length (holotype), .1240 mm., width, .040 mm.; length (paratype), .1184 mm.; width, .0137 mm., (one valve); 24 transverse rows of beads in .01 mm.

Holotype: No. 3248; *paratype:* No. 3249, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

The valves of this species are exceedingly compressed laterally, so that looked at in girdle view the diatom has hardly any thickness at all; this condition is believed to be in part due to pressure in the formation from which the collection was obtained. The diatoms are very delicate and diaphanous so that they are easily destroyed in cleaning operations; nevertheless a considerable number of individuals was seen. Often the valves are warped in preservation thus making it difficult to focus all parts at once in photography. *Tropidoneis membranacea* (Cleve)[55] appears to be closer to this than any described species of the genus but that form lacks the laterally dilated central nodule, and the frustule is almost twice as large. The markings are very nearly the same size and would be difficult to resolve without high aperture lenses and a highly refractive mounting medium.

---

[55] *Amphiprora membranacea* CLEVE, Bih. till Sven. Vet. Akad. Handl. vol. 1, no. 11, 1873, p. 12, pl. 2, fig. 18; Java Sea.—CLEVE Kongl. Sven. Vet. Akad. Handl. vol. 26, no. 2, 1894, p. 24.—MANN, U. S. Nat. Mus. Bull. 100, vol. 6, pt. 1, 1925, p. 174.

74. **Xanthiopyxis acrolopha** Forti

Xanthiopyxis acrolopha FORTI, Nuova Notarisia, vol. 23, 1912, p. 84.—TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, 1915, p. 331.—FORTI, Cont. Diat. XIII. Atti R. Ist. Veneto, Sci. Lett. Art., vol. 72, pt. 2, 1913, p. 1556 (22), pl. 12 (2), figs. 22, 24, 27, 28, 30-37.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 124, pl. 21, figs. 10, 11.

Further down in the Tertiary on the west side of the San Joaquin Valley this species is very common but on the east side in the Temblor it has been found only once. This was at Loc. 1063 (C. A. S.) on the west side of Cottonwood Creek, a few miles east of Bakersfield.

75. **Xanthiopyxis globosa** Ehrenberg

Plate 18, fig. 3

Xanthiopyxis globosa EHRENBERG, Ber. Akad. Wiss. Berlin, 1844, p. 273.—RALFS in PRITCHARD, Hist. Infus. Ed. 4, 1861, p. 827.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 1155.—FORTI, Cont. Diat. XIII, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1557 (23), pl. 12 (2), figs. 39-49.

Forti's application of Ehrenberg's descriptive name seems satisfactory although the species had not previously been illustrated. The valves are so convex that good photographs are hardly possible and I have therefore furnished a drawing, admittedly somewhat diagrammatic. The species is apparently confined to middle and perhaps lower Miocene strata. It is replaced in upper Miocene by *X. umbonata* Greville although the latter is not believed to be a direct descendant. The precursor of *umbonata* is believed to be a large cap shaped form in which the usual sharp spines of the well known species are represented by mere rounded nodules. This latter form is not uncommon in the Temblor strata here being considered but is not now formally described because of lack of suitable type material. *X. globosa* is fairly common in the lighter washings from Locs. 1063 and 1068 (C. A. S.). It is characterized by the bold angular spines. In zonal view it does not have the constriction which seems always to be present in *Omphalotheca.*

The deposit likewise contains a circular form about the same size and shape as this but with many more and smaller spines. Also there is an ovate one with spines as large and arranged about the same as in the present species; these do not appear to have been described and are omitted here because of the lack of sufficient, well preserved specimens.

76. **Xanthiopyxis maculata** Hanna, new species

Plate 18, fig. 4

Valve composed of two ovals joined together by a broad isthmus; border without spines or beads and surface hyaline, marked only by faint maculations irregular in shape and size and visible only under extremely favorable illumination. Length, .050 mm.; width, .0161 mm.

Holotype: No. 3251, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.), southeast side of **Sharktooth Hill, Kern County, California**; Temblor, middle Miocene.

This is the third species of this striking, constricted form of *Xanthiopyxis*. The others are *X. panduræformis* Pantocsek[56] with the "variety" *soleiformis* Forti[57] and *X. specticularis* Hanna.[58] The present species is nearer *panduræformis* but lacks the bold heavy markings of that form from the Miocene of Hungary, Spain and Italy.

77. **Xanthiopyxis marginata** Hanna, new species

Plate 18, fig. 5

Valve circular, hyaline, with the exception of a single row of massive spines just inside the margin; these spines are angular at the base, rounded at the tips and set unequal distances apart. Diameter, .0296 mm.

---

[56] Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, p. 43, pl. 29, fig. 297.
[57] Atti R. Ist. Veneto Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1552.
[58] Journ. Paleo. vol. 1, no. 2, 1927, p. 124, pl. 17, fig. 10.

Holotype: No. 3252, Mus. Calif. Acad. Sci. collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California,** Temblor, middle Miocene.

No species of diatom with which I am familiar approaches this sufficiently close to permit direct comparison. Unfortunately the best mounted specimen is slightly tipped so that one side of the circle of spines is out of focus in the photograph, but it is believed the characters are sufficiently well displayed, nevertheless, to permit description. The species is fairly common in the lighter washings.

78. **Xanthiopyxis oblonga** Ehrenberg

Xanthiopyxis oblonga EHRENBERG, Mikrog. 1854, pl. 33, XVII, fig. 17.—CLEVE, Journ. Quekett Micr. Club, ser. 2, vol. 2, 1885, p. 175, pl. 13, fig. 18.—FORTI, Cont. Diat. XIII, Atti R. Ist. Veneto, Sci. Lett. Art. vol. 72, pt. 2, 1913, p. 1554 (20), pl. 12 (2), fig. 38.—HANNA & GRANT, Proc. Calif. Acad. Sci. ser. 4, vol. 15, 1926, p. 170, pl. 21, fig. 11.—HANNA, Journ. Paleo. vol. 1, no. 2, 1927, p. 124.

These oblong *Xanthiopyxis* seem to be most common in the middle Miocene the world over. During the latter part of this epoch, in formations such as the Monterey shale, they are much scarcer and two species, *acrolopha* and *cingulata* may not be present at all. *X. oblonga* occurs in the Temblor frequently and was noted particularly in the lighter washings from Loc. 1063, several miles east of Bakersfield.

Xystotheca Hanna, new genus

Diatom ovate, biddulphoid with a round auliscoid spot at each end and irregular rugose flat zones radiating to the median line.

Genotype (monotypic): *Xystotheca hustedti* Hanna, new species.

79. **Xystotheca hustedti** Hanna, new species

Plate 18, figs. 5, 6

Valve ovate, slightly convex, almost flat on top, heavily marked with bold irregularly shaped rugosities extending from the narrow margin toward the long median line; in the holotype these rugose areas are patches of no regular shape and arranged roughly in transverse or radiating zones; at each end there is a conspicuous auliscoid eye-spot surrounded by a narrow ring.

Measurements

	Holotype No. 3253	Paratype No. 3254
Length	.0714 mm.	.0268 mm.
Width	.0350 mm.	.0188 mm.

Holotype: No. 3253, Mus. Calif. Acad. Sci. collected by L. G. Hertlein at Loc. 1170 (C. A. S.) **Smugglers Cove, Santa Cruz Island, California;** Temblor Miocene; *paratype:* No. 3254, collected by G. D. Hanna at Loc. 1068 (C. A. S.) southeast side of **Sharktooth Hill, Kern County, California;** Temblor Miocene.

This strange form does not fall readily into any known genus of diatoms. It possesses the shape of some biddulphoid species but has none of the other characters of the members of that heterogenous group. The "eye spots" are similar to those of *Auliscus* but all other characters are very different from any member of that group. I have selected the holotype from Santa Cruz Island Miocene because the species is there beautifully developed. The paratype came from Sharktooth Hill and is a smaller individual with the rugose markings less patchy; nevertheless I believe the two to be the same species because the two deposits contain so many other fossils in common, such as *Annellus californicus, Raphidodiscus marylandicus, Cyclotella kelloggi,* etc.

The species is named for Dr. Frederick Hustedt, the eminent diatomist of Bremen, Germany.

80. Zygoceros (?) quadricornis Grunow

Plate 18, figs. 8, 9

Zygoceros (?) *quadricornis* GRUNOW in VAN HEURCK, Syn. Diat. Belgique, 1880-1882, pl. 105, figs. 5, 6, 7; Nottingham, Maryland.

Zygoceros quadricornis GRUNOW, PANTOCSEK, Beit. Kennt. Foss. Bacill. Ungarns, pt. 1, 1886, p. 49, pl. 26, fig. 248.—WOLLE, Diat. N. America, 1890, pl. 64, figs. 8, 9.—DE TONI, Syl. Algarum, vol. 2, sect. 3, 1894, p. 888.—TEMPERE & PERAGALLO, Diat. du Monde Entier, Ed. 2, p. 132, 1909, Nagy-Curtos, Hungary; p. 278, 1911, San Luis Obispo County, California; p. 417, 1913, Palogla, Hungary.

Biddulphia quadricornis (GRUNOW), BOYER, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900 [1901], p. 713.

This strange species is common in the Sharktooth Hill deposit and elsewhere in strata of the same age in California. Tempere & Peragallo's San Luis Obispo record is probably acceptable because rocks of the same age are found in that county but it should be added that they have included the species in a list which was obviously made from a mixed collection. The list contains uppermost Miocene species which we know definitely do not occur in Temblor strata and also Temblor species which do not occur in the Monterey.

Grunow originally questioned the placing of the species in the genus *Zygoceros* and it is believed he was justified although subsequent authors have expressed no such doubt. Probably a new genus should be erected for it, but it is so delicate that better preserved material than I have seen is needed before so doing. Evidently Grunow had only fragments and his drawings are not good. Pantocsek's are much better. The photographs herewith are of mere fragments but it is believed that they help to give the characters of the form. The most conspicuous and best preserved portion of the diatom is a heavy square of silica, the sides being slightly convex; at each corner there projects a long heavy spine (often broken); the plane of the square is covered with a delicate beading in partial radial arrangement; from the opposite side of the square there projects a funnel-like veil with a narrow border at the outer margin; this veil is supported with light ribs projecting from the square but not reaching to the outer margin.

I have found the species in material from Dunkirk, Maryland, kindly supplied to me by Dr. Remington Kellogg and believe the California forms do not differ specifically in spite of Grunow's drawings.

The characters of the species seem to ally it more with *Stephanopyxis* than with *Biddulphia*, *Zygoceros* probably being a synonym of the latter. However, there is some discrepancy in the selection of the type species of *Zygoceros* which makes a serious complication and we need not go into this at the present time.

PLATE 2

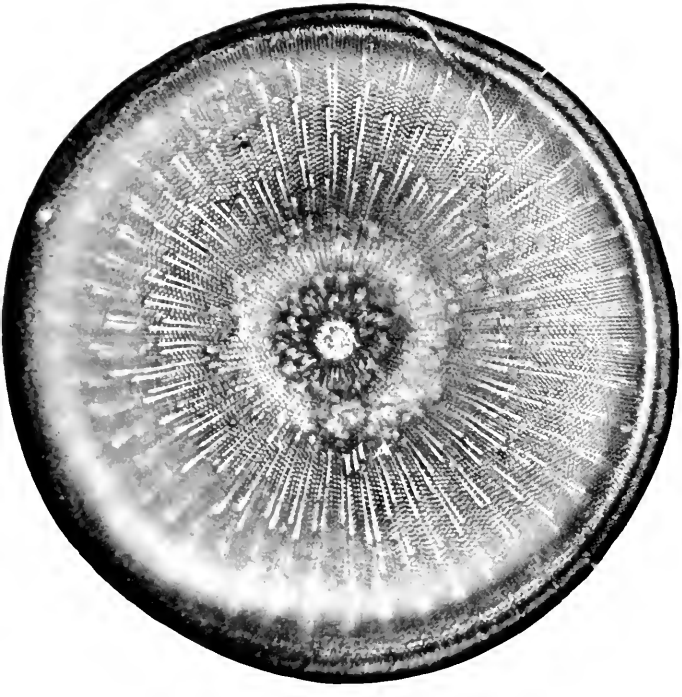
Fig. 1. *Actinocyclus ehrenbergii* Ralfs. Plesiotype, No. 3138, C. A. S.; × 500; diameter, .1780 mm.; 7 beads in .01 mm. near center, 9 near margin.

Fig. 2. *Actinocyclus ehrenbergii* Ralfs. Same specimen as Fig. 1 photographed with a lower focus to show depressed central area.

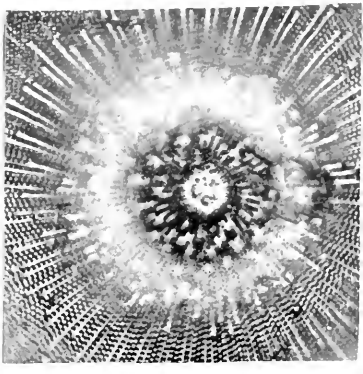
Fig. 3. *Actinocyclus ehrenbergii* Ralfs. Plesiotype, No. 3139, C. A. S.; × 693; diameter, .0649 mm.; 7 beads in .01 mm.

Fig. 4. *Actinoptychus halionyx* Grunow. Plesiotype, No. 3140 C. A. S.; × 575; diameter, .095 mm.

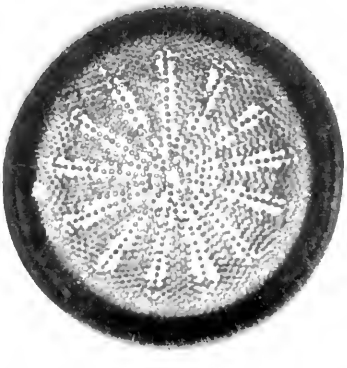
[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



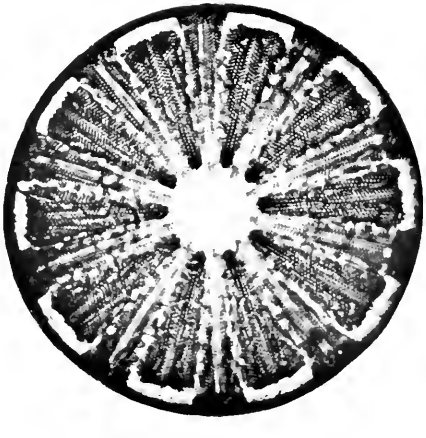
1



2



3



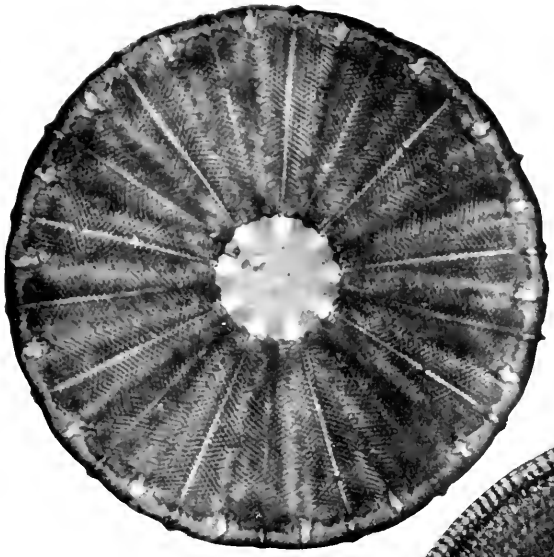
4

PLATE 3

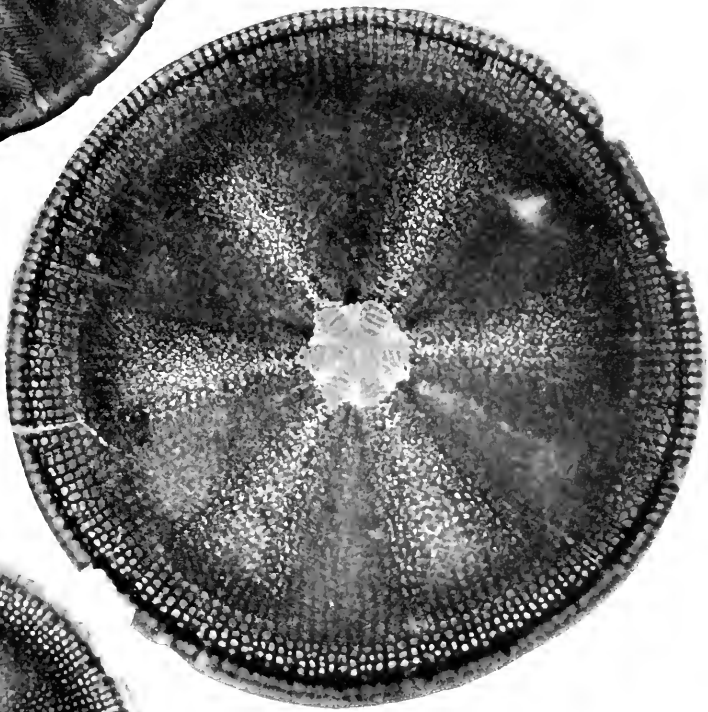
Fig. 1. *Actinoptychus janischii* Grunow. Plesiotype, No. 3141, C. A. S.; × 870; diameter, .084 mm.; from Calif. Acad. Sci. Loc. 1063, west side of Cottonwood Creek, Kern County, California, Sec. 13, T. 29S.; R. 29E., M. D. M.; Temblor Miocene.

Fig. 2. *Actinoptychus kernensis* Hanna, n. sp. Holotype, No. 3142, C. A. S.; × 550; diameter, .1680 mm.; showing one set of segments and border in focus.

Fig. 3. *Actinoptychus kernensis* Hanna, n. sp. Holotype, same specimen as Fig. 2; showing other set of segments in focus; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.



1



2

3

Plate 4

Fig. 1. *Actinoptychus perisetosus* Brun. Plesiotype, No. 3146, C. A. S.; × 1050; diameter, .0621 mm.; showing heavily marked segments in focus; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

Fig. 2. *Actinoptychus perisetosus* Brun. Same specimen as Fig. 1; showing lightly marked segments in focus.

Fig. 3. *Actinoptychus thumii* Schmidt. Plesiotype, No. 3147, C. A. S.; × 600; diameter, .060 mm.; showing heavily marked segments in focus; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill Kern County, California; Temblor Miocene.

Fig. 4. *Actinoptychus thumii* Schmidt. Same specimen as Fig. 3; × 1000; showing lightly marked segments in focus.

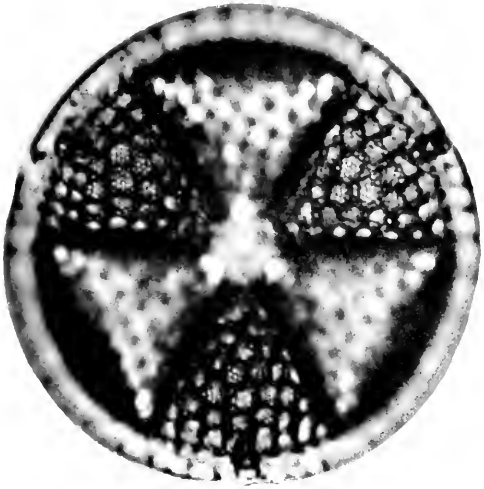
Fig. 5. *Annellus californicus* Tempere. Plesiotype, No. 3148, C. A. S.; × 725; diameter, .0525 mm.; side view of cylinder; from Calif. Acad. Sci. Loc. 1063, west side Cottonwood Creek, Kern County, California; Temblor Miocene.

Fig. 6. *Annellus californicus* Tempere. Plesiotype, No. 3149, C. A. S.; × 725; diameter, .520 mm.; end view of cylinder; from same locality as Fig. 5.

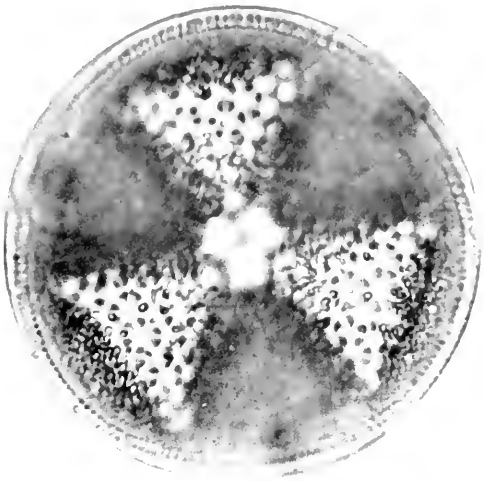
Fig. 7. *Annellus californicus* Tempere. Plesiotype, No. 3150, C. A. S.; × 555; diameter, .1080 mm.; side view of cylinder somewhat crushed; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

Fig. 8. *Annellus californicus* Tempere. Plesiotype, No. 3151, C. A. S.; × 260; diameter, .0720 mm.; end view of cylinder; from Tempere's original material labelled and listed as from "Santa Monica, California," but which may have come from the Temblor Miocene of the Santa Monica Mountains.

Fig. 9. *Annellus californicus* Tempere. Diagrammatic longitudinal section to show structure.

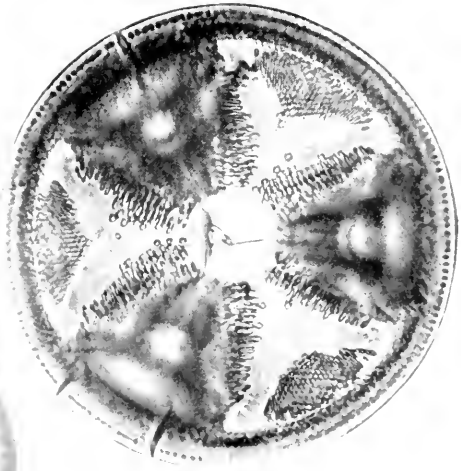


1

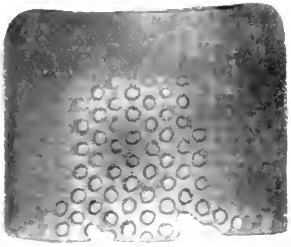


2

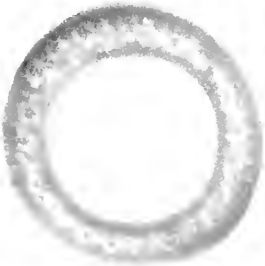
3



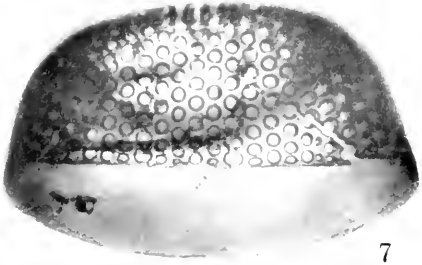
4



5

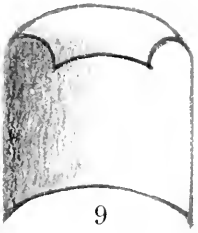


6



7

8



9

PLATE 5

Fig. 1. *Arachnoidiscus manni* Hanna & Grant. Plesiotype, No. 3152, C. A. S.; × 407; diameter, .1515 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

Fig. 2. *Asterolampra rotula* Greville. Plesiotype, No. 3153, C. A. S.; × 440; diameter, .0876 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

Fig. 3. *Aulacodiscus brownei* Norman. Plesiotype, No. 3154, C. A. S.; × 950; diameter, .0378 mm.; from Calif. Acad. Sci. Loc. 1063, west side Cottonwood Creek, Kern County, California, Sec. 13, T. 29S., R. 29E., M. D. M.; Temblor Miocene.

Fig. 4. *Auliscus bonus* Hanna, n. sp. Holotype, No. 3155, C. A. S.; × 880; diameter, .0422 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

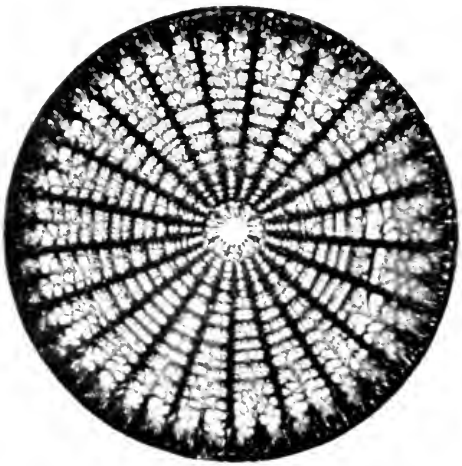
Fig. 5. *Auliscus bonus* Hanna, n. sp. Holotype, No. 3155, C. A. S.; × 880; diameter, .0422 mm.; opposite valve from Fig. 4; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

Fig. 6. *Auliscus suppressus* Hanna, n. sp. Holotype, No. 3156, C. A. S.; × 934; diameter, .0321 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

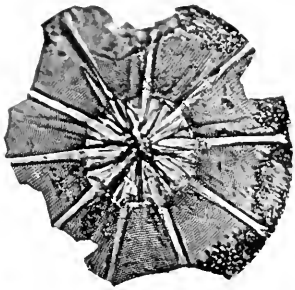
Fig. 7. *Biddulphia angulata* Schmidt. Plesiotype, No. 3157, C. A. S.; × 1875; diameter, .0320 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

Fig. 8. *Biddulphia angulata* Schmidt. Plesiotype, No. 3158, C. A. S.; × 1000; diameter, .0250 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.

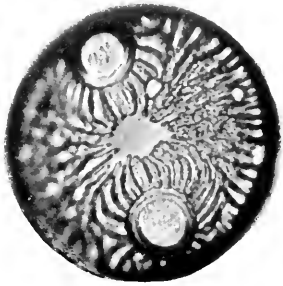
Fig. 9. *Coscinodiscus æginensis* Schmidt. Plesiotype, No. 3159, C. A. S.; × 875; diameter, .0788 mm.; from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.



1

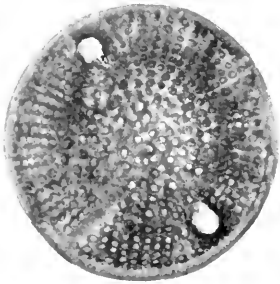


2



4

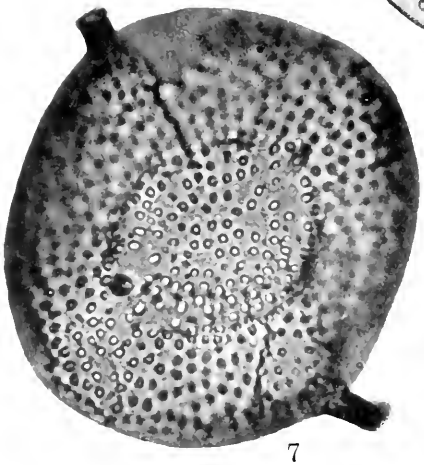
5



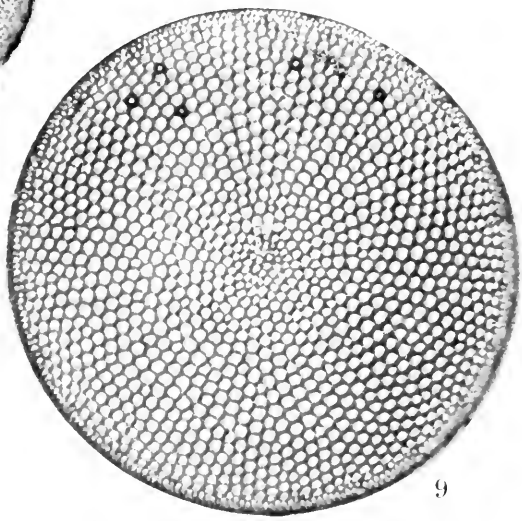
3

6

8



7



9

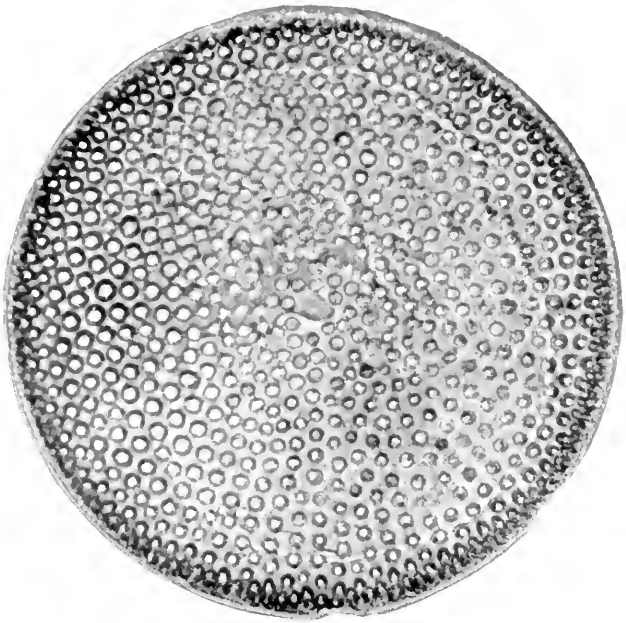
PLATE 6

Fig. 1. *Coscinodiscus apiculatus* Ehrenberg. Plesiotype, No. 3160, C. A. S.; × 532; diameter, .1540 mm.

Fig. 2. *Coscinodiscus convexus* Schmidt. Plesiotype, No. 3161, C. A. S.; × 330; diameter, .2760 mm.

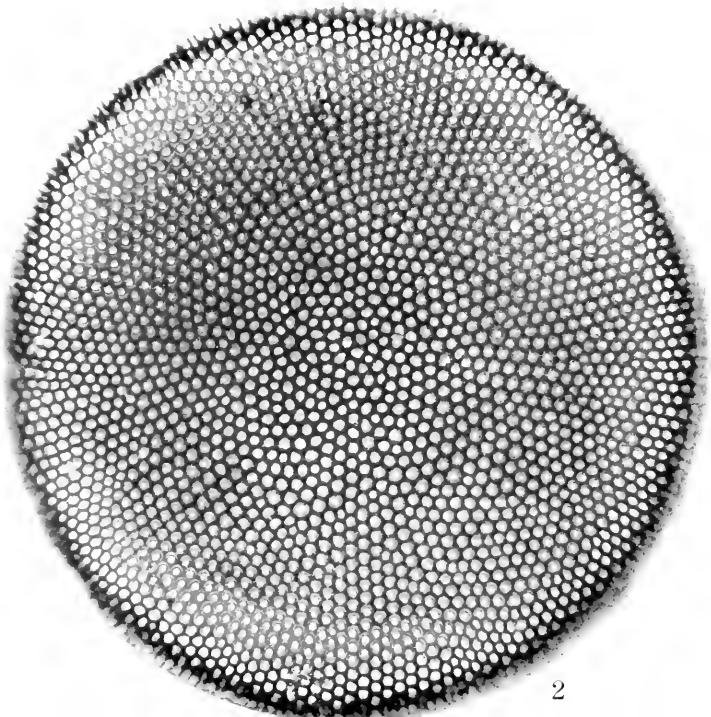
Fig. 3. *Coscinodiscus convexus* Schmidt. Plesiotype, No. 3163, C. A. S.; × 1600; fragment showing secondary sculpture.

[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



1

3



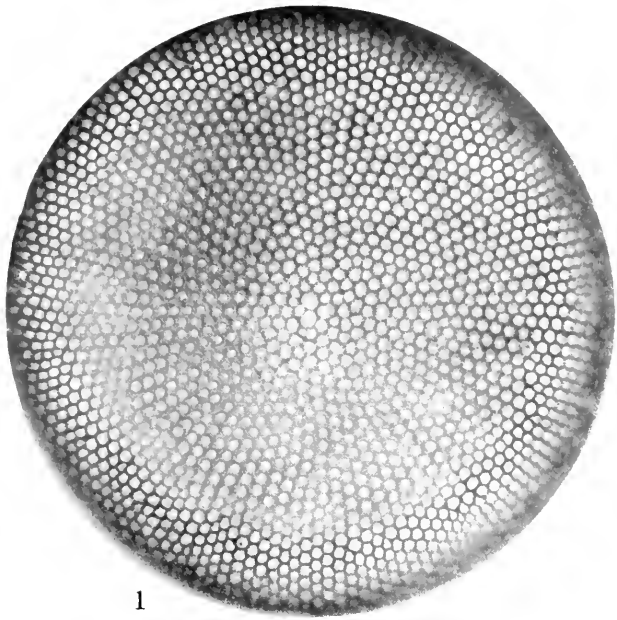
2

PLATE 7

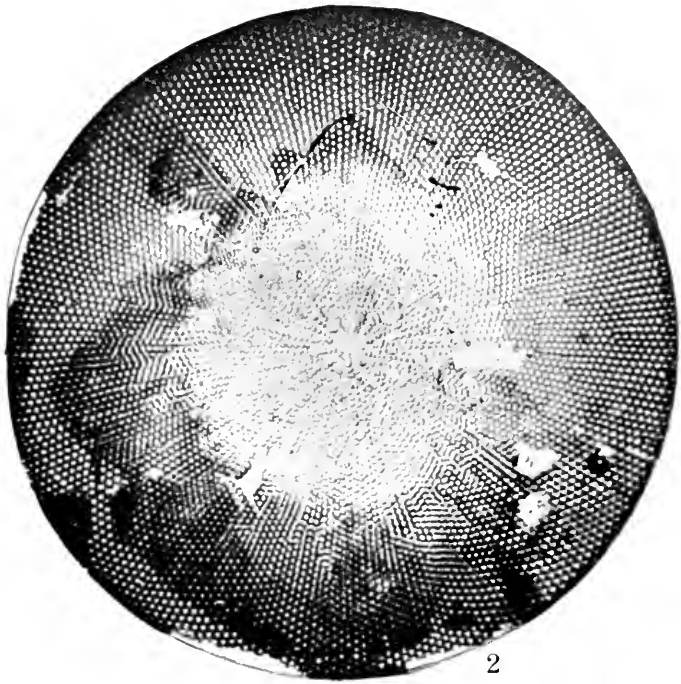
Fig. 1. *Coscinodiscus convexus* Schmidt. Plesiotype, No. 3162, C. A. S.; × 345; diameter, .232 mm.

Fig. 2. *Coscinodiscus fulguralis* Brun. Plesiotype, No. 3164, C. A. S.; × 308; diameter, .2912 mm.

[The diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



1



2

PLATE 8

Fig. 1. *Coscinodiscus lineatus* Ehrenberg. Plesiotype, No. 3165, C. A. S.; × 1600; diameter, .0412 mm.

Fig. 2. *Coscinodiscus lineatus* Ehrenberg. Plesiotype, No. 3166, C. A. S.; × 1600; diameter, .040 mm.

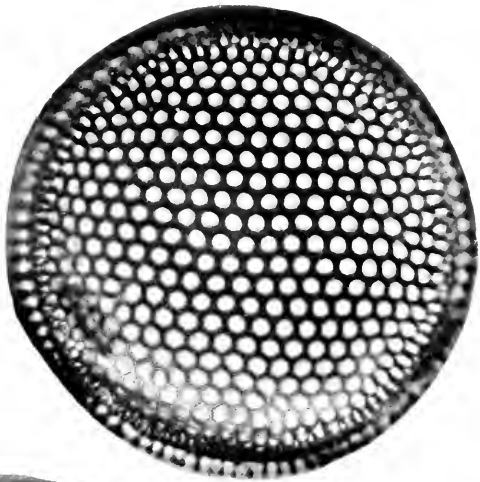
Fig. 3. *Coscinodiscus lineatus* Ehrenberg. Plesiotype, No. 3167, C. A. S.; × 1600; diameter, .0420 mm.

Fig. 4. *Coscinodiscus marginatus* Ehrenberg. Plesiotype, No. 3168, C. A. S.; × 714; diameter, .0840 mm.

Fig. 5. *Coscinodiscus marginatus* Ehrenberg. Plesiotype, No. 3169, C. A. S.; × 433; diameter, .1040 mm.

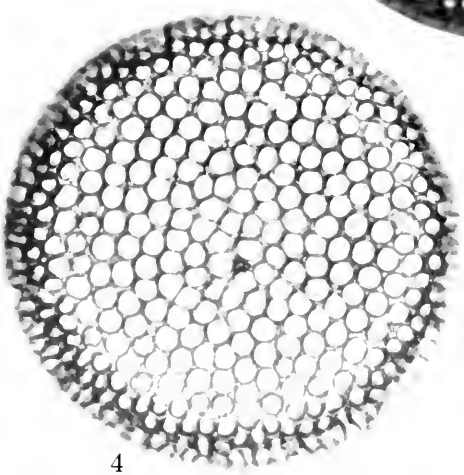
[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]

1

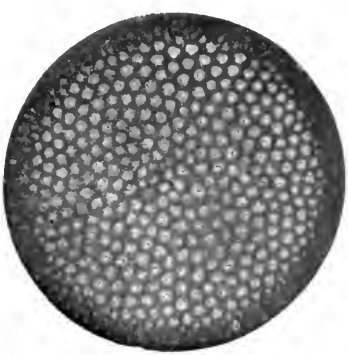


2

3



4



5

PLATE 9

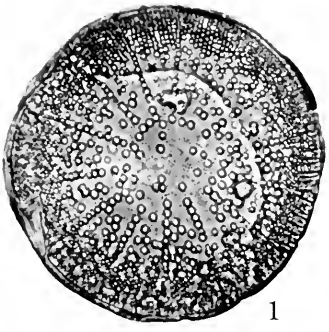
Fig. 1. *Coscinodiscus meditatus* Hanna, n. sp. Holotype, No. 3170, C. A. S.; × 775; diameter, .0541 mm.

Fig. 2. *Coscinodiscus monicæ* Grunow. Plesiotype, No. 3171, C. A. S.; × 430; diameter, .160 mm.

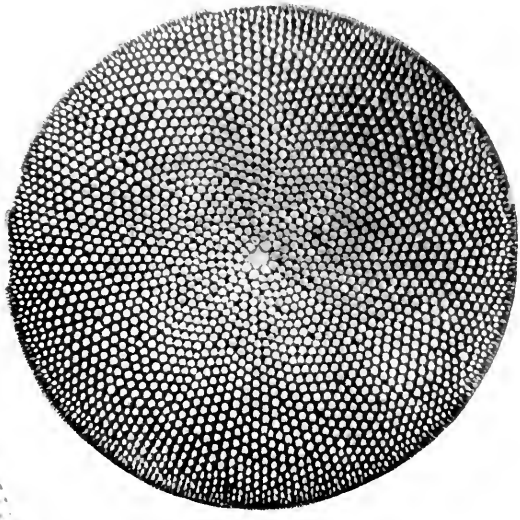
Fig. 3. *Coscinodiscus novozealandius* Grove. Plesiotype, No. 3172, C. A. S.; × 1485; diameter, .0465 mm.; 6 beads in .01 mm.

Fig. 4. *Coscinodiscus oculus-iridis* Ehrenberg. Plesiotype, No. 3173, C. A. S.; × 365; diameter, .240 mm.; 3 beads in .01 mm. near margin.

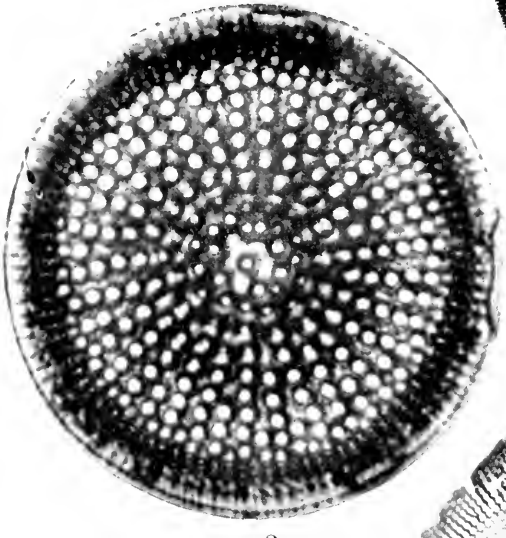
[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



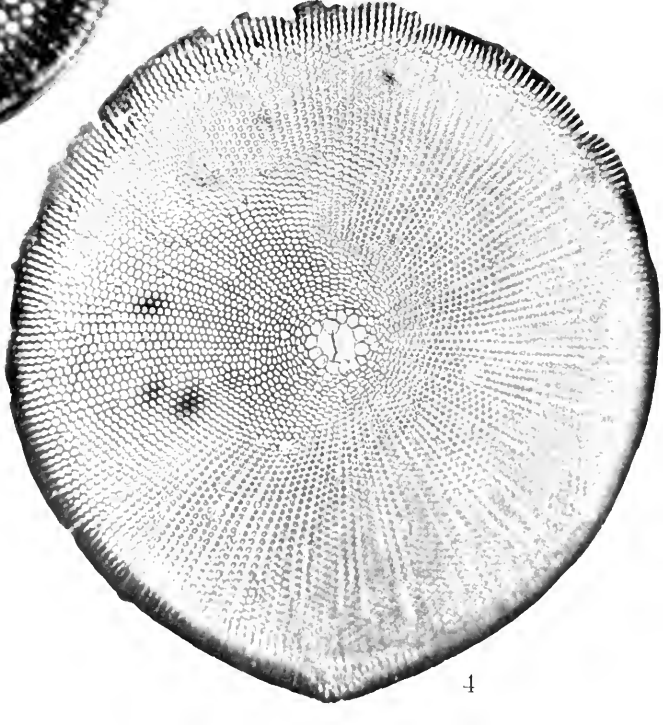
1



2



3



4

PLATE 10

Fig. 1. *Coscinodiscus pacificus* Grunow. Plesiotype, No. 3174, C. A. S.; × 450; diameter, .160 mm.

Fig. 2. *Cyclotella kelloggi* Hanna, n. sp. Holotype, No. 3175, C. A. S.; × 1734; diameter, .0392 mm.

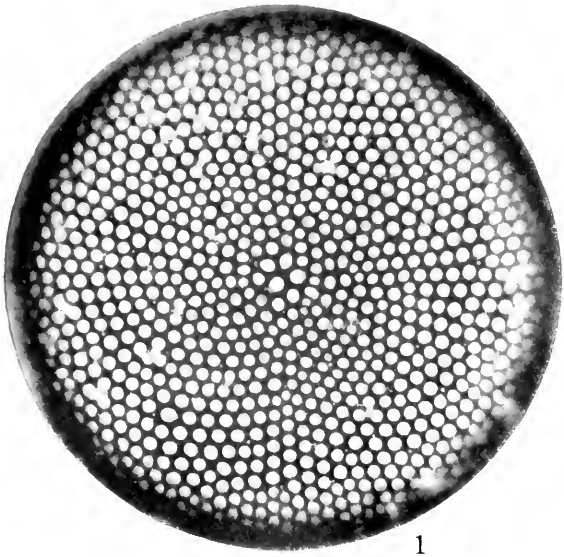
Fig. 3. *Cyclotella kelloggi* Hanna, n. sp. Paratype, No. 3176, C. A. S.; × 1870; diameter, .031+ mm.

Fig. 4. *Cyclotella kelloggi* Hanna, n. sp. Paratype, No. 3177, C. A. S.; × 1518; diameter, .031 mm.; from Calif. Acad. Sci. Loc. 1221, Federal Exploration Company, Kinsella Well No. 1, Sec. 15, T. 22S., R. 24E., M. D. M., Tulare County, California; depth 4156 feet; Temblor (?) Miocene.

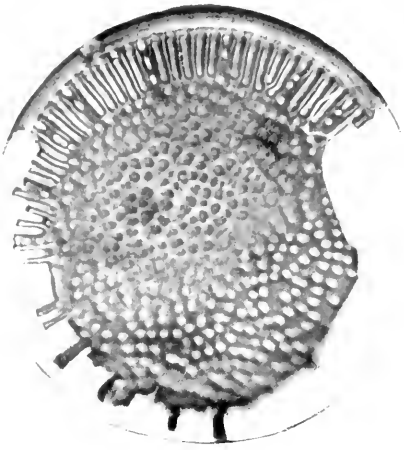
Fig. 5. *Cymatogonia amblyoceras* (Ehrenberg). Plesiotype, No. 3178, C. A. S.; × 550; length of one side, .090 mm.; 13 rows of beads in .01 mm.

Fig. 6. *Cymatosira andersoni* Hanna, n. sp. Holotype, No. 3182, C. A. S.; × 1800; length, .0340 mm.; width, .01 mm.; 10 beads in .01 mm.

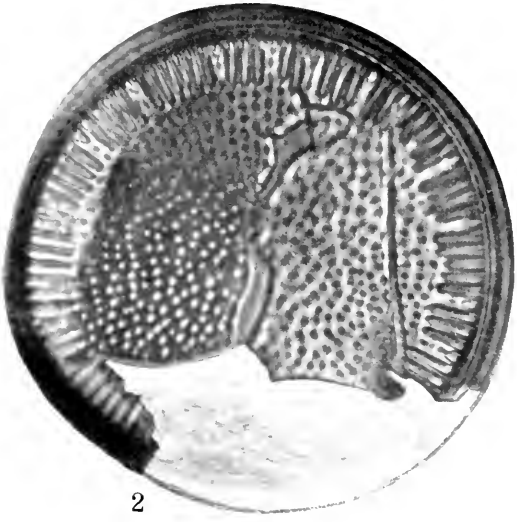
[All of the diatoms illustrated on this plate except figure 4 are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



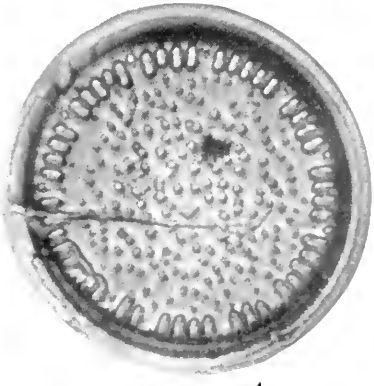
1



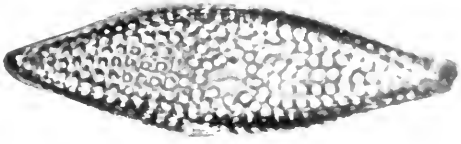
3



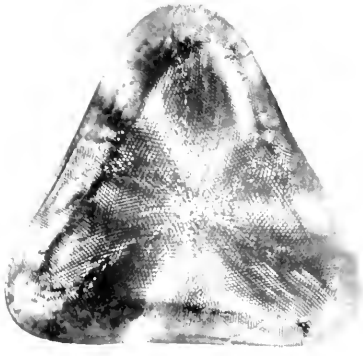
2



4



6



5

PLATE 11

Fig. 1. *Denticula lauta* Bailey. Plesiotype, No. 3183, C. A. S.; × 2000; length, .0216 mm.; width, .0062 mm.

Fig. 2. *Dimeregramma scutulum* Hanna, n. sp. Holotype, No. 3184, C. A. S.; × 1818; length, .0330 mm.; width, .0133 mm.; 9 beads in .01 mm.

Fig. 3. *Dossetia lacera* (Forti). Plesiotype, No. 3185, C. A. S.; × 406; length, .0592 mm.; the dark markings on the disk are sharp spines, out of focus in this view.

Fig. 4. *Goniothecium rogersii* Ehrenberg. Plesiotype, No. 3186, C. A. S.; × 717; length, .0530 mm.; width, .0420 mm.

Fig. 5. *Goniothecium rogersii* Ehrenberg. Plesiotype, No. 3187, C. A. S.; × 900; length, .0735 mm.; width, .0444 mm.

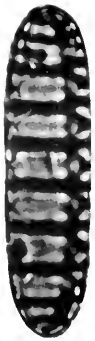
Fig. 6. *Goniothecium rogersii* Ehrenberg. Plesiotype, No. 3188, C. A. S.; × 940; length, .0532 mm.; width, .0428 mm.

Fig. 7. *Hemiaulus polymorphus* Grunow. Plesiotype, No. 3189, C. A. S.; × 842; diameter, .0285 mm.; height, .0220 mm.; 5 rows of beads in .01 mm.

Fig. 8. *Hyalodiscus frenguellii* Hanna, n. sp. Holotype, No. 3190, C. A. S.; × 620; diameter, .0968 mm.

Fig. 9. *Hyalodiscus frenguellii* Hanna, n. sp. Same specimen as figure 8, × 1600; enlarged to show details of sculpture.

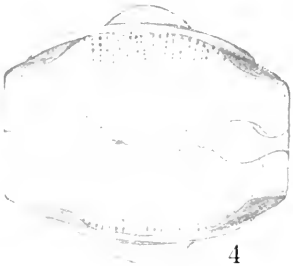
[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



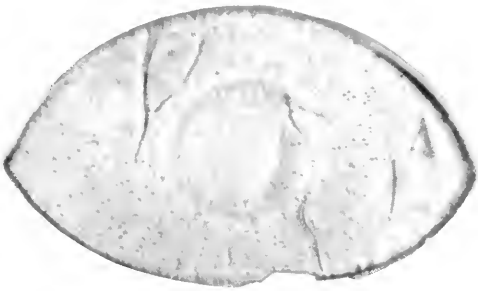
1

2

3

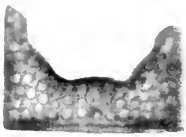


4

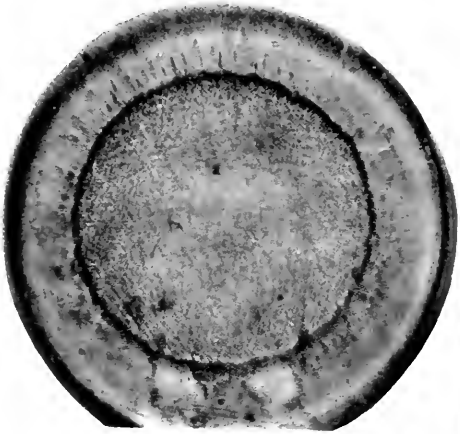


5

6



7



8

9

PLATE 12

Fig. 1. *Eupodiscus antiquus* Cox. Plesiotype, No. 3193, C. A. S.; × 533; diameter, .1426 mm.; 3 beads in .01 mm.

Fig. 2. *Eupodiscus antiquus* Cox. Same specimen as figure 1 with a lower focus.

Fig. 3. *Eupodiscus antiquus* Cox. Diagrammatic cross section through spines.

Fig. 4. *Eupodiscus antiquus* Cox. Diagrammatic side view of border at one of the spines.

Fig. 5. *Liradiscus rugulosus* Forti. Plesiotype, No. 3198, C. A. S.; × 1200; length, .0274 mm.; width, .0153 mm.

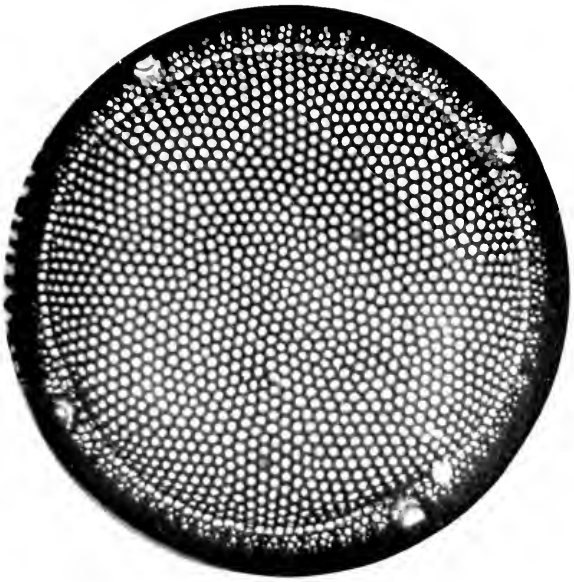
Fig. 6. *Liradiscus rugulosus* Forti. Diagrammatic side view omitting spines.

Fig. 7. *Macrora stella* (Azpeitia). Plesiotype, No. 3199, C. A. S.; × 3290; diameter, .0152 mm.

Fig. 8. *Melosira geometrica* Hanna, n. sp. Holotype, No. 3200, C. A. S.; × 1300; diameter, .030 mm.

Fig. 9. *Melosira geometrica* Hanna, n. sp. Paratype, No. 3201, C. A. S.; × 1275; diameter, .0352 mm.; length, .0139 mm.

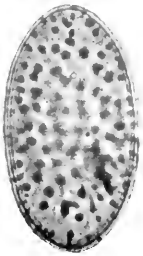
[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



1

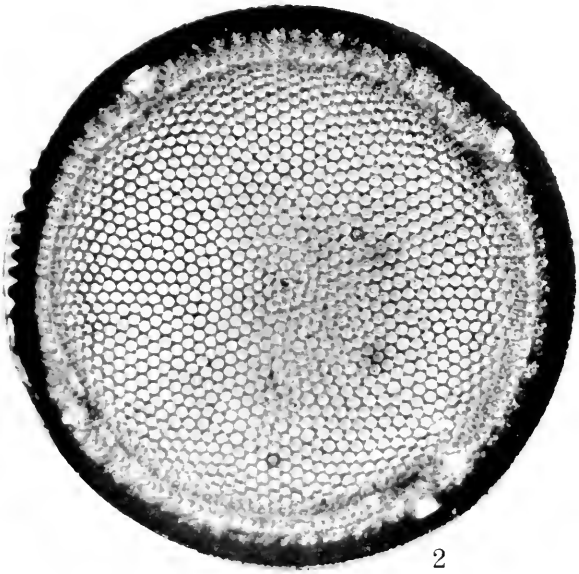
3

4

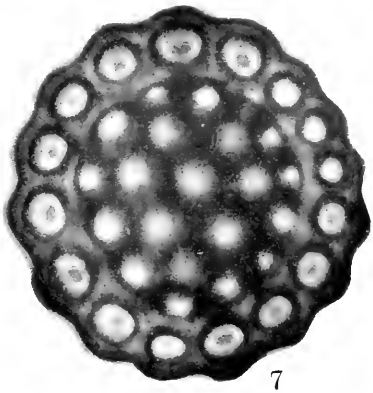


5

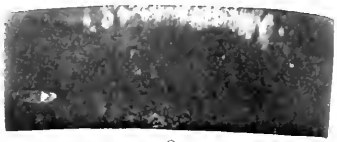
6



2



7



9

8

PLATE 13

Fig. 1. *Navicula kernensis* Hanna, n. sp. Holotype, No. 3202, C. A. S.; × 470; length, .192 mm.; width, .040 mm.; 9 costæ in .01 mm.

Fig. 2. *Navicula lyra* Ehrenberg. Plesiotype, No. 3204, C. A. S.; × 536; length, .1640 mm.; width, .060 mm.; 11 rows of beads in .01 mm.

Fig. 3. *Navicula marina* Ralfs. Plesiotype, No. 3205, C. A. S.; × 722; length, .090 mm.; width, .0447 mm.; 6 rows of beads in .01 mm.

Fig. 4. *Navicula mimicans* Hanna, n. sp. Holotype, No. 3206, C. A. S.; × 666; length, .1350 mm.; width, .0345 mm.

Fig. 5. *Navicula morricei* Hanna, n. sp. Holotype, No. 3209, C. A. S.; × 766; length, .120 mm.; width, .0580 mm.; 10 rows of beads in .01 mm. in center, 9 at ends.

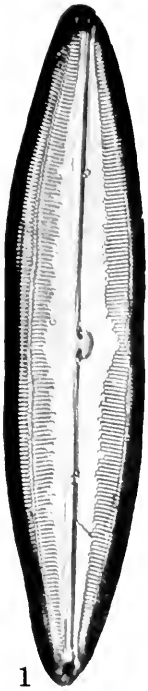
Fig. 6. *Navicula optima* Hanna, n. sp. Holotype, No. 3210, C. A. S.; × 1500; length, .0411 mm.; width, .0114 mm.; 8 costæ in .01 mm.

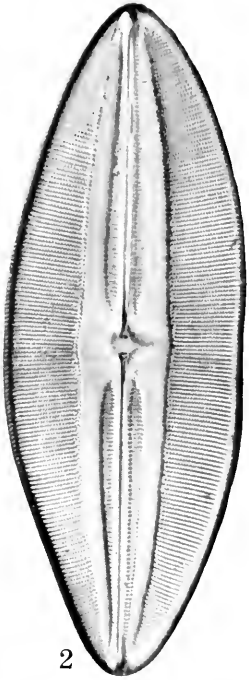
Fig. 7. *Navicula proserpinæ* (?) Pantocsek. Plesiotype, No. 3211, C. A. S.; × 945; length, .0570 mm.; width, .0125 mm.; 15 costæ in .01 mm.

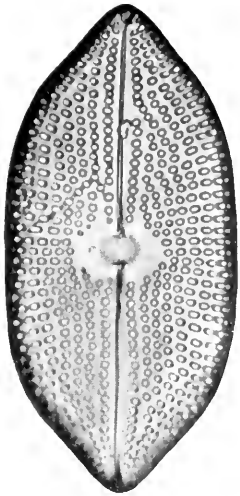
Fig. 8. *Periptera tetracladia* Ehrenberg. Plesiotype, No. 3212, C. A. S.; × 2000; diameter, .0263 mm.

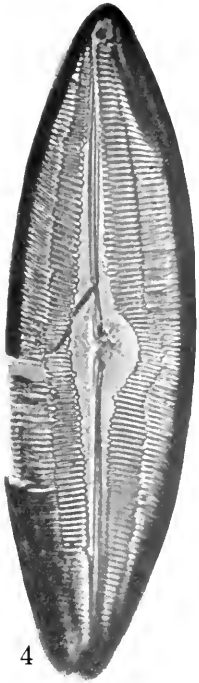
Fig. 9. *Periptera tetracladia* Ehrenberg. Diagrammatic cross-section of frustule.

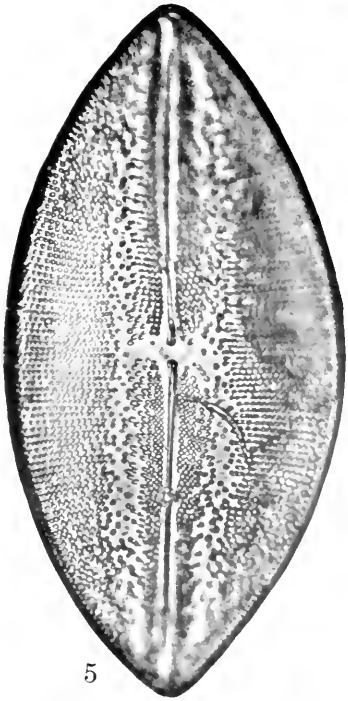
[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]


1


2

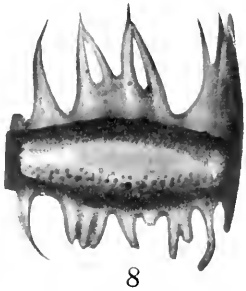

3


4


5


6


7


8

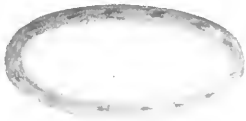

9

PLATE 14

Fig. 1. *Perrya innocens* Hanna, n. sp. Holotype, No. 3213, C. A. S.; × 365; length, .1860 mm., (originally .260 mm.); width, .080 mm.; 4 to 5 major striæ in .01 mm.

Fig. 2. *Plagiogramma truanii* Pantocsek. Plesiotype, No. 3214, C. A. S.; × 2043; length, .0548 mm.; width, .0122 mm.; 17 beads in .01 mm.

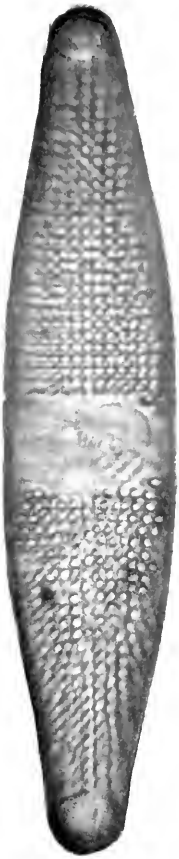
Fig. 3. *Raphidodiscus marylandicus* Christian. Plesiotype, No. 3215, C. A. S.; × 1027; length, .0555 mm.; width, .0515 mm.; 13 transverse rows of beads in .01 mm. in center of valve.

Fig. 4. *Raphidodiscus marylandicus* Christian. Plesiotype, No. 3218, C. A. S.; × 1000; length, .0382 mm.; width, .0382 mm.; 13 rows of beads in .01 mm. in center of valve.

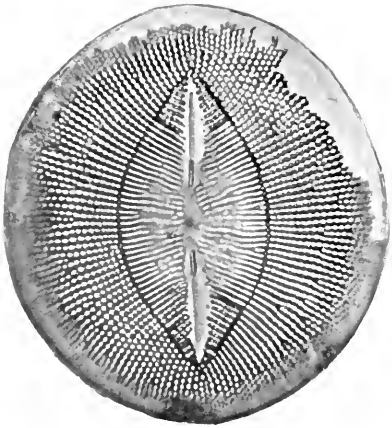
Fig. 5. *Rattrayella inconspicuua* (Rattray). Plesiotype, No. 3219, C. A. S.; × 700; diameter, .1376 mm.; 3 cells in .01 mm. in center of valve.

[All of the diatoms illustrated on this plate are from Calif. Acad. Sci. Loc. 1068, southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]

1

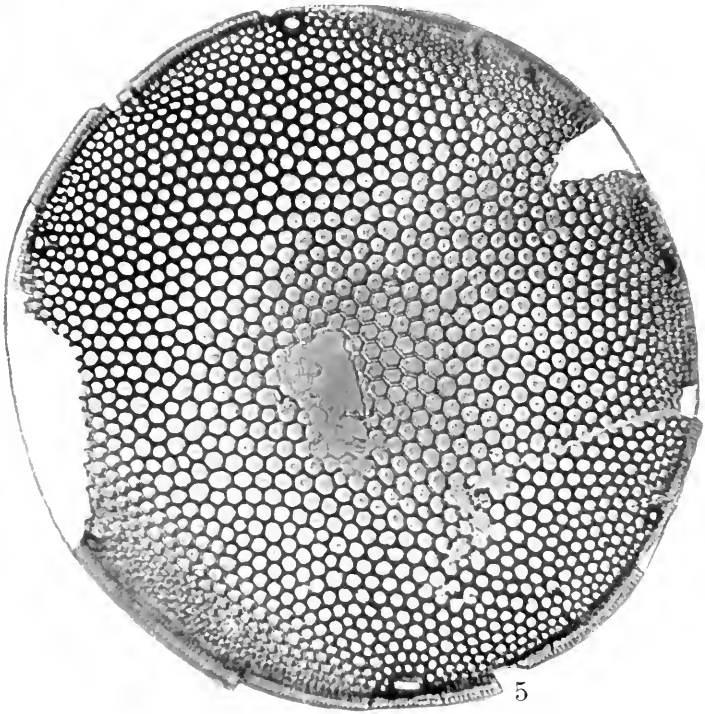


2



3

4



5

PLATE 15

Fig. 1. *Rattrayella inconspicuua* (Rattray). Plesiotype, No. 3220, C. A. S.; × 735; diameter, .0966 mm.; loc. 1068.

Fig. 2. *Rattrayella inconspicuua* (Rattray). Plesiotype, No. 3221, C. A. S.; × 710; diameter, .10 mm.; loc. 1068.

Fig. 3. *Rhaphoneis amphiceros* Ehrenberg. Plesiotype, No. 3222, C. A. S.; × 1116; length, .060 mm.; width, .0293 mm.; 7 beads in .01 mm.; loc. 1063.

Fig. 4. *Rhaphoneis amphiceros* Ehrenberg. Plesiotype, No. 3223, C. A. S.; × 1250; length, .0435 mm.; width, .0238 mm.; 8 beads in .01 mm.; loc. 1063.

Fig. 5. *Rhaphoneis amphiceros* Ehrenberg. Plesiotype, No. 3224, C. A. S.; × 1733; length, .030 mm.; width, .0175 mm.; 8 beads in .01 mm.; loc. 1063.

Fig. 6. *Rhaphoneis elegans* Pantocsek & Grunow. Plesiotype, No. 3225, C. A. S.; × 1185; length, .0363 mm.; width, .0158 mm.; 5.5 beads in .01 mm.; loc. 1187.

Fig. 7. *Rhaphoneis elegans* Pantocsek & Grunow. Plesiotype, No. 3226, C. A. S.; × 1170; length, .0470 mm.; width, .0170 mm.; 5 beads in .01 mm.; loc. 1187.

Fig. 8. *Rhaphoneis elegans* Pantocsek & Grunow. Plesiotype, No. 3227, C. A. S.; × 1185; length, .0668 mm.; width, .0196 mm.; 5 beads in .01 mm.; loc. 1187.

Fig. 9. *Rhaphoneis obesa* Hanna, n. sp. Holotype, No. 3228, C. A. S.; × 1235; length, .0385 mm.; width, .0180 mm.; 8 beads in .01 mm.; loc. 1068.

Fig. 10. *Rhaphoneis obesa* Hanna, n. sp. Paratype, No. 3229, C. A. S.; × 1533; length, .030 mm.; width, .0181 mm.; 8 beads in .01 mm.; loc. 1063.

[Loc. 1063; on west side of Cottonwood Creek, Sec. 13, T. 29S., R. 29E., M. D. M., Kern County, California; Temblor Miocene.]

[Loc. 1068; on southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]

[Loc. 1187, near top of 1340 Hill on west side of Round Mountain, Kern County, California; Temblor Miocene.]

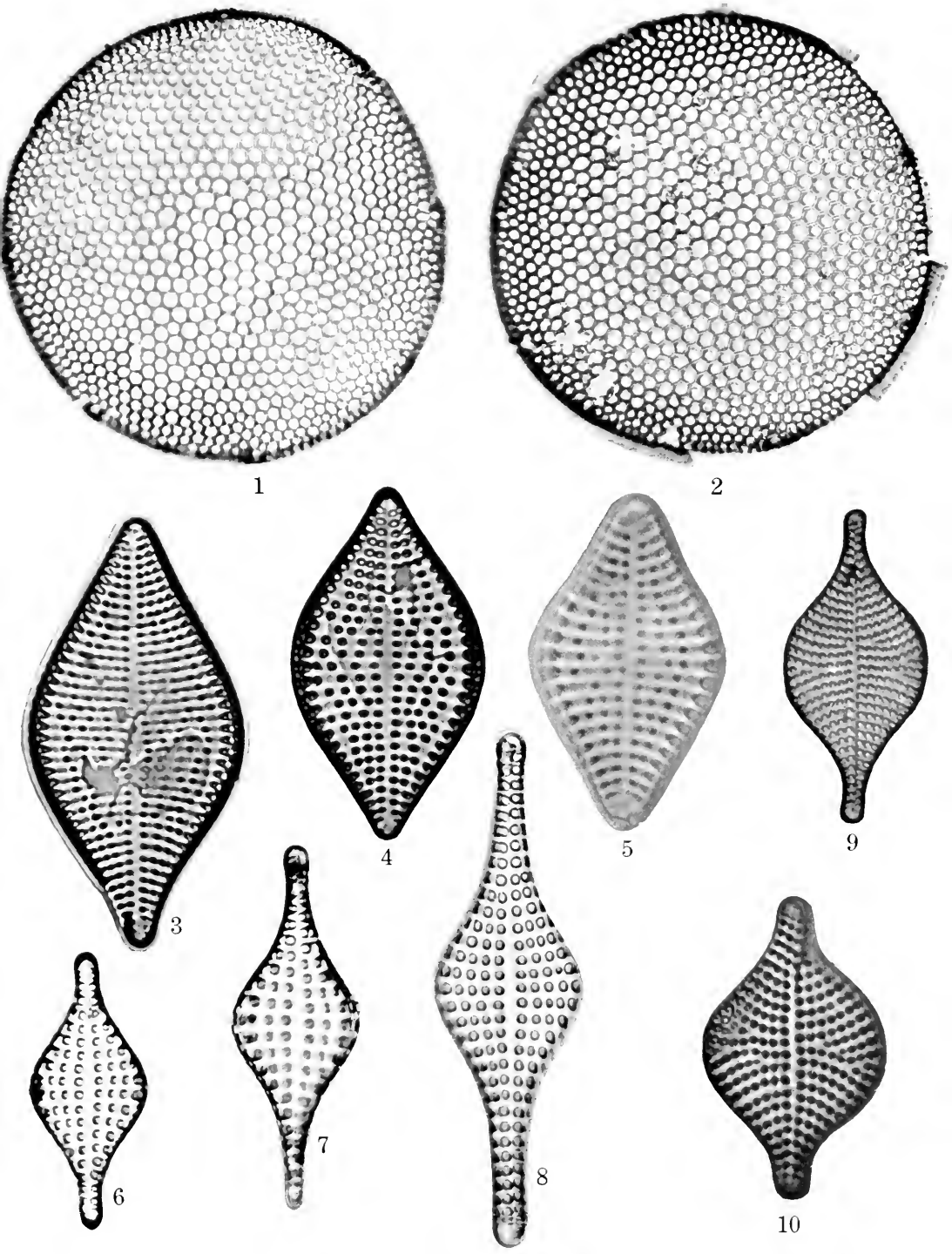

1
2
3
4
5
9
6
7
8
10

PLATE 16

Fig. 1. *Rhaphoneis obesula* Hanna, n. sp. Holotype, No. 3230, C. A. S.; × 1750; length, .020 mm.; width, .0155 mm.; 9 rows of beads in .01 mm.; loc. 1068.

Fig. 2. *Rhaphoneis parilis* Hanna, n. sp. Holotype, No. 3231, C. A. S.; × 1140; length, .0429 mm.; width, .010 mm.; 7 rows of beads in .01 mm.; loc. 1187.

Fig. 3. *Rhaphoneis parilis* Hanna, n. sp. Paratype, No. 3232, C. A. S.; × 1140; length, .0490 mm.; width, .010 mm.; 7 rows of beads in .01 mm.; loc. 1187.

Fig. 4. *Rhaphoneis parilis* Hanna, n. sp. Paratype, No. 3233, C. A. S.; × 1140; length, .0344 mm.; width, .010 mm.; 7 rows of beads in .01 mm.; loc. 1187.

Fig. 5. *Sceptroneis caduceus* Ehrenberg. Plesiotype, No. 3234, C. A. S.; × 450; length, .10 mm.; width, .020 mm.; 3 transverse rows of beads in .01 mm.; loc. 1068.

Fig. 6. *Sceptroneis caduceus* Ehrenberg. Plesiotype, No. 3235, C. A. S. × 463; length, .1466 mm.; width, .0170 mm.; loc. 1068.

Fig. 7. *Sceptroneis caduceus* Ehrenberg. Plesiotype, No. 3236, C. A. S.; × 463; length, .2048 mm.; width, .0167 mm.; loc. 1068.

Fig. 8. *Stephanogonia polyacantha* Forti. Plesiotype, No. 3237, C. A. S.; × 622; diameter, .0868 mm.; loc. 1068.

Fig. 9. *Stephanopyxis lineata* (Ehrenberg). Plesiotype, No. 3238, C. A. S.; × 420; diameter, .0875 mm.; loc. 1068.

Fig. 10. *Stephanopyxis lineata* (Ehrenberg). Plesiotype, No. 3239, C. A. S., × 420; diameter, .066 mm.; loc. 1068.

Fig. 11. *Stephanopyxis lineata* (Ehrenberg). Plesiotype, No. 3240, C. A. S.; × 420; diameter, .070 mm.; loc. 1068.

Fig. 12. *Stictodiscus kittonianus* Greville. Plesiotype, No. 3241, C. A. S.; × 700; diameter, .050 mm.; loc. 1068.

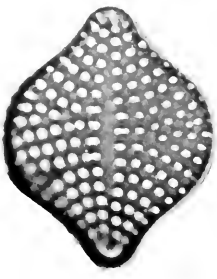
Fig. 13. *Surirella tembloris* Hanna, n. sp. Holotype, No. 3242, C. A. S.; × 932; length, .0954 mm.; width, .040 mm.; 4 marginal costæ in .01 mm.; loc. 1063.

Fig. 14. *Surirella tembloris* Hanna, n. sp. Paratype, No. 3243, C. A. S.; × 555; length, .1080 mm.; width, .0504 mm.; loc. 1063.

[Loc. 1063; on west side of Cottonwood Creek, Sec. 13, T. 29S., R. 29E., M. D. M., Kern County, California; Temblor Miocene.]

[Loc. 1068; on southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]

[Loc. 1187; near top of 1340 Hill on west side of Round Mountain, Kern County, California; Temblor Miocene.]



1

2

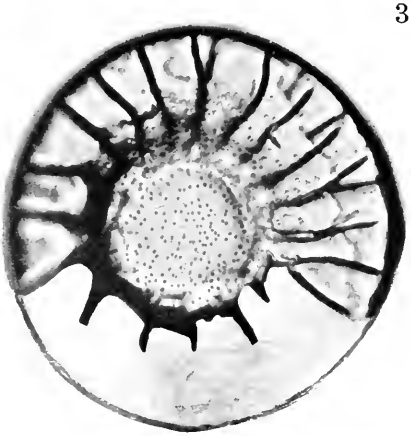
3

4

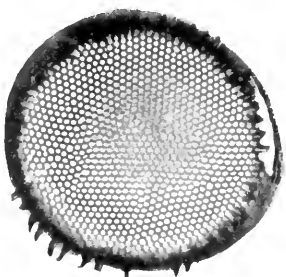
5

6

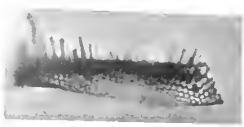
7



8



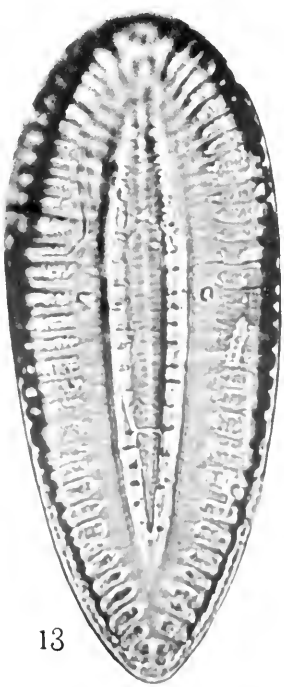
9



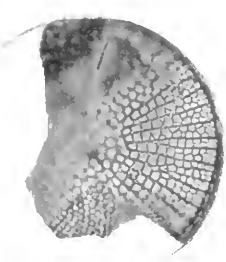
10

11

14



13



12

PLATE 17

Fig. 1. *Triceratium condecorum* Brightwell. Plesiotype, No. 3245, C. A. S.; × 1308; length of one side, .0382 mm.; loc. 1068.

Fig. 2. *Triceratium subrotundatum* Schmidt. Plesiotype No. 3257, C. A. S.; × 450 mm.; length of one side, .0888 mm.; loc. 1063.

Fig. 3. *Triceratum condecorum* Brightwell. Plesiotype, No. 3246, C. A. S.; × 1635; length of one side, .0422 mm.; loc. 1063.

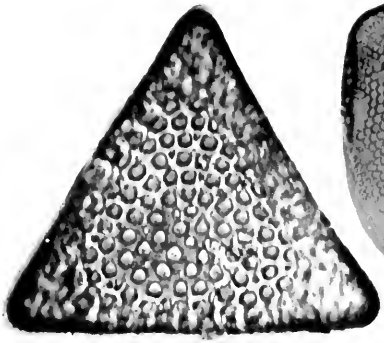
Fig. 4. *Triceratium spinosum* Bailey. Plesiotype, No. 3247, C. A. S.; × 1175; length of one side, .0930 mm.; 6 beads in .01 mm. on disk; loc. 1068. Three long curved setæ placed asymmetrically on the valve are out of focus and are indicated on the photograph as large black dots; the marginal spines are likewise out of focus.

Fig. 5. *Triceratium spinosum* Bailey. Same specimen as figure 3 with a different focus to show the marginal zone.

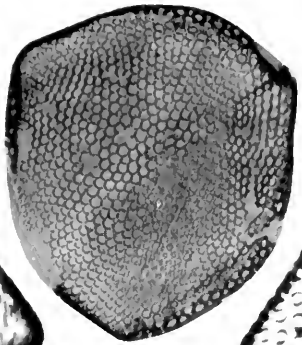
Fig. 6. *Tropidoneis primoris* Hanna, n. sp. Paratype, No. 3249, C. A. S.; × 2000; length, .1184 mm.; width, .0137 mm.; 24 rows of beads in .01 mm.; loc. 1068.

[Loc. 1063; west side of Cottonwood Creek, Sec. 13, T. 29S., R. 29E., M. D. M., Kern County, California; Temblor Miocene.]

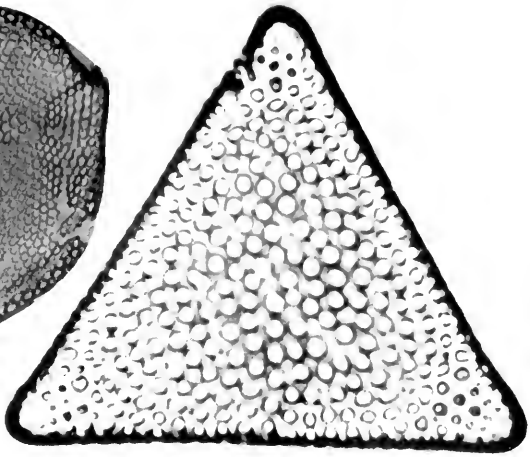
[Loc. 1068; southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]



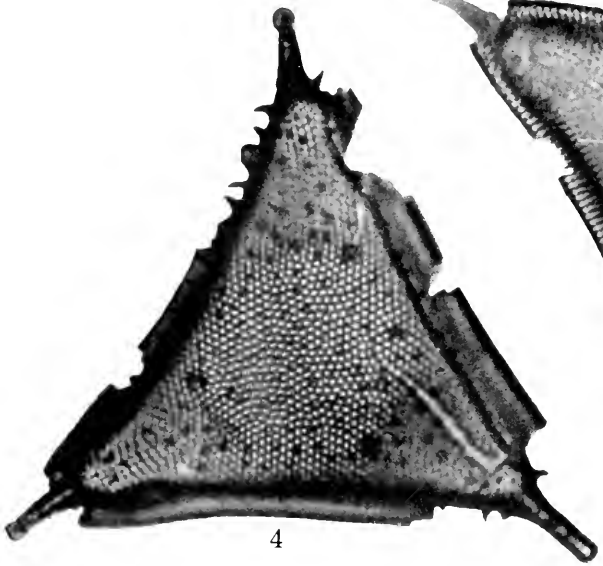
1



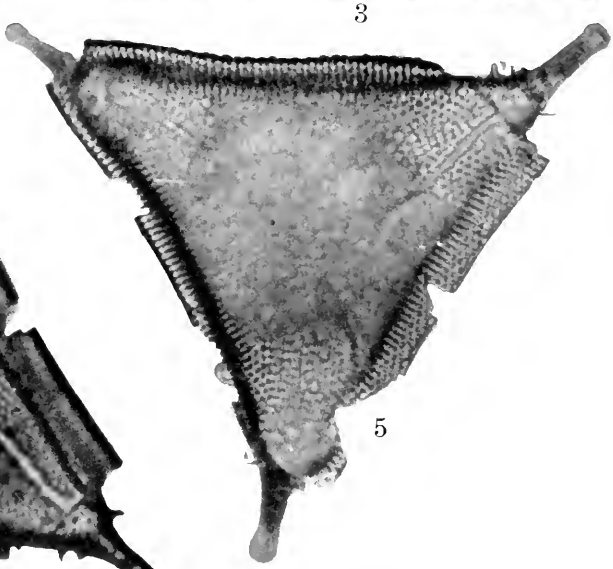
2



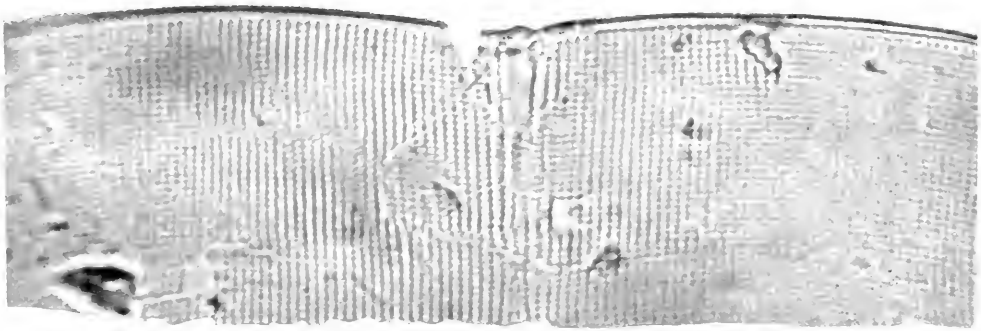
3



4



5



6

PLATE 18

Fig. 1. *Tropidoneis primoris* Hanna, n. sp. Holotype, No. 3248, C. A. S.; × 693; length, .1240 mm.; width, .040 mm.; loc. 1068.

Fig. 2. *Tropidoneis primoris* Hanna, n. sp. Paratype, No. 3249, C. A. S.; × 565; length, .1184 mm.; width, .0137 mm.; 24 rows of beads in .01 mm.; loc. 1068.

Fig. 3. *Xanthiopyxis globosa* Ehrenberg. Plesiotype, No. 3250, C. A. S.; × 1000; diameter, .0250 mm.; loc. 1068.

Fig. 4. *Xanthiopyxis maculata* Hanna, n. sp. Holotype, No. 3251, C. A. S.; × 1820; length, .050 mm.; width, .0161 mm.; loc. 1068.

Fig. 5. *Xanthiopyxis marginata* Hanna, n. sp. Holotype, No. 3252, C. A. S.; × 1200; diameter, .0296 mm.; loc. 1068.

Fig. 6. *Xystotheca hustedti* Hanna, n. sp. Holotype, No. 3253, C. A. S.; × 817; length, .0714 mm.; width, .0350 mm.; from Calif. Acad. Sci. Loc. 1170, Smuggler's Cove, Santa Cruz Island, California; Temblor Miocene.

Fig. 7. *Xystotheca hustedti* Hanna, n. sp. Paratype, No. 3254, C. A. S.; × 1305; length, .0268 mm.; width, .0188 mm.; loc. 1068.

Fig. 8. *Zygoceros* (?) *quadricornis* Grunow. Plesiotype, No. 3255, C. A. S.; × 1411; distance across side of square, .0170 mm.; loc. 1063. Vertical (valval) view showing markings inside of square and projecting riblets supporting portion of funnel-like sides; only one of four corner-spines intact.

Fig. 9. *Zygoceros* (?) *quadricornis* Grunow. Plesiotype, No. 3256, C. A. S.; width at narrowest part, .0129 mm.; loc. 1068. Girdle view; one spine and one margin of valve reconstructed.

[Loc. 1063; on west side of Cottonwood Creek, Sec. 13, T. 29S., R. 29E., M. D. M., Kern County, California; Temblor Miocene.]

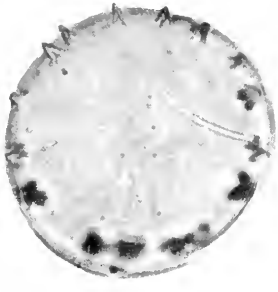
[Loc. 1068; on southeast side of Sharktooth Hill, Kern County, California; Temblor Miocene.]

[Loc. 1187; near top of 1340 Hill on west side of Round Mountain, Kern County, California; Temblor Miocene.]

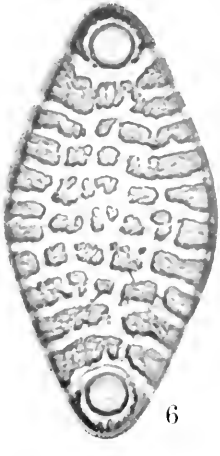

1


2

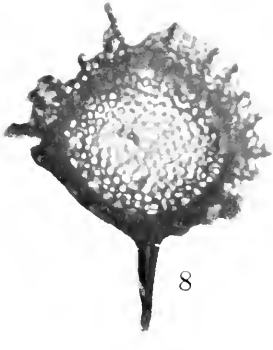

3


5


4


6


7


8


9

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 7, pp. 265-267 JANUARY 8, 1932

VII

A NEW SUBSPECIES OF CORAL SNAKE FROM GUATEMALA

BY

KARL P. SCHMIDT

A series of 13 specimens of coral snakes, collected by Mr. Joseph R. Slevin in Guatemala for the California Academy of Sciences, was loaned through the courtesy of that institution to Field Museum of Natural History for comparison with other Central American coral snakes of the genus *Micrurus*. The Guatemalan specimens prove to be plainly referable to *Micrurus nigrocinctus*, which ranges from Panama to Guatemala. They represent, however, a well-defined subspecies, distinguished by coloration and geographic range.

Since the date of Boulenger's catalogue, the common Central American coral snakes have been lumped together as *Micrurus fulvius* by most authors. I have shown elsewhere[1] that as a preliminary step in breaking up this supposed "species", *M. nigrocinctus* (type locality, Taboga I., Bay of Panama), and *M. fulvius* (type locality, Carolina) can be separated positively by the curious character of supra-anal tubercles in the male *nigrocinctus*, which are wholly wanting in *fulvius*.

[1]Schmidt, Karl P., 1928, Notes on American Coral Snakes <Bull. Antivenin Inst. Amer., 2, p. 63-64.

The races of *nigrocinctus* are in much confusion as to nomenclature which can only be ended by a critical study of types, but this confusion does not apply to the form under consideration, which may prove to range through the Pacific drainage of Guatemala, and which forms the northwestern outpost of *M. nigrocinctus*.

Micrurus nigrocinctus zunilensis Schmidt, new subspecies

Type: A male, No. 66,001, Mus. Calif. Acad. Sci., collected by Joseph R. Slevin, June 1, 1926, at **Finca El Cipres, lower slopes of Volcan Zunil, Province of Suchetepequez, near Samayac, near Mazatenango, Guatemala.**

Diagnosis: Habitus of a typical *Micrurus nigrocinctus*. Tail of adult male with conspicuous supra-anal tubercles; body with red, yellow, and black rings, the yellow rings very narrow, the red rings about four times as long as the black; fifteen to twenty black rings on the body, four to seven on the tail; no black pigment in the red spaces.

Description of type: Amount of rostral visible from above equals length of internasal suture, which is about one-third that of the prefrontals; frontal as long as its distance from snout, shorter than parietals; upper labials 7; lower labials 7; oculars 1–2; temporals 1–1 on right, 1–2 on left; dorsal scales 17 to the fifth ventral, where they reduce to 15; ventral plates (from the chin shields), 198; subcaudals 46; supra-anal tubercles well developed.

Snout black, extending to anterior border of parietals and involving half of fourth lower, and all of fourth upper, labials; lower postocular mostly yellow, as is the triangular tip of frontal and anterior two-thirds of parietals; first black ring involving posterior third of parietals, extending to fifth dorsal and fourth ventral; fifteen black rings on body, separated by red interspaces, with narrow yellow rings, one scale and one ventral in width, between red and black rings; no

black pigment in red spaces above or below; tail with six black rings separated by yellow rings.

Total length 500 mm.; tail 74 mm.

Notes on paratypes: The typical series includes, with the type, nine male and four female specimens, all from the type locality. The ventrals in males vary from 196 to 207, in females from 213 to 218. The subcaudals in males range from 43 to 53, in females from 33 to 38. Three male specimens have respectively 1, 2 and 3 subcaudals entire. The black rings on body and tail are 14 + 5 to 18 + 7 in males, 15 + 4 to 20 + 5 in females. The yellow borders of the black rings tend to disappear and are frequently absent beneath. The temporals are 1–2 on each side in Field No. 3,100, all the others having temporals 1–1, as is normal for *nigrocinctus*.

Remarks: This subspecies of *nigrocinctus* evidently has nothing to do with *Elaps guatemalensis* Ahl, which has a light snout and 28 black rings, or with *Elaps fulvius sapperi* Werner, which has the rings broken up into spots. It differs most conspicuously from typical *nigrocinctus* in the absence of black pigment on the tips of the red scales.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, NO. 8, PP. 269-290 JANUARY 8, 1932

VIII

BIRDS AND MAMMALS FROM THE KOOTENAY VALLEY, SOUTHEASTERN BRITISH COLUMBIA

BY

JOSEPH MAILLIARD, *Curator Emeritus*
Department of Ornithology and Mammalogy
California Academy of Sciences

In the spring of 1928 an opportunity presented itself for carrying on some field work around Creston, Kootenay Valley, southeastern British Columbia, under certain favorable conditions, of which it seemed advisable to take advantage. The party concerned in this work consisted of the writer, Frank Tose, Chief, and Russell Hendricks, student assistant, Department of Exhibits.

Traveling by rail, the party reached Creston on April 30, and the next day established headquarters on some property owned by Mr. Tose, about 1½ miles south of the town on a bench overlooking the Kootenay River bottom, where it remained until May 18. On that date headquarters were moved to the northern edge of town and maintained there until the close of field work, June 5.

Creston is situated on a series of benches on the east side of the Kootenay River about 14 miles southeasterly from Kootenay Landing, which place is at the south end of Lake Kootenay. The altitude of Creston is recorded as 1985 feet,

but the bench mark must be in the lower portion of the town, about 200 feet above the river, which has along this part but a very slight fall. The river bottom here has a width of three to four miles, almost level crosswise, from which rises, at first gradually and then more abruptly, a mountain range on each side; the Purcell Range on the eastern and the Nelson Range on the western side.

Benches of partly open, rolling land extend for some miles above Creston eastward toward the Purcell Mountains, from which flows the Goat River, whose valley widens out at the southern edge of the town on its way to join the Kootenay. On the west side of the latter river rises the gloomy, but less precipitous, Nelson Range, covered with brush and timber. Along the foothills on the east side of the Kootenay are roads and railroads, passing through large timber areas and some open lands, but on the west side, except along the bottom land, there are few roads and fewer trails, the latter made impassable by the melting snow of spring.

On May 2 work began in earnest. Mr. Tose made arrangements with a resident for his labor and the use of a team and wagon with which to visit places in the neighborhood. Tose made a trip across the Kootenay River to West Creston, where collecting was carried on from May 9 to May 14, when warning was received to return at once, as the river was rising to such a height as would soon prevent, for some weeks to come, the bringing back of the outfit. Another trip was made, from May 18 to May 25, to Kitchener and Yahk, at higher elevations than that of Creston, on the western side of the Purcell Range. The two other members of the party meanwhile covered the area within working distance of Creston.

The Kootenay River flows past Creston on its way to the long, narrow Kootenay Lake with so slight a fall as to cause the flood waters to back up, in the spring freshets, for many miles to the southward, past the United States boundary line some distance into northern Idaho. The bottom land here spreads out on each side of the river for a mile or so, much of it being productive of good pasture for stock and hay for winter feeding. The river banks and some higher spots in the bottom

have growths of cottonwoods and willows with small islands of pine here and there, so that there is quite a variety of association, from marsh and open meadow to dense groves of large trees, all available for the support and shelter of various forms of bird life during a large part of the year.

Ordinarily the flood waters commence to encroach upon the bottom lands between the first and the middle of June, according to the reports of residents, with the highest water in July, so it was believed that there would be plenty of time for the party to work over the meadows and cottonwood groves before the overflow would interfere, but in the spring of 1928 late snowfalls, followed by rain and high temperatures, greatly advanced the flood stage. In fact, the water was filling the lowest parts of the river bottom at the time of the arrival of the party, April 30, and in very few days all work there had to be abandoned, while all forms of ground and marsh loving birds were driven away. In consequence, the work of the party was then confined to the higher lands, where bird life was found to be rather scarce, and small rodent life exceedingly so. The necessitated return of Tose from the west side of the river was a distinct disappointment, even though the mountain trails were made impassable by the swollen streams.

Two or three years before the arrival of the Academy party a terrific blizzard had struck the forest, just back of the party's first camp, and had caused so much havoc that sawmills had at once been established in order to save as much of the fallen timber as possible before it rotted.

By the middle of May the Goat River had risen to such a height as seriously to threaten the line of communication and supply of the party, so camp was moved on May 18 to the north side of Creston and established at the foot of Goat Mountain for the rest of the stay.

The list of specimens obtained by the party included 319 birds (of 73 species) and 108 small mammals (of 10 species).

For permission to collect migratory birds, acknowledgments are due to the Dominion Parks Branch, Department of the Interior, and to the Game Conservation Board, Vancouver, B. C., for permission to collect non-migratory birds, in the territory covered by the Academy party in this work.

CHECK-LIST OF THE BIRDS

1. *Mergus americanus* Cassin
2. *Anas platyrhynchos* Linnæus
3. *Querquedula cyanoptera* (Vieillot)
4. *Aix sponsa* (Linnæus)
5. *Botaurus lentiginosus* (Montagu)
6. *Gallinago delicata* (Ord)
7. *Oxyechus vociferus* (Linnæus)
8. *Dendragopus obscurus richardsoni* (Douglas)
9. *Bonasa umbellus umbelloides* (Douglas)
10. *Accipiter velox* (Wilson)
11. *Accipiter cooperi* (Bonaparte)
12. *Cerchneis sparveria sparveria* (Linnæus)
13. *Pandion haliaëtes carolinensis* (Gmelin)
14. *Bubo virginianus* subsp.
15. *Ceryle alcyon caurina* Grinnell
16. *Dryobates villosus monticola* Anthony
17. *Dryobates pubescens leucurus* (Hartlaub)
18. *Picoides arcticus* (Swainson)
19. *Picoides americanus fasciatus* Baird
20. *Sphyrapicus varius nuchalis* Baird
21. *Phloeotomus pileatus picinus* Bangs
22. *Asyndesmus lewisi* Riley
23. *Colaptes cafer collaris* Vigors
24. *Archilochus alexandri* (Bourcier & Mulsant)
25. *Selasphorus rufus* (Gmelin)
26. *Stellula calliope* (Gould)
27. *Tyrannus tyrannus* (Linnæus)
28. *Tyrannus verticalis* Say
29. *Myiochanes richardsoni richardsoni* (Swainson)
30. *Empidonax hammondi* (Xantus)
31. *Empidonax wrighti* Baird
32. *Cyanocitta stelleri annectens* (Baird)
33. *Perisoreus canadensis capitalis* Ridgway
34. *Corvus brachyrhynchos hesperis* Ridgway
35. *Nucifraga columbiana* (Wilson)
36. *Dolichonyx oryzivorus* (Linnæus)
37. *Molothrus ater artemisiæ* Grinnell
38. *Agelaius phoeniceus nevadensis* Grinnell
39. *Sturnella neglecta* Audubon
40. *Icterus bullocki* (Swainson)
41. *Euphagus cyanocephalus cyanocephalus* (Wagler)
42. *Hesperiphona vespertina brooksi* Grinnell
43. *Carpodacus cassini* Baird
44. *Spinus pinus pinus* (Wilson)
45. *Passerculus sandwichensis anthinus* Bonaparte
46. *Zonotrichia leucophrys gambelli* (Nuttall)
47. *Spizella passerina arizonæ* Coues
48. *Junco oreganus shufeldti* (Coale)
49. *Melospiza melodia morphna* Oberholser
50. *Passerella iliaca* subsp.
51. *Pipilo maculatus curtatus* Grinnell
52. *Hedymeles melanocephalus melanocephalus* (Swainson)
53. *Passerina amœna* (Say)
54. *Piranga ludoviciana* (Wilson)
55. *Petrochelidon albifrons albifrons* (Rafinesque)
56. *Hirundo erythrogaster* Boddaert
57. *Iridoprocne bicolor* (Vieillot)
58. *Tachycineta thalassina lepida* Mearns
59. *Stelgidopteryx serripennis* (Audubon)
60. *Bombycilla cedrorum* Vieillot
61. *Vireosylva olivacea* (Linnæus)
62. *Vireosylva gilva swainsoni* (Baird)
63. *Lanivireo solitarius cassini* (Xantus)
64. *Vermivora ruficapilla gutturalis* (Ridgway)
65. *Dendroica æstiva æstiva* (Gmelin)
66. *Dendroica auduboni auduboni* (J. K. Townsend)
67. *Geothlypis trichas occidentalis* Brewster
68. *Setophaga ruticilla* (Linnæus)
69. *Dumetella carolinensis* (Linnæus)
70. *Troglodytes aëdon parkmani* Audubon
71. *Nannus hiemalis pacificus* (Baird)
72. *Sitta canadensis* Linnæus
73. *Penthestes atricapillus septentrionalis* (Harris)
74. *Penthestes rufescens rufescens* (J. K. Townsend)
75. *Regulus satrapa olivaceus* Baird
76. *Corthylio calendula cineraceus* (Grinnell)
77. *Hylocichla ustulata swainsoni* (Tschudi)
78. *Planesticus migratorius propinquus* (Ridgway)
79. *Ixoreus nævius meruloides* (Swainson)
80. *Sialia mexicana occidentalis* J. K. Townsend
81. *Sialia currucoides* (Bechstein)

GENERAL ACCOUNTS OF THE BIRDS

1. **Mergus americanus** Cassin

One noted near Creston May 3, but none identified later.

2. **Anas platyrhynchos** Linnæus

Noted near Creston May 3, but none seen after the rivers rose.

3. **Querquedula cyanoptera** (Vieillot)

A male was noted May 2, on the Kootenay near Creston, and one was taken May 31.

4. **Aix sponsa** (Linnæus)

A male was seen May 2, in the Kootenay bottom, but not secured. No other noted.

5. **Botaurus lentiginosus** (Montagu)

Near the first camp of the party this species was daily heard in the bottom land making its "pumping" sound, but it was soon driven away by the flood waters. One secured June 1, near Creston.

6. **Gallinago delicata** (Ord)

Like the last, commonly heard at night until driven away from the bottom land by high water. One secured May 31, along the edge of the overflow.

7. **Oxyechus vociferus** (Linnæus)

A few pair were scattered along the edge of the bottom land and several specimens were taken.

8. **Dendragapus obscurus richardsoni** (Douglas)

Reported to have been quite common all through the coniferous forest in the vicinity of Creston and on both the Purcell and the Nelson mountain ranges, but in 1928 grouse were very scarce. Some of the resident people ascribed this to an epidemic and others to the fact that the preceding spring had been a very wet one, with consequent high mortality among young broods. A few were found in close vicinity to Creston, on Goat Mountain, and Tose found a few on the higher ranges while out on side trips. Four specimens were secured, all typical *richardsoni*.

9. **Bonasa umbellus umbelloides** (Douglas)

This grouse was found in practically the same localities as the above, but seemed to prefer more brushy ground cover. It was apparently even more scarce than *Dendragapus,* though it may have been only more difficult to find. Three specimens were secured, one of which was taken in the cottonwoods on the bottom land.

10. **Accipiter velox** (Wilson)

Not often met with. Near Kitchener, a male was taken May 23, a few miles east of and at a higher elevation than Creston.

11. **Accipiter cooperi** (Bonaparte)

This hawk also was rare, but less so than the preceding. One specimen only was secured, a very small adult male, May 9.

12. **Cerchneis sparveria sparveria** (Linnæus)

A few pairs were noted in this region, but this species was by no means common. A male and a female were taken at Creston May 5.

13. **Pandion haliaëtus carolinensis** (Gmelin)

Occasionally noted along the river. One specimen secured May 5. None was observed in the act of securing food, so that what it succeeded in finding in the way of sustenance during this flood of muddy, opaque water was not ascertained.

14. **Bubo virginianus** subsp.

At the first camp, owls of this genus were nightly heard hooting, chiefly in the cottonwood groves of the bottom land, with only a few calls from the wrecked forest close by.

15. **Ceryle alcyon caurina** Grinnell

Present, but rarely met with in such a great area as was covered by the abnormally high water of 1928. One specimen was secured May 7.

16. **Dryobates villosus monticola** Anthony

Commonly found in suitable places throughout the region, but not numerous in any part of it. Several specimens secured.

17. **Dryobates pubescens leucurus** (Hartlaub)

Common, but not as abundant as might be expected, even in localities appearing to be very well adapted to its needs. Found scattered about apple orchards and, to some extent, in the coniferous forest where not too dense, but most numerous in the cottonwoods of the bottom land, at least before high water. As this species is not a ground feeder, it hardly seems probable that flood conditions would seriously affect its status there.

18. **Picoides articus** (Swainson)

Three specimens of this woodpecker were collected, two at Kitchener and one at Creston. The latter was taken May 8, when it probably was on its way to a higher altitude, as no more were noted at Creston level.

19. **Picoides americanus fasciatus** Baird

A female was taken near Kitchener May 24, at an altitude of 3000 feet, or over. None other was identified.

20. **Sphyrapicus varius nuchalis** Baird

A very common bird in the Kootenay Valley and more numerous than all other species combined of the woodpeckers noted there.

21. **Phloeotomus pileatus picinus** Bangs

In the woods near Creston this woodpecker is still rather commonly to be heard in the spring time, but it is very wild and not easily seen in the tall timber. Reported by residents of Creston as quite numerous in winter, coming down from higher altitudes to where food conditions were less trying. Often heard by members of our party and seen at a distance. One specimen was secured.

22. **Asyndesmus lewisi** Riley

A few pairs of this conspicuous woodpecker were noted in the Kootenay Valley, scattered over the region, and several specimens were taken.

23. **Colaptes cafer collaris** Vigors

This woodpecker is commonly found throughout the territory around Creston, but is less abundant than one might expect, considering the favorable appearance of the country. Three specimens were secured which appear to be referable to this form.

24. **Archilochus alexandri** (Bourcier & Mulsant)

Very few hummingbirds of any species were seen and most of those noted were in the gardens and orchards in and around Creston, where a female was taken May 28. No other individual of this species was identified.

25. **Selasphorus rufus** (Gmelin)

What few hummingbirds were seen outside of gardens or apple orchards were usually in places where it would have been impossible to retrieve one if shot, on account of weeds and trash on the ground, and none of this species was secured. Several times noted in the town of Creston. A nest was found in an apple tree on the outskirts of town, nearly seven feet above ground, with the female incubating. This bird was so little disturbed by close approach of an observer that her tail feathers were critically examined by the author for some minutes, at a distance of only a few inches. The bird was finally flushed and shot, but attempts to secure it failed, as it fell slantingly into a hopeless tangle of weeds.

26. **Stellula calliope** (Gould)

A male was taken May 14, at Creston, and another May 22, these constituting the only records.

27. **Tyrannus tyrannus** (Linnæus)

This flycatcher was first noted May 12 by the Tose party at West Creston across the Kootenay River, when one specimen was taken. None was seen on the east side of the river until May 29, when a few were noted here and there in favorable localities in the open, rolling country. A few days later a boat trip made by some of the party revealed quite a number of these flycatchers among scattered, bush-like willows, half a mile or more out from the flood shore. The tops of these willows extended 5 to 10 feet above the water, and, at this date, buds were just beginning to show on the exposed twigs. Among these still bare looking branches the Kingbirds were building nests, mostly with dead twigs from the immediate surroundings. Some of the nests seemed to be perilously near the water. Of two discovered on June 1, one was only about a foot above water and the other 18 inches. (See Condor XXXIII, 1931, pp. 73–74.)

28. **Tyrannus verticalis** Say

Noted at West Creston May 10, when two specimens were secured. Farmers of that locality reported that there had been a flight of birds of this species through West Creston just previous to our arrival. This flycatcher was not noted anywhere after May 10.

29. **Myiochanes richardsoni richardsoni** (Swainson)

Rare in this locality. A few were noted at Creston and two specimens were secured, May 28 and 29, respectively.

30. **Empidonax hammondi** (Xantus)

A specimen was taken at Creston May 17, the earliest date on which this species was noted. Later it was found to be common in this vicinity, in suitable association, and was also found between Kitchener and Yahk.

31. **Empidonax wrighti** Baird

The only flycatcher identified as of this species was taken at Creston May 19.

32. **Cyanocitta stelleri annectens** (Baird)

Common resident, mostly in coniferous association. Not numerous in the breeding season, as it scatters out through the higher mountains for nesting. Early in May a few were seen in the cottonwoods of the river bottom, probably in vertical migration. Said to be more numerous in winter.

33. **Perisoreus canadensis capitalis** Ridgway

On May 8, one adult male, two adult females, and four juveniles, were taken in the pine forest on Goat Mountain, close to Creston. These were part of a small band that appeared to be migrating through the locality. Another female was secured May 15, but none was seen after that date.

34. **Corvus brachyrhynchos hesperis** Ridgway

A few crows were apparently resident in this vicinity, but they were so wary that but one was secured. Several pairs were noted in the overflowed cottonwood groves along what are the banks of the Kootenay River at normal stage of water. Here they were nesting in the taller trees, from which they sallied forth in search of food for the young, paying particular attention to drift and to the flood shores.

35. **Nucifraga columbiana** (Wilson)

On May 16, a female of this species was taken on the edge of the wrecked forest, across Goat River from Creston, this constituting the only record.

36. **Dolichonyx oryzivorus** (Linnæus)

Several Bobolinks were seen from the road at the foot of the Creston grade May 28, on a small patch of ground around a farm house that was isolated by high water. A landing was made upon this little island, but the birds were very wary and flew away before any could be secured. Identification, however, as made by the present writer, was unquestionable.

37. **Molothrus ater artemesiæ** Grinnell

The only bird noted of this species, a female, was taken at Creston on June 1, in the top of one of the bush-like willow trees out in the overflowed bottom, where it was in company with some red-winged blackbirds.

38. **Agelaius phœniceus nevadensis** Grinnell

At the date of our arrival, a few red-winged blackbirds were occupying some reeds in the bottom land, a mile or so above Creston. Judging from old nests found, it seemed that they would nest in the willows there, but the rapidly rising flood waters and want of a boat made critical examination of

the situation impossible. Later, when the flood was at its peak, a boat was finally obtained at Creston and redwings were found close to town, in the protruding tops of willows in the submerged area, where nine adult males in good plumage, and one in poorly developed plumage, were taken. Females were scarce and only two were secured. No nests were found.

A careful examination of these specimens shows that the exposed culmen of the nine males averages slightly longer than does that of a series of *Agelaius p. nevadensis* from eastern and north-eastern California, but in every other particular the Kootenay Valley birds correspond so closely with the above from California that there seems to be every reason to consider them as being the extreme eastern representation of *A. p. nevadensis*. In this the British Columbian members may be classed with the redwings of southeastern Arizona (see Swarth, Proc. Calif. Acad. Sci., 4th Series, XVII, no. 12, pp. 317-322), as being the largest representatives of this race, just as the California birds are the smallest.

39. **Sturnella neglecta** Audubon

Common over the open country and on cleared land, but not numerous. There were some in the river bottom in early May, but they were soon driven out by the high water.

40. **Icterus bullocki** (Swainson)

Prior to the end of May this species was not encountered in this region, but a male and a female were taken at Creston June 1. Unless there were further arrivals after our departure on June 6, orioles are poorly represented among the summer birds of this valley, as no other individuals were seen.

41. **Euphagus cyanocephalus cyanocephalus** (Wagler)

Common resident of the Kootenay Valley, but not abundant in spring. Found nesting around Creston.

42. **Hesperiphona vespertina brooksi** Grinnell

A flock of birds of this species appeared near Creston May 14, from which several specimens were secured, mostly males. Others were seen May 19, in the forest on Goat Mountain, but none after that date.

43. **Carpodacus cassini** Baird

Common summer resident in the coniferous forest and relatively numerous.

44. **Spinus pinus pinus** (Wilson)

A male was taken at Creston May 19, and a female the next day, but no further record of this species was made.

45. **Passerculus sandwichensis anthinus** Bonaparte

A pair was taken at Creston May 2, but none was seen after that date. The two collected, migrants, are apparently of the coastal subspecies *anthinus* (see Brooks & Swarth, Birds of British Columbia, Pac. Coast Avifauna, No. 17, p. 91).

46. **Zonotrichia leucophrys gambelli** (Nuttall)

A single individual was seen at Creston May 7, followed in the next few days by a small migratory wave, from which several specimens were taken, after which no more were noted.

47. **Spizella passerina arizonæ** Coues

Common summer resident in the region covered by us.

48. **Junco oreganus shufeldti** (Coale)

Commonly found all through the coniferous association in the localities visited. Nests were found and young noted, May 8 being the date of finding the first nest, which contained five eggs.

49. **Melospiza melodia morphna** Oberholser

Common summer resident of the Kootenay Valley, but not abundant. Found mostly near water. Presumably resident throughout the year, as it is so recorded in similar territory in other parts of southern British Columbia.

50. **Passerella iliaca** subsp.

One heard but not seen, near Creston, May 9, and another shot May 16. The latter fell into a great pile of slash and dead brush, where it could not be found. None other seen.

51. **Pipilo maculatus curtatus** Grinnell

Common along the lower levels about Creston, nesting in congenial association, but not abundant.

52. **Hedymeles melanocephalus melanocephalus** (Swainson)

A male was taken at Creston May 26, the only one seen.

53. **Passerina amœna** (Say)

First noted May 19, when a male was taken. Another male was secured May 30, but this bird was rarely met with.

54. **Piranga ludoviciana** (Wilson)

The note of this species was heard by the writer May 12 and a male was taken May 15, after which date it was relatively common in the forest land of the vicinity.

55. **Petrochelidon albifrons albifrons** (Rafinesque)

A few pairs were nesting in Creston, at which place they arrived rather late in May.

56. **Hirundo erythrogaster** Boddaert

First recorded May 10, near Creston, where a pair was noted among some *Stelgidopteryx* in a deep cut in a road. Soon after this date several pairs were noted nesting in the town.

57. **Iridoprocne bicolor** (Vieillot)

This species was already present in Creston on May 1, and was commonly noted thereafter in all suitable places. Later on many were nesting in old woodpecker holes in the dead trees that were scattered over the overflowed bottom land.

58. **Tachycineta thalassina lepida** Mearns

This species also was present in Creston May 1, and was commonly nesting, in the height of the flood, in the dead trees and stumps of the river bottom in company with the preceding species. A number of pairs of the Northern Violet-green Swallow were found in possession of a lumber yard in town and were nesting inside large, square piles of board lumber that was loosely cross-laid so as to leave space for circulation of air for drying purposes. On May 22 these swallows were seen industriously carrying nesting material in to the depths of the lumber piles, around which the birds could be seen at any time thereafter.

59. **Stelgidopteryx serripennis** (Audubon)

First noted on May 6, near the first camp of the party, where a number were flying up and down a cut in the road, every few minutes perching on bare twigs or examining holes in the banks of the cut. Several specimens were taken.

60. **Bombycilla cedrorum** Vieillot

On June 1, when the writer was out in a boat on the overflowed river bottom, a band of Cedar Waxwings flew into a cottonwood tree within range and two birds were secured, both females. No others were noted.

61. **Vireosylva olivacea** (Linnæus)

Noted first May 24, in a small grove of cottonwood trees on the banks of a tiny stream in the outskirts of Creston. On this date the characteristic song was heard and an occasional glimpse was had of one of the birds among the thick foliage of the tree tops. This lively little songster soon became common in suitable places of the region, but was always difficult to detect among the green leaves. Several specimens were secured.

62. **Vireosylva gilva swainsoni** (Baird)

The first record of this species was made May 25, when a single specimen was taken. It became more common thereafter but was nowhere abundant in this region.

63. **Lanivireo solitarius cassini** (Xantus)

Present around Creston in the coniferous timber land, but not at all numerous. First noted May 3, and one specimen taken May 17.

64. **Vermivora ruficapilla gutturalis** (Ridgway)

First noted May 5, when one specimen was taken. It soon became quite common in suitable association on both sides of the Kootenay River and several others were secured.

65. **Dendroica æstiva æstiva** (Gmelin)

First identified May 4, and the first specimen taken May 9, after which date it became quite common in the vicinity.

66. **Dendroica auduboni auduboni** (J. K. Townsend)

Taken at Creston May 6 and at West Creston May 11. By the end of the month this species had become quite common.

67. **Geothlypis trichas occidentalis** Brewster

The inundation of the lowlands robbed this species of its natural habitat in the region and but one specimen was secured. This was taken near Creston, in some sedge on the shore of the overflow waters.

68. **Setophaga ruticilla** (Linnæus)

On May 28 this bird was discovered in the cottonwood grove near our second camp, at the northern edge of Creston, and within the next few days several others were taken. Not seen anywhere else.

69. **Dumetella carolinensis** (Linnæus)

The Catbird did not appear until near the end of May, after which time its singing was constantly heard in Creston gardens and along the edge of the overflow, wherever there was brushy cover in which it might nest and into which it could dive when alarmed.

70. **Troglodytes aëdon parkmani** Audubon

First noted May 8, when a male bird was secured. Another was taken May 19, but it soon became evident that this species was scarce in the vicinity, as none other was noted.

71. **Mannus hiemalis pacificus** (Baird)

Taken at Creston May 11, at West Creston May 12, and later at Kitchener, but it was nowhere found to be abundant.

72. **Sitta canadensis** Linnæus

This species was heard in the coniferous forest May 1, and one bird was secured May 17. A common summer resident.

73. **Penthestes atricapillus septentrionalis** (Harris)

Very common everywhere in the forest region and some were noted among the cottonwoods in the bottom land. Probably a permanent resident, as it is so recorded from territory further north.

74. **Penthestes rufescens rufescens** (J. K. Townsend)

Noted only once, when one was taken May 11, near West Creston, at the base of the Nelson Range of mountains.

75. **Regulus satrapa olivaceus** Baird

Both this species and the next were very difficult to identify in the upper parts of the tall timber that they frequented, and very little information was obtained concerning either of them, of this species in particular. It was, however, evidently nesting near the top of Goat Mountain, at an elevation of several hundred feet above that of Creston, and a female was there obtained June 3. Except for shortness of wing and tail this bird could easily be mistaken for the eastern form.

76. **Corthylio calendula cineraceus** (Grinnell)

This kinglet was more commonly noted than the preceding species, as it is more apt to be found nearer the ground. A male was taken at Creston May 3, a female the next day, and another male was secured high up on Goat Mountain June 3. While these specimens are not typical *cineraceus* they are decidedly nearer to that form than to *C. calendula calendula.*

77. **Hylocichla ustulata swainsoni** (Tschudi)

Thrushes were scarce and their characteristic musical song was seldom heard. A male was taken near Kitchener May 20, and another at Creston May 31. No others were seen, in spite of the presence of what appeared to be very good cover for this species.

78. **Planesticus migratorius propinquus** (Ridgway)

Very common and nesting in every locality that was visited by us.

79. **Ixoreus nævius meruloides** (Swainson)

On May 11 several specimens were taken at West Creston and this species was noted later at Creston. In the latter locality a family party, consisting of parents and three or four fledglings, was encountered May 27 in second growth forest. When discovered, the juveniles, much desired for specimens, were too close to shoot at without damage to plumage and all managed to fade from sight in the dark, dripping woods on this rainy day while the writer was trying to back away far enough to secure one or two in good shape. All efforts to find them again were unsuccessful.

80. **Sialia mexicana occidentalis** J. K. Townsend

This bird was present at the date of our arrival, April 30, and nesting was soon begun as the weather warmed up. Common, but not abundant.

81. **Sialia currucoides** (Bechstein)

Also present on April 30, and noted nesting at every locality visited by us. A juvenile male was taken May 31, at Creston.

CHECK-LIST OF THE MAMMALS

1. *Sorex vagrans monticola* (Merriam)
2. *Marmota monax petrensis* Howell
3. *Citellus columbianus columbianus* (Ord)
4. *Eutamias ruficaudus simulans* Howell
5. *Sciurus hudsonicus richardsoni* (Bachman)
6. *Peromyscus maniculatus artemisiæ* (Rhoads)
7. *Neotoma cinerea drummondi* (Richardson)
8. *Evotomys gapperi saturatus* Rhoads
9. *Microtus mordax mordax* (Merriam)
10. *Lepus bairdi* (*cascadensis* Nelson ?)

GENERAL ACCOUNTS OF THE MAMMALS

1. **Sorex vagrans monticola** (Merriam)

This shrew was found in traps at Creston on four occasions, but not taken elsewhere. For positive identification of the subspecies the author is gratefully indebted to Dr. H. H. T. Jackson, of the United States Biological Survey.

2. **Marmota monax petrensis** Howell

On June 1, near Creston, Tose found and preserved a freshly killed marmot of this species, that some one had thrown into a hollow stump on the edge of the flooded bottom land. It was an adult female that showed evidence of having, or recently having had, unweaned young. Resident farmers stated that the presence of a marmot in that locality was an extremely rare occurrence. Possibly it floated on driftwood down the flooded Goat River from the Purcell Mountains.

3. **Citellus columbianus columbianus** (Ord)

In some localities around Creston this ground squirrel was noted in small but rather thickly populated colonies. It was extremely wary and yet easier to shoot than to trap. After two of three individuals were caught in a colony, traps were of little further use, as the squirrels then refused to come out of a burrow in the mouth of which a trap had been set, no matter how carefully camouflaged. There was every reason to suppose that the burrows communicated with other openings, as squirrels would appear above ground, in about every part of

a colony, at the mouths of burrows that did not have traps in them, but would carefully avoid those that did have them. The report of a gun did not seem to disturb a colony for any great length of time, yet on occasions, without any apparent reason for it, an alarm signal from some squirrel would keep a whole colony under ground for the rest of the day. Three females taken May 13 contained 3, 5 and 5 embryos, respectively, those of the first female being 34 mm. in length and of the other two 37 mm.

4. **Eutamias ruficaudus simulans** Howell

Cold weather seemed to have kept the chipmunks under cover for the first few days after our arrival at Creston, so that none was taken until May 5, after which date they were commonly seen in the forested lands. By the end of May young also were out foraging.

5. **Sciurus hudsonicus richardsoni** (Bachman)

This is the common red squirrel of the Kootenay Valley and was fairly abundant in the coniferous forest.

6. **Peromyscus maniculatus artemisiæ** (Rhoads)

This mouse was found to be common in every place where trapping was carried on, but it was not actually numerous anywhere, as shown by the small number the party obtained per trap-night. There was good reason to believe that its numbers had been much reduced by some epidemic.

7. **Neotoma cinerea drummondi** (Richardson)

Taken around Kitchener and Yahk, where it was very common. While the party did not come across this wood rat at Creston, residents reported that it occasionally was found in that vicinity, in limited numbers.

8. **Evotomys gapperi saturatus** Rhoads

A male was secured by Tose near Kitchener, May 21. No further record of this species was made.

9. **Microtus mordax mordax** (Merriam)

Farmers around Creston stated that meadow mice had been so numerous in the hay fields of the bottom land for the previous year or two as to be actual pests, but that in 1928 their numbers had diminished almost to the vanishing point. Some old sign of this species was found in favorable places in the meadow land, but the high water soon covered all traces of such habitation. Finally a little fresh sign was found under a collapsed shed on the mesa, some distance above the river bottom, and two adult females, with two immature males, were there taken. These, with several adults from around Kitchener and Yahk, where there was more evidence of occupation than at lower levels, comprised the entire catch of the party.

10. **Lepus bairdi (cascadensis** Nelson ?)

The varying hare was reported to be numerous, ordinarily, in the Kootenay Valley, but, as with the two species of mice above mentioned, it had been almost annihilated by a recent epidemic. Only on rare occasions was an individual seen, and it was not until May 25 that one—the only one—was secured. This was a female with the summer pelage not yet quite complete. It seems to be intermediate between *L. b. bairdii* and *L. b. cascadensis,* but rather nearer to the latter race. To Dr. E. Raymond Hall, of the Museum of Vertebrate Zoology, Berkeley, California, the author desires to acknowledge his indebtedness for valuable assistance in comparing and identifying this specimen.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 9, pp. 291-465 MARCH 3, 1932

IX

MISCELLANEOUS STUDIES IN THE ELATERIDÆ AND RELATED FAMILIES OF COLEOPTERA

BY

EDWIN C. VAN DYKE

University of California

Berkeley, California

These studies were commenced many years ago for the purpose of straightening out some of the confusion which has existed with regard to a number of our species. Many of the North American Elateridæ are extremely variable, differing within the range of the species in size, form, sculpture, and coloration. In some species great sexual differences also exist. Other species split up into many geographical races, the extremes of which are often very different. Nowhere is this plasticity more marked than on the Pacific Coast. As a result we have in this territory many variable species, species presenting many color phases within their area of distribution; many species with well marked races, each race more or less limited to a definite territory; and many closely allied though sharply defined species.

A large amount of material has of necessity been assembled in order to make the studies of any value. Among this material many undescribed species have been found which are here defined. The arrangement and generic terminology are in

general that used by Schenkling in Junk's Coleopterorum Catalogus. When discussing species in genera which have been rather recently reviewed, I have not felt that it was necessary to give a synopsis or a bibliography, but in those genera that I have studied which have not been revised for many years, I have given both synoptic tables and bibliography.

Family MELASIDÆ (EUCNEMIDÆ)

Genus **Hypocœlus** Eschscholtz

SYNOPTIC TABLE

1. Terminal segment of the antennæ very little longer than the preceding, a distinct transverse ridge on the front, clypeus concave ..... *frontosus* (Say)
   Terminal segment of the antennæ longer than the preceding 2
2. Terminal segment of the antennæ in the male as long as the ninth and tenth combined; front with a fine longitudinal carina, clypeus flat ..... *terminalis* Lec.
   Terminal segment of the antennæ in the male longer than the preceding four segments combined; front without carina, clypeus flat ..... *californicus* n. sp.

Hypocœlus californicus Van Dyke, new species

Form moderately elongate, narrowed behind; rufopiceous, antennæ and underside rufous, legs lighter; sparsely clothed with fulvous pubescence. Head convex, rather densely, coarsely punctured, front without carina, clypeus flat, narrower at base than the distance to the eyes; antennæ extending slightly beyond hind angles of prothorax, segment two small, apically transverse, segment three cylindrical, twice as long as broad, longer than two and as long as four and five together, segment four longer than broad, segments five and six as broad as long, segments 7–10 transverse, segments 4–7 triangular, 8–10 subquadrate, and segment eleven longer than the preceding four segments united and almost one-third the length of the entire antennæ. Prothorax wider than long, gradually narrower in front, sides nearly straight, slightly arcuate near the front angles; disk moderately convex, densely, rather coarsely punctured, median longitudinal impression feeble at base, a slight circular impression on each side of the middle. Elytra finely striate, punctures of striæ vague, the intervals flat and finely, rather sparsely punctured, the punctures to a certain extent in rows. Beneath, prosternum rather closely punctured, the propleuræ more coarsely and sparsely, the mesosternum less coarsely and sparsely, and the abdomen very finely and densely punctured. Hind coxal plates triangular, gradually dilated inwardly, the hind margin straight. Length 6 mm., breadth 1.5 mm.

This species looks much like *terminalis* Lec., but the great length of the terminal segment of the antennæ in the male will readily separate it. The hind coxal plate is also gradually dilated inwards and triangular whereas in the other it is rather suddenly dilated inwards.

Holotype: No. 3106, Mus. Calif. Acad. Sci., a unique male in my collection, collected at Boneyard Meadow, **Sierra National Forest, Calif.**, July 28, 1914, by Mr. Robert E. Burton, from red fir, *Abies magnifica* Murr.

Hypocœlus terminalis Lec. has also been taken on the Pacific Coast. I have seen a male, collected by Mr. Henry Dietrich, July 21, 1920, near Chiquito Creek, alt. 4100 ft., Madera Co., Calif., and there is also another male in the Koebele Collection in the California Academy of Sciences, taken at Easton, Washington.

Family ELATERIDÆ

Adelocera Latreille

Adelocera maculata LeConte

In the recent Leng Catalogue this species is placed as a synonym of *A. modesta* Boisd. It is a very distinct species and widely separated from *modesta,* the latter being distinctly striato-punctate, the former without evident striæ and with the punctures densely and irregularly placed. Besides *maculata* is a northern species, the other a southern one which is only listed in our works because it was supposedly found in Lower California.

Adelocera mexicana Candeze

This species should be added to our list. Two specimens were taken by Dr. Lutz at Kits Peak, Rincon, Baboquivari Mts., Ariz., Aug. 1-4, 1916, and are now in the collection of the American Museum of Natural History, New York. Like *A. modesta* Boisd., it has its elytra punctato-striate. It is a much larger species, though, being 20-24 mm. in length and more cylindrical.

Genus **Conoderes** Eschscholtz (*Monocrepidius* Eschscholtz)

The genus *Conoderes* Esch., I accept in its broadest sense. *Heteroderes* Latr. differs from it only as regards the double type of pronotal punctation and in this regard is closely approached by a number of typical *Conoderes*. Together they possess a number of well marked characters as well as a common facies which separate them definitely from all other genera. Their biology and distribution are also similar. For these reasons I, therefore, believe that *Heteroderes* should be considered as but a subgenus of the other and I will so treat it here.

SYNOPTIC TABLE

1. Pronotum with single type of punctation..... *Conoderes* Esch. (*Monocrepidius* Esch.), sens. str..... 2

   Pronotum with double type of punctation, the interspaces between the larger punctures very finely punctured..... .....subgenus *Heteroderes* Latr. 20

2. Fourth tarsal segment strongly or broadly lamellate beneath, the lamella visible from above, large or moderate sized species 3

   Fourth tarsal segment with long and slender lamella beneath, the lamella not visible from above, small species, less than 8 mm. in length, in general castaneous with head, two pronotal vittæ, a series of longitudinal lines more or less transversely united on elytra, and much of ventral surface piceous (in extreme forms most of the castaneous area has been replaced by the piceous)..... 17

3. Intermediate antennal segments almost as broad as long, prothorax as broad as long at middle, large and broad species, 17 mm. long, reddish above with median longitudinal black stripe on pronotum, a black spot on either side and several black spots on each elytron. Texas.....*xysticus* (Cand.)

   Intermediate antennal segments almost twice as long as broad, prothorax generally longer than broad..... 4

4. Species more or less unicolorous above..... 5

   Species which are always distinctly bicolored above..... 13

5. Hind angles of prothorax acute and distinctly produced posteriorly..... 6

   Hind angles of prothorax abruptly truncate, hardly produced beyond hind margin of prothorax..... 11

6. The inner carina of hind angles of prothorax absent or at most indistinct, elytral apices evenly rounded 7

   The inner carina of hind angles of prothorax sharply defined, elytral apices incised and bidentate 12

7. Larger species, 10 mm. or more in length 8

   Small species, not longer than 5 mm 10

8. Dorsal carina of hind angles of prothorax close to and almost parallel with lateral margin, species light brown or brownish ferruginous with rufous antennæ and flavous legs, the pronotum very finely, closely punctured. Eastern North America ..... *lividus* (De Geer)

   Dorsal carina of hind angles of prothorax diverging slightly though distinctly from lateral margin as it extends forward .. 9

9. Species quite similar to *lividus* but darker, of a chocolate brown color with rufous antennæ and flavous legs, more parallel and with pronotal punctation considerably coarser though close. Ariz. and Mex ..... *parallelus* (Cand.)

   Species narrow and elongate, prothorax much narrowed anteriorly in male, color ranging from brown to ferruginous with legs but little lighter than body, the pronotum rather finely punctured but with the punctures distinctly separated, the second antennal segment but little longer than third (nearly twice as long in the preceding two species). Ariz. and N. M ..... *athoides* (Lec.)

10. Very elongate and narrow, rufotestaceous with elytral suture darker, prothorax nearly twice as long as wide, disk densely and rather finely punctured, hind angles not carinate, second and third antennal segments of about equal length. Fla. *debilis* (Lec.)

11. Elongate, subparallel, pale brown, legs flavous, pronotum moderately coarsely and closely punctured, hind angles unicarinate, elytral apices bidentate; length 9 mm. Tybee Is., Ga ..... *scissus* (Schfr.)

12. Robust, somewhat flattened, narrowed posteriorly, piceous brown, antennæ rufous, legs flavous, prothorax broad, very finely, closely punctured, hind angles strongly bicarinate; length 10 mm. Southern Ariz ..... *bicarinatus* n. sp.

13. Dorsal carina of hind angles of prothorax distinctly diverging anteriorly from lateral margin, the sides almost straight in front of hind angles, second antennal segment but little longer than broad 14

    Dorsal carina of hind angles of prothorax close to and almost parallel with lateral margin, diverging but little anteriorly, the sides distinctly sinuate in front of hind angles, second antennal segment considerably longer than broad 15

14. Pronotal punctures very fine and dense, not readily seen, third antennal segment much longer than second, color above varying from all piceous except the hind portion of pronotum which is flavous, to flavous with piceous markings as follows, the base of head, two broad discal pronotal vittæ and two elytral vittæ, a narrow marginal and broad sutural, the latter dilating apically and uniting with the preceding. Ga., Ala. and Fla. to Central America..... *aversus* (Lec.)

Pronotal punctures moderately fine and dense, readily observed, third antennal segment hardly longer than second, color varying from rufocastaneous with base of head, two pronotal vittæ, and a broad sutural vitta suddenly expanded before the apex, piceous, to rufocastaneous with but the sutural vitta or even only a scutellar and two transverse apical markings. Southern Ariz. to Colombia..... *varians* (Steinh.)

15. Species over 7 mm. in length, pronotum moderately finely, closely punctured, outer segments of antennæ narrower than intermediate, color castaneous including scutellum and entire ventral surface, with base of head, two broad frontal vittæ, a narrow marginal and broad sutural vitta, the latter gradually broadened basally and suddenly expanded before apex to meet the lateral, piceous. Eastern North America..... *vespertinus* (Fab.)

Species under 6 mm. in length..... 16

16. Prothorax dilated at middle, narrow anteriorly, disk rather coarsely, sparsely punctured, outer segments of antennæ broader than intermediate, color testaceous or rufotestaceous, the head, narrow median pronotal vitta, scutellum, circumscutellar area and narrow sutural vitta, expanded moderately posteriorly, and entire under surface back of prothorax, piceous. Ala., Ind..... *suturalis* (Lec.)

Prothorax elongate, subparallel, disk finely, densely punctured, color pattern similar to preceding except that entire undersurface is testaceous. Ga..... *lepidus* (Lec.)

17. Species 5 mm. or over in length..... 18

Species 4 mm. or less in length..... 19

18. Pronotum moderately coarsely, closely punctured, slightly finer posteriorly, robust species. Eastern North America. *auritus* (Herbst.)

Pronotum punctured with intermixed larger and smaller punctures, elongate species. Ga..... *blandulus* (Lec.)

19. Distinct carina near prosternal sutures. Eastern North America ..... *bellus* (Say)

No carina near prosternal sutures. Southern Tex..... *similis* (Schfr.)

20. Species over 7 mm. in length..... 21

Species under 6 mm. in length..... 23

21. Hind angles of prothorax unicarinate..... 22

Hind angles of prothorax bicarinate and sides parallel; general form depressed, color piceous with legs and antennæ pale; third segment of antennæ twice length of second and shorter than fourth, outer segments feebly serrate; length 8.2. Jacksonville, Fla.....*nicholsi* (Notman)

22. Pronotum with disk evenly convex, sides arcuate, carina near hind angles close to and almost parallel with side margin, scutellum angulate or tuberculate in front, elytra elongate elliptical, color dirty brown with antennæ and legs castaneous. Ariz. and Mex.....*sordidus* (Lec.)

Pronotum with disk flattened, sides almost parallel at middle, carina near hind angles diverging anteriorly from margin, scutellum flat and gradually declivous in front, elytra cuneiform, color pitchy black with antennæ and legs castaneous. Fla., Ala., and West Indies.....*amplicollis* (Gyll.)

23. Species short and robust, carina near hind angles diverging from margin, color reddish brown. Ariz.....*robustus* (Lec.)

Conoderes bicarinatus Van Dyke, new species

Moderately elongate, somewhat depressed and broad, brownish black, the antennæ, palpi, legs, and margin of last ventral segment rufotestaceous, densely clothed with short, fine grayish pubescence. Head closely, finely, and cribrately punctured, the frontal margin but slightly arcuate; antennæ extending beyond hind angles of prothorax, second segment small, but little longer than broad, the third one-half longer, the two together not quite equal to the fourth. Prothorax wider than long, widest behind, the sides almost straight and slightly convergent from base of hind angles to near apex where broadly rounded, the hind angles strongly produced, slightly divergent, with two well defined carinæ, an outer extending from the apex to well beyond the base of the angle and slightly divergent from the margin and sinuate anteriorly, the second shorter and extending from the apex inwardly, the disk densely, finely, and deeply punctured, obsoletely canaliculate posteriorly. Scutellum large, longer than broad, and regularly declivous forwards. Elytra more than twice as long as prothorax and more than twice as long as broad, the sides rounded near humeri, thence gradually convergent towards the apex, the apices of each elytron distinctly emarginate and bluntly bidentate, disk deeply striate, the striæ distinctly punctate especially forwards, the intervals flat and finely rugulose. Fifth ventral segment evenly rounded at apex. Fourth tarsal segment rather broadly lamellate beneath. Length 10 mm., breadth 3.5 mm.

This sombre colored species can readily be separated by having the apices of the elytra emarginate and the hind angles of the prothorax distinctly bicarinate. *C. scissus* (Schfr.) is our only other species with the elytral apices bidentate, and

nicholsi (Notman) of the subgenus *Heteroderes* the only other species with the hind angles bicarinate. It also differs from any of the species described from Mexico.

Holotype: No. 3107, Mus. Calif. Acad. Sci., a unique in my collection, collected on **Mt. Washington**, near **Nogales, Ariz.**, at an altitude of 6000 feet, July 8, 1919, by Mr. J. August Kusche.

Conoderes varians (Steinheil)

Numerous specimens of this species[1] which superficially very closely resembles the more flavous forms of *C. aversus* (Lec.) and *C. vespertinus* (Fab.), have within recent years been found in various parts of southern Arizona. It was described originally from Colombia but is found ranging through Central America and, according to Champion,[2] along the west coast of Mexico. I have specimens before me from both western Mexico and Arizona.

Conoderes (Heteroderes) amplicollis (Gyllenhal)

This species which is rather widely distributed among the West India islands should now be added to our list. It was first secured in our territory near Mobile, Alabama, by Mr. H. P. Loding and later near Dunedin, Florida, by Dr. W. S. Blatchley; the latter believing it to be new, described it as *Monocrepidius fucosus*.[3] I have a specimen of this received from Dr. Blatchley and find that it is absolutely the same as the Mobile specimens and the same as specimens from the Bermuda Islands submitted by Mr. E. P. Van Duzee, and from Soledad, Cienfuegos, Cuba, by Mr. P. J. Darlington, which agree in all details with the description given by Candeze[4] that was based upon type material.

---

[1] Zur Kenntniss der Fauna von Neu-Granad, von Eduard Steinheil. Col. Hefte, vol. XIV (1875), pp. 121-122.

[2] Biol. Centr. Am., Col., vol. III, pt. 1, 1895, p. 353.

[3] Can. Ent., vol. LIII, 1925, pp. 163-165.

[4] Mon. des Elaterides, par M. E. Candeze, II, 1859, p. 372.

At first thought, I believed that this species was the *Heteroderes lantus* Cand., a species founded upon specimens supposedly captured in Alabama, but they do not fit the description of Candeze nor agree at all with *H. sordidus* Lec., with which Candeze later placed this species as a synonym. This species does, however, somewhat resemble the Mexican *H. granulatus* Champ. but can be separated from the same by having the third antennal segment but little longer than the second whereas in the other it is much longer. *H. granulatus* Champ. also has the base of the prothorax somewhat yellowish.

BIBLIOGRAPHY

Genus **Conoderus** Esch. (*Monocrepidius* Esch.)

Conoderus Esch. (Monocrepidius Esch.) sen. str.

Conoderus xysticus (Cand.) (Monocrepidius), Cand., Mon. Elat., II, 1859, p. 223.

Conoderus lividus (DeG.) (Elater), Mem. l'hist. Insect., IV, 1774, p. 162, tab. 18, fig. 13; (Monocrepidius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 482; Leng Cat. Col., 1922, p. 167.

castaneus Oliv. (Elater), Ent., II, 1790, p. 30.

castanipes Hbst. (Elater), Käfer, X, 1806, p. 23.

elongatus Pal. d. Beauv. (Elater), Ins., 1805-1821, p. 78, pl. 8, fig. 4; (Monocrepidius), Chev., Ann. Soc. Ent. Fr., 1852, p. 629.

lobatus Say (Elater), Jour. Acad. Nat. Sci. Phila., 1823, p. 175; (Monocrepidius), Germ. Zeits. f. d. Ent., I, 1839, p. 228.

Conoderus parallelus (Cand.) (Monocrepidius), Mon. Elat., II, 1859, p. 246.

Conoderus athoides (Lec.) (Monocrepidius), Smiths. Misc. Coll., VI, No. 167, 1863, p. 84.

mutuus Horn (Monocrepidius), Tr. Am. Ent. Soc., III, 1871, p. 312.

Conoderus debilis (Lec.) (Athous), Proc. Am. Phil. Soc., XVII, 101, 2R, 1878, p. 405; (Monocrepidius), Henshaw List Col., 1885, p. 67.

Conoderus bicarinatus, n. sp.

Conoderus scissus (Schfr.) (Monocrepidius), Bul. Brooklyn Inst., I, 1909, p. 378.

Conoderus aversus (Lec.) (Monocrepidius), Tr. Am. Phil. Soc., X, 1853, p. 482.

scutellaris Dej. (Monocrepidius), Cat., ed. 3, 1837, p. 98.

var. *a*. elytris macula humerali testacea.

var. *b*. elytris vitta discoidali testacea.

puellus Dej. (Monocrepidius), Cat., ed. 3, 1837, p. 98.

Conoderus varians (Steinhl.) (Monocrepidius), Col. Hefte, XIV, 1875, p. 121; Champion, Biol. Cent. Am., Col., III, pt. 1, 1895, p. 353.

Conoderus vespertinus (Fab.) (Elater), Syst. Eleuth., II, 1801, p. 240; (Monocrepidius), Dej. Cat., ed. 3, p. 98; Lec., Tr. Am. Phil. Soc., X, 1853, p. 483.

finitimus Say, (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 179.

serotinus Germ., (Monocrepidius), Zeits. f. d. Ent., I, 1839, p. 227.

texanus Cand. (Monocrepidius), Mon. Elat., II, 1859, p. 262.

peninsularis Cand. (Monocrepidius), Ann. Soc. Ent. Belg., XXXIII, 1889, p. 26.

Conoderus suturalis (Lec.) (Monocrepidius), Tr. Am. Phil. Soc., X, 1853, p. 482.

Conoderus lepidus (Lec.) (Monocrepidius), Tr. Am. Phil. Soc., X, 1853, p. 485.

Conoderus auritus (Hbst.) (Elater), Käfer, X, 1806, p. 145; (Monocrepidius), Germ., Zeits. f. d. Ent., V, 1844, p. 148; Lec., Tr. Am. Phil. Soc., X, 1853, p. 483.

crassicollis Melsh. (Oophorus), Proc. Acad. Nat. Sci. Phila., II, 1844, p. 214.

dilectus Say (Oophorus), in. litt.

caseyi Leng (Monocrepidius), Jour. N. Y. Ent. Soc., XXVI, 1918, p. 206.

‖*finitimus* Casey (Monocrepidius), Contrib., II, 1884, p. 170.

Conoderus blandulus (Lec.) (Monocrepidius), Tr. Am. Phil. Soc., X, 1853, p. 483.

Conoderus bellus (Say) (Elater), Jour. Acad. Nat. Sci. Phila., III, 1824, p. 168; (Monocrepidius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 484.

variegatus (Steinh.) (Monocrepidius), Col. Hefte, XIV, 1875, p. 123.

Conoderus similis (Schfr.) (Monocrepidius), Ent. News, XX, 1909, p. 436.

texanus Schfr. (Monocrepidius), Bul. Brooklyn Inst., I, 1909, p. 379.

Subgenus **Heteroderes** Latr.

Conoderus nicholsi (Notman) (Heteroderes), Bul. Brooklyn Ent. Soc., XVII, 1922, p. 107.

Conoderus sordidus (Lec.) (Monocrepidius), Tr. Am. Phil. Soc., X, 1853, p. 482.

lantus Cand. (Monocrepidius), Ann. Soc. Ent. Belg., XXXIII, 1889, p. 31.

Conoderus amplicollis (Gyll.) (Elater), *in* Schön. Syn. Ins., I, Append., 1833, p. 141, 194; (Heteroderes), Cand. Mon. Elat., II, 1859, p. 372.

fucosus (Blatch.) (Monocrepidius) Can. Ent., LVII, 1925, pp. 163–164.

Conoderus robustus (Horn) (Monocrepidius), Tr. Am. Ent. Soc., III, 1871, p. 311.

Conoderus puberulus Mann. (Monocrepidius), Leng Cat. Col., 1920, p. 167. = *Anchastus cinereipennis* (Esch.) (Monocrepidius), Thon., Ent. Archiv., II, 1829, p. 31.

Genus **Elater** Linnæus

The genus *Elater* should be made to include *Ectamenogonus* Buysson. The latter, made to include the species having the hind angles of the prothorax bicarinate, is not founded upon a sound character. In the first place the assemblage is not phylogenetic, the character being an erratic one which may appear here and there in the group. It is also an unstable character, for it may or may not be present in all of the individuals of a species. It is of value for the purpose of separating certain species from their fellows, but no more.

Elater sturmii Germar

This species should be restored. It was omitted in the Leng Catalogue. It is a true *Elater* as observed by LeConte, not a *Megapenthes* and a synonym of *granulosus* as he formerly believed.

Elater ursinus Van Dyke, new species

Elongate, subcylindrical; piceous brown, the mouthparts, antennæ, and legs rufous, the undersurface rufopiceous; and densely clothed with short, coarse, suberect, grayish brown pile. Head coarsely, closely punctured; the antennæ reaching the apex of hind angles of prothorax, the second segment short, but slightly longer than broad, the third segment slightly longer than second and about two-thirds length of fourth, segments 4–10 distinctly serrate. Prothorax slightly broader than long, sides somewhat sinuate in front of hind angles, thence arcuate and convergent forwards and abruptly rounded near front margin, the hind angles moderately prominent, subacute, with a well defined carina extending obliquely inwards from apex, and a poorly defined one between this and the lateral margin; the disk quite convex, rather coarsely and closely punctured, especially at sides, and with a slight median canaliculation at basal half. Elytra about three times the length of prothorax and slightly more than twice as long as broad, with sides quite parallel to apical third, then gradually rounded to apex; disk convex, the striæ rather coarsely and closely punctured towards base, more finely posteriorly, the intervals convex and finely punctured and scabrous. Beneath with the prosternum broad, but slightly convex, the anterior lobe not long and finely and sparsely punctured, the propleuræ and mid-portions rather coarsely and closely punctured, the abdomen rather finely punctured. Length 8.5 mm., breadth 2.75 mm.

Holotype: No. 3108, Mus. Calif. Acad. Sci., and *Paratype* in my collection, taken at **Fallen Leaf Lake, Lake Tahoe, Calif.,** July 4, 1915, and July 22, 1915. A third specimen from the same locality has the abdomen entirely red. A fourth, from Easton, Washington, has been seen.

This species belongs near *melsheimeri* Leng *(hepaticus* Mels.) but differs from that as from others associated with it by being more cylindrical and generally smaller. It also has the second and third antennal segments proportionally shorter, the pile coarser and more elevated, and is different in color. The species is somewhat variable in color, the apical and basal margins of prothorax and the basal margin of elytra being rufous in some specimens, and in one the entire under surface is a bright red as normally is the case with *rhodopus* Lec. If the recently created genus *Ectamenogonus* Buysson were recognized, this species would have to be placed in it.

Elater fenyesi Van Dyke, new species

Similar and closely related to the preceding but differing in the following regards: the head, pronotum, antennæ, legs, and entire under surface a bright red; the pronotum more coarsely and closely punctured; the elytra with the striæ very fine and finely punctured, especially posteriorly, the intervals flat and much smoother posteriorly than basally, with the prosternum much narrowed and more convex, coarsely and rather closely punctured, and with the anterior lobe long.

Holotype: No. 3109, Mus. Calif. Acad. Sci., a unique in my collection, collected at **Bishop, Calif.,** June 16, 1905, by Dr. A. Fenyes. Other specimens are in the Doctor's collection.

I at first took this species to be but an extreme phase of *ursinus* but found the prosternum so different in every way that I could not do otherwise than consider it as distinct.

Elater rhodopus LeConte

There is a race of this well known species found in the Wasatch Mts. of Utah which is in general shorter and blunter, less shining, with head and pronotum more finely and closely

punctured, the outer carina of the hind angles of the prothorax quite vague in contrast to the rather sharply defined ones of the typical form, the elytra with the striæ deeper, the intervals more convex and more coarsely punctured, and the greater portion of the under surface more or less piceous instead of bright red. This, I am calling the subspecies **uteanus** and designating as a holotype (No. 3110, Mus. Calif. Acad. Sci.), and paratypes, a series of six specimens collected in **Provo Cañon, Wasatch Mts., Utah,** May 21, 1913, by Mr. J. R. Slevin. Two other specimens in the California Academy collection were taken in the same region by Mr. E. P. Van Duzee.

Elater rubriventris LeConte

Typical specimens of *Elater sanguinicollis* Schaeffer from Stockton, Utah, when compared with typical specimens of *rubriventris* from New Mexico and Arizona show that they are one and the same species. This is a species ranging throughout the more mountainous portions of the southern part of the Great Basin.

Elater cordifer LeConte, and associates

The members of the *cordifer* group were in certain cases so widely separated in the synoptic table given by LeConte[5] that their recognition was rendered difficult. I believe that they form a definite group and should be treated as such so am taking advantage of the opportunity while describing a number of new species in the group, to give a table which I hope will enable them to be better identified. All species are represented in my collection and by good series except in a few cases. In regard to the LeConte and Horn species, I have specimens which have been very carefully compared with the types so feel quite sure of the determinations. The species of *Elater* which I have associated with *cordifer* are characterized

[5] Short Studies of North American Coleoptera (No. 2), by John L. LeConte, M. D. Tr. Am. Ent. Soc., XII, 1884, pp. 8-11.

in general by having the body black, the basal portion of the elytra of a rich orange or reddish orange color, the antennal segments 4–10 decidedly serrate, the prothorax with the hind angles unicarinate, the notum more or less densely punctured, and the entire upper surface clothed with a somewhat dense yet short, semierect pile, longer and more erect on the pronotum. With the exception of *apicatus,* all are restricted to the Pacific area. *Elater pullus* Germ. might, because of its color pattern, seem to belong in the group but its sculpturing as shown by its sparse pronotal punctation would place it without the pale.

SYNOPTIC TABLE

Cordifer group of Elater Linnæus

1. Pubescence of pronotum black or at least black on disk..... 2
   Pubescence of pronotum yellow or grayish yellow..... 7
2. Apical elytral patch more or less cordiform..... 5
   Apex of elytra uniformly black, the anterior margin of black patch quite transverse..... 3
3. Pronotum subopaque, bluish black, very densely, umbilicately, punctured, pubescence coal black and quite erect, apical third of elytra or over uniformly black, the basal area reddish orange, specimens in general proportionately broader and more flattened than other members of the group; length 8-9 mm. Middle Sierra of Calif. and Great Basin, ranges from Ariz. to B. C..... *phelpsi* Horn
   Pronotum shining, punctures not umbilicate nor approximate.. 4
4. Pronotal pubescence black and semierect, apical black patch of elytra not reaching the middle; length 6-9 mm. High middle Sierra of Calif..... *horni* Cand.
   Pronotal pubescence much inclined, apical black patch of elytra variable, generally extending beyond middle; length 8.5-9 mm. Southern Ore..... *dimidiatus* Lec.
5. Apical black patch touching sides for some distance in front of apex..... 6
   Apical black patch touching sides only close to apex, the yellow area extending backwards along suture beyond frontal margin of black area, pubescence over yellow area, yellow; moderately large species; length 10 mm. or over. Most of Calif..... *cordifer* Lec.

6. Black patch of elytra slightly separated anteriorly by intrusion of yellow, pubescence of pronotum black on disk and fulvous at sides near hind angles; length 9 mm. or less. B. C. to mountains of middle Calif. ..... *varipilis* n. sp.

   Black patch of elytra extending forwards along suture, pubescence black over entire pronotum; length 10 mm. or over. Western Wash., south near coast to Sonoma County, Calif. ..... *behrensi* Horn

7. Elytra entirely orange, without black apical patch 11

   Elytra with black apical patch 8

8. Pronotum somewhat subopaque, rather closely punctured, pubescence fulvous, black elytral patch in touch with margin for some distance in front of apex; length 9 mm. or less 9

   Pronotum rather shining, punctures somewhat separated, pubescence grayish yellow, black elytral patch not touching sides or touching only near apex; length 10 mm. or more 10

9. Prothorax with sides almost parallel at basal half, broadly rounded in front, pronotal pubescence suberect, antennæ barely reaching hind angles of prothorax; length 9 mm. (in a few specimens the apical black patch is vague). Marin and Sonoma counties, Calif., on Douglas fir, *Pseudotsuga*. A coastal species ..... *cordatus* Horn

   Prothorax with sides converging from base to apex and but slightly arcuate, pronotal pubescence much inclined, antennæ distinctly extending beyond hind angles of prothorax; length 7-8 mm. Middle and northern Sierra of Calif. on yellow pine. (Washington *vide* LeConte) ..... *affinis* Lec.

10. Apical elytral patches limited to each elytron and not reaching suture, sides or apex; pronotal pubescence suberect, elytral pubescence black throughout; length 9-10 mm. B. C. south to Sierra of middle Calif. ..... *bimaculatus* n. sp.

    Apical elytral patch cordiform, united along suture and reaching apex and sides for a short distance near apex (in a few cases the patch extends forward parallel to suture almost to base of elytra); pubescence of both pronotum and elytra much inclined; length 10-13 mm. Northern United States and Canada from Atlantic to west of Great Lakes ..... *apicatus* Say

11. Pronotum more coarsely and closely punctured than in case of preceding, prothorax also more broadly rounded in front and elytra less narrowed and less cuneate posteriorly; length 8-14 mm. This species is most decidedly not a variety of *apicatus* as generally listed. B. C., Pacific States and northern Rocky Mountains ..... *phœnicopterus* Germ.

Elater phelpsi Horn

This very beautiful and rather rare *Elater* is to be found in its typical form and color throughout the higher levels of the middle and northern Sierras of California. The brilliant reddish yellow color of the base of the elytra and the coal black, heavily punctured pronotum readily separate it from its fellows. In the mountains of Arizona, there is a phase that is smaller with the base of the elytra a distinct orange color, while in British Columbia still another phase occurs that has the pronotum more finely and not umbilicately nor approximately punctured, with fulvous pile instead of black, and with the apical black patch of the elytra quite cordiform. This latter phase is so distinct that I have designated it as the subspecies **hoppingi.** My Holotype (No. 3111, Mus. Calif. Acad. Sci.) was collected by Mr. Ralph Hopping in Midday Valley, **Merritt, British Columbia,** July 12, 1923. Paratypes are in Mr. Hopping's collection.

Elater varipilis Van Dyke, new species

Elongate, subcylindrical; black, elytra orange except for a cordate black patch, the orange extending along the sides almost to the apex and on the suture at least half way through the black area, the antennæ rufopiceous and the tarsi rufous; surface moderately, finely pubescent, the pile suberect above, black on discal area of pronotum and on black areas of elytra, golden yellow to a slight extent on head, sides of pronotum behind, basal area of elytra and beneath. Head moderately coarsely, densely punctured; antennæ not reaching hind angles of prothorax, third segment one-half longer than second, subcylindrical, 4-10 distinctly serrate, the fourth slightly the longest and almost as long as broad; prothorax slightly broader than long, sides sinuate in front of hind angles, slightly arcuate in front and narrowed near apex, hind angles unicarinate, disk similarly punctured to head anteriorly, more finely and sparsely posteriorly, and quite shining. Elytra distinctly more than twice as long as prothorax and twice as long as broad, the sides gradually narrowing posteriorly, more suddenly at apex, the disk with striæ distinctly impressed and rather coarsely, closely punctured almost to apex, the intervals but slightly convex, finely punctured and rugose. Beneath moderately coarsely but not closely punctured anteriorly, more finely posteriorly. Length 9 mm., breadth 2.75 mm.

Holotype: No. 3112, Mus. Calif. Acad. Sci., and numerous *Paratypes* in my collection, the first from **Strawberry Valley,**

Eldorado County, California, collected by myself August 5, 1912, the rest from mid-Sierran localities. My series consists of 57 specimens ranging from British Columbia through western Washington and Oregon and down the Cascade and Sierra Nevada Mountains to the Yosemite Valley.

This species in size and general appearance closely resembles *Elater cordatus* Horn and no doubt in most collections is placed there. *Elater cordatus* Horn, of which I have typical specimens from the type locality and checked with the type, differs in the fact that the pile of the head and pronotum is much finer and entirely yellow, the prothorax with sides more parallel posteriorly, the disk more opaque, the third segment of the antennæ but little longer than the second and the elytra less cuneate. In general also the yellow of elytra does not have a tendency to extend along the suture so far posteriorly. The most evident character to use for their separation is the color of the pile on the pronotum, black on the disk and yellow at sides near hind angles in *varipilis* and yellow throughout in *cordatus*.

Elater bimaculatus Van Dyke, new species

Elongate, parallel sided; black, elytra orange except for an elongate black maculation near apex of each elytron which does not reach suture, sides or apex, the tarsi rufous and apices of antennæ somewhat so; surface moderately, finely pubescent, suberect above and golden yellow on head, pronotum and sides of elytra near humeri, elsewhere on elytra black, beneath yellowish, sparser, shorter and appressed. Head moderately, coarsely, not closely punctured, more in front; antennæ reaching hind angles of prothorax, second segment one-half longer than third and somewhat triangular, segments 4-10 decidedly triangular but longer than broad, the basal the broadest. Prothorax slightly broader than long, sides perceptibly sinuate in front of hind angles, slightly arcuate at middle and rather distinctly narrowed to apex, hind angles unicarinate, disk quite convex, very shining, and moderately coarsely but not closely punctured. Elytra two and one-half times as long as prothorax and two and one-half times as long as broad, breadth equal to that of prothorax, sides almost straight and parallel anteriorly, just perceptibly sinuate at middle, gradually rounded and convergent to apex, the disk with striæ moderately impressed and finely, rather closely punctured, the intervals flat except near apex, shining, very finely punctured and but slightly rugose. Beneath moderately coarsely but not closely punctured anteriorly, more finely on posterior ventral segments. Length 10 mm., breadth 2.75 mm.

Holotype: No. 3113, Mus. Calif. Acad. Sci., and numerous *Paratypes* in my collection, the first captured by me at **Fallen Leaf Lake, Lake Tahoe, Calif.,** July 1, 1915, the others from various points in the mountains of northern California. In my series are about fifty specimens, and I have seen many more, which range from British Columbia and western Montana south through Washington and Oregon to the southern Sierras of California. It is found in the main beneath the bark of dead fir.

The distinctive peculiarities of this member of the *cordifer* group is that it is the most elongate, most parallel and proportionately narrowest member, and that the apical black patches of the elytra are distinctly isolated, neither touching each other, the suture, nor the margin at any point. From *cordatus* and *affinis* which both have the pile of the pronotum yellow, it is readily separated in addition to the characters mentioned above by having the pronotum shining and the punctures well separated, whereas the pronotum is subopaque in those species and rather finely, closely punctured.

Elater brunneicolor Van Dyke, new species

Size, form and general color of *Elater manipularis* Cand., brown passing into rufous at margins, basal margin of elytra yellow, the antennæ and legs rufous; surface clothed with moderately coarse, yellowish brown pile, somewhat erect on dorsum. Head coarsely, rather closely punctured; antennæ reaching a segment and a half beyond hind angles of prothorax, third segment one and a half times as long as second and cylindrical, segments 4-10 distinctly serrate, the fourth one-third longer than broad, the outer ones somewhat narrower. Prothorax as wide as long, sides just perceptibly sinuate in front of hind angles, but slightly arcuate and convergently narrowed anteriorly, hind angles unicarinate, disk rather finely, sparsely punctured posteriorly, more coarsely and closely at sides and towards apex. Elytra almost three times as long as prothorax and three times as long as broad, sides parallel in front, gradually rounded posteriorly to apex, disk rather finely striate, the striæ finely, closely punctured with elongate punctures, the intervals flattened, shining and very finely punctured. Beneath rather coarsely, closely punctured in front and gradually more finely and sparsely behind. Length 9 mm., breadth 2.5 mm.

Holotype: No. 3114, Mus. Calif. Acad. Sci., collected by myself at **Forest Home, San Bernardino County, California,** June 18, 1928, *Paratypes* from Mt. Wilson, Los Angeles

County, California, and Forest Home, San Bernardino County, California. Of the fourteen specimens which I have before me, all are from southern California except two from the Santa Cruz Mountains, one from Oroville, and one from Placer Co., California. They also show considerable variation as to color from brown to rufotestaceous, in size from 7–9 mm. in length, and as regards the coarseness of pronotal punctation and distinctness of elytral striæ. Several typical specimens in the collection of Dr. F. E. Blaisdell have also been examined.

This species superficially looks very much like *Elater manipularis* Cand. as stated previously. It differs from that by having the median segments of the antennæ definitely serrate, the same segments in *manipularis* being only slightly enlarged apically and by having the pile coarser and more erect on the dorsal surface. From *Elater longicornis* Lec., a brown species which is found in its territory, it differs by being much shorter, by having its prothorax as long as wide, whereas in *longicornis* it is distinctly broader than long, by having shorter antennæ, the antennæ in the latter extending at least three segments beyond the hind angles of prothorax, and also by having the median segments more serrate.

Elater brevis Van Dyke, new species

Short, compact, black, sides, hind angles and outer part of base of prothorax rufous, elytra rufotestaceous with a vague fuscous patch along suture near apex, the antennæ and legs reddish with femora slightly piceous; surface sparsely pilose, the pile but little elevated even on upper surface. Head rather finely and sparsely punctured; the antennæ only reaching the base of the hind angles of prothorax, third segment a third longer than second and hardly dilated apically, fourth segment almost as long as second and third together, segments 4-10 serrate but about one-third longer than broad. Prothorax slightly broader than long, sides almost parallel in front of hind angles, gradually arcuate and anteriorly narrowed to apex, hind angles unicarinate, disk slightly convex, finely yet distinctly and not closely punctured. Elytra slightly more than twice as long as wide and almost three times as long as prothorax, sides almost parallel anteriorly, gradually rounded and narrowed to apex, the disk with striæ well defined and rather finely, closely punctured, the intervals quite flat, finely punctured and finely transversely rugose. Beneath moderately

coarsely, not closely punctured anteriorly, much more finely punctured on ventral segments. Length 8 mm., breadth 2.75 mm.

Holotype: No. 3115, Mus. Calif. Acad. Sci., a female collected by myself in **Paradise Valley, Mt. Rainier, Washington,** July 15, 1920; *Paratype,* a smaller specimen, from Moscow Mt., Idaho, May, identical in all essentials with preceding. A third specimen is entirely black except hind angles and a narrow lateral margin to prothorax, both above and beneath, which are rufous, a rufous cast to the humeral region of elytra and rufous antennæ and legs. It was collected on Red Mountain, Nevada Co., Calif., July 3, 1911, by Dr. Chas. Von Geldern. A number of other specimens from eastern British Columbia have also been submitted to me for determination by Mr. Ralph Hopping. He reports that he has "six specimens, two from Trinity Valley, which is just east of Vernon, two from Copper Mountain, near the International Boundary, one from Vernon and one from Williams Lake, which is in the Caribou District, about sixty miles north of the C.P.R."

This species, which suggests some of the species of *Drasterius,* both because of the form and coloration, would run in the LeConte table, close to *pullus,* where it most probably belongs. It is of the same stocky build, but larger and differently marked. It seems to show no relationship whatever to any of our other species.

Genus **Megapenthes** Kiesenwetter

The genus *Megapenthes* is quite polymorphic yet the species in general appearance and in most structural details are much like those of *Elater.* They all differ fundamentally, however, by having the sutures of the prosternum not excavated in front between the sternum and the flanks, and in addition also are distinguished by the following characters of lesser moment: prosternum concave or channeled between the front coxæ and the inner portion of the posterior coxal plates, not

suddenly expanded but gradually dilated, though often markedly broad as compared with the outer portion. In most of our species both the second and third antennal segments are small and in a number the antennæ of the males are ornamented with rather long erect hair in addition to the usual pile. The genus is world wide in distribution with the bulk of the species in the warmer parts of the world, while *Elater* is mainly Holarctic. In the United States there are but few species while in Mexico and the countries to the south they are far more abundant.

There is much confusion in the literature concerning the status of our species. For instance, Otto Schwarz in Genera Insectorum, places *tartareus, aterrimus* and *limbalis* in the genus *Trichophorus*. As stated by Schaeffer,[6] these most decidedly do not belong there but in *Megapenthes*. *Elater sturmii* Germ. was at one time believed by LeConte to be the same as *granulosus*, now recognized as but the female of *Megapenthes limbalis* (Hbst.). Later, however, he[7] discovered that they were two distinct species and placed *sturmii* where it truly belongs in the genus *Elater*. In the Leng Catalogue, there are also several errors as regards the synonymy. *Megapenthes aterrimus* Horn is a true synonym of *Dolopiosomus aterrimus* Mots., not the latter a synonym of *Megapenthes tartareus* (Lec.), therefore the name *horni* as a substitute for *aterrimus* Horn is unnecessary. The corrected bibliography will be found following the discussion of the species.

SYNOPTIC TABLE

1.	Hind angles of prothorax unicarinate	2
	Hind angles of prothorax bicarinate	17
2.	Opaque, very densely punctured; antennæ strongly serrate, segments 2-3 small, in the male outer segments with stiff erect hairs; large and robust species	3
	Somewhat shining, less densely punctured; antennæ but moderately serrate; smaller and more linear species	6

[6] Jour. N. Y. Ent. Soc., XXIV, 1916, p. 26.
[7] Trans. Am. Ent. Soc., XII, 1884, p. 9.

3. Pubescence entirely black..... 4
   Pubescence brown or variegated..... 5

4. Prosternal lobe subtruncate in front, prosternum but moderately broad between coxæ and slightly channeled; abdomen rather coarsely punctured; color dull black, legs sometimes dark red; distinctly narrowed in front as well as behind; length 9.5-11 mm. Ore., Calif., more common south and inland ..... *tartareus* (Lec.)
   Prosternal lobe arcuate in front, prosternum as broad as long between coxæ and deeply channeled; abdomen rather finely, densely punctured; color dull black, sometimes with white spot near apex of each elytron; stouter species than preceding, blunter both in front and behind; length 9-16 mm. Calif. and N. M..... *aterrimus* (Mots.)

5. Similar in structure to *aterrimus;* black or piceous, elytra yellow transversely barred with from two to three irregular black bands, prothorax also sometimes yellow as well as antennæ and legs often rufous; length 11-14 mm. Southern Calif... ..... *turbulentus* (Lec.)
   Prosternum much as in *aterrimus;* abdomen very finely densely punctured; male black with occiput, pronotum except hind angles and median area, entire margin of elytra and often legs and antennæ reddish yellow, female entirely black; length 8-16 mm. Middle and southern states..... *limbalis* (Hbst.)

6. Antennæ with segments 2-3 small and about equal in size..... 9
   Antennæ with second segment alone small, third almost as long as fourth and quite triangular..... 7

7. Head and elytra entirely coal black..... 8
   Black, front of head, prothorax except for large discal and sternal black spot, and basal margin of elytra yellowish red; first tarsal segment almost as long as following four united; simulates *rufilabris;* length 6 mm. Southern Pines, N. C... *tarsalis* Schfr.

8. Black, pubescence black, entire prothorax except sternum reddish yellow; pronotum and propleuræ finely, sparsely punctured; elytral striæ well impressed and distinctly, regularly punctured; intermediate segments of antennæ quite serrate; length 7-8 mm. Middle Sierra of Calif..... *lepidus* Lec.
   Similar to above in structure and coloration except that prothorax more sanguineous; the propleuræ rather coarsely, closely punctured, elytral striæ finely impressed and not distinctly punctured except at sides; length 6.5 mm. Ill.... ..... *illinoiensis* n. sp.

9. Black, more or less ornamented with orange or red..... 10
   Ferruginous or brownish, more or less unicolorous..... 14

10. Pronotum black or black with hind angles yellow..... 11
Pronotum, propleuræ and legs reddish orange; antennæ of males with erect hair; length 8-9 mm. Wash. to Calif....*nigriventris* Lec.

11. Elytra in great part black..... 12
Elytra in great part orange..... 13

12. Pronotum coarsely, deeply punctured; black, the hind angles of prothorax always orange, males in addition with basal and sometimes transverse subapical elytral spots yellow (rarely a third between them), females with basal third of elytra yellow except for suture and small oblique subhumeral patch, and a small subapical spot; length 7-10 mm. Coastal area of northern Calif. (lives in rotting California laurel, *Umbellularia californica* Nutt.).....*elegans* Horn
Pronotum finely, shallowly punctured; black, pronotum sometimes with small yellow area near hind angles, males in addition with basal and often subapical elytral spot yellow, females with yellow lunule (often broken) extending from base to near middle of elytra and a subapical spot; length 5-7 mm. Extends from Nova Scotia to B. C. and throughout Pacific States.....*stigmosus* (Lec.)

13. Black, elytra with large orange spots, extending beyond middle, and subapical spots, outlining a black cross; length 5-6 mm. Calif.....*quadrimaculatus* (Horn)
Black, elytra orange, scutellar spot and two transverse bands connected along the suture black; length 8 mm. Great Lake States and Canada (not Calif.).....*rogersi* Horn

14. Narrow and elongate species, over four times as long as broad.. 15
Larger and more robust species, not four times as long as broad; ferruginous brown above, rufous beneath; antennæ in males extending slightly beyond hind angles; pronotum rather finely, closely and deeply punctured; length 9 mm. Southern N. M. and southern Ariz.....*obtusus* n. sp.

15. Very narrow and elongate; antennæ in males reaching three segments beyond hind angles of prothorax; pronotal punctures not close together..... 16
Smaller and less elongate; antennæ in males extending about a segment and a half beyond hind angles of prothorax; pronotal punctures shallow, umbilicate and closely approximate; length 7.5 mm. Southern Ariz.....*variolatus* n. sp.

16. Reddish brown above, rufous beneath; head in males broader than apex of prothorax, eyes very large; pronotal punctures shallow and variolate; length 7.75-8 mm. Southern Ariz. .....*megalops* n. sp.
Ferruginous above, lighter beneath; head in males not broader than apex of prothorax; eyes normal; pronotal punctures more punctiform; length 8-9 mm. Southern Ariz..*longicornis* Schfr.

17. Smaller species, not over 8 mm. in length, second and third antennal segments small, outer carina poorly defined..... 18

Larger and more robust species, 10 mm. or over in length, both carinæ of hind angles of prothorax well defined..... 19

18. Black or piceous, base of prothorax and elytra and legs testaceous, beneath more or less rufous in front; pronotal punctures fine sparse; outer carina of hind angles of prothorax evident but vague; length 7-8 mm. Middle and southern states. *rufilabris* (Germ.)

Ferruginous, head somewhat piceous; pronotal punctures coarse and variolate; hind margin of posterior coxal plates emarginate near trochanter; length 8 mm. Brownsville, Tex. *nigriceps* Schfr.

19. Elongate, sub-cuneiform, brown; antennæ reaching hind angles of prothorax, second and third segments small, together shorter than fourth; prothorax longer than wide, pronotum deeply punctured; length 10 mm. Mo..... *angularis* Lec.

Elongate, brown, antennæ and legs rufous; antennæ in male reaching two segments beyond hind angles of prothorax, second segment small, third two-thirds length of fourth, together fully equal to fourth; prothorax longer than wide, disk coarsely, deeply and moderately closely punctured, hind angles with both carinæ sharply defined, the outer the longer; length 11 mm. Tex., southern Ariz..... *insignis* (Lec.)

Megapenthes aterrimus (Motschulsky)

This common California species is generally of a uniform sooty black color. Recently, however, several male specimens have been taken near Riverton, Eldorado Co., Calif., which had a patch of white pile near the apices of each elytron.

Megapenthes illinoiensis Van Dyke, new species

Small, elongate, shining, coal black, pronotum except anterior and posterior margins and propleuræ bright red, sparsely clothed with short, semierect black pile. Head rather coarsely, umbilicately, and closely punctured; antennæ in male reaching at least one segment behind hind angles of prothorax, second segment small, third three-fourths as large as fourth and triangular, third to tenth distinctly serrate. Prothorax longer than broad, narrowed in front, sides slightly and evenly arcuate, hind angles acute, unicarinate, disk smooth, rather finely and sparsely punctured, more coarsely and closely near anterior angles. Elytra more than twice as long as broad, quite parallel anteriorly, gradually narrowed posteriorly, disk with striæ not deeply impressed and rather finely punctured near suture, more coarsely and distinctly at sides, intervals flat and more or less transversely rugose. Beneath with the prosternum dis-

tinctly but not closely punctured, the propleuræ rather closely and coarsely punctured, the meso and metasternum distinctly but not closely punctured, and the abdomen more finely punctured. Length 6.5 mm., breadth 2 mm.

Holotype: Male, No. 3116, Mus. Calif. Acad. Sci., a unique collected near **Urbana, Illinois,** April 28, 1928, by Mr. A. T. McClay and by him kindly presented to me.

This species is very close to the Californian *Megapenthes lepidus* Lec., but is somewhat smaller, with the prothorax sanguineous rather than orange, the front of the head more coarsely and closely punctured, the propleuræ also much more coarsely and closely punctured, and the elytra with the striæ finer and the strial punctures less clearly defined. It superficially resembles *Elater collaris* Say and might possibly be confused with that in eastern collections.

Megapenthes obtusus Van Dyke, new species

Male subelongate, robust; ferruginous brown, base of prothorax and elytra slightly yellowish, beneath more rufous, antennæ rufotestaceous and legs testaceous; surface clothed with coarse, yellowish brown pile. Head rather finely, not densely punctured; antennæ slender, reaching about one segment behind hind angles of prothorax, second segment small, third one-third longer, fourth the longest, longer than second and third combined, not quite twice as long as broad at apex, segments 4-10 serrate and gradually diminishing in length and breadth. Prothorax slightly longer at middle than broad; sides almost straight from apex of hind angles to anterior angles and gradually convergent, hind angles robust, rather long, slightly divergent, and unicarinate; disk convex, flattened above, feebly canaliculate basally, rather coarsely, deeply and closely punctured, finer apically, punctures obscure at base. Elytra more than twice as long as broad and twice as long as prothorax, sides almost straight and slightly converging posteriorly to posterior third, thence more rounded and convergent to blunt apex, disk rather deeply striate, striæ closely, moderately coarsely punctured, intervals subconvex, finely punctured and rugose, especially towards base. Beneath moderately, finely, sparsely punctured in front, more finely and closely on abdomen, posterior coxal plates but moderately dilated inwardly and with margin in front of trochanters slightly sinuate. Length 9 mm., breadth 2.75 mm.

The female is more robust, with sides of prothorax more parallel posteriorly, more rounded anteriorly, the elytra likewise with sides more arcuate and generally less cuneate, the antennæ also shorter.

Holotype: Male, No. 3117, Mus. Calif. Acad. Sci., from the **Chiricahua Mountains, Arizona,** July 9, 1908; *Allotype:* Fe-

male, No. 3118, Mus. Calif. Acad. Sci., from Cloudcroft, Sacramento Mountains, New Mexico, July 9, 1917, and one *Paratype* female, Texas Pass, Dragoon Mountains, Arizona, July 19, 1917, the last two collected and kindly presented by Prof. W. M. Wheeler.

Judging from the description of *Megapenthes angularis* Lec., this species somewhat resembles that in general features but it lacks the bicarinate hind angles to prothorax and the transverse posterior margin to the expanded inner portion of the posterior coxal plates. It suggests none of our other species.

Megapenthes variolatus Van Dyke, new species

Elongate, narrow, somewhat narrowed in front and distinctly so posteriorly; ferruginous, base of elytra somewhat yellowish, tarsi testaceous; clothed with rather coarse, yellowish pile. Head rather coarsely and moderately closely punctured, eyes not projecting beyond sides of prothorax, antennæ slender, extending at least a segment and a half beyond hind angles of prothorax, second and third segments small and of about equal length, fourth distinctly longer than the two combined, segments 4-10 slightly serrate and diminishing in breadth towards apex. Prothorax slightly longer than broad, sides straight, convergent forwards from apices of hind angles to anterior angles, hind angles prominent, slightly divergent and unicarinate, disk slightly convex, vaguely canaliculate posteriorly, densely, shallowly umbilicately punctured, obscurely so at base. Elytra slightly more than two and a half times as long as broad and two and a half times as long as prothorax (excluding hind angles), sides quite parallel in front, slightly arcuate and convergent to bluntly rounded apex, disk distinctly striate, the striæ finely, closely punctured, intervals flattened, finely punctured, and rugose, especially on basal area. Beneath rather finely and sparsely punctured in front, more closely so over ventral surface, posterior coxal plates distinctly broadened inwardly and with posterior margin in front of trochanters conspicuously emarginate. Length 7.5 mm., breadth 2 mm.

Holotype: Male, No. 3119, Mus. Calif. Acad. Sci., and several *Paratype* males from a series of eight specimens in my collection, taken at 6000-foot elevation on **Mt. Washington, near Nogales, Arizona,** July 16 and 17, 1919, by Mr. J. August Kusche.

This species in size and general shape somewhat resembles *rufilabris* and *nigriceps* but differs from the first in color, in

having longer antennæ and hind prothoracic angles distinctly unicarinate; and from the latter in having the antennæ slightly longer and the hind prothoracic angles not bicarinate. From *longicornis* which it resembles in color, it differs by being shorter, more cuneate anteriorly and posteriorly, with shorter antennæ, and with the disk more coarsely and closely punctured.

Megapenthes megalops Van Dyke, new species

Male elongate, narrow, parallel; reddish brown, beneath rufous, antennæ and legs testaceous; sparsely clothed with rather coarse yellowish pile. Head shallowly, rather sparsely, umbilicately punctured, broader than prothorax at apex; the eyes large and prominent, almost hemispherical; antennæ long and slender, reaching at least three segments beyond hind angles of prothorax, second segment small, third slightly longer, fourth a third longer than second and third combined and twice as long as broad, segments 4-10 serrate and diminishing in breadth towards apex. Prothorax slightly longer than broad, sides slightly sinuate in front of hind angles, thence straight and barely converging, almost parallel, to anterior angles, hind angles prominent, slightly diverging and unicarinate; disk slightly convex, shallowly, umbilicately and not closely punctured as on head. Elytra over two and a half times as long as broad and nearly three times as long as prothorax (excluding hind angles), sides quite parallel for basal two-thirds, thence gradually rounded to apex; disk distinctly striate, striæ rather finely, closely punctured, intervals flattened, finely punctured and finely rugose. Beneath moderately finely and sparsely punctured in front, umbilicately on propleuræ, more minutely and closely on ventral surface, posterior coxal plates distinctly widened inwardly and with posterior margin in front of trochanters emarginate. Length 7.75 mm., breadth 2 mm.

The female differs by having the head not broader than anterior part of prothorax, the eyes less prominent, the antennæ shorter, just reaching beyond hind angles of prothorax, and the prothorax more robust, the sides a bit arcuate at middle and slightly rounded in front.

Holotype: Male, No. 3120; and *Allotype:* Female, No. 3121, Mus. Calif. Acad. Sci., and two *Paratypes* in my collection, the males from **Mt. Washington**, near **Nogales, Ariz.**, collected July 20, 1919, by Mr. J. August Kusche, and the female from Miller Cañon, Huachuca Mts., Ariz., July 14, collected by Mr. H. A. Wenzel and kindly presented to me by the late Mr. Henry Wenzel.

This species in size and general shape is most like *longicornis* and is perhaps closely related to it as indicated by its

very long antennæ, but it differs by being darker in color, by having a broader head and larger eyes in the male, and a coarser type of punctation on pronotum.

BIBLIOGRAPHY

Megapenthes tartareus (Lec.) (Elater), Proc. Acad. Nat. Sci. Phila., 1859, p. 85; (Megapenthes), Lec., Tr. Am. Ent. Soc., XII, 1884, p. 6.

‖*aterrimus* Schwarz (Trichophorus), Gen. Insect., fasc. 46, 1906, p. 259.

Megapenthes aterrimus (Mots.) (Dolopiosomus), Bul. Mosc., XXXII, II, 1859, p. 382; (Megapenthes), Horn, Tr. Am. Ent. Soc., III, 1871, p. 309; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 6.

‖*tartareus* Schwarz (Trichophorus), Gen. Insect., fasc. 46, 1906, p. 259.

horni Leng (Megapenthes), Cat. Col., 1920, p. 173.

Megapenthes turbulentus (Lec.) (Elater), Tr. Am. Phil. Soc., X, 1853, p. 463; (Megapenthes), Cand., Mon. Elat., II, 1859, p. 508; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 6.

Megapenthes limbalis (Hbst.), male, (Elater), Käfer, IX, 1806, p. 53, t. 162, f. 10; Say, Tr. Am. Phil. Soc., VI, 1836, p. 167; Lec., Tr. Am. Phil. Soc., X, 1853, p. 463; (Ampedus), Germ., Zeits. f.d. Ent., V, 1844, p. 164; (Megapenthes), Gemm. & Har., Cat. Col., V, 1869, p. 1537; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 6.

granulosus (Melsh.), female, (Ectinus), Proc. Acad. Nat. Sci. Phila., II, 1844, p. 159; (Megapenthes), Cand., Mon. Elat., II, 1859, p. 497; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 6.

Megapenthes lepidus Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7.

Megapenthes illinoiensis n. sp.

Megapenthes tarsalis Schfr., Jour. N. Y. Ent. Soc., XXIV, 1916, p. 259.

Megapenthes nigriventris Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7.

Megapenthes elegans Horn, Tr. Am. Ent. Soc., III, 1871, p. 310, pl. iv, fig. 12; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7.

Megapenthes stigmosus (Lec.) (Elater), Tr. Am. Phil. Soc., (2) X, 1853, p. 472; (Megapenthes), Cand., Mon. Elat., II, 1859, p. 509; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7.

caprella (Lec.) (Elater), Rept. Exp. & Surv. Miss. to Pac., XII, p. 3; separate erroneously marked IX, 1860, p. 47; (Megapenthes), Cand., Mon. Elat., II, 1859, p. 510.

Megapenthes quadrimaculatus (Horn) (Limonius), Tr. Am. Ent. Soc., III, 1871, p. 313; (Megapenthes), Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7; Horn, Henshaw List Col., 1885, p. 68; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Megapenthes rogersi Horn, Tr. Am. Ent. Soc., III, 1871, p. 310, pl. IV, fig. 9; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7.

Megapenthes obtusus n. sp.

Megapenthes variolatus n. sp.

Megapenthes megalops n. sp.

Megapenthes longicornis Schfr., Jour. N. Y. Ent. Soc., XXIV, 1916, p. 258.

Megapenthes rufilabris (Germ.) (Elater), Ins. sp. nov. *etc.*, 1824, p. 47; Lec., Tr. Am. Phil. Soc., X, 1853, p. 472; (Ampedus), Germ., Zeits., f.d. Ent., V, 1844, p. 169; (Megapenthes), Cand., Mon. Elat., II, 1859, pp. 98-99; Lec., Tr. Am. Ent. Soc. XII, 1884, p. 6.

delicatulus (Dej.) (Oophorus), Cat., ed. 3, 1837, p. 105.

Megapenthes nigriceps Schfr., Jour. N. Y. Ent. Soc., XXIV, 1916, p. 259.

Megapenthes angularis Lec., Proc. Acad. Nat. Sci. Phila., 1866, p. 360; Lec., Tr. Am. Ent. Soc., XII, 1884, p. 7.

Megapenthes insignis (Lec.) (Elater), Tr. Am. Ent. Soc., XII, 1884, p. 11.

Genus **Anchastus** LeConte

SYNOPTIC TABLE

1. Smaller species, less than 7 mm. in length, hind angles of prothorax unicarinate, hind coxal plates suddenly dilated inwardly 2

   Larger species, usually over 7 mm. in length 4

2. Broad and flattened, second and third antennal segments both much shorter than fourth; nigropiceous or black (elytra sometimes flavous), clothed with cinereous pubescence, fourth antennal segment longer than fifth and about as long as second and third together; length 4-6.5 mm. Calif..... ..... *cinereipennis* (Esch.)

   Narrower and moderately convex, second antennal segment alone short, third and fourth about equal in length 3

3. Black with base of prothorax rufous, prothorax longer than broad; length 6 mm. Southeastern states.... *signaticollis* (Germ.)

   Dark brown to castaneous, head and elytra sometimes piceous, prothorax not longer than broad; length 5-6 mm. Fla... *asper* Lec.

4. Upper surface uniformly black or piceous or ornamented with red or yellow markings, hind coxal plates gradually dilated inwardly 5

   Upper surface more or less uniformly light brown, rufous or castaneous 8

5. Outer segments of antennæ broadly serrate, second segment small, third large and triangular and at least equal to fourth in length 6

   Outer segments of antennæ cylindrical or but slightly serrate.. 7

6. Body somewhat shining, either entirely black or with basal area of elytra orange; length 8 mm. Calif. ..... *militaris* Cand.

   Body subopaque, black with antennæ, legs, and basal angles of prothorax rufous, also often with head, basal margin of prothorax and elytra, and propleuræ red; length 8 mm. Calif... ..... *subopacus* n. sp.

7. Body black with elytra ornamented with two large humeral and two subapical yellow spots, antennæ and legs rufous, second antennal segment small, third three-fourths length of fourth and cylindrical; length 8 mm. Ind., Ga., Ala., Fla.... *binus* (Say)

8. Hind angles of prothorax unicarinate (a vague outer carina sometimes present), hind coxal plates gradually dilated inwardly 9

   Hind angles of prothorax distinctly bicarinate, the outer carina parallel to the margin 11

9. Much elongated and cylindrical, prothorax very closely and cribrately punctured, third antennal segment but little longer than second and much shorter than fourth, rufocastaneous throughout; length 9-11 mm..... *digitatus* Lec.

   Less elongated and more flattened, third antennal segment one-half longer than second and but little shorter than fourth, bicolored 10

10. Head, prothorax and underside rufous, elytra black, punctures of prothorax rather fine and well separated though numerous; length 6-7.5 mm. Ariz., southeastern Calif. and L. Calif. *bicolor* Lec.

    Entire upper surface dark brown, beneath rufous, punctures of prothorax coarse, umbilicate and approximate; length 8 mm. ..... *ventralis* n. sp.

11. Third segment of antennæ as long or longer than the fourth, posterior coxal plates gradually dilated inwardly 12

    Third segment of antennæ distinctly shorter than fourth..... 13

12. Prothorax longer than broad, third segment of antennæ triangular and distinctly longer than fourth, second very small; length 8 mm. Ariz..... *arizonicus* n. sp.

    Prothorax broader than long, third segment of antennæ equal to fourth; length 10 mm. New Orleans, La..... *rufus* Cand.

13. Prothorax longer than broad, third segment of antennæ longer than second and with second about equal to fourth, hind coxal plates suddenly dilated inwardly; length 8-9 mm. Fla., Ga..... *bicarinatus* Lec.

    Prothorax nearly square, third segment of antennæ longer than second, second and third together hardly equal to fourth, hind coxal plates gradually dilated inwardly; length 10.5 mm. Ariz., southeastern Calif..... *sericans* Cand.

Anchastus subopacus Van Dyke, new species

Broad and depressed, subopaque, black, the head, entire margin of prothorax including the posterior angles, the propleuræ, first two segments of antennæ and legs a bright red; upper surface moderately densely clothed with a fine, short grayish black pile, suberect on the head and prothorax, more depressed on the elytra, the under surface more sparsely clothed. Head coarsely and closely punctured, middle portion of clypeal margin slightly lobed; antennæ reaching beyond the hind angles of the prothorax, the second segment small and transverse, the third longer than the fourth and but slightly longer than broad, segments 3-10 very much serrated, the eleventh elliptical and constricted before apex. Prothorax as broad as long, sides gradually arcuate from base to apex, basal angles prominent, acute, projecting backwards and unicarinate, the carinæ extending forwards to base of angles and diverging from sides; disk moderately convex, coarsely and closely punctured, canaliculate only in front of scutellum. Elytra over three times length of prothorax and twice as long as broad, sides almost parallel in basal portion, thence gradually arcuate to apex; disk moderately convex, finely punctato-striate, the punctures more evident anteriorly, the intervals flat, finely punctured and granulate. Beneath the prosternum finely, sparsely punctate, the propleuræ, meso- and metasternum coarsely, closely punctate, and the abdomen more finely and somewhat strigosely punctate, the hind coxal plates gradually but rather strongly dilated inwardly. Length 8 mm., breadth 3 mm.

Holotype: No. 3122, Mus. Calif. Acad. Sci., from **Havilah, Calif.**, collected June 13, 1913, and three paratypes in my collection, one from Clear Lake, Lake Co., Calif., collected May, 1895, which agrees with the holotype except in being a bit smaller and in having only the anterior margin of the head and the basal portion of the prothorax red, lacking the red sides and propleuræ, though having the basal margin of the elytra distinctly reddened. The other paratyes from Sequoia National Park, Calif., May 28, 1929, approach the type very closely in size and coloration. I have also seen two other specimens, one collected near Kaweah, Calif., by Mr. Ralph Hopping and now in his collection, and one in the collection of Dr. George Horn, now in the Philadelphia Academy.

This species because of its general appearance and type of antennæ should be placed near to *militaris* Cand. It differs from that by being broader and more generally robust, subopaque and by having a different color pattern.

Anchastus militaris Candèze

The typical bicolored phase of this species is rather rare. I have seen only a few specimens of these, one in the collection of Dr. George Horn, three in my own collection and two or three elsewhere. My specimens were collected: one near Lake Tahoe, one at Meadow Valley, Plumas Co., Calif., June 6, 1924, and one in the Sequoia National Park, June 5, 1929.

An all-black phase is, however, less rare and is widely distributed throughout the Sierra Nevada mountains and northern California generally. This phase, I am calling the subspecies **corvus** and designating two specimens from **Eldridge, Sonoma Co., Calif.**, one as the holotype (No. 3123, Mus. Calif. Acad. Sci.), the other as a paratype. Other specimens in my series of thirteen specimens are from Humboldt Co., Shasta Co., Placer Co., and Forest Home, San Bernardino Co., Calif., June 18, 1928. It does not differ structurally at all from the typical form.

Anchastus ventralis Van Dyke, new species

Elongate, slightly depressed, shining, brown, the antennæ, posterior margin of pronotum, including the angles and entire underside, rufous, darker in front, surface moderately clothed with a short yellowish pubescence. Head coarsely and closely punctured, the clypeal margin entire and slightly lobed at the middle; antennæ reaching one segment beyond the hind angles of prothorax, the second segment small, but slightly longer than broad, the third almost twice the length of second and but little shorter than fourth, segments 3-10 but slightly serrated. Prothorax as broad as long, sides straight near base and slightly arcuate and convergent forwards, hind angles prominent, acute, projecting backwards and unicarinate, the carinæ acute and extending forward almost to middle of prothorax and close to and almost parallel to side margin; disk convex, coarsely umbilicately and densely punctured, canaliculate posteriorly at middle, a fine longitudinal carina evident in the depression. Elytra almost three times as long as prothorax and a little over twice as long as broad, sides almost straight and parallel to apical third, thence arcuate to apex; disk moderately convex, punctato-striate, the punctures rather large and crenulate, the intervals slightly convex, finely punctate and perceptibly scabrous. Beneath moderately coarsely, closely punctured anteriorly, more finely on abdomen; coxal plates moderately wider inwardly, very narrow outwardly. Length 8 mm., breadth 2.5 mm.

Holotype: No. 3124, Mus. Calif. Acad. Sci., a unique in my collection, collected on **Mt. Washington** near **Nogales, Ariz.,** alt. 6000 ft., July 13, 1919, by Mr. J. August Kusche. A second specimen, a male, collected on Kits Peak, Rincon, Baboquivari Mts., Ariz., Aug. 4, 1916, by Dr. Lutz, is in the collection of the American Museum of Natural History. This, I have designated as a paratype. It differs from my specimen only by being a bit lighter in color and by having the punctures less umbilicate at the center of the pronotum.

This species is no doubt closely related to *Anchastus bicolor* Lec. but it differs by being of a uniform dark brown color above with a golden yellow pile, not with head and prothorax a bright red and elytra black and with black pile; by being slightly longer and more definitely attenuated both before and behind, less parallel; and by having the prothoracic punctures coarse, umbilicate and approximate, not sharply impressed and well spaced. It is possible that it is the same as *Anchastus desertus* Horn, the type of the latter being a poorly pigmented or immature specimen. If so, the latter is most certainly not a synonym of *bicolor* as generally placed, but a good species.

Anchastus arizonicus Van Dyke, new species

Elongate, narrowed anteriorly and posteriorly, rufous, antennæ and legs paler, moderately shining, clothed with short yellowish hairs giving the surface a silken appearance. Head coarsely, moderately closely punctured; antennæ reaching beyond hind angles of prothorax, second segment small and transverse, third long, nearly twice as long as broad and about one-fourth longer than fourth, segments 4-7 of about equal length and breadth, 8-10 somewhat narrower, 3-10 serrate, eleventh about as long as third, elliptical and slightly constricted near apex. Prothorax longer than broad, sides feebly arcuate and gradually narrowed from base to apex, hind angles acute, prolonged backwards, bicarinate, the inner carina very sharp, the outer finer, longer and close to lateral margin; disk moderately convex, coarsely, rather closely punctured at middle, more coarsely, shallowly, umbilicately, and approximately at sides. Elytra barely narrower than the prothorax at the humeri, gradually narrowed from base to apex, moderately convex, disk striate, the striæ coarsely punctured basally, much finer apically, intervals flat, rather coarsely, closely punctured and somewhat scabrous anteriorly, much more finely and sparsely punctured posteriorly. Beneath moderately coarsely and closely punctured in front, abdomen more finely; the hind coxal plates strongly and suddenly dilated internally. Length 7 mm., breadth 2.25 mm.

Holotype: Male, No. 3125, Mus. Calif. Acad. Sci.; and *Paratype:* Male, in my collection; the first collected at **Texas Pass, Dragoon Mts., Ariz.,** July 21, 1917, by Prof. W. M. Wheeler, the second taken at Coyote Mts., Ariz., Aug. 4-7, 1918, by Dr. Frank E. Lutz, and both specimens kindly presented by the collectors. Three other specimens collected by Dr. Lutz at Kits Peak, Rincon, Boboquivara Mts., Ariz., Aug. 1-4, 1916, and kindly submitted for study by the American Museum of Natural History, have also been designated as paratypes.

This species because of the bicarinate hind angles of the prothorax might be confused with *bicarinatus* and *sericans,* but it differs from both by having the third antennal segment distinctly longer than the fourth. In addition, the finer and closer pronotal punctation of *bicarinatus* and the larger size and greater robustness of *sericans* will readily assist in their separation. It is perhaps even closer to *rufus* but that is stated to be larger, to have a broader prothorax and third antennal segment equal to fourth. It cannot be confused with any species described by Champion from Mexico, in the Biologia.

BIBLIOGRAPHY

Anchastus cinereipennis (Esch.) (Monocrepidius), Thon., Ent. Arch., II, 1829, p. 31; Dej., Cat., 3rd ed., 1837, p. 98; (Cryptohypnus), Mann., Bul. Mosc., XVI, 1843, p. 240; (Anchastus), Cand., Mon. Elat., II, 1859, p. 406.

tantillus (Mann.) (Cardiophorus), Bul. Mosc., XVI, 1843, p. 239; (Aplastus), Cand., Mon. Elat., II, 1859, p. 407.

puberulus (Mann.) (Cryptohypnus), Bul. Mosc., XVI, 1843, p. 240.

recedens (Lec.), Tr. Am. Phil. Soc., n. s. X, 1853, p. 460.

hirsutulus (Mots.) (Monocrepidius), Bul. Mosc. XXXII, 1859, p. 364.

regularis (Mots.) (Monocrepidius), Bul. Mosc., XXXII, 1859, p. 364.

piliferus (Mots.) (Monocrepidius), Bul. Mosc. XXXII, 1859, p. 365.

Anchastus signaticollis (Germ.) (Ampedus), Zeits. f.d. Ent., V, 1843, p. 190; (Anchastus), Cand., Mon. Elat., II, 1859, p. 403.

Anchastus asper Lec., Proc. Am. Phil. Soc., XVII, 1878, p. 404.

Anchastus militaris Cand., Mem. Soc. Sci. Liege, 2d Ser., IX, 1881, p. 59; Horn, Tr. Am. Ent. Soc., XII, 1885, p. 49.

Anchastus militaris corvus n. subsp.

Anchastus subopacus n. sp.

Anchastus binus (Say) (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 178; (Discrepidius?), Lec., Tr. Am. Phil. Soc., X, 1853, p. 461; Henshaw, List Col., 1885, p. 67.

Anchastus digitatus Lec., Tr. Am. Phil. Soc., X, 1853, p. 459.
longulus Lec., Proc. Am. Phil. Soc., XVII, 1878, p. 404.

Anchastus bicolor Lec., Proc. Acad. Nat. Sci. Phila., 1866, p. 390; Tr. Am. Ent. Soc., XII, 1885, p. 50.
desertus Horn, Tr. Am. Ent. Soc., III, 1871, p. 311.

Anchastus ventralis n. sp.

Anchastus arizonicus n. sp.

Anchastus rufus Cand., Mon. Elat., II, 1859, p. 404.

Anchastus bicarinatus (Lec.) (Brachycrepis), Tr. Am. Phil. Soc., X, 1853, p. 461; (Anchastus), Cand. Mon. Elat., II, 1859, p. 405.

Anchastus sericans Cand., Mem. Soc. Sci. Liege, 1891, p. 106.
sericeus Horn, Tr. Am. Ent. Soc., III, 1871, p. 311.
horni Schw., Gen. Insect., fasc. 46, 1907, p. 315.

Anchastus frontalis Horn, Tr. Am. Ent. Soc., XII, 1885, p. 49.
= *Physorrhinus fusculus* Champ., Biol. Cent. Am., Col., III, pt. 1, p. 385.

Anchastus fuscus Lec., Proc. Am. Phil. Soc., XVII, 1878, p. 404.
= *Ischiodontus fuscus* (Lec.), Tr. Am. Ent. Soc., IX, 1882, p. 238.

Hypnoidini

In his revision of our species, Horn[8] used *Cryptohypnus* Germ. as the genus to include the bulk of our species. Later he[9] accepted *Hypnoidus* Steph. for those species which had the middle coxal cavities closed outwardly only by the meso- and metasternites. The present belief is that all of the species listed under these two genera as is done in the Leng Catalogue, belong to a single genus as Horn treated them but that the genus *Hypnoidus* Steph., being the older name, should be used instead of *Cryptohypnus* Germ. This procedure is followed by Schenkling,[10] the latest to catalogue them. *Cryptohypnus* may be used as a subgenus of *Hypnoidus,* to include those generally larger species which have the middle coxal cavities closed outwardly by the meso-epimeron as well as the

[8] A monograph of the species of Cryptohypnus of Boreal America, by George H. Horn, Tr. Am. Ent. Soc., XVIII, 1891, pp. 1-31.

[9] A note on Cryptohypnus, by George H. Horn, Ent. News, V, 1894, pp. 6-7.

[10] Schenkling, Junk's Col. Cat., Pars 80, Elateridæ I, pp. 200-215.

meso- and metasternites. Inasmuch as I am establishing a new genus in the tribe, I thought that it might be well to make out a key for the North American genera of that tribe.

KEY TO GENERA

1. Tarsal claws simple, tarsi clothed beneath with stiff hair..... 2
   Tarsal claws toothed, tarsi clothed beneath with silken pile..... 3
2. Front completely margined, last maxillary palpal segment simply dilated.....*Hypnoidus* Steph.
   Front with margin interrupted at middle, last maxillary palpal segment cultriform.....*Anthracopteryx* Horn
3. Last maxillary palpal segment cultriform[11].....*Paroedostethus* n. genus
   Last maxillary palpal segment dilated.....*Oedostethus* Lec.

Hypnoidus glacialis Van Dyke, new species

Elongate, broad, and flattened; shining black above, rufopiceous beneath, the antennæ and legs bright red; upper surface clothed with short, suberect black pile, lower surface with very fine, closely appressed gray pile. Head longitudinally impressed at middle, finely, sparsely punctured; antennæ long, about reaching hind angles of prothorax, all segments considerably longer than broad, the second twice as long as broad and about two-thirds the length of third, the latter one-fourth longer than fourth, the following gradually shorter and slightly broader. Prothorax large, about as broad as long at middle, sides markedly arcuate, narrowed and sinuate in front of hind angles, the latter narrowed, elongate, divergent, and with a fine carina extending forwards and near the margin, one-third the length of the prothorax; disk slightly convex, finely sparsely punctured and with well impressed median canaliculation near base. Elytra over twice as long as prothorax and twice as long as broad, the sides arcuate from humeri to near base and gradually rounded at apex, disk slightly convex, striæ sharply impressed and finely punctured, intervals convex and very finely punctured. Beneath very finely, sparsely punctured. Length 8.5 mm., breadth 3 mm.

Holotype: No. 3126, Mus. Calif. Acad. Sci., and eight *Paratypes* in my collection, the first from Lake MacDonald, **Glacier National Park, Montana,** July 7, 1930, the others from near Eureka, Montana, July 9, 1930. Besides these, I also collected one in the Yellowstone National Park and have studied specimens from Garibaldi, B. C., July 24-31, 1926,

[11] The segment is not quite so long as it is in *Anthracopteryx* Horn, see Plate I, fig. 7, Tr. Am. Ent. Soc., XVIII, 1891.

collected by Mr. G. A. Hardy and from Waterton Lake, Alberta, Canada, July 10, 1930, collected by Mr. F. S. Carr.

This species is very closely related to *grandicollis* (Lec.) and looks very much like it. It differs by having the pronotum very finely and sparsely punctured instead of coarsely, closely punctured, the head sulcate, the hind angles of prothorax narrow, not more or less triangular, and the elytra with well impressed striæ and convex intervals, in contrast with the five striæ and flat intervals of *grandicollis*.

Hypnoidus sanborni (Horn)

Hypnoidus barbatus (Sahlb.) and *sanborni*, I consider one and the same. I have series of both and cannot separate them except by the labels.

Hypnoidus lecontei hirsutus Van Dyke, new subspecies

This subspecies resembles the more typical form of *lecontei* which extends clear across the continent from the northern New England States to British Columbia and throughout the mountains of Washington and Oregon, except that it is more convex and decidedly hairy, the pile over the entire upper surface being from two to three times as long as it is in the typical from and much finer in texture. So pronounced is this feature that even when examined superficially, one's attention is immediately attracted to it.

Holotype: Male, No. 3127; and *Allotype:* Female, No. 3128, Mus. Calif. Acad. Sci., and several designated *Paratypes* in the collection of the California Academy of Sciences, from a series of about a dozen specimens collected on **Mt. Timpanogos, Wasatch Mts., Utah,** July 9, 1922, by Mr. E. P. Van Duzee. I have also four specimens which I collected in the same region, June 6, 1926.

Genus **Paroedostethus** Van Dyke, new genus

Robust, simulating in general appearance the members of the *hyperboreus* group of *Hypnoidus*. Head with front slightly convex above, flattened anteriorly, frontal margin complete and elevated; antennæ reaching beyond posterior angles of prothorax, segment two, twice as long as broad, three, one and a

half times as long as two, segments 3-10 feebly serrate, gradually shorter and broader towards apex, eleventh as long as fourth and acute at apex; maxillary palpi moderately long, the last segment broadly cultriform, longer than the preceding two segments together. Thorax without defined basal incisures and with margin acute and straight when viewed laterally. Scutellum subquadrate, the posterior margin slightly arcuate. Elytra elliptical, humeri broadly rounded, wings well developed. Prosternum broad, lobe well developed but not concealing the mouth anteriorly, the sutures slightly arcuate outwardly and somewhat convergent posteriorly, tip of prosternum acute, flexed upward toward the body. Middle coxal cavity closed outwardly by the mesosternum, the mesoepimeron (broadly), and metasternum. Posterior coxal plates suddenly but obliquely and not very greatly dilated at inner third, the internal lamina with an acute tooth at the inner side of the trochanter. Tarsi as long as the tibiæ, the first segments gradually decreasing in length and not lobed but densely clothed beneath with short silken pile, the claws with a broad obtuse tooth near the middle.

Genotype *Paroedostethus relictus* n. sp.

This genus undoubtedly belongs in the tribe Hypnoidini because of its suddenly dilated posterior coxal plates, broad prosternum with single lateral sutures, convex outwardly, and the filiform tarsi. Its relationship to the other American genera contained within the tribe can best be seen by referring to the table.

Paroedostethus relictus Van Dyke, new species

Oblong, convex, robust, flavocastaneous, head and prothorax moderately shining, elytra subopaque, sparsely clothed with short, inconspicuous yellow pubescence, longer and more evident on abdomen. Head distinctly, regularly, not closely punctured; eyes moderately large; antennæ reaching beyond hind angles of prothorax. Prothorax slightly broader than long, broadest at middle, sides evenly arcuate from anterior angles to near posterior angles where distinctly sinuate; hind angles acute, divergent, and carinate; disk convex, median longitudinal impression complete but vague, moderately closely and regularly punctured. Elytra elliptical, broadest behind the middle, sides straight from humeral angle to point of greatest width then evenly arcuate to apex; disk finely striate and punctate, less defined apically; intervals flat, finely and rather regularly punctured and slightly rugose. Beneath rather coarsely and moderately closely punctured on prothorax, more finely and closely over abdomen. Length 8.5 mm., breadth 3 mm.

Holotype: No. 3129, Mus. Calif. Acad. Sci., a unique in my collection, collected in Cold Water Cañon, slopes of **Mt. San Antonio** (Old Baldy), **Los Angeles Co., Calif.**, Sept. 10, 1906, by Mr. J. August Kusche.

Genus **Horistonotus** Candeze

This genus which is related to *Cardiophorus* by having a cordiform scutellum, though differing from the same by having the prothorax laterally margined in the basal half, is represented in the material before me by two very distinct new species. Horn's revision[12] is so comparatively recent that the synopsis and bibliography of the genus can be omitted for the species can readily be placed by referring to Horn's key.

Horistonotus umbilicatus Van Dyke, new species

Elongate, moderately slender, convex, rufopiceous, the prothorax and sides beneath generally rufous, the antennæ and legs testaceous, and sparsely clothed with somewhat coarse fulvous pile. Head slightly convex, finely punctured with coarser punctures here and there, the clypeus projecting, the anterior margin subangulate at middle; the antennæ slender, extending about one segment beyond apex of hind angles of prothorax in male, about reaching base of hind angles in female. Prothorax as long as broad in male, slightly broader in female, distinctly broader at base than apex, the base biemarginate, without notch but with fine plicæ, the sides moderately arcuate, the hind angles not divergent, the disk finely punctured and with series of large, shallow, umbilicate impressions rather regularly dispersed over the surface. Elytra not wider than prothorax, slightly more than twice as long as wide, the sides slightly arcuate and gradually narrowed towards apex, disk with striæ deeply impressed and rather coarsely punctured, the intervals convex, somewhat costiform near apex, very finely punctured. Beneath finely punctured with large and shallow punctures irregularly disposed over surface anteriorly. Tarsal claws dentate from beyond middle to base. Length 6 mm., breadth 2 mm.

Holotype: Male, No. 3130; and *Allotype:* Female, No. 3131, Mus. Calif. Acad. Sci., and two *Paratypes* in the collection of the California Academy of Sciences, the first two from **Patagonia, Ariz.**, Aug. 1, 1924, collected by Mr. J. O. Martin; the paratypes, both males, from Badger, Ariz., July 31, 1924, and St. Xavier Mission, Ariz., July 30, 1924, collected by Mr. E. P. Van Duzee. A fifth specimen belonging to the American Museum of Natural History and collected at Tucson, Arizona, July 21-23, 1916, has also been designated as a paratype.

This species superficially resembles *Horistonotus exoletus* Er. but differs by having toothed, not cleft tarsal claws, sub-

[12] Trans. Am. Ent. Soc., XII, 1884, pp. 33-41.

angulate clypeus, and a series of large umbilicate impressions over the pronotum. In Horn's group B, to which it belongs because of the toothed tarsal claws, it would run to the series containing *simplex, curiatus* and *gracilis,* to which species it shows no resemblance whatever though it is about the size and shape of the last. The only Mexican species which it approaches is *H. obliteratus* Champ., from which it differs by being quite convex, with distinctly convex elytral intervals and by having the large *"punctures"* of the pronotum equally dispersed, not mainly confined to the frontal area.

Horistonotus lutzi Van Dyke, new species

Small, rather broad, but slightly convex and testaceous or rufotestaceous throughout. Head somewhat flattened, finely, sparsely punctured; the clypeal margin arcuate; the antennæ rather robust, extending about two segments beyond hind angles of prothorax. Prothorax broader than long, broader at base than apex, the base biemarginate, without notch or plicæ, the sides almost straight and parallel in basal half, gradually rounded at apex, the disk very finely, quite obscurely punctured, and with larger punctures intermixed. Elytra about twice as long as broad, the sides very slightly arcuate, gradually rounded towards apex, the disk with striæ finely impressed and rather coarsely punctured towards base but finer towards apex, the intervals more or less flattened and very finely punctured. Beneath very finely, obscurely punctured, the prosternum and propleuræ with quite coarse punctures intermixed, the abdomen with a series of punctures somewhat larger than the fine ones intermixed with them. Tarsal claws dentate from beyond the middle to base. Length 4 mm., breadth 1.5 mm.

Holotype and two *Paratypes* in the collection of the American Museum of Natural History, the first collected on Kits Peak, Rincon, **Baboquivari Mts., Ariz.,** Aug. 1-4, 1916, the others from Sta. Cruz Village, Cobabi Mts., Ariz., Aug. 10-12, 1916, and Tucson, Ariz., Aug. 21-23, 1916. I have retained for my collection two other paratypes, one collected at Palo Alto, Ariz., July 29-30, 1916, and Santa Cruz Village, Cobabi Mts., Ariz., Aug. 10-12, 1916. I am naming this after Dr. F. E. Lutz, the presumed collector of the specimens, who has so kindly placed this material at my disposal for study.

This small testaceous species would run in Horn's key to the series containing *simplex, curiatus,* and *gracilis.* Its color

and size, for it is smaller and less convex than *curiatus* the smallest of the three species mentioned above, will readily separate it. No described Mexican species seems to resemble it either. Superficially it very much resembles *Esthesopus pusio* Horn but the latter is not only more convex but differs generically.

Genus **Melanotus** Eschscholtz

This genus is very poorly represented in California. Though there are several species which are to be found within its confines, there is but one which is more or less characteristic of it and that is *Melanotus longulus*[13] (Lec.). This species is, however, very variable, with the result that several of the phases have been described as distinct. Field studies carried on over a period of many years as well as a careful study of a large series of specimens has convinced me that *longulus, variolatus* and *oregonensis* are but variations of one thing. *Cratonychus longulus* Lec. was described in 1853 on page 473, of the same work in which *oregonensis* Lec. was described on page 480. The first was based upon rather small, elongate specimens from San Diego, Calif. My specimens from this type locality average 10 mm. in length. In 1861, *Melanotus variolatus* Lec., was described from specimens taken at San Pedro, Los Angeles Co., Calif., a point on the coast not so very far north of San Diego. This form is rather common throughout Los Angeles County and it extends north along the coast as far as Carmel, Monterey County, and inland at least as far as Fort Tejon, Kern County. It averages about the same length as *longulus* but is in general slightly more robust and a bit blacker though many specimens cannot be separated from typical *longulus*. The characters given by LeConte for the separation of *variolatus* are not specific but individual. I also have a number of small specimens from Exeter, Utah, collected by Mr. Tom Spalding, which cannot be distinguished. Throughout the San Francisco

[13] This *longulus* should not be confused with the *longulus* of page 480 of the same publication in which it is described, Tr. Amer. Phil. Soc. (2), X, 1853, p. 473.

Bay region and much of middle California, these small forms are replaced by a race which is in general large and robust, 13–15 mm. in length, of a very black color, with antennæ and legs rufous as is the case with the others. As much as this large and typical lowland race or subspecies is without a distinguishing name I will call it **franciscanus** and designate a holotype (No. 3132, Mus. Calif. Acad. Sci.) and paratypes from **Alameda County, Calif.** In the Sierra Nevada Mountains as well as north through Oregon into British Columbia and eastward as far as the Wasatch Mountains of Utah, this race is replaced by the equally long but narrower *oregonensis*. This northern race is also generally lighter in color, brown instead of black, and sometimes with dark legs though contrary to what LeConte states, the legs of *oregonensis* are generally rufous as they are in the other races. His material was too limited. The small, narrow, dark brown *longulus* of San Diego gradually becomes larger and passes into *oregonensis* as it ranges eastward into the Great Basin and northward through the Sierra Nevada Mountains, and darker and broader as it ranges north through Los Angeles County and becomes still larger and more robust by the time it reaches the lowlands of middle California. This last is the race or subspecies *franciscanus*. These are all subspecies or races of one species and they grade gradually into each other, though in certain definite areas the majority of specimens are generally of a pure racial strain.

Genus **Limonius** Eschscholtz

This genus is generally defined by having the clypeus distinctly and completely margined in front and elevated above the labrum, the mouth anterior, the prosternal sutures nearly straight, double and but shallowly or deeply excavated in front, the hind coxal plates narrowed outwardly and but gradually dilated inwards, the tarsi subcylindrical with the first segment the longest and the following gradually shorter and without lobes beneath, and the tarsal claws simple. As such it falls in the tribe *Lepturoidini* as previously constituted, but with *Lepturoides* Herbst. and its close allies removed as should be done because of their short prosternal lobe, it would then have to be placed in the tribe *Athoini*. Of the various characters given, the most useful for separating the species from those of related genera are the double prosternal sutures and the type of tarsi, the presence of the very long first and short fourth segment in

Athous readily separating the members of this genus from *Limonius*. The clypeus is quite variable, often deeply impressed at base as in typical *Athous* and sometimes with the anterior margin much depressed and even slightly interrupted at its middle, approaching in this regard *Ludius* (*Corymbites*).

The genus *Nothodes* Lec. was founded upon a species with the clypeal margin interrupted, but as much as this character has been found to be variable in general and variable even within specific limits as has been shown in the type species, *dubitans* (Lec.), by a series of specimens received from Charles Dury. In this series, which was all from one locality, some of the specimens had the clypeal margin depressed and interrupted at middle, others had the clypeus complete. These latter were all typical *Limonius* and very close in all regards to the members of the group containing *canus* Lec. and *agonus* Say. For this reason I have suppressed the genus *Nothodes* and placed its lone species, *dubitans,* in *Limonius*. The prosternal sutures are also very variable. In typical *Limonius* Esch., they are more or less excavated in front, the excavation in some extending posteriorly for quite a distance while in others they are but feebly if at all excavated in front. These latter have been placed by some in the genus *Pheletes* Kies. I have preferred, however, to place this as but a subgenus of *Limonius,* for the character upon which it is founded is not only variable but unsupported by any other, the species being in the main like typical *Limonius*. It is parallel to what exists in *Hypnoidus* Steph. and *Cryptohypnus* Esch. The former resembles *Limonius,* having the open sutures, and the latter *Pheletes* with the closed sutures, yet the latest European authorities place them together as one genus. The genus *Gambrinus* Lec. was established for *armus* Say, a synonym of *stigma* Hbst., and was suppressed by Lacordaire[14] as he could find no generic characters to distinguish it.

The genus *Limonius* is a moderately large one, holarctic in distribution with one exception, and with a large proportion of the species confined to North America and especially evident on the Pacific Slope. The last revision of our species was by

[14] Gen. Col., IV, 1851, p. 183.

LeConte[15] and his data were incorporated in the great work of Candeze.[16] Since this time quite a number of new species have been added. I am adding eight more and one subspecies, and at the same time trying to place the others in their proper relationships with each other. I have specimens of all of the known species from our fauna, most species represented by large series, and in addition possess a fair knowledge of the habits of the majority. In this latter regard, Mr. L. C. Lane of Walla Walla, Wash., has greatly assisted me by supplying me with some of his field notes and allowing me to study most of his specimens, thus fortifying my opinion with regard to the status of several of the variable species such as *californicus* and *occidentalis, canus* and *discoidens. Limonius (Pheletes) quadrimaculatus* Horn was correctly removed by Horn and placed in *Megapenthes. Limonius cribricollis* Horn was found to be a synonym of *Melanotus longulus* (Lec.). *Limonius (Pheletes) ornatipennis* Lec., I consider an *Athous*, chiefly because of its single prosternal sutures and type of tarsi, so am placing it in that genus. The status of others will be discussed later on or shown in the synoptic table or bibliography, the synonymical portion of the latter showing their relationships best.

SYNOPTIC TABLE

1.	Prosternal sutures distinctly grooved in front, *Limonius* s. str..	2
	Prosternal sutures not distinctly grooved in front, subgenus *Pheletes* Kies.....	34
2.	Species with elytra bicolored or rufous.....	3
	Species with elytra black, brown or piceous.....	14
3.	Clypeal margin semicircularly incised at middle, dentiform at sides of incision.....	13
	Clypeal margin simply emarginate at most at middle.....	4
4.	Pronotum deep blue, bronzed or metallic.....	5
	Pronotum black or piceous, not metallic.....	10
5.	Prothorax as broad or almost as broad as long.....	6
	Prothorax distinctly longer than broad.....	7

[15] Revision of the Elateridæ of the United States, by John L. LeConte, Tr. Am. Phil. Soc., X, 1853, pp. 424-426, 428-435.

[16] Monographie des Élatérides, par M. E. Candeze, Liege, III, 1860, pp. 377-413.

6. Elytra varying from yellow or orange with black sutural stripe and cordiform patch covering apical half, to all yellow or orange except small black sutural marking near apex; prothorax in general with sides quite parallel basally and evenly rounded to apex, disk slightly bronzed, elytral striæ rather deeply impressed in front with circular punctures; length 9-11 mm., northern Calif. ..... *mirus* Lec.

Elytra vermilion or orange red with the suture towards apex and the apex black, prothorax gradually arcuately convergent from base forwards, pronotum a deep bluish black, elytra with striæ more finely impressed and with smaller and more elongate punctures; length 9-11 mm. Northern Calif. .... *ulkei* Horn

7. Greater portion of elytra orange 9

Greater portion of elytra black 8

8. Elytra with humeral area alone orange, pronotum coarsely, cribrately punctured; length 9.5-12 mm. Pacific States, Utah, B. C., and Alberta ..... *crotchi* Horn

Elytra with apical half and one large maculation on each elytron near base, black, the latter sometimes united transversely or posteriorly with the apical area, pronotum less coarsely punctured; length 7-10 mm. Mountains of northern Calif. and Cascades of Ore. and Wash. ..... *pictus* n. sp.

9. Each elytron with two black maculations, one in front and one behind middle, quite vague in more southern specimens, pronotum moderately finely and closely punctured, species more elongate than usual; length 10-15 mm. Northern Great Basin from eastern B. C. south to Siskiyou Co., Calif. ..... *venablesi* Wick.

10. Elytra unicolorous red 11

Elytra more or less bicolored 12

11. Entire elytra as well as hind angles of prothorax and a portion of feet rufous, pronotum black and finely not closely punctured except at sides; second and third antennal segments small and equal, together hardly as long as fourth; length 8-9 mm. Mountains of northern Calif. and north to B. C. ..... *bicolor* n. sp.

12. Basal portion of elytra rufotestaceous, as well as antennæ, legs and much of under surface; the apical portion of elytra more or less piceous, the darker area not sharply differentiated from basal portion; pronotum moderately finely, closely punctured; second and third antennal segments each but little shorter than fourth; length 10 mm. B. C., northern Calif. and northern Ariz. ..... *nebulosus* n. sp.

Black or rufo-piceous, basal margin or basal patch on elytra, the latter often faintly extended posteriorly as a broad vitta, epipleuræ and legs testaceous (base of prothorax and basal angles in the male, also often testaceous), head and pronotum finely or moderately finely and not closely punctured; second and third antennal segments longer than broad, about equal in length or third slightly longer, and together distinctly longer than fourth; length, female 9.5 mm., male 7 mm. Mountains of middle and northern Calif. . . . *huguenini* n. sp.

13. Second and third antennal segments small, of about equal length, together about as long as fourth; body black with hind angles of prothorax, entire elytra or merely margins, all or most of legs, and sometimes antennæ, rufous; length 7.5-9 mm. Napa, Plumas and Sacramento Cos., Calif. . . . . *clypeatus* Mots.

14. Clypeal margin rather deeply incised or emarginate at middle . . 15

Clypeal margin arcuate, transverse or but feebly emarginate at middle 21

15. Larger species, 8-13 mm. in length 16

Smaller species, body bronzed above, sparsely pubescent, pronotum rather sparsely, finely punctured 20

16. Body black clothed with fulvous or cinereous pile, pronotum coarsely, closely punctured 17

Body brown, sparsely, finely pilose, pronotum moderately finely, sparsely punctured 19

17. Third antennal segment distinctly longer and narrower than second, as long as fourth, clypeal margin semicircularly incised, prothorax as broad as long, legs somewhat rufous, head and pronotum densely clothed with golden or fulvous pile; length 10-11.5 mm. Atlantic States, especially southern Allegheny Mts . . . . . *auripilis* Say

Second and third antennal segments small, of about equal length, together about as long as fourth, prothorax longer than broad 18

18. Head and pronotum densely clothed with fulvous pile; clypeus bilobed, elytral intervals always flat; length 10-13 mm. Northern Calif. . . . . *fulvipilis* Cand.

Entire body rather sparsely clothed with cinereous or faintly fulvous pile, clypeal incision more V-shaped, elytral intervals often somewhat convex; length 9-11 mm. Northern Calif. to Idaho . . . . . *fulvipilis seminudus* n. subsp.

19. Clypeal margin with a broad V-shaped emargination, second and third antennal segments each distinctly longer than broad, together longer than fourth; body brown, beneath slightly rufous, antennæ and tarsi red; elytral striæ fine and finely punctured, intervals flat and very finely punctured; length 9-13 mm. Ariz . . . . . *sinuifrons* Fall

20. Second and third antennal segments each twice as long as broad, together much longer than fourth, first three antennal segments and legs red; length 6-7 mm. Eastern North America ..... *quercinus* Say

Second and third antennal segments small, not much longer than broad, together not as long as fourth; hind angles of prothorax and legs red (in the var. *semiæneus* Lec., the elytra also are rufous); length 6-7 mm. Eastern North America.. ..... *basillaris* Say

21. Larger and more robust species, at least 8 mm. in length..... 22

Smaller species..... 28

22. Clypeal margin evidently emarginate..... 23

Clypeal margin transverse or vaguely emarginate..... 27

23. Prothorax distinctly longer than broad, sides evidently sinuate in front of hind angles..... 24

Prothorax broader than long, sides quite straight or even slightly arcuate in front of hind angles..... 26

24. Second and third antennal segments rather short, third about two-thirds length of fourth; elytral striæ simply impressed, not sharply grooved, and coarsely, moderately closely punctured, the intervals subconvex and irregularly punctured and rugulose; body black, elytra often somewhat brownish, antennæ, legs and margins of elytra rufous, rather densely clothed with long, cinereous pile; length 9 mm. Eastern Colo., S. D., and Alberta..... *ursinus* n. sp.

Second and third antennal segments moderately long, third almost length of fourth; elytral striæ finely though sharply grooved and finely closely punctured, intervals flat and with fine, more or less biseriately arranged punctures..... 25

25. Body black or brown, somewhat bronzed above, antennæ, legs and margins of elytra rufous, sometimes also hind angles of prothorax and base of elytra; moderately clothed with fulvous pile; length 12-15 mm. Eastern North America.. ..... *griseus* Beauv.

Body generally brown, less bronzed above, pronotum generally more coarsely, cribrately punctured; length 16 mm. (generally considered as little more than an enlarged form of the preceding). Middle States..... *interstitialis* Melsh.

26. Broad and very short, black, slightly æneous above, moderately pilose; pronotum moderately coarsely, not closely punctured except at sides, elytra finely striato-punctate, intervals broad, flat and finely, irregularly punctured, second and third antennal segments moderately long, in male almost as long as fourth, in female somewhat shorter; clypeal margin in female faintly emarginate, in male almost transverse; length 8 mm. Sonoma and Lake Cos., Calif..... *kuschei* n. sp.

27. Second and third antennal segments short, together about equal or slightly longer than fourth, clypeal margin slightly arcuate, pronotum distinctly canaliculate at middle; elytral intervals rather densely triseriately punctured; body in general a piceous brown, slightly bronzed, above, moderately pilose and with legs and epipleuræ red; length 10 mm. Eastern Canada and northeastern States..... *confusus* Lec.

Second and third antennal segments moderately long. Each about three-fourths length of fourth; clypeal margin truncate or faintly emarginate; pronotum but vaguely canaliculate at middle near base; elytral intervals somewhat regularly biseriately punctured, body otherwise quite similar to above; length 9-10 mm. Eastern States of America.... *plebejus* Say

28. Body above distinctly bicolored..... 29

Body above black and unicolored..... 30

29. Black, elytra brown, basal three segments of antennæ, apical and basal margin of prothorax including hind angles, margins of propleuræ, epipleuræ, tibiæ and tarsi and hind margins of ventral segments, rufotestaceous, clypeal margin transverse; antennæ short, in male barely reaching hind angles of prothorax, second and third segments rather long, the third the longer and about equal in length to fourth; pronotum very convex and finely, not very closely punctured; elytra finely striato-punctate, the intervals flat, finely, irregularly punctured and granulate; length 7.5 mm. Alaska and northern Canada..... *pectoralis* Lec.

Very black, the elytra often with violet cast, head and pronotum a brilliant ruby color, shining, metallic, apices of hind angles of prothorax and prosternal lobe somewhat testaceous; clypeal margin emarginate; antennæ long, reaching well beyond hind angles of prothorax, second and third antennal segments small, together about equal to fourth, fourth to tenth broadly serrate; pronotum moderately convex and finely sparsely punctured; elytra coarsely striato-punctate, the intervals subconvex and deeply, rather coarsely irregularly punctured; length 6-7 mm. Lake States, Eastern Canada and Allegheny Mts..... *aurifer* Lec.

30. Basal segments of antennæ and legs rufotestaceous..... 33

Entire antennæ and legs black..... 31

31. Broad robust species, prothorax as broad as long, antennæ rather short, third segment about as long as fourth..... 32

Species more linear and subcylindrical, prothorax longer than broad and subparallel, clypeal margin vaguely emarginate at middle, antennæ long, extending well beyond hind angles

of prothorax, second and third segments small, together about equal to fourth, fourth to tenth large and broadly serrate; prothorax finely, sparsely punctured; elytra rather finely striato-punctate, the punctures coarser at sides and apex, intervals finely, biseriately punctured; length 5-6 mm. Eastern Wash., Alberta..... *lanei* n. sp.

32. Prothorax parallel from base to about apical fourth, thence evenly arcuate to apical margin, pronotum coarsely, rather closely punctured, especially at sides, propleuræ coarsely, closely punctured; a small, black, subparallel species, subæneous above and very finely, sparsely pubescent; length 7-8 mm. Wash., Ore., and the higher mountains of Calif..... ..... *nitidulus* Horn.

Prothorax not parallel beyond middle, thence gradually arcuate to apex, pronotum less coarsely and rather sparsely punctured even at sides, propleuræ but moderately coarsely and not closely punctred even in front; somewhat broader and more æneous above than the preceding yet closely resembling it otherwise; length 7-8 mm. Higher elevations of Black Mts. of N. C..... *beutenmuelleri* n. sp.

33. Small, elongate, black species, æneous above, head and pronotum rather finely, closely punctured, elytra finely striato-punctate, intervals somewhat flat and irregularly triseriately punctured as in the two preceding species; length 6-7 mm. Nova Scotia and New England west to B. C. and south through Rocky Mts. to N. M. and from the Cascade Mts. to Mt. Hood, Ore..... *æger* Lec.

34. Larger species, 7.5 mm. or over in length..... 35

Smaller species, 7 mm. or less in length..... 44

35. Elytra unicolored or at most with epipleuræ of a different color.. 36

Elytra bicolored, black as is most of the insect, with humeri orange, portions of legs also often ferruginous; second and third antennal segments small, subequal, together about length of fourth; pronotum shining and finely, sparsely punctured; elytra distinctly striato-punctate, intervals flattened, finely irregularly punctured and rugulose; length 7.5 mm. Eastern Canada and Atlantic States, rare..... *stigma* (Hbst.)

36. Pronotum coarsely, closely and generally cribrately punctured.. 37

Pronotum more finely, less closely and not cribrately punctured.. 40

37. Clypeal margin not distinctly notched and depressed at middle, head and pronotum more or less æneous, anterior pronotal margin but slightly lobed at middle, elytral intervals not carinate apically; species in general robust and not markedly narrowed either in front or behind..... 38

Clypeal margin quite distinctly notched and depressed at middle in most cases, head and pronotum not evidently æneous though often shining, black or bicolored, anterior pronotal margin quite evidently lobed at middle; elytral intervals more or less carinate apically; females robust, males considerably narrowed both in front and behind..... 39

38. Species in general black with head and pronotum æneous, elytra sometimes brown, distinctly pilose; second antennal segment slightly longer than broad, third still longer and subcylindrical, together longer than fourth especially in the female; elytra finely striato-punctate, intervals broad, flat and distinctly and irregularly punctured; length 8.5-12 mm. Pacific States..... *californicus* (Mann.)

39. Species in general piceous with black head and prothorax and brown or slightly rufous elytra, lighter in females, pilose; second antennal segment hardly longer than broad, third longer, together about equal to fourth in male, longer in female; elytra rather coarsely striato-punctate anteriorly, more finely posteriorly; length 8-12 mm. Pacific States and Western Canada, mainly in sandy areas..... *canus* Lec.

Rufotestaceous above, disk of pronotum piceous or pronotum all black; a lighter phase of above restricted to females; length 10-12 mm. Northern Calif. to Wash. and Idaho.. *canus discoideus* Lec.

40. Second and third antennal segment moderately long, second at least twice as long as broad and third much longer, as long as fourth; elytral intervals at most but vaguely subcarinate towards apex..... 41

Second and third antennal segments short, second not twice as long as broad and third though longer, not equal to fourth, elytral intervals subcarinate towards apex..... 42

41. Prothorax about as broad as long, gradually narrowed from base forwards, clypeal margin generally depressed and interrupted at center, elytral striæ often well impressed and usually rather coarsely punctured anteriorly and at sides; a robust, quite convex, blunt, and piceous brown species, somewhat æneous above, especially the pronotum, antennæ, legs and epipleuræ somewhat rufous; length 7 mm. N. Y., Penn., Ind. and Ohio..... *dubitans* Lec.

Prothorax always slightly longer than broad, subparallel towards base, narrower from middle forwards, elytral striæ always fine and finely impressed; pronotum shining and with punctures generally well spaced; a variable species, very robust and blunt especially in females, disk of both pronotum and elytra somewhat flattened, dark piceous brown (*pilosulus* Cand.) to rufopiccous or even rufous, especially the elytra

(var. *vernalis* Fall), the legs and epipleuræ lighter, the pronotum always æneous; length 11-14 mm. Pacific Slope ..... *infuscatus* Mots.

42. Third antennal segment somewhat triangular and similar to fourth though smaller 43

Third antennal segment subcylindrical, always shorter and much narrower at apex than fourth; pronotum rather finely and closely to somewhat distantly punctured and more or less metallic; elytra with striæ distinctly impressed and somewhat coarsely punctured near the base, intervals irregularly punctured and slightly rugulose; clypeal margin transverse and but slightly depressed if at all at middle; propleuræ finely and closely punctured; a moderately robust species, narrowed apically, piceous brown, with elytra and legs lighter, brown or even rufous; length 7-12 mm. Eastern Canada and northeastern States ..... *ectypus* Say (*agonus* Say)

43. Striæ rather finely and sharply impressed and finely punctured; clypeal margin slightly depressed at middle; pronotum convex, elongate and generally with sides subparallel or sinuate towards base, rather finely and sparsely to closely punctured, metallic and shining; propleuræ finely and but moderately closely punctured; a more or less elongate, subcylindrical species, piceous brown, head, pronotum and underside submetallic, elytra lighter, brown or rufous; length 7.5-12 mm. Eastern Wash. and Idaho to northern Calif. (a dichromatic species) ..... *subauratus* Lec.

Striæ fine but not sharply impressed, finely punctured, intervals also finely punctured; clypeal margin slightly depressed at middle; pronotum finely and moderately closely punctured, shining, metallic, propleuræ very finely punctured; body piceous with rufous antennæ, legs and elytra; length 8-9 mm. (This is probably only a phase or variety of *ectypus*). Eastern Canada and northeastern States ..... *anceps* Lec.

44. Bicolored species 45

Unicolored species, black, shining, somewhat æneous above, clypeal margin transverse and distinctly reflexed, second antennal segment robust and longer than broad, third narrower and two-thirds length of fourth; pronotum finely, rather sparsely punctured, hind angles distinctly carinate; elytra finely striato-punctate, intervals flat and somewhat biseriately punctate; length 6.5-8 mm. Vanc. Is. to northern Calif. ..... *consimilis* Walk.

45. Prothorax and elytra both bicolored above 46

Prothorax alone bicolored above 47

46. Black, basal angles or entire base of prothorax yellow, elytra variable from black with suture yellow, through both suture

and base yellow to all yellow; second and third antennal segments somewhat elongate though shorter than fourth; pronotum rather coarsely, closely punctured; elytra rather coarsely striato-punctate, intervals finely punctured; length 5-7 mm. Calif. ..... *ornatulus* Lec.

A more pronounced black, with basal margin of prothorax and large humeral maculations orange, otherwise as above though generally smaller and more shining; length 5-6 mm. Mts. of middle and northern Calif. ..... *ornatulus humeralis* Cand.

47. Pronotal punctures quite numerous but not approximate 49

Pronotal punctures numerous and approximate 48

48. Prothorax with sides and base rufous or rufotestaceous or base and hind angles alone colored; basal segments of antennæ and portions of legs also often testaceous; clypeal margin but slightly emarginate; second and third antennal segments each distinctly longer than broad but never equal to fourth; sides of prothorax generally evenly arcuate from base to apex, in a limited number sinuate in front of hind angles; elytra finely striato-punctate, the punctures but little coarser basally, intervals finely punctured and rugulose; propleuræ very coarsely, rather closely punctured, prosternum more finely and sparsely, and abdomen still more finely punctured; length 5-6 mm. Middle Calif. north to Vanc. Is. . *maculicollis* Mots.

Prothorax with basal margin alone flavous, basal segments of antennæ and portions of legs also often testaceous, general body color brown, never black as is usually the case with preceding species; clypeal margin transverse or vaguely emarginate; second and third antennal segments short, together but little longer than fourth; sides of prothorax either straight or slightly sinuate near base; elytra with striæ rather deep, the punctures quite coarse basally, intervals finely punctured and rugulose; propleuræ very coarsely yet rather distantly punctured, prosternum and abdomen quite finely and rather closely punctured; length 5 mm. Atlantic States ..... *definitus* Zieg.

49. Prothorax with basal and apical margins narrowly testaceous, basal segments of antennæ, legs and portions of prosternum also testaceous, basal color as in preceding but more bronzed; clypeal margin slightly emarginate; second and third antennal segments small, together about equal to fourth; sides of prothorax as in preceding species; elytra with striæ rather deep, the punctures very coarse basally, intervals finely punctured and rugulose; propleuræ very coarsely, closely punctured, prosternum finely, rather distantly and abdomen finely, closely punctured; length 3.5-4 mm. Atlantic States ..... *nimbatus* Say

Limonius ulkei Horn

This species is not a synonym nor even a variety of *Limonius mirus* Lec. but a distinct species. It is in general more robust, of a different color, vermilion rather than yellow or orange, elytra with never more than a trace of black along the suture and at the apex, head and pronotum an inky blue-black rather than bronze, antennæ generally longer and more robust; prothorax almost as broad as long, gradually narrowing forwards, with the sides distinctly lobed near apex, and the disk grossly, cribrately punctured, in contrast to the prothorax of *mirus* which is always longer than broad, subparallel near base, with the sides barely lobed near apex and the disk more finely, densely punctured; elytra with the striæ finer, less deeply impressed, with small, somewhat linear punctures, the intervals broader and very flat in front, whereas in *mirus* the striæ are well impressed, punctured with large, rather round punctures and the intervals quite convex. Neither species is common, *ulkei* being very rare, though both frequent flowers.

Limonius pictus Van Dyke, new species

Elongate, subparallel; black, head and pronotum slightly æneous, basal half of elytra orange with large oval, black maculation on each elytron near base, the antennæ, tibiæ and tarsi rufo-piceous. Head moderately coarsely, deeply punctured, front flattened; clypeal margin faintly emarginate and slightly depressed at middle; antennæ reaching slightly beyond hind angles of prothorax in male, just reaching apex in female, second and third segments small though distinctly longer than broad, the second slightly longer and more robust than third, together about as long as the long fourth segment, fourth to tenth serrate and each about one-half longer than broad, the segments proportionally shorter in female. Prothorax slightly longer than broad, subparallel, apex moderately emarginate, base bisinuate, sides slightly sinuate near base, moderately convergent towards apex, apical angles small, vertically lamellate below, hind angles distinct, barely divergent, truncate at apex and without carinæ; the disk convex, obscurely canaliculate at middle behind, moderately coarsely, closely and deeply punctured, and finely, sparsely pubescent. Elytra three times as long as prothorax and as long as broad, subparallel in front, evenly rounded to apex, disk moderately convex, striæ distinctly impressed and closely, rather coarsely punctured, the intervals flat or slightly convex and faintly, biseriately punctured and rugose. Beneath coarsely, closely punctured on prothorax, finely, sparsely punctured on afterbody and clothed with

sparse, fine cinereous pile, the anterior prosternal suture well separated in front and distinctly sulcate almost to middle. Length 8 mm., breadth 2 mm.

The female is in general slightly larger, with shorter antennæ, and broader and more convex prothorax. The elytral color pattern varies from that described as typical, on one hand towards a reduction in the size of the anterior maculation to the extreme on the other where these have not only united with each other but with the black apical patch leaving but a limited area at the base and sides orange.

Holotype: Male, No. 3133; and *Allotype:* Female, No. 3134, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection, the first two from **Fallen Leaf Lake, Lake Tahoe, Calif.,** July 4th and 9th, 1915. This species is fairly abundant at higher altitudes in the northern Sierra Nevada Mts. and extends its range into the Cascades of Oregon and Washington. My series of forty or more specimens was beaten from fir trees, at the following localities: Yosemite Nat. Park, the Lake Tahoe region, Nevada Co., McCloud, Trinity Co., Calif., Klamath Falls, Ore., and Easton, Wash.

This moderate sized and very attractive species should be easily recognized by its color pattern, which is distinctive.

Limonius bicolor Van Dyke, new species

Elongate, subparallel, black, hind angles of prothorax, elytra, antennæ, tibiæ and tarsi red. Head moderately coarsely, sparsely punctured, front impressed, clypeal margin prominent, slightly emarginate at middle; antennæ in male reaching a segment and a half beyond hind angles of prothorax, barely reaching the apices of the angles in the female, second and third segments small, about equal in length, together hardly equal to fourth, fourth to tenth serrate, the outer about twice as long as broad, shorter in female. Prothorax slightly longer than broad, apex emarginate, anterior angles not prominent, base bisinuate, hind angles well marked, hardly divergent and truncate at apex, distinctly carinate, sides almost straight and slightly convergent forward, disk slightly convex, non-canaliculate, rather finely and sparsely punctured and pubescent, shining. Elytra perceptibly broader than prothorax and considerably more than twice as long; with sides gradually narrowing towards apex, more parallel anteriorly in females; disk convex, striæ well impressed and rather closely, distinctly punctured, the intervals somewhat convex and very finely, biseriately punctured. Beneath with prosternum rather finely, sparsely punctured, the propleuræ coarsely and closely and the afterbody rather finely and sparsely punctured, finely and sparsely pubescent, and with the anterior prosternal sutures well separated in front and distinctly sulcate, though latter not reaching the middle. Length 8 mm., breadth 2.25 mm.

The females differ from the males by having shorter antennæ and by being less narrowed both anteriorly and posteriorly.

Holotype: Male, No. 3135; and *Allotype:* Female, No. 3136, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection, the first from **Fallen Leaf Lake, Lake Tahoe, Calif.,** June 30, 1915, and the second from Grass Lake, Lake Tahoe, Calif., June 24, 1915. In my series of more than a dozen are specimens collected at Sequoia Nat. Park, Plumas Co. and Trinity Co., and I have seen others from as far north as Victoria, B. C.

This species because of its rather small size and unicolored red elytra stands out conspicuously from its fellows.

Limonius nebulosus Van Dyke, new species

Moderately elongate and robust, rather blunt at both ends, rufotestaceous, head, prothorax and abdomen darker, often piceous, and the elytra more or less darkly clouded in the apical region. Head rather finely and moderately closely punctured, front deeply, broadly impressed, clypeal margin prominent and slightly arcuate; antennæ short, barely reaching hind angles of prothorax in male, segments two and three elongate, of about equal length, each about twice as long as broad and almost as long as fourth, segments four to ten slightly serrate, the outer about twice as long as broad. Prothorax somewhat longer than broad, apex and base emarginate, anterior angles not prominent, hind angles slightly divergent, subacute, acutely carinate, the carinæ prominent and almost one-third length of prothorax, sides slightly sinuate in front of hind angles, moderately but evenly arcuate at middle and gradually convergent forwards; the disk convex, indistinctly canaliculate at middle near base, rather finely and closely punctured, and sparsely, finely pilose, the pile semierect. Elytra a bit more than twice as long as prothorax, subparallel anteriorly, evenly rounded to apex, the disk convex, the striæ well impressed and moderately coarsely, closely punctured, finer apically, the intervals convex, very finely and irregularly punctured and rugose, the surface sparsely clothed with short, semierect pile. Beneath finely, sparsely punctured, the propleuræ more closely and coarsely punctured, the prosternal sutures of prothorax well separated in front and sulcate posteriorly to middle. Length 10 mm., breadth 2.75 mm.

Holotype: Male, No. 3137, Mus. Calif. Acad. Sci., collected by myself at **El Tovar, Grand Canyon, Ariz.,** July 26, 1926, and two *Paratypes,* one collected by Mr. W. F. Breeze at Castle Crags, Siskiyou Co., Calif., Sept. 1914, in my collection, the second with a piceous head and prothorax, from Pender

Harbor, B. C., collected by R. T. Turner, July 26, 1929, in the collection of Mr. Ralph Hopping. I have also seen a fourth specimen, collected by Mr. Warren Knaus at Zion Canyon, Utah, July 28, 1921.

This rather greasy looking species is related to *Limonius sinuifrons* Fall and like it has the facies of some of the more robust species of *Athous,* as for instance *cucullatus.* The color pattern though distinctive is not sharply contrasting for the lighter areas gradually give place to the darker. It is no doubt in the main a species of the more arid portions of the Great Basin though it extends into the mountains of northern California and even to the coastal area of British Columbia.

Limonius huguenini Van Dyke, new species

Robust and rather blunt at both ends, rufopiceous, maculations at base of elytra, faintly extending as broad vittæ, epipleuræ and legs flavous. Head moderately coarsely, closely punctured; front deeply, broadly, triangularly impressed, clypeal margin prominent, horizontal and truncate; antennæ short, reaching hind angles of prothorax, second and third segments slightly longer than broad, third somewhat longer and about three-fourths length of fourth, segments four to ten moderately dilated and serrate. Prothorax slightly longer than broad, apex and base emarginate, anterior angles distinct, hind angles triangular and slightly divergent, finely and acutely carinate, the carinæ about one-fourth length of prothorax, sides sinuate in front of hind angles, arcuate at middle and gradually narrowed to apex; disk convex, vaguely canaliculate near base at middle, moderately finely and not very closely punctured, and very finely, sparsely pubescent. Elytra slightly more than twice as long as prothorax, slightly arcuate at sides and evenly rounded at apex; the disk somewhat convex, striæ distinctly impressed and punctured, intervals slightly convex and indistinctly punctured and finely rugulose, the pile fine and sparse as on the pronotum. Beneath, moderately finely, closely punctured on prosternum, more coarsely and sparsely on propleuræ, and very finely, rather closely over abdomen; the prosternal sutures well separated in front and sulcate posteriorly for a short distance. Length 10 mm., breadth 3 mm.

Holotype: Female, No. 3138, Mus. Calif. Acad. Sci., collected in **Plumas Co., Calif.,** June 22, 1911, by Mr. Leon Munier and kindly presented to me by my good friend, the late Mr. J. C. Huguenin. Two other female specimens, quite similar, collected at Cayton, Shasta Co., Calif., July 1919, are in the collection of Mr. Ralph Hopping. With these, I have

associated three small males, which I am confident though not positive, are the opposite sex of this species. They differ not only by being smaller, 6–7 mm. in length, but by being darker and more shining, less greasy in appearance; black with hind angles of prothorax or basal margin, basal margin of elytra, suture to a slight extent, and in two of the specimens, the basal segments of antennæ as well as legs, flavous; the head more transversely less deeply impressed, the clypeus not so thick, the head and pronotum more finely and sparsely punctured, the prothorax narrower, and the elytral striæ more coarsely punctured. They were collected by myself, two in Paradise Valley, Kings River Canyon, Fresno Co., Calif., July 16, and 23, 1910, and one at Tallac, Lake Tahoe, Calif., July, 1899.

This species belongs near *nebulosus* but differs in general by being less narrowed in front and behind, by having the front more deeply impressed in the female, the head and pronotum much more sparsely punctured, and the color pattern quite different. It, particularly the males, superficially looks very much like *Athous limbatus* Lec., an insect apt to be found in its same territory.

Limonius clypeatus Motschulsky

This long unrecognized species is a very distinct one and though rare, has been taken within recent years in the territory to the northeast of San Francisco Bay and not far from the type locality, "Nova Helvetia" or Sutter's Fort, as it was more commonly called by the California pioneers. I have studied eight specimens, seven from my own collection and one belonging to the California Academy of Sciences, all of which agree with the original description in regard to all major features, only differing slightly as regards the color pattern which is not constant. In all the specimens the clypeal margin is semicircularly incised and "distincte bidentato." The type was black except the mouthparts, antennæ, epipleuræ,

"Elytrorum limbo subtus," and margin of abdomen and feet which were somewhat rufotestaceous. The Academy specimen collected near Chico, Calif., April 26, 1920, by Mr. E. P. Van Duzee, absolutely agrees with this description in all regards. In two of my specimens from Napa Co., the hind angles of the prothorax and elytra are also red, while in the remaining specimens from Plumas Co. the antennæ are black and the elytra as well except for a broad lateral margin of red. Some of the darker or more typical specimens look much like small specimens of *Limonius fulvipilis* Cand., but they are proportionately shorter and blunter, with the pile finer and shorter, the clypeus semicircularly emarginate not bilobed, the antennæ shorter, and the hind angles of prothorax more divergent.

Limonius fulvipilis seminudus Van Dyke, new subspecies

In the more typical forms which are found in middle California, both in the low Sierras and near the coast, the body is black, legs and antennæ somewhat rufous, and the head, pronotum and base of elytra densely clothed with long, silken, fulvous pile, the elytra posteriorly less densely clothed. It thus superficially very closely resembles the well known *auripilis*. In the mountains of northern California and again in eastern Washington and Idaho, there is a form which appears quite black for the vestiture is sparse, short and quite uniformly dispersed. The pile is also quite light, a fulvous gray. In the northern California forms the pronotum is in addition more coarsely, cribrately punctured and the elytral intervals somewhat convex while in the Washington and Idaho specimens the pronotal punctation is less coarse and close and the elytral intervals flattened as in the typical *fulvipilis*. The northern California forms, I am calling the subspecies **seminudus** and designating as a Holotype (No. 3139, Mus. Calif. Acad. Sci.), a specimen collected at **Carrville, Trinity County, Calif.**, July 1, 1913, and as paratypes, one other specimen from Trinity Co. and two from Siskiyou Co. The Washington and Idaho specimens, I am also associating with these.

Limonius ursinus Van Dyke, new species

Moderately elongate, robust, piceous brown, faintly bronzed above, elytra lighter, antennæ, epipleuræ, tibiæ and tarsi rufous, rather densely clothed with long cinereous pile. Head densely, coarsely punctured, front flattened, clypeal margin depressed at middle and as a result distinctly though not markedly bilobed; antennæ in male reaching just beyond apices of hind angles of prothorax, shorter in female, segments two and three moderately short, second but little longer than broad, third slightly longer and about two-thirds length of fourth, 4-10 serrate, the median hardly longer than broad, the outer somewhat longer. Prothorax distinctly longer than broad, apex broadly emarginate, hind angles broadly triangular, slightly divergent and with short though conspicuous carinæ; sides slightly sinuate in front of hind angles, barely arcuate at middle and gradually rounded and convergent to apex; the disk quite convex, vaguely canaliculate at middle near base, and coarsely, closely punctured. Elytra nearly three times as long as prothorax, very gradually narrowed posteriorly and rounded to apex, disk with striæ shallowly impressed but not sharply, and with moderately fine, somewhat distantly placed punctures, intervals slightly elevated and finely closely and irregularly punctured and rugose. Beneath moderately finely and sparsely punctured, the propleuræ rather coarsely, closely punctured and clothed with long pile similar to that of upper surface, the prosternal sutures distinctly opened and sulcate in front. Length 9 mm., breadth 3 mm.

Holotype: No. 3140, Mus. Calif. Acad. Sci., and *Paratype* in my collection, the first from **Fort Collins, Colo.**, collected May 12, the second from Volga, S. Dak. I also had a third, imperfect specimen from the latter locality and have seen a specimen from Medicine Hat, Alberta, belonging to Mr. F. S. Carr.

This very distinct species looks much like some of the hairy species of the subgenus *Pheletes,* especially *canus* and its allies, but it is always less narrowed behind, shorter and generally stubbier in appearance. It is probably not uncommon throughout the territory along the eastern flanks of the Rocky Mountains but has no doubt been confused with other species.

Limonius kuschei Van Dyke, new species

Rather short, broad and subparallel, black and clothed with short, semierect pile. Head coarsely, closely and rather cribrately punctured, front flattened, anterior margin of clypeus slightly emarginate; antennæ short, not reaching apices of hind angles of prothorax, second segment but little longer than broad, third longer and narrower but not as long as fourth, fourth to

tenth moderately serrate, median segments as broad as long. Prothorax distinctly broader than long, apex faintly, base distinctly bisinuate, hind angles broadly triangular, barely produced, not divergent and with short yet distinct carinæ; sides divergent from base or barely sinuate in front of hind angles, arcuate at middle, then evenly rounded to apex; the disk very convex, sometimes vaguely canaliculate at middle near base, rather coarsely, deeply and rather closely punctured. Elytra two and one-half times as long as prothorax, subparallel to posterior third, dilated behind middle, and arcuate to apex, the disk finely, sharply striatopunctate, the intervals broad, flat and rather coarsely, closely and irregularly punctured. Beneath rather coarsely, closely punctured in front, very closely on propleuræ, gradually more finely and sparsely posteriorly, the prosternal sutures narrowly open and sulcate in front. Length 8 mm., breadth 2.75-3 mm.

Holotype: No. 3141, Mus. Calif. Acad. Sci., and two *Paratypes* in my collection, collected at **Eldridge, Sonoma Co., Calif.**, April 9-12, by Mr. J. A. Kusche.

This species is very short and robust, looking something like an abbreviated *californicus*. It also superficially resembles some of the larger and more robust specimens of *nitidulus* but is more opaque, has shorter antennæ, a much broader prothorax, less pronounced hind angles to the same, broader and flatter elytral intervals with closer and deeper punctures. Its general facies, particularly as regards its prothorax, is much like that of some of the more robust species of *Cardiophorus*. It is apparently a very rare and local species for the three specimens mentioned are the only ones that I have seen.

Limonius lanei Van Dyke, new species

Small, narrow, subcylindrical, black, slightly shining and æneous, and sparsely clothed with gray pile. Head finely, deeply but not closely punctured, front with a deep triangular impression in front, clypeal margin prominent and but vaguely emarginate at middle; antennæ long, reaching well beyond hind angles of prothorax, second and third segments small, together about equal in length to fourth, fourth to tenth markedly serrate and with all segments longer than broad. Prothorax distinctly longer than broad, apex bisinuate, slightly lobed at middle, base bisinuate, hind angles broadly triangular, not divergent, but moderately prominent, and each with a fine carina close to the margin, sides straight and slightly convergent forwards, rounded at front angles, disk convex, faintly canaliculate at middle near base, finely and sparsely punctured and shining. Elytra almost two and a half times as long as prothorax and slightly broader at base, sides parallel to posterior third

thence arcuate to apex, disk with deep semicircular impression at base of each elytron, finely striatopunctate, the intervals flat, finely, irregularly, biseriately punctured. Beneath finely but distinctly and not closely punctured, more coarsely in front, the prosternal sutures of prothorax open in front and sulcate for a short distance backwards. Length 6.75 mm., breadth 1.75 mm.

Holotype: No. 3142, Mus. Calif. Acad. Sci., and three *Paratypes* in my collection, collected at **Lind,** eastern **Washington,** May 1, 1924, by Mr. M. C. Lane, after whom I take pleasure in naming it. Other specimens are also in the collection of Mr. Lane who kindly presented me with my series. I also have a specimen from Medicine Hat, Alberta, collected April 26, 1926, by Mr. F. S. Carr and others are in Mr. Carr's collection.

This interesting little species because of its elongated subparallel form, long and markedly serrate antennæ, and other physical characters shows that it is related to *aurifer,* but it can readily be separated from that by its color and the type of elytral punctation. From *æger* and other small æneous species, it can always be told by being less narrowed in front, by the type of its antennæ and color of legs.

Limonius beutenmuelleri Van Dyke, new species

Small, robust, black, distinctly shining and æneous, the tibiæ and tarsi piceous, and sparsely, finely pilose. Head rather coarsely, sparsely punctured, clypeal margin prominent and slightly arcuate; antennæ just reaching apex of hind angles of prothorax, second segment about a third longer than broad, third somewhat longer and equal to fourth, fourth to tenth serrate, the segments all slightly longer than broad. Prothorax as broad as long, apex slightly, base distinctly, bisinuate, hind angles broadly triangular, but slightly projected at apex, not divergent, and each with a well marked carina slightly diverging from lateral margin, the sides straight and parallel near base and arcuate and convergent from before middle to apex, disk convex, faintly canaliculate at middle near base, and finely yet deeply and sparsely punctured. Elytra two and a half times as long as prothorax, sides straight and slightly diverging to posterior third, thence, gradually arcuate to apex, disk finely striatopunctate, intervals flat or slightly convex and finely, irregularly biseriately punctured. Beneath rather finely, not closely punctured, the propleuræ more coarsely punctured, the prosternal sutures of prothorax distinctly opened and sulcate anteriorly. Length 7 mm., breadth 2.25 mm.

Holotype: No. 3143, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection from a large series collected by myself on **Mt. Mitchell** and the tops of the adjacent peaks of the **Black Mountains** of **North Carolina,** June, 1902. It is named as a slight tribute to Mr. Wm. Beutenmueller, who was my travelling companion during my trip to the mountains of North Carolina.

This small, robust species has a surprising resemblance to *Limonius nitidulus* Horn of the Pacific Coast and no doubt had a common origin with that. It can readily be distinguished, however, by its generally broader form, more shining aspect, sparser and more distant punctation, and in having the sides of prothorax arcuate and narrowed from before the middle to apex.

BIBLIOGRAPHY

Limonius mirus Lec., Tr. Am. Phil. Soc., X, 1853, p. 429; Cand., Mon. Elat. III, 1860, p. 385.

Limonius ulkei Horn, Tr. Am. Ent. Soc., III, 1871, p. 314.

Limonius crotchi Horn, Tr. Am. Ent. Soc., IV, 1872, p. 148.

Limonius pictus n. sp.

Limonius venablesi Wick., Psyche, XX, 1913, p. 27; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius bicolor n. sp.

Limonius nebulosus n. sp.

Limonius sinuifrons Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 227.

Limonius clypeatus Mots., Bul. Mosc., XXXII, III, 1859, p. 369.

Limonius auripilis (Say) (Elater), Jour. Acad. Nat. Sci. Phila., III, 1823, p. 172; Tr. Am. Phil. Soc., VI, 1836, p. 168; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 429; Cand., Mon. Elat., III, 1860, p. 382; Blatchley, Col. Ind., 1910, p. 756.

Limonius fulvipilis, Cand., Mon. Elat., III, 1860, p. 383.

Limonius fulvipilis seminudus n. subsp.

Limonius quercinus (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 262; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 431; Dej., Cat., ed. 3, 1837, p. 103; Cand., Mon. Elat., III, 1860, p. 397; Blatchley, Col. Ind., 1910, p. 758.

Limonius basillaris (Say) (Elater), Jour. Acad. Nat. Sci. Phila., III, 1823, p. 172; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 431; Cand., Mon. Elat., III, 1860, p. 398; Blatchley, Col. Ind., 1910, p. 758.

Limonius basillaris var. semiæneus Lec., Tr. Am. Phil. Soc., X, 1853, p. 432; Cand., Mon. Elat., III, 1860, pp. 398-399.

Limonius ursinus n. sp.

Limonius griseus (Beauv.) (Elater), Ins. Afr. et Amer., 1805, p. 214, pl. 9, f. 8; (Limonius), Cand., Mon. Elat., III, 1860, p. 388; Cat. Method. Elat., 1891, p. 148; Blatchley, Col. Ind., 1910, p. 757.

? *cylindiformis* Hbst. (Elater), Käfer, X, 1806, p. 93, tab. 166, fig. 9.

cylindriformis Say (Elater), Jour. Acad. Nat. Sci. Phila., III, 1823, p. 176; Tr. Am. Phil. Soc., VI, 1836, p. 166; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 430.

hirticollis Melsh., Proc. Acad. Nat. Sci. Phila., II, 1846, p. 215.

perplexus Dej., Cat., ed. 3, 1837, p. 102.

propexus, Cand., Mon. Elat., III, 1860, p. 386; Cat. Method. Elat., 1891, p. 149.

Limonius interstitialis (Melsh.) (Corymbites), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 215; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 430; Cand., Mon. Elat., III, 1860, p. 389; Blatchley, Col. Ind., 1910, p. 757.

diversus Dej., Cat., ed. 3, 1837, p. 102.

Limonius kuschei n. sp.

Limonius confusus Lec., Tr. Am. Phil. Soc., X, 1853, p. 430; Cand., Mon. Elat., III, 1860, p. 390; Blatchley, Col. Ind., 1910, p. 758.

ænescens Lec., Tr. Am. Phil. Soc., X, 1853, p. 431; Cand., Mon. Elat., III, 1860, p. 413; Cat. Method. Elat., 1891, p. 148.

Limonius plebejus Say (Elater), Am. Lyc. Nat. Hist. N. Y., I, 1825, p. 263; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 431; Cand., Mon. Elat., III, 1860, p. 390; Cat. Method. Elat., 1891, p. 148; Blatchley, Col. Ind., 1910, p. 758.

metallescens Melsh., Proc. Acad. Nat. Sci. Phila., II, 1856, p. 158.

Limonius pectoralis Lec., Proc. Acad. Nat. Sci. Phila., 1866, p. 391; Cand., Cat. Method. Elat., 1891, p. 148.

Limonius aurifer Lec., Tr. Am. Phil. Soc., X, 1853, p. 429; Dej., Cat., ed. 3, 1837, p. 102; Cand., Mon. Elat., III, 1860, p. 386; Cat. Method. Elat., 1891, p. 148; Blatchley, Col. Ind., 1910, p. 757.

Limonius lanei n. sp.

Limonius nitidulus Horn, Tr. Am. Ent. Soc., III, 1871, p. 315; Cand., Cat. Method. Elat., 1891, p. 149.

Limonius beutenmuelleri n. sp.

Limonius æger Lec., Tr. Am. Phil. Soc., X, 1853, p. 431; Cand., Mon. Elat., III, 1860, p. 397; Cat. Method. Elat., 1891, p. 148.

Limonius stigma (Hbst.) (Elater), Käfer, X, 1806, p. 86, pl. 166, f. 1; (Limonius), Dej., Cat., ed. 3, 1837, p. 102; Cand., Mon. Elat., III, 1860, p. 404; Cat. Method. Elat., 1891, p. 148; (Pheletes), Leng, Cat. Col., 1920, p. 168.

armus Say (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 171; (Gambrinus), Lec., Tr. Am. Phil. Soc., X, 1853, p. 435; Lac., Gen. Col., IV, 1857, p. 183.

Limonius californicus (Mann.) (Cardiophorus), Bul. Mosc., XVI, 1843, p. 238 (136); (Limonius), Cand., Mon. Elat., III, 1860, p. 407; Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

hispidus Lec., Tr. Am. Phil. Soc., X, 1853, p. 432; Cand., Mon. Elat., III, 1860, p. 407; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius californicus var. occidentalis Cand., Mon. Elat., III, 1860, p. 411; Cat. Method. Elat., 1891, p. 148; Horn, Tr. Am. Ent. Soc., III, 1871, p. 315; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius canus Lec., Tr. Am. Phil. Soc., X, 1853, p. 433; Cand., Mon. Elat., III, 1860, p. 413; Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

subcostatus Mots., Bul. Mosc., XXXII, III, 1859, p. 370.

Limonius canus var. discoideus Lec., Proc. Acad. Nat. Sci. Phila., 1861, p. 348 Cand., Cat. Method. Elat., 1891, p. 148; Leng, Cat. Col., 1920, p. 168.

Limonius dubitans Lec., Tr. Am. Phil. Soc., X, 1853, p. 433; Cand., Mon. Elat., III, 1860, p. 407; (Nothodes), Lec., Smiths. Misc. Coll., III, Class. Col. N. Am., 1861, p. 171; Cand., Cat. Method. Elat., 1891, p. 174; Henshaw, List Col., 1885, p. 70; Leng, Cat. Col., 1920, p. 433.

Limonius infuscatus Mots., Bul. Mosc., XXXII, II, 1859, p. 371; Horn, Tr. Am. Ent. Soc., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 148; Leng, Cat. Col., 1920, p. 168.

Limonius infuscatus var. pilosulus Cand., Cat. Method. Elat., 1891, p. 149; Leng, Cat. Col., 1920, p. 168.

pilosus Lec., Tr. Am. Phil. Soc., X, 1853, p. 433; Cand., Mon. Elat., III, 1860, p. 405; Henshaw, List Col., 1885, p. 69.

Limonius infuscatus var. vernalis Fall, Tr. Am. Ent. Soc., XXXVI, 1910, p. 129; Leng, Cat. Col., 1920, p. 168.

Limonius ectypus Say (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 167; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 433; Cand., Mon. Elat., III, 1860, p. 409; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

agonus Say (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 171; (Limonius), Lec., Tr. Am. Phil. Soc., X, 1853, p. 434; Cand., Mon. Elat., III, 1860, p. 410; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius subauratus Lec., Tr. Am. Phil. Soc., X, 1853, p. 432; Cand., Mon. Elat., III, 1860, p. 406; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius anceps Lec., Tr. Am. Phil. Soc., X, 1853, p. 433; Cand., Mon. Elat., III, 1860, p. 409; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius consimilis Walk., Lord's Nat. Vanc., II, 1866, p. 325; Horn, Tr. Am. Ent. Soc., III, 1871, p. 316; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

nitidicollis Lec., Ann. Mag. Nat. Hist., (4), IV, 1869, p. 378; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius ornatulus Lec., Rept. Expt. and Surv. Miss. to Pac., XII, 1859, p. 46; Cand., Mon. Elat., III, 1860, p. 401; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 148; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius ornatulus subsp. humeralis, Cand., Mon. Elat., III, 1860, p. 402; Horn, Tr. Am. Ent. Soc., III, 1871, p. 316; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 148; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius maculicollis Mots., Bul. Mosc., XXXII, II, 1859, p. 372; Horn, Tr. Am. Ent. Soc., III, 1871, p. 316; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 148; Leng, Cat. Col., 1920, p. 168.

discicollis Cand., Elat. Nouv., I, Mem. Acad. Sci. Brux, XVII, 1865, p. 49; Horn, Tr. Am. Ent. Soc., III, 1871, p. 316; Cand., Cat. Method. Elat., 1891, p. 148; Leng, Cat. Col., 1920, p. 168.

Limonius definitus Zieg., Proc. Acad. Nat. Sci. Phila., II, 1844, p. 268; Lec., Tr. Am. Phil. Soc., X, 1853, p. 434; Cand., Mon. Elat., III, 1860, p. 404; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius nimbatus (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 255; (Limonius), Lec., Proc. Acad. Nat. Sci. Phila., 1866, p. 391; Henshaw, List Col., 1885, p. 69; Cand., Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius infernus Lec., Tr. Am. Phil. Soc., X, 1853, p. 434; Proc. Acad. Nat. Sci. Phila., 1866, p. 391; Cand., Mon. Elat., III, 1860, p. 403; Cat. Method. Elat., 1891, p. 149; (Pheletes), Leng, Cat. Col., 1920, p. 168.

Limonius debilis Dej., Cat. ed. 3, 1837, p. 103.

Genus **Leptoschema** Horn

This genus was established by Horn[17] for the reception of a peculiar species of Elateridæ originally described as *Agriotes protractus* Horn, and placed in the tribe Athoini. Its most distinctive characters are that the clypeal margin is short, free and well elevated above the labrum, the posterior coxal plates are gradually dilated inwards, and the prosternal sutures are double. The first two characters distinguish it from the tribe Agriotini where it had formerly been placed and it was in the main because of these that Horn removed it and placed it in a new genus at the same time putting it in the Athoini. With the members of the latter tribe, it agrees in having the free clypeal margin and certain other general characters, but it differs markedly from all of the genera included therein by having the head convex, the mouth inferior, and the hind angles of the prothorax prolonged and acute, as well as by its general facies and sculpturing. Though having some of the characters of *Agriotes,* I believe that, because of its type of hind coxal plates and certain other features, it belongs near *Sericus*. It most certainly does not belong in the Athoini. The typical species, *protractum,* is of a uniform piceous brown but there is a beautiful color variety which I will describe. The two species, *discalceatus* (Say) and *bicolor* (Lec.), provisionally placed in *Leptoschema* by Horn because of the double prosternal sutures, are not at all congeneric with *protractum*. They are in every regard species of *Athous* except for the type of prosternal suture and should as a result be removed from *Leptoschema*.

As much as they cannot go into *Athous*, they should be placed in another genus and fortunately we have this in *Elathous* Reitt.,[18] a genus founded for the reception of two European species which are truly congeneric with them. This genus has for some time been considered as a synonym of *Leptoschema* but it is not, their genotypes not being congeneric. In addition to the characters given by Horn for

[17] Trans. Am. Ent. Soc., XII, 1884, p. 50.
[18] Ent. Nachricht., XVI, 1890, pp. 247-248.

Leptoschema, we should add small eyes, for those of *protractum* (Horn) are much smaller proportionally than they are in *Agriotes.*

SYNOPTIC TABLE

Body piceous brown, the elytra generally lighter, often somewhat rufous.....*protractum* (Horn)

Body piceous, the entire upper surface a rich orange yellow except portions of head and a longitudinal vitta at middle of pronotum, the propleuræ and tarsi also yellow.....
.....*protractum* var. *elegans* n. var.

Leptoschema protractum var. **elegans** Van Dyke, new variety

This variety differs from the more or less uniformly piceous brown form by having the prothorax, except the sternum and a longitudinal pronotal vitta at the middle, and the elytra, of a rich orange yellow color. The head and terminal portions of the legs are also somewhat yellowish. The general form and sculpturing is the same as in the typical phase.

Holotype: No. 3144, Mus. Calif. Acad. Sci., a specimen collected in **Humboldt Co., Calif.,** May 15, 1911, by Mr. F. W. Nunenmacher. Another specimen has also been seen. The typical forms have all been found in the coastal portions of middle California.

Genus **Elathous** Reitter

The species of this genus resemble somewhat the species of *Athous* related to *Athous cucullatus* (Say), particularly in regard to the robust form, deeply impressed front, and carinate hind angles of prothorax, but they differ materially in having the double prosternal sutures and the tarsi narrower and without lobes. From the members of *Athous* like *rufifrons* Rand., which have no tarsal lobes or but vague ones, they differ by having well developed carinæ on the hind angles of the prothorax, double prosternal sutures, and tarsi that are more cylindrical and with a shorter second and generally longer fourth segment, similar in many ways to that of *Limonius.* Our

American species are all of a somewhat piceous, brown or rufous color, with the ventral surface very much lighter, generally rufotestaceous; the second and third antennal segments small though usually longer than broad, the third sometimes the longer, and together as long or longer than the fourth, and the antennæ as a whole not or hardly reaching the apices of the hind angles of the prothorax in the female and but slightly longer in the male. *Elathous oberndorfferi* O. Schwarz[19] is without doubt but a synonym of *discalceatus* (Say).

SYNOPTIC TABLE

1. Pronotum quite coarsely, numerously and generally approximately punctured even at middle; elytra finely striate and with distinct punctures, the intervals slightly convex and finely but distinctly and numerously punctured and subrugose..... 3

   Pronotum with punctures not approximate on disk; elytra finely striate, the punctures very fine, often indistinct, intervals flat or hardly convex and finely, somewhat indistinctly, punctured and shining..... 2

2. Head very coarsely, closely and cribrately punctured; the pronotal punctures likewise coarse and umbilicate, somewhat finer on disk; prothorax generally but moderately narrowed in front, with sides but slightly sinuate behind, and with elytra very finely and closely clothed with suberect pile.. .....*discalceatus* (Say)

   Head but moderately coarsely and not cribrately nor approximately punctured; the pronotal punctures somewhat similar on the sides, but always well spaced, finer and sparser on the disk; prothorax always distinctly narrower in front and with sides slightly sinuate behind, making the hind angles quite divergent; the entire upper surface sparsely clothed with short, less erect pile.....*californicus* n. sp.

3. Head rather coarsely and closely, not cribrately punctured; the prothorax slightly and gradually narrowed in front, the sides slightly sinuate behind; the entire upper surface clothed with very fine and suberect pile.....*bicolor* (Lec.)

---

[19] Wien. Ent. Zeit., XXII, 1903, p. 207.

Elathous californicus Van Dyke, new species

Elongate, slightly depressed, subparallel, somewhat narrowed in front and behind, sparsely pilose; dark piceous brown, almost black in holotype, the basal margin of prothorax, elytral suture and epipleuræ, antennæ and entire underside rufotestaceous. Head triangularly depressed in front, clypeus prominent and with anterior margin arcuate, front moderately coarsely but not closely punctured; antennæ in male reaching one segment beyond hind angles of prothorax, in female not quite reaching apex of hind angles, the second segment small, slightly longer than broad, third longer, about twice as long as broad, together barely longer than fourth in male though distinctly longer in female. Prothorax slightly longer than broad in male, as broad as long in female, with hind angles prominent, divergent, blunt at apex, and distinctly carinate, the sides sinuate in front of angles, slightly arcuate at middle and gradually narrowed toward apex, the apex four-fifths as broad as base, lateral margin fine, disk convex and rather coarsely, somewhat numerously punctured, the punctures but little coarser laterally and always well spaced, median canaliculation vague even near base. Scutellum rather finely punctured. Elytra over two and a half times as long as prothorax, in male gradually narrowed almost from humeri to apex, in female subparallel anteriorly, the disk finely striate and very finely punctured, the intervals flattened, finely, irregularly punctured and indistinctly rugulose. Beneath moderately coarsely, closely punctured in front, more finely behind. Male, length 11 mm., breadth 3 mm.; female, length 12 mm., breadth 3.5 mm.

Holotype: Male, No. 3145; and *Allotype:* Female, No. 3146, Mus. Calif. Acad. Sci., and three *Paratype* females, besides an imperfect male, in my collection. The first was from **Strawberry Valley, Eldorado Co., Calif.**, Aug. 6, 1912, the second from Tallac, Lake Tahoe, Calif., Aug. 1912, the others from Meadow Valley, Plumas Co., Calif., July 1914, Quincy, Calif. July 1915, and Tallac, Aug. 1912. These were all found beneath the bark or in the wood of dead yellow pines, being truly lignivorous, as I believe are all members of the genus.

This species resembles quite closely our other species but is in general darker above, more narrowed in front, with more prominent and divergent hind angles to prothorax, a somewhat finer and less closely punctured head and pronotum and more finely punctured elytral striæ.

BIBLIOGRAPHY

Leptoschema protractum (Horn) (Agriotes), Tr. Am. Ent. Soc., III, 1871, p. 317; (Leptoschema), Horn, Tr. Am. Ent. Soc., XII, 1884, p. 50; Cand., Cat. Method. Elat., 1881, p. 200.

Leptoschema protractum elegans, n. var.

Elathous discalceatus (Say) (Elater) Say, Tr. Am. Phil. Soc., VI, 1839, p. 169; (Athous), Lec., Tr. Am. Phil. Soc., X, 1853, p. 427; Cand., Mon. Elat., III, 1860, p. 455; (Leptoschema), Horn, Tr. Am. Ent. Soc., XII, 1884, p. 51; Cand., Cat. Method. Elat., 1891, p. 201; Blatchley, Col. Ind., 1910, p. 761.

oberndorfferi O. Schwarz, Wien. Ent. Zeit., XXII, 1903, p. 207.

Elathous californicus, n. sp.

Elathous bicolor (Lec.) (Athous), Lec., Tr. Am. Phil. Soc., X, 1853, p. 428; Cand., Mon. Elat., III, 1860, p. 486; (Leptoschema), Horn, Tr. Am. Ent. Soc., XII, 1884, p. 51; Cand., Cat. Method. Elat., 1891, p. 201; Blatchley, Col. Ind., 1910, p. 761.

Genus **Athous Eschscholtz**

The genus *Athous* has the clypeus distinctly margined and elevated in front, the mouth anterior, the posterior coxal plates gradually dilated inwards, the first tarsal segment greatly elongated, the fourth usually quite small, and several of the median segments with posterior projecting lobes beneath, the prosternal lobe long and the prosternal sutures single. Other characters are quite variable. In fact the genus is decidedly polymorphic for the front may be flattened, sulcate or deeply triangularly impressed; the posterior prothoracic angles carinate or not carinate; the median tarsal segments lobed or not lobed; or the antennæ varying from the filiform to the usual serrate or even flabellate type and with the basal segments of varying length. There is often a great difference between the sexes as to size, length of antennæ, and so forth; and in many species a great deal of variability as to color. In a number of our species, particularly those confined to the Pacific Coast, there are several geographical color races and a few are quite decidedly dichromatic, having within the same territory both a black or dark phase as well as a lighter one, especially one with lighter elytra. This has also been noted in *Limonius* as indicated previously and it occurs here and there in *Ludius*.

The genus is dominantly holarctic, with a large number of species in all the major portions of that region. The bulk of the species dwell in the mountains, especially in heavily forested areas, much as *Limonius* shows a preference for the valleys and more open places.

In Europe, there has been a tendency to divide up the genus into subgenera or even to separate off several of the groups as distinct genera. This classification if applied to our species would lead to great confusion and at the same time give the impression that many of the species were widely separated whereas they are but slightly divergent elements of a common

stock. I have, therefore, thought it best to ignore these groupings. Some of our species superficially resemble those of other genera and a typical species as well as individuals have often been placed elsewhere. A study of the species in relation to the essential characters should prevent this confusion. I have removed *Limonius ornatipennis* Lec. from *Limonius* and placed it in *Athous,* the long first and short fourth tarsal segment being essentially characteristic of the latter and not of the former. Other characters also back this up. I have also placed *Corymbites polygenus* Fall here. Fall's type specimen was atypical of the species. Typical specimens are *Athous* in every regard. *Athous debilis* Lec. *(debilitarsus* Cand.) is a *Monocrepidius; Athous trivittatus* Melsh. a European species according to LeConte; and *Athous quadrivittatus* Walker, an immature specimen of *Ludius (Corymbites) lateralis* Lec., according to LeConte.[20] I have, therefore, dropped these from the genus *Athous. Athous exclamationis* O. Schwarz, I have not been able to place and am inclined to believe was never found in our territory as is the case without doubt, of a number of the Elateridæ described as from this country by O. Schwarz. Collectors are at times notoriously careless with their material as regards locality labels and have thus often misled the describer. A number of previously listed species will also be reduced to subspecific rank.

The arrangement of the species in the bibliography shows their phylogenetic relationship better than that given in the synoptic table.

SYNOPTIC TABLE

1. Tarsi not distinctly lobed beneath, second and third tarsal segments at most slightly prolonged backwards and beneath, hind angles of prothorax not carinate..... 2

   Tarsi with one or more segments evidently lobed beneath or prolonged backwards at least on first pair of legs..... 5

2. Front deeply impressed with prominent clypeal margin, second antennal segment small, third almost as long as fourth.... 3

[20] Syn. Notes on N. Am. Col., by John L. LeConte, Ann. Mag. Nat. Hist. (4), vol. 6, 1870, p. 7.

Front feebly impressed, clypeal margin but moderately prominent, second and third antennal segments about equal in length and each two-thirds length of fourth..... 4

3. Piceous or vittate species, anterior prothoracic angles prominent, scutellum as broad as long, intermediate antennal segments distinctly serrate, tarsi quite filiform; length 11-15 mm. Lake Superior to eastern Canada and Maine, and Allegheny Mts..... *rufifrons* (Rand.)

Rufotestaceous, anterior prothoracic angles not prominent, scutellum narrow, longer than broad, prothorax with sides straight and parallel, the disk but slightly convex, the intermediate antennal segments elongated and parallel sided, filiform; length 12 mm. Black Mts., N. C..... *appalachius* n. sp.

4. Small species, piceotestaceous, with sides of prothorax posteriorly, an elytral vitta extending from humeri to beyond middle and including most of fifth, sixth and seventh intervals, transverse oval patches extending from third intervals to margin at posterior third, a triangular area at apex, and feet, rufotestaceous; antennæ short, prothorax considerably longer than broad and moderately coarsely, closely and somewhat aciculately punctured, elytra distinctly striato-punctate, intervals rather markedly punctured and surface clothed with short, suberect pile; length 6 mm. Middle States, uncommon..... *ornatipennis* (Lec.)

5. Anterior tarsi with second and third segments slightly lobed beneath, middle and hind legs with tarsi not distinctly lobed; rufotestaceous, generally with base of head, somewhat elliptical median pronotal vitta, and broad sutural and lateral vittæ near side margin of elytra, black; second antennal segment longer than broad, the third as long or longer than fourth, front deeply triangularly impressed, pronotum moderately coarsely, closely punctured, intervals slightly convex and finely punctured, general surface rather sparsely, finely, pilose; length 7-11 mm. B. C. to northern Calif. along coast..... *vittiger* Lec.

All tarsi with some segments evidently prolonged or lobed beneath..... 6

6. Hind angles of prothorax not distinctly carinate (females of *rufiventris* Esch. with angles sometimes finely carinate).... 7

Hind angles of prothorax distinctly carinate in both sexes..... 31

7. Hind angles of prothorax short, broad and earlike, fourth tarsal segment quite small..... 8

Hind angles of prothorax somewhat prolonged and acute, fourth tarsal segment but little shorter than third, the three middle segments all distinctly lobed beneath (the genus *Harminius* Fairm.)..... 30

8. Second antennal segment short, third much longer, almost as long as or equal to fourth, front deeply impressed, clypeal margin prominent, antennæ long and more or less fiiiform.. 9

Second antennal segment longer than broad, generally twice as long as broad and but slightly shorter or equal to third, the latter never as long as fourth, front flattened or sulcate, clypeal margin but little elevated at middle..... 22

9. Punctures of pronotum rather fine, not umbilicate..... 10

Punctures of pronotum, broad, shallow and more or less umbilicate..... 17

10. Second and third tarsal segments distinctly prolonged beneath, forming well marked lobes..... 11

Second tarsal segment almost cylindrical, third but slightly lobed beneath, fourth segment somewhat more elongate or more evident than in preceding group..... 14

11. Larger species, over 9 mm. in length, pronotum moderately coarsely punctured..... 12

Smaller species less than 9 mm. in length, pronotum very finely punctured..... 13

12. Prothorax always somewhat narrowed in front, rather densely punctured and quite densely clothed with long cinereous pile, last segment of maxillary palpi over twice as long as broad; reddish brown to piceous, head and pronotum darker, elytra coarsely striato-punctate, intervals convex and surface sparsely though evidently pilose; length 11-15 mm. Common throughout Atlantic States.....*brightwelli* (Kirby)

Prothorax hardly narrower in front than behind, conspicuously but not densely punctured and but sparsely pubescent, last segment of maxillary palpi hardly twice as long as broad, rufotestaceous with head piceous behind and an elongate black area on disk of pronotum (typical species) and varying to all piceous or black with head, sides of prothorax and often large humeral patch red, elytra coarsely striato-punctate (more finely in var. *angelicus*), intervals somewhat convex, sparsely pilose; length 10-13 mm. Calif., chiefly along coast.....*excavatus* (Mots.)

13. Narrow, elongate, testaceous with back of head and disk of pronotum slightly piceous, second segment of antennæ but one-half length of third, prothorax more or less quadrate, little longer than broad, disk very finely, sparsely punctured. Elytra with well marked transverse rugæ between strial punctures enhancing the prominence of punctures, surface finely, sparsely pilose; length 8.5 mm. Black Mts., N. C.....*carolinus* n. sp.

Narrow, elongate, piceous or rarely testaceous, with or without lateral margins of prothorax rufous, second segment of antennæ over one-half length of third, prothorax subparallel

and distinctly longer than broad, pronotum rather finely and moderately closely punctured especially at sides, elytra with rugæ between strial punctures less evident especially at sides, surface sparsely pilose; length 6-8 mm. Eastern States ..... *acanthus* (Say)

14. Large black species, 13 mm. or over in length, shining and with fine, closely appressed and inconspicuous pile over entire upper surface 16

Species of medium size, with pile on upper surface sufficiently long and dense to be quite evident, the cinereous or fulvous pile of head and pronotum on its dark background a noticeable feature 15

15. Prothorax with sides but slightly if at all sinuate in front of hind angles, generally quite parallel for basal half or three-fourths, head and pronotum densely, closely punctured and with long, flying hairs quite evident, elytral striæ sharply impressed and closely punctured, the intervals slightly convex and distinctly irregularly punctured, third and fourth tarsal segments evidently prolonged beneath and slightly lobed, color variable, head, prothorax and scutellum always piceous or black, the elytra varying from orange through brown to black, legs black or yellow in lighter phases; length 10-15 mm., average 10-12 mm. Alaska, south to northern California, along coast, through the Cascades and Sierra Nevada and into northern Rocky Mts. ..... *pallidipennis* Mann.

Prothorax with sides noticeably sinuate, especially in males, in front of hind angles, angles slightly divergent, head and pronotum finely and but moderately closely punctured, the flying hairs but rarely evident; elytra with striæ evident but not sharply defined and distinctly punctured, the intervals but slightly convex and finely rugulose, so that punctation generally is vague; third and fourth tarsal segments barely prolonged beneath and but faintly lobed; color brown to piceous, head and prothorax darker, piceous or black, scutellum never black; length 10-12 mm. San Francisco Mts. of N. M. ..... *coquerelli* Reitt.

16. Head and pronotum deeply, rather coarsely, closely and regularly punctured, somewhat umbilicate at sides, prothorax with sides straight posteriorly or slightly sinuate in front of hind angles and arcuate at middle, hind angles at times with vague carinæ (the var. *ingens* Fall); elytra deeply and coarsely punctured, the intervals varying from very convex in typical to quite flat in large females of var. *ingens;* third and fourth tarsal segments slightly prolonged beneath and slightly lobed; length 13-22 mm. Western Wash. south to northern Calif., along coast and throughout Sierra Nevada Mts. ..... *scissus* Lec.

17. Front deeply triangularly sulcate, the clypeal margin sharply defined but depressed at middle 21

Front triangularly impressed, the clypeal margin thick and prominently elevated throughout entire extent 18

18. Elytra deeply striate, the intervals convex 19

Elytra finely striate, the intervals flat 20

19. Prothorax not distinctly longer than broad, the punctures coarse, umbilicate even on disk and closely placed, hind angles sometimes finely carinate in females; antennæ not extending more than three segments beyond hind angles of prothorax and with segments 3-7 evidently triangular; second and third tarsal segments evidently prolonged beneath and lobed, fourth small; color varying from all rufotestaceous to nigropiceous; length 8-12 mm. Alaska south through B. C. and Pacific States to coastal area of northern Calif. and to northern Rocky Mts ..... *rufiventris* (Esch.)

Prothorax distinctly longer than broad, entire insect very long and narrow, the punctures of pronotum but moderately coarse, distinctly umbilicate only at sides, and not closely placed even laterally; antennæ very long, extending four segments beyond hind angles of prothorax in male, segments 3-6 but slightly triangular; third and fourth tarsal segments but slightly prolonged beneath and lobed, the fourth but little smaller than third; color rufotestaceous; length 12 mm. Mts. of northern N. M ..... *rufotestaceous* Fall

20. Head and pronotum very coarsely, umbilicately and closely punctured; antennæ not extending more than three segments beyond hind angles of prothorax, segments 3-6 but slightly triangular; third and fourth tarsal segments slightly dilated and lobed beneath; color black with legs, antennæ and elytra nigropiceous or brownish; length 10 mm. Rocky Mts. of southern Colo. and northern N. M ..... *cribratus* Lec.

21. Head and pronotum coarsely, approximately punctured and clothed with conspicuous yellowish pile; antennæ extending three segments beyond hind angles of prothorax in males; segments 3-5 distinctly triangular; first and second tarsal segments quite cylindrical, third very distinctly prolonged beneath and lobed, the fourth small and cylindrical; color black with hind angles of prothorax, elytra and legs reddish yellow, the general surface subopaque; length 9-10 mm. Calif. from Los Angeles north to San Mateo Co ..... *agriotoides* Fall

22. Second and third antennal segments about equal in length and each but little shorter than fourth, the antennæ as a whole not reaching hind angles of prothorax; head and pronotum rather coarsely, very closely, somewhat aciculately punctured; hind angles of prothorax short and broad 23

Second and third antennal segments rather short, the third a little longer than second (considerably longer in male of *palpalis*) and distinctly shorter than fourth, punctation of pronotum moderately close..... 24

23. Prothorax distinctly longer than broad; front flattened, slightly impressed in front and with clypeal margin slightly reflexed; second and third tarsal segments but slightly prolonged beneath and lobed; color variable, black with hind angles of prothorax and legs yellow and elytra varying from black with yellow humeral patches or broad yellow vittæ to entirely yellowish red or rufous (anterior angles or apical margin of prothorax also often flavous); length 6-11 mm. Sierra Nevada and mountains of northern Calif. extending to B. C. ..... *imitans* Fall

Prothorax fully as broad as long; front flattened, clypeal margin not reflexed; second and third antennal segments evidently prolonged beneath and lobed; color brown to piceous, elytra lighter, anterior and posterior margin of prothorax, basal margin of elytra and epipleuræ flavous, basal segments of antennæ as well as outer parts of legs lighter; length 5.5-8 mm. Northern Calif. generally on hillsides on scrub oak. *brevis* n. sp.

24. Elytra entirely rufous or brown..... 25

Elytra black or bicolored, antennæ reaching hind angles of prothorax or extending beyond..... 29

25. Second and third antennal segments rather small, together about as long as or barely longer than fourth..... 26

Second and third antennal segments longer, together distinctly longer than fourth; front broadly sulcate, clypeal margin slightly reflexed at sides; pronotum rather finely though closely punctured; second tarsal segment not evidently lobed but third very distinctly lobed; reddish brown with head piceous and legs lighter; length 5-6 mm. Southwestern Ore. and northwestern Calif..... *palpalis* Fall

26. Front broadly sulcate, elytra always markedly rufous; somewhat larger species, over 8 mm. in length..... 28

Front flattened or at most very shallowly sulcate..... 27

27. Clypeal margin narrow but distinctly reflexed; antennæ reaching slightly beyond hind angles of prothorax, second and third segments together barely longer than fourth; prothorax slightly longer than broad, hind angles short and broad, disk moderately coarsely, closely, somewhat aciculately punctured; elytra moderately flattened, striæ fine and distinctly though not coarsely punctured, intervals flat and almost as coarsely punctured as striæ; color brown with slight reddish tinge, antennæ, side margins of elytra and legs more rufous; length 8 mm. Los Angeles, Calif.... *sordidus* n. sp.

Clypeal margin well defined but not reflexed, front broadly and shallowly excavated; antennæ not reaching hind angles of prothorax, second segment as broad as long, the third longer, about two-thirds length of fourth, the intermediate segments hardly serrate; prothorax slightly longer than broad, hind angles short and broad, disk rather coarsely and moderately closely punctured; elytra distinctly punctato-striato, intervals punctured but not conspicuously so and shining, and surface pilose; third segment of anterior tarsi alone lobed beneath, the second pair of legs with third tarsal segment but slightly elongated posteriorly; piceous with elytra rufous and antennæ and legs rufopiceous; length 8 mm. Dutch Flat, Calif. ..... *rufipennis* n. sp.

28. Clypeal margin sharply defined throughout, pronotum rather coarsely, evenly and closely punctured, canaliculation vague, second and third tarsal segments slightly prolonged beneath and lobed, black with rufous elytra and rufo-piceous antennæ and legs; length 9.5-11 mm. Middle Sierra of Calif. ..... *essigi* n. sp.

Clypeal margin sometimes sharply defined throughout or slightly depressed at middle, pronotum moderately, coarsely punctured, distantly on disk and closely on sides, canaliculation pronounced, second tarsal segment but slightly prolonged beneath, the third more evidently prolonged and lobed, entirely rufous or with head, a broad discal area and side margins of prothorax black; length 8-12 mm. Coastal counties of middle Calif. ..... *polygenus* (Fall)

29. Front flattened, clypeal margin well defined but not prominent, head and pronotum coarsely, closely punctured, pronotum slightly canaliculate at middle near base, elytra deeply striate, the striæ rather coarsely punctured, intervals convex, finely punctured and somewhat rugulose, upper surface evidently pilose, the pile cinereous on head and pronotum and interspersed with flying hairs; color black, sometimes with hind angles and basal margin of prothorax, basal margin, adjacent portion of suture, and epipleuræ of elytra, mouthparts and portions of legs rufous; length 9-11 mm. Southern Calif. ..... *discrepans* Reitt.

Front somewhat convex, clypeal margin sometimes slightly elevated, head and pronotum moderately, finely, rather closely punctured, prothorax but vaguely canaliculate at middle, front angles prominent and obliquely truncate, hind angles short and broad, elytra striato-punctate, intervals slightly convex; color black with hind angles of prothorax, a broad vitta extending back from elytral humeri almost to middle, a broad maculation at posterior third reaching from sides almost to suture, a triangular patch at apex, epipleuræ, and basal segments of antennæ and legs orange; length 6-7 mm. Ohio and middle Sierra Nevada Mts. of Calif. ..... *opilinus* Cand.

30. Larger species, front slightly impressed, clypeal margin but little elevated; antennæ reaching beyond hind angles of prothorax, second segment small, third large and triangular like following and slightly longer than fourth; head and pronotum coarsely, densely, very closely punctured, prothorax broader than long, disk canaliculate at middle posteriorly, hind angles prominent, divergent and subacute, elytra deeply striate, the striæ finely impressed, intervals convex and finely rugulose; color black with front and sides of head and greater portion of sides of pronotum rufous, elytra brown with basal triangle and two broad oblique bars clearly defined by being denuded of pile, the surface elsewhere as also the head and pronotum finely, densely pilose; length 15 mm. Hudson Bay and Lake Superior regions, also northern Europe and Asia..... *undulatus* (DeG.)

Smaller species, quite similar to preceding, head and pronotum densely, closely punctured, prothorax longer than broad, disk canaliculate at middle and hind angles prominent and divergent, elytra distinctly punctato-striate, the intervals flattened and finely punctured; color nigropiceous, prothorax with median rufous vitta extending from base to apex (type)[21] or all black (Katmai specimen),[22] the elytra reddish with three undulating oblique fasciæ produced by absence of pile or with two fasciæ and entire apex denuded; length 7 mm. Sitka and Alaska Peninsula..... *triundulatus* Mann.

31. Second segment of antennæ short, third very long, almost as long or even longer than fourth..... 32

Second and third antennal segments short, together about as long as fourth..... 40

32. Subopaque species, head and pronotum closely, shallowly, umbilicately punctured, elytra finely scabrous..... 33

More shining species, pronotal punctures not so closely placed, deeper and less umbilicate on disk, black or brown, sometimes with slight color pattern..... 35

33. Sooty black, unicolorous, front triangularly impressed, clypeal margin thick and reflexed; antennæ reaching hind angles of prothorax, second segment small, third almost equal to fourth, third to ninth serrate; prothorax about as broad as long, punctures of head and pronotum fine but very distinct, hind angles of prothorax broad and short, not divergent, carinæ fine and slightly divergent from side margin, elytra distinctly striato-punctate, intervals somewhat elevated and

---

[21] Bull. Mosc., XXVI, 1853, p. 222.

[22] The Coleoptera Collected by the Katmai Exped., by Edwin C. Van Dyke, Contrib. Tech. Ser., Nat. Geogr. Soc., Wash., 1924, p. 20.

finely scabrous, upper surface clothed with short, inconspicuous though rather dense black pile, second and third tarsal segments slightly prolonged beneath and lobed; length 11-12 mm. Central Calif., chiefly Sierra..... *aterrimus* Fall

Bicolored species, dull black with yellow or red markings..... 34

34. Head entirely black, hind angles of prothorax and basal margin and lunate patches on elytral humeri orange red; front triangularly impressed, the clypeal margin thick and reflexed; antennæ reaching beyond hind angles of prothorax, second segment small, third slightly longer than fourth, third to ninth distinctly serrate; prothorax longer than broad, punctures of head and pronotum rather coarse and surface clothed with long fulvous pile, pronotum canaliculate at middle, hind angles broad, slightly prolonged and somewhat divergent, carinæ sharp and fine, diverging slightly from margin, elytra finely striato-punctate, intervals convex, finely punctured and scabrous; second and third tarsal segments distinctly prolonged beneath and lobed; length 12-14 mm. Eastern States..... *scapularis* (Say)

Head with frontal area red, pronotum also red except for broad irregular basal area and sometimes hind angles; antennæ not reaching beyond hind angles of prothorax, second segment small, third almost equal to fourth and serrate like following; prothorax longer than broad, rather coarsely, shallowly punctured, sparsely clothed with cinereous pubescence, hind angles broad and sharp, carinæ sharp and divergent from sides, elytra striato-punctate, intervals finely scabrous, second and third tarsal segments but slightly prolonged beneath and lobed; length 13 mm. Ga., Kans.. ..... *equestris* (Lec.)

35. Upper surface black, more or less ornamented with red or yellow, head and pronotum densely punctured..... 36

Upper surface unicolorous, black or brown, punctures of pronotum always well separated on disk..... 37

36. Rather short and compact species, black or somewhat piceous and dull, basal margin of elytra and epipleuræ flavous, antennæ and legs slightly rufous; antennæ extending slightly beyond hind angles of prothorax, intermediate segments distinctly but not markedly serrate; prothorax but slightly longer than broad, hind angles short and hardly divergent, carinæ fine and close to side margin, elytra distinctly striato-punctate, intervals flattened and finely punctured and rugose, third segments of tarsi alone slightly prolonged beneath and lobed; length 6-9 mm. Sierra and Mts. of northern Calif..... *limbatus* Lec.

Somewhat larger species, black and shining with frontal excavation of head and basal margin of elytra rufous; second antennal segment small, third elongate and triangular; prothorax longer than broad, pronotum densely, coarsely and umbilicately punctured, hind angles short, carinæ close to side margin, elytra with striæ profoundly punctured, intervals convex and sparsely punctured; length 12.5 mm. Mont. ..... *orophilus* Harr

37. Prothorax distinctly longer than broad, sides quite straight and convergent forwards from hind angles in males, more parallel or arcuate at middle in females..... 38

Prothorax hardly longer than broad, sides sinuate in front of hind angles, thence quite straight and parallel or convergent forwards from hind angles with hind angles distinctly divergent in males, more arcuate at middle and narrowed in front in females; male antennæ long and with outer segments quite parallel sided; second tarsal segment hardly, third slightly prolonged beneath and lobed..... 39

38. Reddish brown, legs generally flavous, pronotum but moderately coarsely yet densely punctured, slightly canaliculate at middle posteriorly, elytra gradually arcuately narrowed from about middle to apex, distinctly striato-punctate, the intervals finely punctured and slightly rugose, second and third tarsal segments both distinctly prolonged and lobed beneath; length 11-15 mm. Northeastern and eastern States ..... *cucullatus* (Say)

Black or dark brown, legs somewhat lighter, pronotum but moderately coarsely and closely punctured on disk, more coarsely, closely and umbilicately at sides, canaliculation at middle quite vague, elytra with sides moderately arcuate at middle, rounded from posterior third to apex, disk rather strongly striato-punctate, intervals flat or convex, finely punctured and rugose, second tarsal segment hardly, third slightly, prolonged beneath and lobed; length 10-14 mm. The typical black phase (*nigropilis*), B. C. south to middle Calif., the brown phase (*nugalis*), middle and southern Calif. ..... *nigropilis* Mots.

Similar to above but somewhat smaller and with oval polished unpunctate area on each side of the median line of pronotum; length 9.5 mm. Tacoma, Wash..... *speculifer* Fall

39. Rufous or rufopiceous, often with suture of elytra flavous, legs rufotestaceous, pronotal punctures somewhat fine and but moderately close on disk, coarser and umbilicate at sides, canaliculation evident at middle posteriorly, elytra finely striato-punctate, intervals flattened, finely punctured and vaguely scabrous; length 11-14 mm. Southern Ariz. and N. M..... *arizonicus* n. sp.

Rufopiceous, often suture and margins of elytra as well as legs and underside quite rufous, disk quite flattened in male, moderately coarsely not closely punctured, a bit closer at sides, but faintly canaliculate at middle at most, elytra distinctly striato-punctate, the intervals slightly convex and finely punctured; length 12-14 mm. Sierra Nevada Mts. of Calif. ..... *rectithorax* Reitt.

40. Species in great part black or nigropiceous 41

Species in great part brown or brownish castaneous 42

41. Coal black above, faintly shining, legs rufocastaneous, head triangularly depressed in front, clypeal margin prominent and horizontal, head and pronotum coarsely, very closely and umbilicately punctured; antennæ reaching hind angles of prothorax, second and third segments small, equal in length and together as long as fourth, median segments strongly serrate; prothorax longer than broad, sides quite straight and strongly convergent forwards from hind angles, hind angles broad, prominent, the sides markedly reflexed, the carinæ sharp, disk with distinct canaliculation at middle, elytra finely striato-punctate, the intervals flattened, finely punctured and coarsely scabrous, second tarsal segment hardly prolonged beneath, the third distinctly so and lobed; length 12 mm. Marquette, Mich. ..... *erebus* n. sp.

Piceous, base of prothorax, basal segments of antennæ and feet testaceous; prothorax elongate, slightly convex, disk densely punctured and canaliculate at middle, hind angles rounded and inflexed, carinæ oblique and distinct, elytra striato-punctate, intervals flat, finely rugosely punctured, tarsal lobes not conspicuous; length 12 mm. Penn. and southeastern States ..... *posticus* (Melsh.)

42. Piceous brown above, underside, antennæ, legs and sometimes suture and margin of elytra castaneous; head rather coarsely punctured with front broadly, deeply impressed, clypeal margin narrow, not reflexed, antennæ extending slightly beyond hind angles of prothorax, median segments but little dilated; prothorax not longer than broad, hind angles subacute and slightly divergent, carinæ fine and short, poorly defined, disk finely, rather sparsely punctured; elytra finely striato-punctate, intervals flat and finely punctured, second tarsal segment but slightly prolonged beneath, third distinctly so and evidently lobed; length 10 mm. Rocky Mts. of Colo ..... *simplex* Lec.

Piceous brown or rufous, elongate, head triangularly impressed in front, clypeal margin arcuate and but little reflexed, coarsely, closely punctured; antennæ reaching hind angles of prothorax in female, distinctly longer in male; prothorax

longer than broad, hind angles broad and short, not divergent and with carinæ fine and close to margins, disk finely, not densely punctured, elytra finely striato-punctate, intervals flattened, finely punctured and rugulose, third tarsal segment alone evidently prolonged and lobed beneath; average length 11-14 mm. though sometimes 18 mm. Sierra Nevada Mts. of Calif. ..... *falli* Reitt.

Athous rufifrons (Randall)

There are three well marked color phases of this species: the true *rufifrons* (Rand.), a rather large piceous species with the clypeus, broad margins to prothorax and a broad vitta on each elytron rufous or rufotestaceous; *reflexus* Lec., a variety, large like the preceding but more or less uniformly piceous in color; and *lengi* Dury, a smaller variety, in reality a geographical race or subspecies, with sides of prothorax quite parallel, the clypeus and margins of prothorax rufotestaceous and a broad vitta on each elytron testaceous. *Athous rufifrons* (Rand.) in its typical phase is limited to eastern Canada and the northeastern States; *reflexus* Lec. most common in the Lake States; and *lengi* Dury confined to the southern Alleghenies, the specimens so far found being from the Black Mountains of North Carolina.

Athous appalachius Van Dyke, new species

Elongate, subparallel, somewhat flattened, rufotestaceous, head above piceous, very sparsely clothed with fine white pile. Head deeply, triangularly impressed in front, clypeal margin prominent, eyes large, front distinctly but not closely punctured; antennæ long and filiform, reaching four segments beyond hind angles of prothorax, second segment small, but little longer than broad, third almost twice as long, somewhat triangular and about three-fourths length of fourth, fourth to eleventh two to three times as long as broad, with sides parallel. Prothorax slightly longer than broad, apex distinctly arcuate, base broadly emarginate, basal margin elevated, sides straight and parallel, apical angles but slightly developed, basal angles hardly divergent, blunt and arcuate posteriorly, and without carinæ, lateral margin broad and flattened, sinuous when viewed laterally; the disk slightly convex, rather finely, somewhat closely punctured, and without canaliculation at middle. Scutellum cordate, flattened and sparsely punctate. Elytra broader than prothorax, at least four times as long, with sides quite parallel; the disk slightly convex, distinctly striate and quite coarsely, closely punctured, with intervals some-

what convex and rugulose, the punctation not evident. Beneath finely, sparsely punctured. Legs long and delicate, tarsi long, the three intermediate tarsal segments of all legs slightly prolonged beneath and lobed. Length 11 mm., breadth 3 mm.

Holotype: No. 3147, Mus. Calif. Acad. Sci., and *Paratype,* presumably males, collected by myself on **Mt. Mitchell, North Carolina,** during July 1902.

This species in color and general form suggests the more usual phase of *rufiventris* Esch., called *ferruginosus* Esch., but differs by having the sides of the prothorax straight and parallel and the punctures of the disk rather fine, not at all umbilicate.

Athous vittiger LeConte

This well known species which ranges along the Pacific Coast from British Columbia to San Francisco Bay, like *rufifrons* (Rand.), also varies in color. The normal phase is rufotestaceous with a median pronotal black vitta, a common sutural and lateral black vitta on each elytron. These darker markings often become so vague as to be hardly discernible or may entirely disappear so that we may have, particularly in females, individuals with unicolorous elytra or individuals that are entirely unicolorous. These latter are also often much larger than normal specimens.

Athous excavatus (Motschulsky)

Athous excavatus (Mots.) is likewise a Pacific Coast species but it has a greater range than the preceding and varies more in color. The typical phase is rufotestaceous with disk of pronotum black, and extends from northern Washington to Santa Cruz Co., Calif. It is fairly constant in coloration except for the fact that in many females the black pronotal marking disappears leaving them unicolorous and somewhat resembling the unicolorous phase of *vittiger* Lec. They are however, always much longer, with sparser pronotal punctation and larger tarsal lobes. On the Carmel peninsula of Monterey Co.,

a rather dark phase, a piceous brown subspecies with the pronotal disk black and the elytra reddish brown, appears. This contrasts quite markedly with the typical phase and seems to rather abruptly replace it. This phase, I am calling the subspecies **carmeli** and am designating a holotype (No. 3148, Mus. Calif. Acad. Sci.) and several specimens as paratypes from a series collected at **Carmel, Monterey Co., Calif.**, May 16, 1909. In Santa Barbara County, there is a second subspecies. This is *axillaris* Horn and like *carmeli* is in the main piceous brown but with the head, sides of prothorax, a short vitta extending backwards from the humeri and lateral margins of the elytra rufotestaceous. With this I am also associating a more attractive phase from the middle Sierras, my specimens from Tuolumne Co., which differ only in having the basal color a deep black and the contrasting markings more red. In Los Angeles Co. and the mountains of San Bernardino and Riverside Counties, another subspecies appears. This is black with the head and margins of prothorax alone rufotestaceous or even a clear red. This subspecies, I am calling **angelicus** and likewise selecting several specimens to stand as a holotype (No. 3149, Mus. Calif. Acad. Sci.) and paratypes from my **Los Angeles** series.

Athous carolinus Van Dyke, new species

Elongate, narrow, depressed, testaceous, back of head and disk of pronotum somewhat piceous, sparsely clothed with short cinereous pile. Head broadly, triangularly depressed in front, clypeus porrect, prominent and with anterior margin transverse, front rather finely, somewhat sparsely punctured, eyes prominent; antennæ long, filiform, extending several segments beyond hind angles of prothorax, second segment small, slightly longer than broad, third almost twice as long as second and three-fourths length of fourth, the following segments about three times as long as broad, with parallel sides Prothorax longer than broad, slightly narrower anteriorly, apex slightly arcuate, base emarginate, sides almost straight in male, somewhat arcuate at middle in female, the anterior angles not prominent, hind angles broad, blunt, somewhat divergent and extending backwards for a short distance, margin fine, disk slightly convex, shining, vaguely canaliculate at middle, finely, evenly and rather sparsely punctured. Scutellum somewhat companulate, flat, shining and finely, sparsely punctured. Elytra broader than prothorax, somewhat more than three times as long, sides but slightly arcuate, disk with striæ mod-

erately impressed, coarsely punctured, the transverse rugæ between punctures deepening and broadening the depressions, the intervals hardly convex, the general surface sculpturing much as in *acanthus* (Say). Beneath rather finely, somewhat closely punctured on propleuræ, more sparsely elsewhere. Legs delicate, tarsi long, second and third segments distinctly prolonged beneath and lobed, the fourth small and linear. Length 8 mm., breadth 2.25 mm.

Female somewhat larger, 9 mm. in length, more robust, with antennæ shorter, and sides of prothorax arcuate.

Holotype: Male, No. 3150; and *Allotype:* Female, No. 3151, Mus. Calif. Acad. Sci., collected on the summit of the **Black Mountains of North Carolina,** June 1912, by Wm. Beutenmueller, and one *Paratype* from Mt. Mitchell, North Carolina, collected in June 1902, by myself.

This species is in general slightly larger than *Athous acanthus* (Say) but is of the same facies and type of sculpturing. It differs in coloration, in having the prothorax less narrowed in front and the anterior prothoracic angles not prominent or dentate as they are in the greater number of *acanthus.* It is also closely related to *excavatus* Mots., but smaller with the punctures in general, both of prothorax and elytra, finer.

Athous acanthus (Say)

Athous acanthus (Say) varies much in the same way that *excavatus* does. The typical form is piceous, with or without testaceous legs; the weak variety *flavangularis* Horn, has the hind angles of the prothorax yellower than usual; and the well marked subspecies *maculicollis* Lec., is darker, black, with the margins of the prothorax and legs rufotestaceous, sometimes with the clypeus also rufous. This form is also generally somewhat smaller than the typical form and more northern in distribution. West of the Alleghenies as in Ohio and Kentucky, we also find a tendency for this species to become paler as a whole. This last variety quite closely resembles *carolinus.*

Athous pallidipennis Mannerheim

This is one of the most variable of our species both as to color and sculpture. In most places where found it is truly

dichromatic, there being a dark phase, piceous or black, and a light phase, black with orange red elytra and generally with the basal angles of prothorax and legs of the same color. In some localities the two phases will be found together, in others separately. In southeastern Alaska, western British Columbia, Washington, Oregon, and northwestern California, comprising the humid coastal area, the typical form is found. In this, the head and pronotum are rather finely, somewhat closely punctured, the elytra but moderately deeply striate and the intervals but slightly convex. The phase described by Mannerheim was of course the lighter one, piceous with orange red elytra, but the darker phase, all black or piceous with suture and side margins of elytra pale is by far the commoner one, at least on the mainland. In this territory intermediate color phases are also quite commonly met with. East of the Cascade mountains as at Pullman, Washington, the species tends to become more truly dichromatic and to have the pronotal punctation finer and the elytral striation and punctation also much finer and the intervals flatter. In the mountains of northern California and the Sierra Nevada, the species becomes much larger, more robust, with the punctation of head and pronotum coarser and closer, and the elytra more convex with the striæ deeply impressed and coarsely punctured, and the intervals quite convex. In the northern part of the state there is a tendency for the dark phase which is coal black, to dominate but in the middle Sierras, the lighter phase seems to be the more common. This robust phase, both light and dark, has such a distinctive appearance that I propose to list it as a subspecies, describing it as follows:

Athous pallidipennis sierræ Van Dyke, new subspecies

Similar in general structural peculiarities to the typical form but differing by being larger, more convex and generally more robust, the antennæ heavier and with segments 2-6 quite serrate (almost filiform in typical form), the head and pronotum densely, coarsely, cribrately punctured and subopaque, the elytra deeply striate, the striæ coarsely punctured, the intervals very convex and distinctly punctured and somewhat rugose; color black with hind angles

and basal margin of prothorax, elytra, hind margins of ventral segments, and antennæ and legs in male (in female rufopiceous) reddish orange. Male, length 12 mm., breadth 3.75 mm.; female, length 14 mm., breadth 4.5 mm.

Holotype: Male, No. 3152; and *Allotype:* Female, No. 3153, Mus. Calif. Acad. Sci., and several designated *Paratypes* from a series of twenty specimens collected by myself at **Yosemite Valley, Calif.,** June 3 and 10, 1921. I also have good series of the light phase of *sierræ* from numerous other localities in the Sierras and mountains of northern California as well as a series of over seventy specimens of the all black phase of the same subspecies. My entire series of all phases of the species is close to two hundred specimens.

Athous scissus LeConte

This large and shining black species is one of the most characteristic species of the heavily timbered areas of the Pacific Coast. It is generally found beneath the bark of old rotting stumps. The typical form ranges from western British Columbia south along the coast to the Russian River in California. In the mountains of northern California and the Sierra Nevadas, it is also to be found but here there is a tendency at times for the elytral carinæ to appear at the hind angles of the prothorax. Specimens of this kind were described by Fall as *ingens.* This is, however, not a well marked form but rather an individual peculiarity, not entitled, therefore, to even subspecific rank. Indistinct carinæ near the hind angles are to be met with as often in specimens from the coastal area as in those from the mountains.

Athous rufiventris (Eschscholtz)

As stated elsewhere,[23] I have combined this species with *ferruginosus* Esch. In the typical *rufiventris,* of which I have two specimens collected by myself from the type locality, Unalaska, the head and prothorax are almost entirely black, the

[23] The Coleoptera Collected by the Katmai Exped., by Edwin C. Van Dyke, Tech. Papers, Nat. Geog. Soc., Wash., 1924, p. 20.

underside in front piceous, the abdomen somewhat rufous, elsewhere rufotestaceous. In typical *ferruginosus,* the insect is entirely ferruginous or rufotestaceous, but the species is as a whole very variable and specimens similar to typical *rufiventris* are commonly to be met with in company with typical *ferruginosus.* Some of the large females also often have well defined though fine carinæ near the hind angles. This common species ranges from Unalaska Island south along the Pacific Coast to the San Francisco Bay region. Throughout most of this area the dominant color is ferruginous but along the immediate coast from Newport, Ore., to Humboldt Bay in California, is a region of extreme humidity where a melanotic phase is to be found. This is so definite a geographical race and contrasts so markedly with the usual color phases that I propose to give it a subspecific name calling it:

Athous rufiventris maritimus Van Dyke, new subspecies

It resembles the lighter and more typical phases in every physical regard, only differing in color, being black or piceous with antennæ, legs and elytra somewhat lighter.

Holotype: Male, No. 3154; and *Allotype:* Female, No. 3155, Mus. Calif. Acad. Sci., and several designated *Paratypes* from **Humboldt Co., Calif.,** collected presumably near Eureka, by myself, during June 1901. In my series of over twenty individuals are specimens from Newport, Waldport and Marshfield, Oregon, as well as from several places in Humboldt Co., Calif. It resembles in color and general appearance *Athous cribratus* Lec., but differs in the main by having deeper and more coarsely punctured elytral striæ.

Athous imitans Fall

This species as indicated in the table is very variable as to both size and color. It is fairly common in places throughout the mountains of northern California and is to be found as far north as Nanaimo, B. C. Its flattened or subsulcate head,

not prominent clypeal margin and coarsely, very closely and somewhat aciculately punctured prothorax, with broad, short hind angles, would place it in association with *agriotoides, brevis* and *sordidus,* species which have a facies quite suggestive of *Limonius ornatulus* Lec. and its associates.

Athous brevis Van Dyke, new species

Small, short and moderately robust, somewhat flattened, black, elytra brown, narrow basal margin of prothorax and elytra luteous, epipleuræ, outer parts of legs and base of antennæ rufous. Head flattened, clypeus porrect and moderately prominent, anterior margin transverse, front coarsely, closely punctured; antennæ reaching hind angles of prothorax, second and third segments about equal in length, twice as long as broad, and almost equal to fourth, median segments somewhat longer than broad and distinctly triangular. Prothorax as broad or broader than long, apex almost truncate, base emarginate, sides slightly arcuate, almost subparallel, suddenly constricted near apex, hind angles broad and hardly extended, disk coarsely, closely, evenly and somewhat aciculately punctured. Elytra twice as long as prothorax, slightly broader at base, sides subparallel and evenly rounded at apex, disk somewhat flattened, striæ distinctly impressed, rather coarsely punctured anteriorly, finer posteriorly, intervals flattened, distinctly but somewhat irregularly punctured and faintly rugulose, entire upper surface rather finely, sparsely pubescent. Beneath, prosternum coarsely and not closely punctured, propleuræ coarsely and closely and afterbody finely and sparsely punctured. Legs short, second and third tarsal segments evidently extended beneath and slightly lobed, fourth segment small but quite evident. Length 7 mm., breadth 1.75 mm.

Holotype: Male, No. 3156; and *Allotype:* Female, No. 3157, Mus. Calif. Acad. Sci., and several designated *Paratypes,* collected by myself from the slopes of **Mt. Tamalpais, Marin Co., Calif.,** May 20 and 23, 1909. My series consists of thirty-five specimens and is from the following localities in California: Siskiyou Co., June, Nunenmacher; Carrville, Trinity Co., June, Van Dyke; Plumas Co., June, Nunenmacher; Glen Alpine, Eldorado Co., June, Van Dyke; Placer Co., Napa Co., Marin Co., Ben Lomond, Santa Cruz Co., and Fresno Co. They are fairly constant as to color and general characteristics.

This short, little species of the brushy or chaparral areas of California looks much like several of the smaller species of *Limonius* especially some of the more sombre phases of

ornatulus and *maculicollis* though it is a bit larger. It is rather closely related to *Athous sordidus* n. sp. and also belongs near *agriotoides* Fall and *imitans* Fall.

Athous sordidus Van Dyke, new species

Rather small, moderately robust, somewhat flattened; brown with a slight rufous tinge, antennæ, mouthparts, epipleuræ and legs quite rufous; slightly shining above and rather sparsely clothed above with conspicuous, rather long, gray pile. Head somewhat flattened, transversely impressed near clypeus, clypeus porrect with margin distinct, somewhat depressed at middle and slightly emarginate, front coarsely, closely punctured; antennæ reaching about one segment beyond hind angles of prothorax, second and third segments about twice as long as broad, equal in length, and each two-thirds length of fourth, median segments distinctly longer than broad, apex faintly lobed at middle, base emarginate, sides subparallel behind, gradually arcuately narrowing in front, front angles projecting forwards, hind angles short and broad, disk convex, rather coarsely, closely and somewhat aciculately punctured, median canaliculation not evident, scutellum elongate, flattened and sparsely punctured. Elytra slightly broader than prothorax, almost three times as long, sides subparallel in front, gradually arcuate behind to apex, disk somewhat flattened, striæ fine but distinct, finely punctate with elongate punctures, intervals flattened, rather coarsely, somewhat biseriately punctured, the punctures conspicuous and almost as large as those of the striæ. Beneath with prosternum moderately coarsely, rather sparsely punctured, propleuræ more closely and afterbody more finely and but moderately closely punctured. Legs rather short, second and third tarsal segments prolonged beneath and slightly lobed, fourth segment small but evident. Length 8 mm., breadth 2 mm.

Holotype: No. 3158, Mus. Calif. Acad. Sci., a unique in my collection, collected many years ago in **Los Angeles Co., Calif.,** probably in the hills.

This species is evidently related to *brevis,* replacing it in southern California. It is larger, more elongate, with longer prothorax, longer antennæ, coarser punctation on elytral intervals, and with much longer pubescence.

Athous rufipennis Van Dyke, new species

Rather small and short, head and prothorax nigropiceous, elytra rufocastaneous, beneath piceous, antennæ and legs rufopiceous, shining above and with a somewhat greasy aspect, the pubescence fine and sparse. Head broadly flattened in front, clypeal margin arcuate but clypeus not sharply demarked

from front, front coarsely and rather closely punctured; eyes moderate in size; antennæ short, not reaching hind angles of prothorax, second segment a little longer than broad, third slightly longer and about two-thirds length of fourth, fourth longest, the following one and a half to two times as long as broad and but slightly enlarged distally. Prothorax over a third longer than broad, apex at middle faintly arcuate, base emarginate, sides moderately arcuate at middle, anterior angles not prominent, hind angles short, non-divergent and non-carinate, disk very convex, coarsely and somewhat closely and evenly punctured, not canaliculate at middle. Scutellum cordate, finely cristate at middle and rather coarsely punctured. Elytra but little broader than prothorax and two and a half times as long, slightly arcuate at sides and broader behind the middle, disk convex, striæ fine and finely punctured, the intervals almost flat and finely, irregularly biseriately punctured. Beneath rather coarsely, closely (umbilicately on propleuræ) punctured in front, more finely and sparsely behind. Legs rather short, tarsi with three intermediate segments but little prolonged and lobed beneath. Length 7.5 mm., breadth 2.25 mm.

Holotype: No. 3159, Mus. Calif. Acad. Sci., a unique and probably a female, collected at **Dutch Flat, Placer Co., Calif.,** June 16, 1914.

This chubby little species suggests by its size, general shape, and color, some of the phases of *imitans* Fall or even some of the smaller species of *Ludius (Corymbites)* like *angularis* (Lec.). Its characters are, however, definite and should enable it to be recognized should anyone be so fortunate as to collect it.

Athous essigi Van Dyke, new species

Elongate, somewhat depressed, narrowed in front and behind, head and prothorax black, elytra rufous, antennæ and outer portions of legs rufopiceous, underside of body nigropiceous, surface clothed with fine, short and rather sparsely placed pile. Head deeply, broadly sulcate in front, clypeal margin broadly rounded in front and well defined but not elevated, front coarsely, quite closely punctured; antennæ long, reaching at least two segments beyond hind angles of prothorax, second segment small, hardly longer than broad, third slightly longer, the two just perceptibly longer than fourth, median segments at least twice as long as broad and serrate. Prothorax almost a third longer than broad, anterior margin subtruncate, barely emarginate, sides sinuate in front of hind angles, thence almost straight and slightly converging to near front angles where rounded, front angles not prominent, hind angles prominent, triangular and somewhat divergent, disk coarsely, rather closely and evenly punctured, median canaliculation but vaguely indicated. Scutellum elongate, with vague longitudinal crista at middle and slightly punctured.

Elytra almost three times as long as prothorax, distinctly broader than the latter, sides slightly arcuate at middle, gradually narrowed from posterior third to apex, disk finely but sharply striate, the striæ finely punctured with elongate punctures, the intervals slightly convex, finely punctured and finely rugulose. Beneath with prosternum rather coarsely, not closely punctured, propleuræ more coarsely, the punctures umbilicate, and afterbody very finely, rather closely punctured, prosternal spine long and acute and finely sulcate. Legs long, second tarsal segment almost cylindrical, third but slightly prolonged beneath and lobed, and fourth small and just barely prolonged backwards. Length 11.5 mm., breadth 3.25 mm.

Holotype: No. 3160, Mus. Calif. Acad. Sci., and *Paratype* in my collection, the first collected by my associate Prof. E. O. Essig, at **Placerville, Calif.**, and kindly presented to me, the latter collected at Dutch Flat, Placer Co., Calif., June 15, 1915. A large series of specimens was collected this last summer at Forest Hill, Placer Co., June 1931, and at Riverton, Eldorado Co., during July.

This species has physical characters which place it well apart from others, but in color, size and superficial appearance it somewhat resembles the more typical light phases of *pallidipennis*. Its sharply defined and depressed clypeus, thick and elevated in *pallidipennis,* short third segment of antennæ and type of tarsi, will, however, always readily distinguish it.

Athous polygenus (Fall)

This peculiar species is quite variable. It was placed by Fall in the genus *Corymbites* or *Ludius* as it is now called. The type was, however, one of the smaller, somewhat depauperized and atypical forms, which had the clypeal margin not only depressed at the middle but slightly interrupted there. In fully developed specimens, the clypeus is somewhat depressed for the front is always quite broadly and deeply sulcate, but it is complete and sharply defined. The tarsi are also those of *Athous* for though the lobes of the intermediate segments are not very prominent they are evident, besides the long first and very small fourth segments are characteristic of the genus.

Athous opilinus Candeze and **Athous ornatipennis** (LeConte)

The first species, a small and attractive one, was described as from Ohio. It seems to be very scarce there for but few Ohio specimens are represented in collections. In California it is more often found, sometimes quite commonly as in the Sequoia National Park. I have carefully compared a specimen from the type locality with California specimens and find them absolutely the same. A rather close relative of this is *Athous ornatipennis* (Lec.), a species which is of the same size and has a similar color pattern. This latter differs mainly in having the tarsi without well defined lobes. It was formerly placed with *Limonius* but the single prosternal suture and long first and short fourth tarsal segments will, as stated before, clearly place it with *Athous*.

Athous undulatus (De Geer)

This is a well known boreal species found in the more northern parts of Europe and Asia as well as North America. American specimens are, however, very rare in collections. My single representative was collected by Mr. John D. Sherman Jr., in the Lake Superior region. The genus *Harminius* Fairm. erected for the reception of this and a limited number of associated species is not worthy of being considered as of more than subgeneric value at the most. The dominating characters of *undulatus* are those of *Athous*. The characters selected for *Harminius* are merely such as would assist in separating it from some of the more typical *Athous*.

Athous triundulatus Mannerheim

This species is closely related to the preceding but much smaller though quite distinct. As far as known, there are but two specimens in existence, the type presumably in Moscow, and a single specimen collected by the members of the Katmai Expedition to Alaska and now in the collection of the Ohio State University.

Athous cucullatus (Say)

With the above, I have placed *fossularis* Lec. The latter is nothing more than a large and robust female, as I have proved by comparing several typical female specimens with the type.

Athous nigripilis Motschulsky

This species is widely distributed throughout the Pacific region, extending as far east in the north as Alberta. It varies somewhat in size, size of punctures and degree of convexity as regards the elytral intervals. The black or northern phase could only be confused with black phases of *pallidipennis* but the dense pronotal punctures of the latter and long cinereous pile should readily separate it. In southern California, *nugalis* Fall replaces it to a great extent. This I consider as but a subspecies at the most, as it only differs in color and in general by being slightly larger. It also definitely intergrades with the more typical northern phase. *Athous speculifer* Fall I am also inclined to consider as but an atypical specimen but am leaving it as distinct until we can get more evidence.

Athous arizonicus Van Dyke, new species

Elongate, narrowed in front and behind, rufotestaceous, antennæ, legs and underside lighter or more rufous. Head coarsely, closely punctured, front deeply, triangularly impressed, clypeus thick and reflexed; antennæ reaching hind angles of prothorax in female, extending two segments beyond in male, second segment small, third very long, longer than fourth, segments 3-5 in male broad and triangular, the following very elongate and with sides almost parallel, segments 3-10 in female all somewhat triangular. Prothorax but slightly longer than broad, with sides straight and convergent forward from hind angles or somewhat sinuate in front of hind angles and more parallel forwards in male, more arcuate in female, hind angles broad, somewhat extended and slightly divergent, the carinæ fine, long and close to margin, disk moderately coarsely and densely punctured, a slight median canaliculation near base. Elytra almost three times as long as prothorax, very finely striato-punctate in male, more coarsely in female, the intervals flattened in male or slightly convex in female and finely punctured, the general surface dull and clothed with sparse, short, suberect pile. Beneath quite coarsely, closely punctured in front and very finely, closely behind, the legs long, tarsi with

second segment hardly prolonged beneath, third distinctly prolonged and lobed, and fourth but little shorter than third and subcylindrical. Male, length 13 mm., breadth 3.5 mm., female, length 14 mm., breadth 4 mm.

Holotype: Male, No. 3161; and *Allotype:* Female, No. 3162, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection, collected in the **Chiricahua Mts.** of southern **Arizona,** in June 1908, by Mr. Virgil Owen. I have also designated several paratypes among the material submitted to me for study by the American Museum of Natural History. I have examined specimens from several other localities in Arizona as the Huachuca Mts., as well as the Jemez Mts., and Fort Wingate, New Mexico.

This species somewhat resembles both *cucullatus* and *rectithorax,* being separated from the former by its much less dense pronotal punctation and flatter disk in male, the less development of the lobes of the tarsal segments as well as by its somewhat greasy appearance; and from the latter, by its longer prothorax, denser pronotal punctures, less suddenly divergent hind angles of prothorax, finer elytral striation and less shining appearance. It also appears to be quite different from any of the described Mexican species.

Athous erebus Van Dyke, new species

Robust, coal black above, legs rufotestaceous, faintly shining and sparsely clothed with short, very fine gray pile. Head coarsely, closely and umbilicately punctured, front triangularly impressed, clypeus horizontal and prominent; antennæ robust, reaching hind angles of prothorax, second and third segments small, of about equal length and together as long as fourth segment, fourth longer than fifth, intermediate segments all elongate and strongly serrate. Prothorax distinctly longer than broad, sides straight and convergent from apices of hind angles to near apex, side margins broad and reflexed, front angles not prominent, hind angles very broad and auriculate, the sides greatly reflexed, carinæ fine, long, sinuately diverging from margins; disk moderately convex, coarsely, densely and umbilicately punctured, median canaliculation fine but complete. Scutellum closely punctured and with pit at center. Elytra somewhat more than twice as long as prothorax, subparallel at sides and evenly rounded apically, disk moderately convex, striæ deeply impressed and finely punctured, intervals flattened, finely punctured and evidently scabrous. Beneath coarsely and densely punctured in front and very finely, rather closely

behind, second tarsal segment hardly prolonged beneath, the third evidently prolonged and lobed, the fourth short but subcylindrical. Length 12 mm., breadth 3.5 mm.

Holotype: No. 3163, Mus. Calif. Acad. Sci., a unique in my collection, collected at **Marquette, Mich.,** June 29, by Mr. John D. Sherman, Jr.

This interesting species in size and robustness somewhat suggests *scapularis,* a black phase of which I at first thought it to be, but it differs markedly as regards the antennæ, tarsi and minuter sculpturing and has an entirely different color pattern as well as type of pubescence.

BIBLIOGRAPHY

Athous rufifrons (Rand.) (Elater), Boston Jour. Nat. Hist., II, 1838, p. 6.

Athous rufifrons var. reflexus Lec., Tr. Am. Phil. Soc., X, 1853, p. 427; Cand., Mon. Elat., III, 1860, p. 474; Blatchley, Col. Ind., 1910, p. 761.

Athous rufifrons subsp. lengi Dury, Ent. News, XXII, 1911, p. 275; Leng, Cat. Col., 1920, p. 168.

Athous appalachius n. sp.

Athous vittiger Lec., Tr. Am. Phil. Soc., X, 1853, p. 427; Cand., Mon. Elat., III, 1860, p. 486.

Athous brightwelli (Kirby) (Pedetes), Fauna Bor. Am., IV, 1837, p. 146; Lec., Tr. Am. Phil. Soc., X, 1853, p. 425; Blatchley, Col. Ind., 1910, p. 759.

oblongicollis Melsh., Proc. Acad. Nat. Sci. Phila., II, 1846, p. 155.

articollis Melsh., Proc. Acad. Nat. Sci. Phila., II, 1846, p. 156.

affinis Cowper, Tr. Lit. and Hist., Soc. Quebec, 1865, p. 61.

Athous excavatus (Mots.) (Pedetes), Bull. Mosc., IV, 1859, p. 367, Cand., Cat. Method. Elat., 1891, p. 156.

Athous excavatus carmeli n. subsp.

Athous excavatus axillaris Horn, Tr. Am. Ent. Soc., III, 1871, p. 316.

Athous excavatus angelicus n. subsp.

Athous carolinus n. sp.

Athous acanthus (Say) (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 178; (Pedetes), Lec., Tr. Am. Phil. Soc., X, 1853, p. 425; (Athous), Blatchley, Col. Ind., 1910, p. 760.

mendicus Dej., Cat., ed. 3, 1837, p. 102.

Athous acanthus var. flavangularis Horn, Tr. Am. Ent. Soc., III, 1871, p. 317.

Athous acanthus sub sp. maculicollis Lec., Smiths. Misc. Coll., VI, No. 167, 1863, p. 85.

Athous pallidipennis Mann., Bull. Mosc., XVI, 1843, p. 244.

Acanthus pallidipennis sierræ n. subsp.

Athous coquerelli Reitt., Wien Ent. Zeit., XXVII, 1908, p. 36.

‖*jejunus* Fall, Tr. Am. Ent. Soc., XXXII, 1907, p. 231.

Athous scissus Lec., Rept. Exp. and Surv. Miss. to Pac., XII, pt. 3, 1857, p. 46; Cand., Mon. Elat., III, 1860, p. 487.

ingens Fall, Tr. Am. Ent. Soc., XXXVI, 1910, p. 131.

Athous rufiventris (Esch.) (Elater), Entomogr., 1822, p. 71; (Athous), Mann., Bull. Mosc., XVI, 1843, p. 245; Cand., Mon. Elat., III, 1860, p. 428; Van Dyke, Col. Katmai Exped., Tech. Pap. Nat. Geog. Soc. Wash., 1924, p. 20.

Athous rufiventris var. ferruginosus Esch., Thon, Ent. Arch. I, ii, 1829, p. 33; Mann., Bull. Mosc., XVI, 1843, p. 244; Cand., Mon. Elat., III, 1860, p. 432.

Athous rufiventris subsp. maritimus n. subsp.

Athous rufotestaceus Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 231.

Athous cribratus Lec.. Rep. Col. W. 100th Mer., Ann. Rep. Chf. Eng., App. VV, 1876, p. 516.

Athous agriotoides Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 230.

Athous imitans Fall, Tr. Am. Ent. Soc., XXXVI, 1910, p. 131.

Athous brevis n. sp.

Athous sordidus n. sp.

Athous rufipennis n. sp.

Athous opilinus Cand., Mon. Elat., III, 1860, p. 435.

Athous ornatipennis (Lec.) (Limonius), Smiths. Misc. Coll., VI, 1863, p. 84; Leng, Cat. Col., 1920, p. 168; Blatchley, Col. Ind., 1910, p. 757.

Athous palpalis Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 229.

Athous essigi n. sp.

Athous polygenus (Fall) (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 136.

Athous discrepans Reitt., Wien Ent. Zeit., XXVII, 1908, p. 36.

‖*discors* Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 230.

Athous undulatus (DeGeer) (Elater), Ins., IV, 1774, p. 155; (Athous), Kiesen. Naturg. des Ins. Deutsch., IV, 1861, p. 320; Cand., Mon. Elat., III, 1860, p. 450; Lec., Proc. Acad. Nat. Sci. Phila., 1866, p. 391.

trifasciatus (Herbst) (Elater), Käfer, X, 1806, p. 31, 39, pl. 160, fig. 12; (Athous), Redt., Faun. Austr., ed. 2, 1858, p. 492.

Athous triundulatus Mann., Bull. Mosc., XVI, 1843, p. 222; Cand., Cat. Method. Elat., 1891, p. 157; Van Dyke, Col. Katmai Exp., Tech. Pap. Nat. Geog. Soc. Wash., 1924, p. 20.

Athous aterrimus Fall, Tr. Am. Ent. Soc., XXXVI, 1910, p. 130.

Athous scapularis (Say) (Elater), Tr. Am. Phil. Soc., VI, 1839, p. 178; (Pedetes) Lec., Tr. Am. Phil. Soc., X, 1853, p. 425; (Athous), Cand., Mon. Elat., III, 1860, p. 429; Blatchley, Col. Ind., 1910, p. 760.

Athous equestris (Lec.) (Pedetes), Tr. Am. Phil. Soc., X, 1853, p. 426; (Athous), Dej., Cat., ed. 3, 1837, p. 101; Cand., Mon. Elat., III, 1860, p. 428.

Athous limbatus Lec., Proc. Acad. Nat. Sci. Phila., 1861, p. 391.

Athous orophilus Har., Gemm. and Harold, Cat. Col., V, 1869, p. 1567.

‖*montanus* Lec., Proc. Acad. Nat. Sci. Phila., 1866, p. 391.

Athous nigripilis Mots., Bull. Mosc., XXXII, III, 1859, p. 368; Cand., Cat. Method. Elat., 1891, p. 156.

Athous nigripilis subsp. nugalis Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 228.

Athous speculifer Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 229.

Athous cucullatus (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 264; Tr. Am. Phil. Soc., VI, 1836, p. 177; (Pedetes), Lec., Tr. Am. Phil. Soc., X, 1853, p. 425; (Athous), Cand., Mon. Elat., III, 1860, p. 430; Blatchley, Col. Ind., 1910, p. 760.

hypoleucus Melsh., Proc. Acad. Nat. Sci. Phila., II, 1846, p. 155.

procericollis Melsh., Proc. Acad. Nat. Sci. Phila., II, 1846, p. 156.

strigatus Melsh., ♀ Proc. Acad. Nat. Sci. Phila., II, 1846, p. 154.

fossulatus (Lec.) ♀ (Pedetes), Tr. Am. Phil. Soc., X, 1853, p. 426; (Athous), Cand., Cat. Method. Elat., 1891, p. 156.

Athous arizonicus n. sp.

Athous rectithorax Reitt., Wien Ent. Zeit., XXVII, 1908, p. 36.

‖*recticollis* Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 228.

Athous erebus, n. sp.

Athous posticus (Melsh.) (Limonius), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 158; (Pedetes), Lec., Tr. Am. Phil. Soc., X, 1853, p. 426; (Athous), Cand., Cat. Method. Elat., 1891, p. 156.

Athous simplex Lec., Rep. Col. W. 100th Mer., Ann. Rep. Chf. Eng., App. VV, 1876, p. 516; Cand., Cat. Method. Elat., 1891, p. 156.

Athous falli Reitt., Wien. Ent. Zeit., XXVII, 1908, p. 35.
‖*quadricollis* Fall, Tr. Am. Ent. Soc., XXXIII, 1907, p. 229.

Genus **Ludius** Eschscholtz

In using the name *Ludius* Esch. instead of *Corymbites* Latr., I am following Hyslop instead of Schenkling, even though the latter in the Catalogus Coleopterorum, is the latest cataloguer. I also refuse to break up the genus into the numerous illy defined genera that have been used by many of the recent workers in Europe. There the fauna is limited and the species are apparently the remnants or relict terminals of the phylogenetic tree. As such they can more readily be assembled into lesser groups capable of being somewhat defined. In this country, the number of species is large and they show all degrees of divergence from those which are more or less isolated, relict species as in the Old World, to those which are rather recent offshoots from the parent stem. They, therefore, do not readily fall into the groupings which have been adopted in Europe. Too many of them are also annectant species. In this paper I will use but the one genus. Perhaps at a later date, good characters may be found which will enable certain groups to be separated off into genera of lesser size. I am unable to find such characters now.

The genus as here used may be defined as containing those Elateridæ having the front somewhat flattened, the clypeal margin interrupted or absent at the middle, the mouthparts projecting forwards, the mandibles emarginate at apex, the first segment of the antennæ of normal size, no antennal grooves beneath, the prosternal sutures generally single (one small group of four species with double sutures), and not widely separated, the mesosternum declivous and with distinct sutures separating them from metasternum, the posterior coxal plates gradually dilated inwards, the tarsi without lobes beneath and the claws simple. The genus is a large one and

very polymorphic, containing narrow elongate species as well as broad and more or less flattened ones, those having antennæ which vary from the filiform through the serrate to the pectinate type, as well as those which show all manner of coloration and degree of pilosity. The antennæ on the whole have been found to be the character most useful for separating the species though even they are variable and must not be completely relied upon.

I have been able to study either the types or carefully determined representatives of all except one of our species and have in my collection specimens of all except two or three of them. Most species are represented by large series which with an extensive field knowledge has enabled me to better estimate their degrees of variation. As a result I have reduced many of those listed to subspecific or varietal rank or even to synonymy. I have also attempted to place some of the unrecognized species described by Mannerheim, Motschulsky and other early workers. The Siberian species, *confluens* Gebler and *sericeus* Gebl., credited to Alaska, the latter listed by Schwarz in the Harriman Report,[24] I have been unable to study so could not incorporate in my table. Many new species discovered within recent years have also been added.

SYNOPTIC TABLE

1. Elytral striæ always distinct, prosternal spine more or less elongate and horizontal 2

   Elytral striæ to a great extent obliterated, at least on disk, prosternal spine short and suddenly curved upwards ..... subgenus *Paranomus* 89

2. Antennæ pectinate or markedly and acutely serrate in males ... 3

   Antennæ not pectinate and but moderately acutely serrate at most in males 4

3. Male antennæ decidedly pectinate, the appendages long and narrow, head and prothorax bronzed, elytra luteous with elongate black maculations near apex or entirely bronzed with violaceous reflections; length 12-16 mm. Alaska to Alberta, Great Lakes and Maine ..... *virens* (Schr.)

[24] Harriman Alaska Exped., vol. VIII, pt. 1 (1904), p. 181.

Male antennæ not strictly pectinate but very acutely serrate, the appendages not as long as the segments, black, elytra luteous with scutellar and two large maculations on each elytron black; length 8-10 mm. Eastern Canada, Ohio to Mass. ..... *vernalis* (Hentz)

4. Third antennal segment quite similar to following segments, though sometimes a bit shorter or longer than fourth 5

Third antennal segment quite unlike the following, either as short as second, slightly longer, or elongate and more or less cylindrical 39

5. Antennæ with intermediate segments transverse and quite strongly serrate in the males 6

Antennæ with intermediate segments not transverse and less strongly serrate even in the males 11

6. Pronotum rather deeply sulcate or canaliculate, at least as far forward as middle 7

Pronotum canaliculate only at base or with median smooth line observable 8

7. Bronzed, irregularly clothed with patches of gray pile, prothorax rather strongly punctured and with prominent and divergent hind angles; length 13-17 mm. Northern Europe and Asia and northeastern America ..... *sjaelandicus* (Müller)

Coal black, females much broader and flatter than males, second antennal segment almost as long or as long as third, moderately triangular, median segments broadly triangular, and prolonged backwards beneath, prothorax longer than broad, coarsely, moderately closely punctured in males, very closely in females, hind angles prominent, slightly divergent and with distinct carinæ, elytra distinctly striate, the intervals slightly convex, biseriately punctured in males, more numerously and irregularly punctured in females; length 15-23 mm. Pacific States ..... *cribrosus* (Lec.)

8. Pronotum definitely canaliculate towards base 9

Pronotum not distinctly canaliculate but with smooth median line 10

9. Prothorax margined with red, first antennal segment and legs somewhat rufous, pronotum rather finely, sparsely punctured, third antennal segment distinctly triangular and but two-thirds length of fourth, hind angles of prothorax carinate and divergent, elytra with striæ deep and distinctly punctured, the intervals very convex and finely, biseriately punctured; length 8-11 mm. South Central States ..... *signaticollis* (Melsh.)

Black, faintly æneous, prothorax strongly, closely, more or less cribrately punctured, third antennal segment fully as long as fourth or even longer and distinctly triangular, almost as broad at apex as following segment, median segments as broad as long and prolonged beneath, hind angles of prothorax straight or but slightly divergent, strongly carinate, elytra distinctly striate, the striæ finely, rather closely punctured, intervals slightly convex and distinctly, irregularly punctured and finely rugose; length 12-16 mm. Northwestern Calif., B. C. ..... *uliginosus* n. sp.

10. Black with black pubescence, third antennal segment smaller than fourth, pronotum densely punctured, hind angles short, divergent and blunt at apex, elytral striæ fine and well impressed, intervals rather densely punctured; length 12 mm. Calif. ..... *obscurus* (Lec.)

11. Much elongated and narrow species, third antennal segment almost as long or as long as fourth, intermediate segments fully as long as broad and generally with sides somewhat parallel 12

Species smaller and but moderately elongate and narrow, third antennal segment triangular and quite similar in size and shape to fourth, intermediate segments somewhat serrate but not twice as long as broad 32

12. Narrow and very elongate species, antennæ in males extending several segments behind hind angles of prothorax 13

Species generally larger, flatter, and broader, the antennæ in males shorter, rarely extending more than a segment and a half behind hind angles of prothorax 30

13. Upper surface more or less unicolorous, black or brown 14

Upper surface bicolored, elytra vittate or of contrasting color to head and prothorax 25

14. Surface conspicuously clothed with closely appressed pile producing a pruinose appearance 15

Surface less evidently pilose or quite glabrous 17

15. Pronotum evenly convex from side to side, not flattened laterally, coarsely, densely punctured, distinctly canaliculate; color black, somewhat subnetallic; length 13-20 mm. B. C. to Mts. of northern Calif. and Sierra ..... *silvaticus* n. sp.

Pronotum convex at middle, flattened or deplanate laterally ... 16

16. Flattened or but slightly convex, pronotum rather sparsely punctured at middle, densely at sides, not evidently canaliculate, color black, somewhat submetallic, or testaceous, all antennal segments beyond second at least a third longer than broad, prothorax gradually narrowed forwards from hind angles, elytral intervals but slightly convex, punctured and shining; length 13-20 mm. B. C. to northern Calif. . *protractus* (Lec.)

Distinctly convex, brown with head and prothorax darker, fourth antennal segment but little longer than broad, prothorax less narrowed in front, almost as broad just back of apex as in front of hind angles, elytral intervals convex, punctate-rugose and dull; length 15-16 mm. Central Calif. ... *aplastoides* n. sp.

17. Black or slightly bronzed species, with or without rufous legs.. 18

Brown or reddish brown species 22

18. Large and shining, coal black species, the pile fine and black, prothorax distinctly narrowed anteriorly and not evidently canaliculate 19

Moderate sized species, 14 mm. in length or less, upper surface less shining, sparsely clothed with gray hair, prothorax elongate, subparallel in front or spatulate, rather suddenly narrowed near front angles, and distinctly canaliculate.... 20

19. Prothorax with sides almost straight and divergent backwards, disk coarsely, sparsely punctured at middle, densely at sides, elytral intervals flat and rather coarsely punctured; length 16-19 mm. (Closely related to *protractus* but coal black, subglabrous and generally more robust.) Northwestern coastal counties of Calif. ..... *anthrax* (Lec.)

Prothorax with sides distinctly arcuate, disk finely and densely punctured throughout, elytral intervals convex and finely, rather densely punctured; length 18-25 mm. (Has the facies of *volitans* but with longer antennæ.) Middle Sierra of Calif. ..... *atlas* n. sp.

20. Entirely black, pronotum coarsely, densely and evenly punctured, elytral intervals rather finely punctured; length 11-15 mm. Northern Calif. especially near coast ..... *dolorosus* n. sp.

Bicolored species 21

21. Black or slightly bronzed with red legs, pronotum more finely punctured at middle, more coarsely at sides, elytral intervals more coarsely punctured; length 13-15 mm. Northeastern States ..... *fulvipes* (Bland)

Plumbeous black, elytra ochraceous yellow, base and underside of first antennal segment, mandibles, labrum and prosternal lobe rufous, anterior angles of prothorax narrowly and obscurely rufescent, hind angles and narrow marginal band and legs rufotestaceous. Similar to preceding except for color and more elongate and parallel-sided prothorax, more rounded anterior angles, more divaricate hind angles, and wider elytra; length 13.5 mm. Schoharie, N. Y. ..... *exilis* Notman

22. Prothorax somewhat flattened or deplanate laterally, the side margins almost straight and gradually divergent backwards, outer margin of hind angles hardly more divergent, elytra evidently broader than prothorax at hind angles..... 23

Prothorax with disk more evenly convex, barely flattened laterally, the sides almost straight or slightly arcuate and quite parallel, the hind angles distinctly more divergent than side margins, elytra barely broader than prothorax at hind angles 24

23. Species 15 mm. or more in length, antennæ in males narrow and quite filiform, fourth segment almost as long as broad and about equal to fifth in length, hind angles of prothorax long and rather acute, the disk finely, sparsely punctured at middle, more densely at sides; length 18-23 mm. Eastern North America..... *pyrrhos* (Hbst.)

Species 14-15 mm. in length, antennæ in males more robust, fourth segment about one and a half times as long as broad and three-fourths length of fifth, hind angles of prothorax broad and more or less auriculate, disk coarsely, moderately closely punctured; length 14 mm. Middle Sierra of Calif.. *macer* (Fall)

24. Antennæ in males narrow and filiform, segments 3-5 but little broader than the almost cylindrical ones that follow, disk of prothorax rather finely, moderately closely punctured, hind angles narrow and sharp; length 13-14 mm. Middle Sierra and northern Calif..... *tenellus* n. sp.

Antennæ in males more robust and noticeably serrate, segments 3-5 evidently broader than those that follow, disk of prothorax umbilicately and closely punctured, hind angles broad and acute; length 9-16 mm. (Superficially looks much like an *Aplastus*.) Coastal area of southwestern Ore. and northern Calif..... *jaculus* (Lec.)

25. Elytra vittate..... 26

Elytra and legs orange red, the head and prothorax black with æneous lustre..... 29

26. Prothorax black with hind angles alone flavous..... 27

Prothorax black with sides and sometimes median vitta flavous.. 28

27. Prothorax fully 4 mm. in length and with disk finely, not closely punctured, antennæ in males reaching middle of elytra or beyond, elytra with flavous vittæ extending laterally from second to seventh striæ, epipleuræ also flavous; length 13-14 mm. Southern Appalachian Mts..... *horni* O. Schw.

Prothorax but little more than 3 mm. in length and with disk more coarsely and closely punctured, antennæ in male not reaching beyond basal third of elytra, elytra marked as in preceding species; length 12.5 mm. Southern Ore.... *patricius* n. sp.

28. Prothorax with broad yellow vitta close to side margins, elytra with yellow vittæ the breadth at most of from fourth to seventh striæ, epipleuræ and suture also yellowish; length 14 mm. Northern coastal counties of Calif..... *linearis* (Fall)

Prothorax with narrow median as well as lateral vittæ, sometimes reduced, hind angles very acute, each elytron with two three-intervals wide yellow vittæ, separated by a one-interval wide darker stripe; length 10 mm. Middle and western States ..... *bivittatus* (Melsh.)

29. Head and pronotum finely (or coarsely in female) densely punctured, clothed with rather coarse fulvous pile, prothorax convex with hind angles distinctly produced but blunt at apex, elytra finely striato-punctate with flattened and finely punctured intervals; length 10-12 mm. Female suggestive of a small bicolored *fraternus*. Southwestern Ore. and northwestern Calif. ..... *humboldti* n. sp.

30. Prothorax as broad as long, very finely and rather closely punctured, a distinct incisure just within base of hind angles. Elytra finely and shallowly striate, intervals flat or barely convex, both striæ and intervals very finely punctured, light rufous, disk of pronotum sometimes piceous, and rather densely clothed with very short, fine pile; length 16-18 mm. Middle Sierra of Calif. ..... *trunculentus* Cand.

Prothorax longer than broad, pronotum rather coarsely and closely punctured, especially at sides 31

31. Upper surface entirely piceous to piceous or rufous with sides or hind angles of prothorax lighter in color than disk, never with prothorax entirely piceous or black above and the elytra rufous; length 12-18 mm. Southeastern Alaska to Maine, Allegheny Mts., northern Rocky Mts., and Sierra Nevadas of Calif. ..... *volitans* Esch.

Upper surface with pronotum entirely black and elytra entirely red ..... *rufipennis* (Fall)

32. Species moderately convex or somewhat flattened, with hind angles of prothorax rather short, broad at base, divergent and blunt at apices 33

Species more generally convex and with hind angles narrower and more acute 34

33. Pronotum coarsely, densely punctured, hind angles not carinate or with only the faintest indication of carina and flattened; length 10-13 mm. Alaska to Maine and especially throughout Pacific Coast ..... *lobatus* Esch.

Pronotum finely, sparsely punctured, hind angles less divergent and with fine though distinct carina, elliptical in front of hind angles, black, shining and with legs piceotestaceous; length 10.5 mm. New Brunswick to Appalachian Mts. .... *elongaticollis* (Ham.)

34. Elytra piceous or somewhat bronzed 35

Elytra more or less fulvous or reddish 37

35. Subcylindrical, piceous black with apex and sides of prothorax, epipleuræ, legs and antennæ more or less rufous; length 10-14 mm. Middle Sierra of Calif. ..... *tahoënsis* n. sp.

Aeneous or bronzed species 36

36. Larger, quite convex, a violet bronze, the basal segments of antennæ, epipleuræ posteriorly and legs somewhat rufous; length 13 mm. Atlantic States, chiefly north and in mountains ..... *atropurpureus* (Melsh.)

Smaller, but moderately convex, æneous and shining though quite pilose, the apex and hind angles of prothorax, suture and sides of elytra, antennæ, mouthparts and legs more or less rufous; length 4-6 mm. Dak., Man. and Alta ..... *limoniiformis* (Horn)

37. Rather small and narrow species, the front sulcate, opaque, piceous, the elytra, tibiæ and tarsi generally more or less fulvous and rather conspicuously and evenly clothed with fulvous pile; length 8-10 mm. Pacific States ..... *opaculus* (Lec.)

Somewhat larger and broader species 38

38. Smooth and shining, side margins of prothorax more or less evenly arcuate and divergent to apices of hind angles of prothorax, color piceous with apex and sides of prothorax, above and below, rufous, the elytra yellow with black markings along suture, obliquely from humeri, at middle of disk and towards apex; length 11-12 mm. Lake States to Nova Scotia and Maine ..... *appressus* (Rand.)

39. Third antennal segment short, equal to second or barely longer, fourth always much longer 40

Third antennal segment somewhat cylindrical, always evidently longer than second, sometimes quite long, as long as fourth or even slightly longer 44

40. Rather large and elongate species, 12 mm. or more in length ... 41

Smaller and shorter species, not over 8 mm. in length 43

41. Median antennal segments quite serrate and hardly one and a half times as long as broad, entirely æneous or with rufous elytra, pronotum deeply, often closely, somewhat cribrately punctured, elytra with both striæ and intervals distinctly punctured, general surface quite pubescent; length 13-15 mm. Southeastern Alaska and south along Cascades to Mt. Hood, Ore. ..... *angusticollis* (Mann.)

Median antennal segments more elongate, twice as long as broad or longer 42

42. Black with rufous elytra, outer antennal segments fully twice as long as broad, the median segments barely so, pronotum finely, closely punctured, the hind angles sharp and quite divergent, elytra with striæ shallow and finely, not distinctly punctured, the intervals rather finely but not sharply punctured; length 12-15 mm. Southeastern Alaska to high altitudes of Cascades and Sierra Nevadas.....*sagitticollis* (Esch.)

Rufotestaceous throughout, fourth and following antennal segments long and narrow, from two to three times as long as broad, pronotum finely, rather closely punctured, side margin almost straight and divergent to apex of hind angles, elytra finely striate, the strial punctures very fine and more or less indistinct, the intervals flattened and finely, closely yet shallowly punctured; length 16 mm. Mt. Rainier, Wash.....*rainieri* n. sp.

43. Piceous with rufotestaceous pronotum and propleuræ, and yellow elytra, the pronotum with a narrow V-shaped black marking extending forwards from the middle of the base and the elytra with a black diamond shaped patch at the apex, the basal segments of antennæ and tibiæ and tarsi pale, the outer segments of antennæ but slightly serrate, and the prothorax elongate, somewhat spatulate and rather finely but not closely punctured; length 8 mm. Siskiyou Co., Calif.....*nunenmacheri* n. sp.

Black with yellow elytra except for black suture, the third antennal segment distinctly longer than second, the second and third together longer than fourth, the outer segments but slightly serrate, prothorax as broad as long, somewhat flattened and æneous, and finely, rather closely punctured; length 7 mm. Lake Superior region to Rocky Mts. and north to Alaska.....*ochreipennis* (Lec.)

44. Species more or less elongate and subcylindrical, prothorax as long or longer than broad, hind angles distinctly prolonged and finely carinate, antennæ variable as to length, third segment shorter than fourth or barely equal to it, the median segments always much longer than broad..... 45

Species broader and generally flatter, prothorax as broad or broader than long, hind angles broad at base, antennæ generally short, rarely reaching beyond hind angles of prothorax, third segment long, often longer than fourth..... 60

45. Third antennal segment always distinctly shorter than fourth.. 46

Third antennal segment almost or quite equal to fourth in length 48

46. Elytra rufous, testaceous, or light brown in color..... 47

Elytra black, each elytron with a broad discal and narrow marginal flavous vitta, the pronotum with large median discal

area and margins black, the remainder red, antennæ robust, reaching to end of basal third of elytra, second segment transverse, third three-fourths length of fourth and subcylindrical, fourth to tenth dilated and serrate; length 13-15 mm. Southern Alleghenies..... *trivittatus* (Lec.)

47. Head and pronotal disk black, the sides of pronotum and elytra rufous, surface conspicuously clothed with coarse pile, the prothorax subparallel at sides, the striæ of elytra rather coarsely punctured, antennæ delicate, third segment about three-fourths length of fourth and but little dilated apically, fourth to third moderately serrate; length 10 mm. Northern Calif..... *shastensis* n. sp.

Head and median portion of pronotum more or less piceous, the remainder of upper surface varying from reddish brown to castaneous, surface rather sparsely clothed with short and fine hair, prothorax somewhat arcuate at sides and with divergent and prominent hind angles, elytral striæ fine and finely punctured, antennæ delicate, third segment three-fourths length of fourth and but slightly serrate; length 10-12 mm. Appalachian Mts. and from Maine to eastern B. C. and north..... *insidiosus* (Lec.)

48. Prothorax somewhat quadrilateral, as broad anteriorly as posteriorly, rufous or rufopiceous, antennæ short, not reaching hind angles of prothorax..... 59

Prothorax always definitely narrowed in front, antennæ reaching close to hind angles of prothorax or beyond..... 49

49. Elytra somewhat rufous or flavous, not metallic..... 50

Upper surface either brilliantly metallic or with evident bronze lustre..... 51

50. Moderately convex, conspicuously clothed with fine gray or slightly fulvous pile, head and prothorax black, the lateral margins of latter in female rufous, coarsely, deeply and rather closely punctured, pronotum deeply canaliculate posteriorly, elytra rufous, distinctly punctate-striate, somewhat coarsely so in female, legs rufotestaceous; length 11-15 mm. Lagunitas, Marin Co., Calif..... *blaisdelli* n. sp.

A small species, somewhat flattened, sparsely clothed with fine fulvous pile, head and prothorax black, the anterior and posterior angles of latter as well as basal segment of antennæ testaceous, head and pronotum rather finely, moderately closely punctured, the pronotum sometimes finely canaliculate posteriorly, elytra testaceous (in one phase piceous), sutural interval sometimes rufous, finely striato-punctate, legs more or less testaceous; length 8-10 mm. Eastern Canada to B. C. and south through Cascades and Sierra Nevadas..... *falsificus* (Lec.)

51. Elongate and subcylindrical species with a slight coppery or metallic lustre..... 52

More flattened and less subcylindrical species, either brilliantly metallic or piceous with but faint bronze sheen..... 55

52. Smaller species averaging 10 mm. in length, third antennal segment slightly shorter in general than fourth..... 53

Larger species, 12 mm. or more in length, third antennal segment generally equal to fourth in length..... 54

53. More or less uniformly piceous, the upper surface faintly though evidently bronzed and clothed with fine pubescence, the latter not concealing the sculpturing of elytra, elytral intervals very finely, inconspicuously punctured; length 10 mm. Yukon Valley, Alaska to Great Lakes.....*mendax* (Lec.)

Piceous with distinct coppery lustre above, the legs, basal segment of antennæ and often margins of elytra reddish yellow, surface above clothed with rather coarse pile often partly concealing elytral sculpturing, elytral intervals rather conspicuously punctured; length 10-12 mm. Western foothills of Sierra Nevada Mts., Calif. and northwest into Ore.....
.....*monticola* (Horn)

54. Prothorax and elytra slightly arcuate at sides, pronotum æneous, rather coarsely, closely punctured, canaliculation deep and at base, elytra with marked cupreous lustre, the intervals finely punctured, legs and epipleuræ somewhat rufous; length 13-15 mm. B. C. to Ore. west of Cascade Mts..*furtivus* (Lec.)

Prothorax and elytra more parallel, pronotum piceous with faint æneous lustre, anterior margin and hind angles rufous, punctures moderately fine, canaliculation generally extending forward to apex, elytra rufopiceous with faint cupreous lustre, the suture and margins rufous, the intervals rather coarsely punctured, somewhat rugose, legs rufous; length 12-16 mm. Eastern North America.....*cylindriformis* (Hbst.)

55. Brilliantly metallic species..... 56

Species more or less piceous or rufopiceous and with only faint metallic lustre..... 58

56. Pronotum sparsely, finely punctured on disk, third segment of antennæ slightly shorter than fourth..... 57

Pronotum coarsely, closely punctured over entire surface and fully as long, including hind angles, as broad, third segment of antennæ fully as long as fourth, color varying from brilliant green to deep copper; length 14 mm. Alaska to Great Lakes and Mts. of northeastern States, Rocky Mts., Cascade and Sierra Nevada Mts.....*resplendens* (Esch.)

57. Upper surface clothed with fine, sparse pile, pronotum fully as long as broad, with sides more or less straight and convergent in front and distinctly sinuate in front of hind angles, color varying from æneous to a rich copper; length 13 mm. High Mts. of N. C. to Catskills of N. Y. ..... *appalachius* n. sp.

Upper surface quite glabrous, pronotum somewhat wider than long, sides broadly arcuate in front and almost parallel until just before hind angles, color generally a brilliant green; length 11 mm. Mts. of B. C. to Mt. Rainier, Wash. .. *weidti* (Angell)

58. Piceous, slightly bronzed, hind angles of prothorax and small irregular area near elytral apices testaceous, prothorax slightly longer than broad, disk with coarse, closely placed umbilicate punctures; length 12 mm. Va. ..... *copei* (Horn)

Rufopiceous, faintly bronzed and more or less clothed with fulvous pile, prothorax about as long as broad in males and with sides straight and convergent forwards, broader in females and with sides rather broadly arcuate, disk rather coarsely, closely punctured in males, more finely and sparsely in females, elytral striæ coarsely punctured, intervals flat in males, and rather definitely punctured, quite convex in females and very finely punctured; length 10-12 mm. Allegheny Mts. ..... *divaricatus* (Lec.)

59. Prothorax definitely longer than broad, gradually broadened forwards until near anterior angles, disk with canaliculation at middle deep and complete, elytral intervals just perceptibly punctured; length 17 mm. Atlantic States. .... *sulcicollis* (Say)

Prothorax just perceptibly longer than broad, broadest about middle, disk with canaliculation defined only in basal half, elytral intervals rather finely yet distinctly punctured; length 14 mm. Vanc. Is. inland through Great Basin to Ariz. ....
..... *rupestris* (Germ.)

60. Hind angles of prothorax prominent, elongated, more or less subacute at apex and with well defined carinæ, species in general glabrous or at most not densely pilose. 61

Hind angles of prothorax in most cases broad, short and truncate or very blunt at apex and with fine or poorly defined carinæ, species in general clothed with a dense closely applied pile and, except in *planus*, with elytra more or less yellow. 77

61. Species clothed with a coarse yet not very dense pile. 62

Species almost glabrous, the pubescence at most very fine and sparse. 65

62. Elongate species, over three times as long as broad. 63

Shorter and broader species, barely three times as long as broad at most. 64

63. Piceous or black, epipleuræ and legs somewhat rufous, pile fulvous, antennal segments 4-6 strongly dilated, the following gradually narrower and more elongate, pronotum coarsely, densely punctured, elytral striæ deep but rather finely punctured, the intervals very definitely punctured; length 12 mm. Central Calif. to eastern Wash. and B. C. ..... *fusculus* (Lec.)

Rufopiceous or piceous, the elytra varying from flavous with suture, a short vitta extending backwards from humeri and subapical patch, black, to almost entirely black, antennæ and pronotum as in preceding species. Elytral striæ rather deep and coarsely punctured, the intervals conspicuously punctured but less evident than in *fusculus;* length 11-16 mm. Colorado and coastal areas of Pacific Coast from middle Calif. to B. C. ..... *semivittatus* (Say)

64. Piceous generally with slight æneous lustre, legs and epipleuræ often somewhat reddish, intermediate antennal segments moderately dilated, elytral striæ well impressed and finely punctured, the intervals finely, rather densely punctured; length 8-12 mm. The northern U. S. and southern Canada from the Atlantic to the Pacific..... *inflatus* (Say)

65. Prothorax very broad, as broad or broader than long, but slightly convex and densely punctured at least at sides where punctation is generally approximate or even confluent..... 66

Prothorax less broad, more convex and less densely punctured.. 71

66. Species not metallic or with but a slight metallic gloss..... 67

Species with elytra or entire upper surface brilliantly metallic.. 70

67. Third antennal segment not quite as long as fourth, segments 4-11 all considerably longer than broad, and antennæ as a whole reaching beyond hind angles of prothorax, pronotum very coarsely, densely punctured, hind angles rather abruptly divergent, scutellum rather sparsely pubescent, elytra deeply striate, striæ moderately finely closely punctured, intervals finely punctured and sometimes finely rugulose, entirely black or rarely reddish near lateral margin; length 13-15 mm. Yukon Valley, Alaska, eastern B. C., Alta. to Mt. Rainier, Wash..... *morulus* (Lec.)

Third antennal segment fully as long or longer than fourth.... 68

68. Median antennal segments but little longer than broad, pronotum varying from rather dense to somewhat sparse punctation, hind angles prominent but short and blunt at apex, scutellum densely clothed with gray pubescence, elytra with striæ moderately impressed and rather coarsely, densely punctured, the intervals convex and finely punctured, entire upper surface shining, pubescence hardly evident, color of upper sur-

face varying from yellow or straw color, with prothoracic disk and margins, the elytral suture, an elongate humeral vitta and transverse postmedian spot, black, to entirely black; length 11-15 mm. The more northern parts of the U. S., most of Can., the northern Rocky Mts. and the Cascade and Sierra Nevada Mts., also northern Europe and Asia..... *crucialus* (Linn.)

Median antennal segments much longer than broad, hind angles of prothorax long and prominent, scutellum rather sparsely clothed with gray pubescence, the punctures of elytral striæ fine, hardly coarser than those of intervals, the upper surface in general less shining because of the more evident pubescence..... 69

69. Upper surface generally moderately shining, the pubescence at most fine and sparse, prothorax broader than long, with sides distinctly arcuate, somewhat rapidly narrowed in front, the disk rather coarsely, closely punctured even at middle, entirely black or with sides of prothorax red; length 13-16 mm., western Ore. and northern Calif..... *carbo* (Lec.)

Upper surface rather dull and pruinose as a result of rather definite though fine pubescence over entire area, prothorax about as broad as long, the sides but slightly arcuate and gradually narrowing forwards, the disk coarsely punctured at sides but rather finely and sparsely so at middle, always dull black; length 12-16 mm. The more northern parts of Great Basin from Wasatch to Sierra Nevada Mts.. *pruininus* (Horn)

70. Elytra alone brilliantly metallic, ranging from green to a violet bronze, head and pronotum a dull black and latter always much broader than long at middle, elytral striæ rather finely punctured; length 9-20 mm., average 13 mm. Entire northern part of continent, the Rocky, Cascade and Sierra Nevada Mts..... *æreipennis* (Kirby)

Head and prothorax as well as elytra a coppery bronze, prothorax about as broad as long at middle, elytral striæ rather coarsely punctured; length 10-11 mm. Northeastern States ..... *splendens* (Zeigl.)

71. All antennal segments beyond third more or less evidently longer than broad, the antennæ either reaching hind angles of prothorax or beyond..... 72

Fifth and sixth or following antennal segments, more or less transverse, but little longer than broad, the antennæ not reaching or barely reaching the hind angles of prothorax.. 75

72. Species somewhat elongate, black or black with fulvous markings, and quite shining, legs generally dark in color..... 73

Species blunter and shorter, upper surface in the main piceous or black with æneous or submetallic lustre, the antennæ, legs, epipleuræ and often other portions of body beneath more or less rufous..... 74

73. Larger species, 13 mm. or over in length, pronotum and elytra quite glabrous, prothorax about as broad across middle as at apices of hind angles, the punctures at middle of disk generally fine and not closely placed, elytra with striæ well impressed and distinctly punctured, the intervals convex and minutely punctured, color varying from entirely black to black with elytra maculated with yellow (typical form), the yellow markings in the form of an irregular lunule extending from the outside of humerus to near the suture at the middle and a more or less transverse post median blotch; length 13-17 mm. Western B. C. south to Willamette Valley, Ore..... *suckleyi* (Lec.)

Smaller species 12 mm. or less in length, pronotum and elytra rather sparsely but evidently clothed with fine gray or fulvous pile, prothorax narrower at middle than at hind angles, punctures of disk fine or moderately coarse, elytra with striæ finely or moderately impressed and finely to coarsely punctured, the intervals flat or slightly convex, color varying from all black to black with yellow markings, the latter sometimes on sides of prothorax though generally confined to elytra where there is a marginal vitta and an irregular discal vitta, the latter dilated at base, at middle where it sometimes divides the black sutural and lateral vittæ, and subapically; length 8-12 mm. Extends from western B. C. to northern Calif. and through northern Great Basin to Wasatch Mts. of Utah..... *leucaspis* Germ.

74. Prothorax with sides rather broadly rounded to apex, hind angles short and blunt at apex, the elytral striæ well impressed and intervals convex towards base, the upper surface æneous, the prothorax with apical margin and hind angles rufous, beneath the lobe of prosternum, propleuræ, epipleuræ, legs and much of abdomen rufous; length 11 mm. Eastern Can. and northeastern States..... *aratus* (Lec.)

Prothorax with sides rapidly narrowing from middle to apex, hind angles rather long and subacute, the elytral striæ finely impressed except close to base and intervals generally quite flat, the upper surface rather uniformly black or æneous, the hind angles of prothorax at most faintly reddish, beneath with prosternal lobe, epipleuræ and legs reddish; length 10-12 mm. Manitoba and Great Lakes to Maine as well as northern Europe and northern Asia..... *metallicus* (Payk.)

75. Large species, 15 mm. or more in length, the antennæ about reaching hind angles of prothorax in males, the median segments broadly triangular and almost as broad as long, pronotum evenly and distinctly but not closely punctured on disk, elytra at base with striæ well impressed and intervals slightly convex, apically the striæ more finely impressed and intervals flat, striæ and intervals evidently punctured, coal black and shining; length 15-25 mm. Atlantic States. *æthiops* (Hbst.)

Smaller species, 14 mm. or less in length, the antennæ never reaching hind angles of prothorax..... 76

76. Hind angles of prothorax broad at base and more or less directed backwards, elytral intervals somewhat convex and conspicuously punctured, upper surface finely, sparsely pilose and dull, color ranging from all black to black with reddish antennæ and legs, epipleuræ and prothorax; length 11-13 mm. Ore. and Calif..... *conjungens* (Lec.)

Hind angles of prothorax not broadly triangular but peg-like and rather suddenly divergent, elytral intervals flattened or barely convex and minutely punctured, upper surface somewhat smooth and shining, color ranging from all black to black with lateral margins or all of prothorax red; length 10-13 mm. Atlantic States and Pacific States.... *rotundicollis* (Say)

77. Hind angles of prothorax with more or less evident carinæ..... 78

Hind angles of prothorax without clearly defined carinæ..... 86

78. Entire body black, antennæ and legs sometimes rufous, pile fine, short and not dense, not concealing the sculpturing, antennæ extending beyond hind angles of prothorax and with segments 4-10 markedly serrate, a smooth longitudinal line at middle of pronotum and carinæ of hind angles evident but not distinctly defined; length 11 mm. Colo..... *planus* (Lec.)

Body more or less bicolored..... 79

79. Head and entire pronotum as well as underside black, the elytra rufous or bicolored..... 80

Prothorax brown or rufous or at least with hind angles light, the elytra orange or bicolored..... 83

80. Elytra entirely rufous or orange, in *fallax* occasionally piceous, carinæ distinct and well separated from margin..... 81

Elytra bicolored..... 82

81. Pile of upper surface rather long and fulvous, variously directed on both pronotum and elytra so as to form a distinct pattern, the elytra so minutely and closely punctured that it appears granular, legs generally piceous though tibiæ and tarsi or tarsi alone somewhat rufous; length 9-13 mm. Entire northern part of continent..... *fallax* (Say)

Pile of upper surface shorter and less dense though fulvous, the sculpturing beneath more evident, no distinctive pattern formed by pile on elytra, elytra finely and closely punctured but not granular, legs reddish yellow; length 9-12 mm. Eastern Canada and northeastern States.....*medianus* (Germ.)

82. Antennæ long, extending well beyond hind angles of prothorax, the intermediate segments much longer than broad, prothorax more elongate than usual in the group, gradually narrowing from middle to apex, elytra with striæ well impressed and rather coarsely punctured, orange yellow with a broad oblique black band in front of middle, not reaching sides or suture and another triangular black area posterior to middle, legs somewhat rufous; length 10-12 mm. Lake States to B. C., Colo. and northeastern Calif.....*nigricollis* (Bland)

Antennæ short, barely reaching hind angles of prothorax in males, the intermediate segments hardly longer than broad, prothorax broad and well rounded at middle, rather suddenly narrowed before apex, elytra much flattened, with striæ finely impressed and finely punctured, orange yellow with apical region more or less piceous, the upper surface rather densely clothed with fulvous pile, variously directed so as to form a distinctive design as in *fallax*, antennæ and legs black, the tarsi rufous; length 7-9 mm. The middle Sierra Nevada Mts. of Calif.....*candezei* Leng

83. Species broad and flat with unicolored elytra, the head and prothorax brown or sometimes piceous, elytra short, barely reaching hind angles of prothorax, the intermediate segments but slightly longer than broad, prothorax very broad at middle, sides conspicuously arcuate, suddenly narrowed to apex and to base of hind angles, the hind angles short but triangular, abruptly divergent and apically elevated, elytra with striæ finely impressed and rather indistinctly punctured, orange in color, the upper surface densely clothed with conspicuous orange pile, variously directed so as to form a distinctive design, underside black, the tibiæ and tarsi rufous; length 8 mm. Middle and southern Sierra of Calif.....*mirabilis* (Fall)

Species more or less elongate, somewhat convex and elytra bicolored..... 84

84. Prothorax black or piceous with hind angles reddish yellow.... 85

Entire prothorax a reddish brown, quite convex, the sides gradually narrowed from before middle to apex, hind angles prominent, elytra with striæ evidently impressed and moderately coarsely punctured, straw yellow with a triangular or hooked dark brown maculation on apical third, the pile on upper

surface fulvous, short and not dense, antennæ, legs and entire under surface rufous; length 9-11 mm. Atlantic States..... *hamatus* (Say)

85. Prothorax piceous, bronzed and with hind angles reddish, moderately prolonged, and with carinæ parallel to lateral margins, elytra yellow with striæ well impressed and finely punctured, ornamented with short humeral lunules, elongate triangular black markings on second and third intervals before middle and posteriorly with an irregular hooked marking with long arm close to suture and a transverse hook directed outwardly and backwards just behind middle, antennæ, legs, prosternal lobe and propleuræ rufous, the remainder of underside piceous; length 11-13 mm. Eastern North America..... *hieroglyphicus* (Say)

Posterior angles of prothorax, legs and apical area of abdomen rufous, the head, antennæ as a rule, and remainder of prothorax and underside of body black, prothorax moderately convex, sides arcuate and gradually narrowing to apex, the hind angles short, decidedly truncate at apex and with carinæ sometimes distinct, at other times obscure, but parallel to margin, elytra orange yellow with striæ finely impressed and finely punctured, the intervals quite flat, the black markings somewhat similar to those of preceding species but in general much reduced, especially in the large western forms, to a posthumeral spot, a spot on second interval internal to the preceding and often united with it, and a transverse postmedian lunule, with concavity directed backwards; length 9-14 mm. Northern parts of country from Maine and Nova Scotia to Pacific, the Rocky, Cascade, and Sierra Nevada Mts..... *propola* (Lec.)

86. Prothorax fully as long at middle as broad..... 88

Prothorax broader than long at middle..... 87

87. Entire body black except elytra, prothorax with sides arcuate and narrowed from before middle to apex, hind angles moderately prolonged with carinæ sometimes faintly indicated, the elytra with striæ very finely impressed, sometimes obliterated on disk and finely punctured, orange yellow, with a subbasal black spot on second, third and fourth intervals, a large common black W-shaped marking slightly behind middle, sometimes broken at suture, and the apices often tipped with black; length 9-10 mm. The middle Sierra Nevada Mts. of Calif..... *exclamationis* (Fall)

Entire body black except elytra, prothorax with sides evenly arcuate, hind angles short, carinæ sometimes vaguely indicated, elytra with striæ finely impressed and finely punc-

tured, yellow or reddish orange with two transverse zigzag black markings, one midway between base and middle, the second at middle, and a black lunule or triangular area near apex; length 8-12 mm. Northern parts of continent, Rocky, Cascade and Sierra Nevada Mts. ..... *triundulatus* (Rand.)

88. Entire body black except elytra, prothorax with sides evenly but not broadly arcuate, hind angles with outer margin much elevated and without trace of carinæ, disk shining even though sparsely clothed with fulvous pile like head and elytra, elytra narrow and somewhat pointed apically, of an orange yellow with apical area somewhat piceous, the striæ finely impressed and very finely punctured; length 9 mm. B. C., Yukon T., Mt. Rainier, Wash. ..... *hoppingi* n. sp.

89. Fourth antennal segment broader and generally longer than third segment, pronotum with punctures well separated on disk, densely placed at sides, sides of prothorax faintly sinuate in front of hind angles, thence arcuately convergent forwards, color varying from entirely piceous with æneous lustre to piceous with basal segments of antennæ, most of legs, epipleuræ and the following elytral markings, a basal spot, an oblique median and sub-apical bar, with narrow outer margin, yellow; length 5-9 mm. Alaska to Alta., Lab. and N. H. ..... *costalis* (Payk.)

Fourth antennal segment not or hardly broader than third and always of about the same length. 90

90. Pronotum with punctures well separated over entire area, somewhat similar to *costalis* but prothorax smaller, more compressed at center, sides more parallel, hind angles more divergent; length 6-7 mm. Lake States to N. H. and Me. ..... *estriatus* (Lec.)

Pronotum very finely, closely punctured throughout, the prothorax moderately robust, sides well rounded in front, almost parallel behind or slightly sinuate in front of hind angles, the latter slightly divergent, basal margin between angles almost transverse. Color much as in *costalis* but the colored females with only a triangular marginal spot behind the humerus instead of the oblique band; length 5-6.5 mm. Cascade Mts. from Mt. Rainier, Wash., to Mt. Hood, Ore. ..... *granicollis* n. sp

Ludius cribrosus (LeConte)

This well known species which ranges throughout much of western Oregon and California has been shown by careful field studies to be decidedly polymorphic, the male being the typical *cribrosus* and the female, larger, broader and flatter, the typical *maurus* (Lec.). In the southern Sierra Nevada Mountains, along with normal robust males and females are often to be found giant females. These are *colossus* (Lec.) and differ from ordinary females not only by being generally larger but by having a more shining appearance, the sides of prothorax more arcuate, and the elytral intervals absolutely flat, the usual well impressed striæ almost obliterated or indicated by very finely impressed lines. The *Corymbites rufipes* Mots., I believe to be but a variety of this species. I have several male specimens of *cribrosus* with rufous legs.

Ludius uliginosus Van Dyke, new species

Moderately elongate yet robust, entirely coal black except tarsal claws which are rufous, the head and prothorax sparsely clothed with a few curved hairs, the elytra with only minute and widely scattered hair. Head slightly convex, coarsely, cribrately punctured; antennæ barely reaching hind angles of prothorax in males, shorter in females, second segment short and transverse, third triangular, little longer than broad and fully as long as fourth, fourth to sixth triangular and almost as broad as long, the following gradually narrowed. Prothorax longer at middle than broad, hind angles robust, slightly diverging with well marked carinæ, sides oblique, though somewhat sinuous, and gradually converging from apices of hind angles to near apex, thence arcuate to apex; disk moderately convex and strongly, closely and at sides cribrately punctured, the margin narrow and poorly defined, canaliculation well defined at middle near base; scutellum elliptical and finely punctured and hairy posteriorly. Elytra almost three times as long as prothorax and over twice as long as broad, quite convex, disk with striæ deeply impressed and finely punctured, the intervals convex, distinctly punctured and very rugose. Beneath very coarsely, umbilicately punctured on prothorax, cribrately on propleuræ, finer and sparser on metasternum and still finer on abdomen though close at sides and on last adbominal segment. Male, length 13.5 mm., breadth 4 mm.; female, length 15 mm., breadth 5 mm.

Holotype: Male, No. 3164; and *Allotype:* Female, No. 3165, Mus. Calif. Acad. Sci., and several designated *Paratypes* from a series of thirty specimens collected by myself from the

bunch grass in a swamp near **Carrville, Trinity Co., Calif.,** June 6, 1913. I also have two specimens from Bon Accord, B. C., which differ only in having a slight bronzy lustre.

This very black and generally dull species superficially more closely resembles the common California *Megapenthes aterrimus* (Mots.) than it does any of the other members of its own genus. From the large black species of *Ludius* like *morulus* (Lec.) and *carbo* (Lec.), it can always be told by its more convex and gradually narrowed prothorax and quite rugose elytra as well as by the antennal peculiarities.

Ludius obscurus (LeConte)

The type is, I believe, the only known specimen of this species. I have several times examined it without being able to assign it, even as an eberrant specimen, to any other species.

Ludius silvaticus Van Dyke, new species

Elongate, narrowed in front and behind, upper surface but moderately convex, black, slightly shining, moderately clothed above with short silvery white pile, longer and denser beneath, giving the insect a plumbeous appearance, the larger females often submetallic and with a violet sheen, the legs sometimes rufous. Head slightly convex, coarsely rugosely punctured; antennæ long, reaching two segments beyond hind angles of prothorax in males, about reaching apex in females, second segment but little longer than broad, third twice as long, triangular, almost as wide or as wide at apex as fourth, the following elongate triangular and gradually narrowed. Prothorax distinctly longer than broad, hind angles long, narrow, blunt at apex and strongly diverging, less narrowed and less diverging in females, carinæ long and prominent, sides gradually narrowing, slightly arcuate at middle, more parallel in females; disk moderately convex, densely punctured, median canaliculation distinctly defined throughout, deeper behind. Elytra not quite three times as long as broad, subparallel in front, gradually narrowed apically, disk distinctly striate, the striæ finely, closely punctured, intervals slightly convex, rather densely punctured and slightly rugose. Beneath coarsely, densely punctured on propleuræ, more sparsely on prosternum and finely, densely on afterbody. Male, length 15 mm., breadth 4 mm.; female, length 19 mm., breadth 5 mm.

Holotype: Male, No. 3166; and *Allotype:* Female, No. 3167, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection, the first from **Fallen Leaf Lake, Lake Tahoe**

region, Calif., July 1, 1915, and the second from the Nash Mine, 6000 ft. alt., northern Trinity Co., Calif., June 14, 1913. This elongate, pruinose species is fairly common and widely distributed throughout the coniferous forests of the Pacific States. I have a large series including representatives from Moscow Mt., Idaho, Lake Quinault, Wash., Corvallis, Ore., and from numerous localities in the mountains of northern California and the Sierra Nevadas as far south as Fresno Co. It also varies greatly as to size, the females generally far larger and more robust.

This species somewhat resembles *Ludius protractus* (Lec.) but the latter has the prothorax more definitely cuneate, with the sides evidently deplanate, and without median canaliculation. It also closely resembles *Ludius fraternus* (Lec.) and is often listed as such but the latter has the prothorax slightly shorter, the median canaliculation vague at the most, and the third antennal segment but little longer than the second and the following segments more evidently bilaterally dilated. It is also to be found in a similar environment and in fact replaces *fraternus* in the more southern forests of the Pacific Coast.

Ludius protractus (LeConte)

This species is also widely distributed along the Pacific Coast but it is a species of the meadows. In British Columbia, Washington and Oregon, it is uniformly pruinose in color but in Shasta and Siskiyou counties of California, it often appears of a rufotestaceous color. This is the variety *jouteli* (Dow) and nothing more than a color phase. *Ludius anthrax* (Lec.) is also an offshoot of the same stock but it has diverged enough to warrant it being considered as a distinct species. It is in general broader, more robust, with longer and heavier antennæ, and very black and shining, the pubescence only evident under high magnification.

Ludius aplastoides Van Dyke, new species

Elongate, convex, rather blunt in front, somewhat narrowed behind, reddish brown, head and prothorax darker, generally black, and conspicuously but not densely clothed with fulvous pile. Head flattened or slightly sulcate, rather densely, coarsely punctured; antennæ long and robust, reaching three segments beyond hind angles of prothorax in male, second segment small, barely longer than broad, third large and triangular, twice as long as second and fully as long as fourth, the fourth almost as broad as long, the segments 5-10 gradually narrower, the tenth not quite twice as long as broad, and all distinctly serrate. Prothorax one-eighth longer at middle than broad, hind angles robust and triangular, acute, moderately diverging and finely carinate, sides feebly arcuate from base of hind angles to near apex; disk convex at middle, more or less depressed or flattened laterally, without median canaliculation and coarsely, rather densely punctured especially at sides. Elytra two and a half times as long as broad and two and a half times as long as prothorax at middle, sides barely arcuate at middle, gradually narrowing and rounded to apex, the disk convex, striæ well impressed and finely punctured, the intervals convex, finely punctured and distinctly, transversely rugose. Beneath coarsely, rather closely punctured in front, the propleuræ somewhat more closely than prosternum, and finely, rather closely punctured behind. Length 15-16 mm., breadth 4 mm.

Holotype: Male, No. 3168, Mus. Calif. Acad. Sci., and several *Paratypes* in my collection from a series of twenty-nine specimens collected by Mr. E. Zimmerman in the hills back of **Oakland, Calif.,** May 7-11, 1930. Several designated paratypes and the majority of the specimens remain in Mr. Zimmerman's collection. I also have a single specimen collected at Sebastopol, Sonoma Co., Calif., in July 1915, by Mr. Hora. All specimens examined seem to be males.

This species belongs in the key immediately after *protractus* Lec., from which it differs by being more convex and narrower, less narrowed both in front and behind, by being mostly brown in color instead of black (typical phase), the pile somewhat longer and more erect, the general surface less shining, the median segments of antennæ more robust, the prothorax more parallel, the hind angles shorter and less acute, and the elytral intervals conspicuously convex and rugose. Superficially it also looks much like the larger specimens of *jaculus* (Lec.), but differs by having far more robust antennæ, the disk of pronotum simply punctured, not punctured with coarse, umbilicate punctures, the hind angles of pro-

thorax triangular, not more or less auriculate, and the elytral intervals rather coarsely rugose. It is strange that such a large and conspicuous species should remain so long unknown in such a well collected region.

Ludius jaculus (LeConte)

Corymbites teres Lec. is nothing more than the female of this species, as I have found by a careful examination of the type. The males also vary considerably, both as regards size and length of prothorax and development of the hind prothoracic angles. The Oregon specimens are generally much larger and better developed in every regard than are those to be found in the San Francisco bay region.

Ludius atlas Van Dyke, new species

Elongate yet broad, quite flattened, black, shining; pubescence short, black, not evident except under magnification. Head flattened in front, moderately coarsely and densely punctured, antennæ extending two segments beyond hind angles of prothorax in males, just reaching apices in females, second segment small, slightly longer than broad, third twice as long, longer than fourth and fully as broad at apex, segments 3-10 elongate serrate, gradually diminishing in width towards apex. Prothorax a fourth longer than broad, hind angles triangular and conspicuously prolonged, blunt at apex, slightly divergent, carinæ long, narrow and somewhat divergent from sides, sides moderately sinuate in front of hind angles, arcuate towards middle and gradually narrowed forwards, lateral margin conspicuous, disk slightly convex, finely, rather densely punctured throughout and vaguely canaliculate at middle. Elytra two and three-fifths times as long as broad and as long as prothorax, subparallel in front, gradually narrowed from middle to apex, disk moderately convex, deeply striate and with striæ finely, closely punctured, intervals very convex, finely, rather densely punctured. Beneath coarsely, rather sparsely punctured on prosternum, finely and very densely on propleuræ and still more finely and quite closely on afterbody. Male, length 18 mm., breadth 5.25 mm., female, length 20 mm., breadth 6 mm.

Holotype: Male, No. 3169; and *Allotype:* Female, No. 3170, Mus. Calif. Acad. Sci., and two *Paratypes* in my collection, three including the first two, collected by myself at **Meadow Valley, Plumas Co., Calif.**, June 5, 3 and 6, 1924, the fourth collected on Red Mt., Nevada Co., Calif., July 3, 1911, by Dr.

C. Von Geldern. Other specimens in my collection are a male from Eldorado Co. and two large females, bearing simply the "Calif." label. One of the females is 25 mm. long and proportionally robust, superficially looking like a large *Ludius æthiops* (Herbst.). I have also examined several other specimens in the collection of the California Academy of Sciences.

This very large and coal black species, somewhat suggests *æthiops* as stated above, both because of its color and size. It is, however, more or less closely related to *Ludius volitans* Esch., as shown by its general facies though very easily separated from that, as from others associated with that, by the convex elytral intervals, greater width and coal black color. *Ludius anthrax* (Lec.) though often as large and of similar color, is much narrower, with heavier antennæ, and coarser pronotal punctation.

Ludius dolorosus Van Dyke, new species

Elongate, subparallel, moderately flattened, black, hardly shining, sparsely clothed with short cinereous pile. Head depressed in front, coarsely, densely punctured; antennæ reaching two segments beyond hind angles of prothorax in male, hardly reaching base of angles in female, second segment small, but little longer than broad, third fully twice as long, just perceptibly longer than fourth, segments 3-10 elongate serrate and gradually narrowing towards apex. Prothorax over one-fourth longer than broad, hind angles long, blunt at apex and strongly divergent, carinæ long, sharp and close to border, sides almost parallel from in front of hind angles to near apex where evenly rounded, slightly arcuate in females; disk flattened at middle, depressed towards sides, coarsely, closely punctured, cribrately and umbilicately at sides, distinctly canaliculate at middle, less evidently so in female. Elytra slightly more than twice as long as prothorax, subparallel in front, gradually narrowed posteriorly, striæ distinctly impressed, finely, closely punctured, intervals convex, moderately coarsely punctured and slightly rugose. Beneath coarsely, moderately closely punctured on prosternum, coarsely, very closely punctured on propleuræ, finely and closely punctured on afterbody.

Holotype: Male, No. 3171; and *Allotype:* Female, No. 3172, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection from a series of thirteen specimens. The first was collected in **Lagunitas Cañon, Marin Co., Calif.**, April 11, 1915, the second from Fallen Leaf Lake, Lake Tahoe region, Calif., June 20, 1915, and the others in Humboldt Co.,

Eldorado Co., Yosemite Valley, and various localities near San Francisco Bay.

This species is undoubtedly very closely related to *Ludius fulvipes* (Bland), differing from the same in the main by being slightly more robust, with antennal segments less dilated, the pronotum more coarsely punctured, the elytral intervals more convex and the legs generally black (piceous brown or red in rare cases). These two species with *exilis* Notman stand well apart from all others in our fauna. The new species has often been mistaken for *moerens* (Lec.) but a careful examination of the type of the latter has shown that it is but a subspecies of *lobatus* (Esch.) as I will more fully bring out when discussing that species.

Ludius tenellus Van Dyke, new species

Elongate, narrow, subparallel, reddish brown, clothed with short, sparse pile. Head broadly, shallowly sulcate in front, coarsely, densely punctured, eyes of male prominent; antennæ in male almost filiform, reaching beyond first third of elytra, second segment small, hardly longer than broad, third two and a half times as long, slightly broadened apically, segments 4-10 two to three times as long as broad, subparallel and gradually diminishing in breadth apically, female antennæ slightly more robust and just reaching beyond hind angles of prothorax, prothorax distinctly longer than broad, hind angles triangular, elongate, slightly divergent, carinæ fine, long, close to margin, sides almost straight and convergent forwards from base of hind angles, disk slightly convex, deplanate at sides especially posteriorly, coarsely, quite closely punctured, not evidently canaliculate at middle, the females with sides more parallel and disk more convex. Elytra over three times as long as prothorax and three times as long as broad, sides subparallel, gradually rounded to apex, disk finely striate, the striæ finely, closely punctured, intervals flat, finely, irregularly punctured and slightly rugose. Beneath moderately finely, not densely, punctured on prosternum, very densely on propleuræ and finely, rather closely punctured on afterbody. Length 13 mm., breadth 3.5 mm., females slightly broader and more generally robust.

Holotype: Male, No. 3173; and *Allotype:* Female, No. 3174, Mus. Calif. Acad. Sci., and three designated *Paratypes* from a series of seven specimens, the first collected at **Fallen Leaf Lake, Lake Tahoe region, Calif.,** July 13, 1909, the allotype at Meadow Valley, Plumas Co., Calif., June 19, 1924, the others from Fallen Leaf Lake, Humboldt Co., and Castella, Shasta Co., Calif.

This very narrow species which has somewhat the facies of *Athous brightwelli* (Kirby) belongs very near *Ludius macer* (Fall) but is slightly smaller, with less robust antennæ, shorter and less cuneate prothorax, and with hind angles subacute and slightly divergent, not broad and auriculate as in the latter.

Ludius patricius Van Dyke, new species

Elongate, narrow, subparallel, black, slightly æneous with hind angles of prothorax, a broad vitta extending from the second to seventh striæ and from base to apex of each elytron, the epipleuræ and legs pale luteous and sparsely clothed with very fine pale hair. Head slightly depressed in front, rather coarsely, closely punctured; antennæ long and narrow, reaching to end of basal third of elytra, second segment small, hardly longer than broad, third fully two and a half times as long, dilated at apex and almost equal in length to fourth, segments 3-10 elongate, serrate, gradually narrowing, the last four subparallel. Prothorax not quite a third longer than broad, hind angles broad, auriculate yet projecting well backwards, sides almost straight and but slightly convergent forwards; disk slightly convex, rather coarsely, closely punctured, not canaliculate at middle. Elytra almost three times as long as prothorax and over three times as long as broad, sides subparallel in front, gradually narrowed posteriorly, disk finely striate, the striæ rather coarsely, closely punctured and finely rugose. Beneath with prosternum rather finely, not closely punctured, propleuræ densely punctured, and the afterbody in general finely, rather closely punctured. Length 13 mm., breadth 2.75 mm.

Holotype: Male, No. 3175, Mus. Calif. Acad. Sci., a unique in my collection from **Stella, Wash.**, collected April 27, 1915.

This elegant species in facies and color pattern very closely resembles *Ludius horni* Schwarz but differs from that by being slightly shorter, with shorter and black antennæ instead of red, shorter and more coarsely punctured pronotum, and shorter elytra. From *Ludius linearis* (Fall); it differs in the main by having only the hind angles of prothorax luteous, the black sutural vitta of elytra narrower, and the sides of pronotum not flattened.

Ludius humboldti Van Dyke, new species

Elongate, narrowed in front and behind, black. Elytra, tibiæ and tarsi rufotestaceous, in the type male a slight darkening or infuscation near the suture, and rather conspicuously though not densely clothed with fulvous pile. Head slightly flattened in front, finely, sparsely punctured; antennæ long,

somewhat filiform, reaching to end of basal third of elytra, second segment small, little longer than broad, third about two and a half times as long and as long as fourth, segments 3-10 slightly serrate, gradually narrowed towards apex, the posterior segments subparallel. Prothorax slightly longer than broad, hind angles narrow and slightly divergent, carinæ rather fine, sides slightly arcuate at middle and narrowed forwards; disk somewhat convex and finely, moderately densely punctured. Elytra over three times as long as prothorax, finely striato-punctate, intervals flattened, and finely punctured. Beneath finely, rather sparsely punctured except propleuræ which are more coarsely, closely punctured. Length 10 mm., breadth 2.75 mm.

With this male, I have associated a female which I am confident is the opposite sex of the same species. It is somewhat larger, more generally convex and robust, with coarser pronotal punctation, and antennæ just reaching hind angles of prothorax. Length 12 mm., breadth 3.5 mm.

Holotype: Male, No. 3176; and *Allotype:* Female, No. 3177, Mus. Calif. Acad. Sci., the first collected by Mr. F. W. Nunenmacher at **Kirby, Josephine Co., Oregon,** June 11, 1910, the second from Humboldt Co., Calif. The species is no doubt characteristic of the cool and moist Humboldt region of California and the adjacent part of Oregon.

This rare species somewhat suggests a very small specimen of the bicolored phase of *Ludius fraternus* Lec. but has a very different type of antennæ; the male is also much narrower, more delicate and with longer antennæ, the female more robust.

Ludius truculentus Candeze

This very distinct though uncommon species has been collected only about Lake Tahoe, the Yosemite Valley and the middle Sierra Nevada generally. Though placed near *volitans,* it is generally larger, more densely pilose, with a much broader prothorax, and shorter, finer and more divergent hind angles.

Ludius volitans Eschscholtz

The typical phase of this species is found throughout southeastern Alaska, western British Columbia and southward at higher elevations along the Cascade Mountains of Washington

and Oregon. In the high Sierra Nevada Mountains they are apt to be of a brighter color, more or less orange and the males at times with a dark spot near the end of each elytron. The more northern phases vary considerably in color from the usual rufous with piceous head and prothorax, or prothorax without disk piceous, to an all piceous form. In Alberta, Manitoba and the adjacent parts of the United States, the specimens are generally piceous, with the prothorax less angulated at the sides and narrowed in front, as well as more convex. These gradually pass into the subspecies *spinosus* (Lec.) found abundantly about the Great Lakes and the country to the east. More or less associated with the typical form in southeastern Alaska is a phase that is quite piceous with the hind angles of the prothorax testaceous, the prothorax also quite spatulate and the hind angles very divergent. This is *umbricola* Esch. which I am at present unwilling to consider as more than a subspecies. It is most decidedly not related to *lobatus* Esch. as was indicated by Schwarz in Wytsman's Genera Insectorum. A simple reading of the original description would show that it is closely related to *volitans*. The rare *vulneratus* (Lec.) of Maine and the Allegheny Mountains, I also consider as but a subspecies of *volitans*. I collected a specimen on Mt. Mitchell, North Carolina, which has been carefully compared with LeConte's type. It is in shape much like a typical *volitans,* slightly narrower, of a piceous bronze color with the sides of prothorax and legs rufous.

Ludius lobatus Eschscholtz

This species has been misunderstood, perhaps, to a greater extent than have any of the other species of the genus. The typical *lobatus* was described from Unalaska, Alaska, where it is fairly common. It is plumbeous in color, rather robust and fairly convex. *Ludius caricinus* Germ. with Sitka as the type locality is perhaps a little less convex but otherwise so similar to *lobatus* that it cannot readily be distinguished, therefore is not worthy of being listed even as a subspecies. The form

lobatus extends from the Aleutian Islands, along the south side of the Alaska peninsula and throughout southeastern Alaska. In British Columbia, the specimens show a tendency to become flatter, narrower and more elongate and this form continues south through western Washington and Oregon and as far south as middle California where the most extreme forms are to be found. This was described as *moerens* Lec. and is so different that it should be listed as a subspecies even though in its territory fairly typical specimens of *lobatus,* particularly females, are to be found. In the San Francisco bay region, a form like *moerens* but somewhat blacker and with the base of the elytra orange is to be found. This is *xanthomus* Horn, little more than a color variety of *moerens.* From Plumas County, I have a series with the elytra entirely yellow, the extreme of the color tendency. In Alberta, Canada, and ranging eastward through Manitoba to New Brunswick and the Adirondack Mts. of New York, we have a small phase of *lobatus* which is moderately depressed, sometimes much like the less elongate forms of *moerens* in form and generally quite variable in color, plumbeous to forms with all yellow elytra. This depauperized form I am calling the subspecies **pygmæus** and designating as the holotype (No. 3178, Mus. Calif. Acad. Sci.), a piceous specimen from **Awene, Manitoba,** collected by Mr. E. Criddle. A similar colored paratype will also be designated. The well known *tarsalis* Melsh. of the northeastern part of America, I also consider as but a subspecies of the widely distributed and variable *lobatus.* This last mentioned form is more generally elongate than any of the forms except *moerens* and more convex than any except the typical *lobatus.* It is also very variable in color.

Ludius tahoensis Van Dyke, new species

Medium sized, elongate, subcylindrical, piceous black, somewhat dull, the anterior margin and sides of pronotum as well as propleuræ rufous, sometimes the hind angles of prothorax as well as epipleuræ and legs more or less rufous, and clothed with a few, short, scattered cinereous or slightly fulvous hairs. Head rather evidently, triangularly impressed between the eyes, coarsely,

closely, somewhat confluently punctured and with a few, irregular callosities; antennæ reaching one segment beyond hind angles of prothorax in males and about hind angles in females, the second segment short though longer than broad, the third elongate, just perceptibly longer than fourth and not quite twice as long as broad, segments 3-10 elongate serrate and gradually diminishing in length and breadth towards apex. Prothorax slightly longer at middle than broad, hind angles rather robust and prolonged, more triangular and backward-projecting in males, somewhat narrowed and more divergent in females, blunt at apices and with distinct carinæ near the margin, sides almost straight and but slightly convergent to near apex in males, distinctly arcuate in females; the disk moderately convex and rather coarsely, closely, uniformly punctured, more coarsely, umbilicately, closely and somewhat cribrately punctured laterally, not evidently canaliculate at middle; scutellum subcordate, finely punctured and pubescent. Elytra distinctly over twice as long as prothorax and twice as long as broad, with sides but slightly divergent and arcuate to posterior third, the disk convex, the striæ well impressed and very finely punctured, the intervals slightly convex and distinctly though irregularly biserially punctured. Beneath rather coarsely, closely punctured on prosternum, very closely on propleuræ, and finely, more sparsely punctured on abdomen. Male, length 11 mm., breadth 3 mm.; female, length 13 mm., breadth 4.5 mm.

Holotype: Male, No. 3179; and *Allotype:* Female, No. 3180, Mus. Calif. Acad. Sci., and five *Paratypes,* the first and second collected by me near **Fallen Leaf Lake,** July 8, 1915, and Tallac, June 1899, both near Lake Tahoe, Calif., the paratyes all from the same general neighborhood.

This species in size, coloration and general appearance resembles the well known *Agriotes fucosus* (Lec.). In shape it also resembles *Ludius furtivus* (Lec.) and others of the elongate, subcylindrical form, but is apparently not closely related to any of the known species of the genus to which it belongs.

Ludius atropurpureus (Melsheimer)

This rather attractive and uncommon species is much like our more common *furtivus* (Lec.) of the northwest and probably of the same ancestry. It is generally shorter and blunter, with the hind angles of the prothorax broader, the elytral striæ deeper and the punctures coarser, and the antennæ shorter, the third segment quite definitely serrate, not subcylindrical as in the latter.

Ludius limoniiformis (Horn)

Ludius limoniiformis (Horn) seems to stand apart, resembling in some aspects *monticola* (Horn), but in shape and general appearance simulating a *Limonius* more than anything else. It seems to be rather widely spread in the country to the west of the Great Lakes.

Ludius opaculus (LeConte)

This small species with more or less fulvous elytra and opaque appearance is moderately common at times in the more open places in the forest from middle California to British Columbia. It shows a color relationship with no other. *Diacanthus serricornis* Mann. is probably this species.

Ludius appressus (Randall)

This well known and robust species is one of the most isolated of our species. Its general shape and color pattern would seem to place it near *cruciatus* (Linn.) but it shows no structural resemblances.

Ludius angusticollis (Mannerheim)

Much confusion has existed concerning this well known elongate species of Alaska and our Northwest. The typical species has robust and triangular hind angles to the prothorax and is restricted to southeastern Alaska. In British Columbia and Washington its place is taken by a form having the angles much narrowed but otherwise not different. This is *fraternus* (Lec.) which I consider as nothing but a subspecies. In the high northern Cascades as on Mt. Rainier, Wash., and extending south to Mt. Hood, Oregon, there occurs a color phase of the latter with bright rufous or orange elytra. *Corymbites spectabilis* Mann. seems to be but a large female of the typical *angusticollis*.

Ludius sagitticollis Eschscholtz

In this species there is far more variation than is generally realized. The usual black forms with orange red elytra, short second and third antennal segments, and sharp, divergent hind angles to prothorax are readily recognized. I, however, have an all-piceous specimen from the Yellowstone National Park, and have seen several females which have the third antennal segment about as long as the fourth, thus out of place in the usual table.

Ludius rainieri Van Dyke, new species

Somewhat narrow and much elongated, flattened, light reddish brown, the body including head and prothorax sparsely clothed with fine pubescence, the elytra sparsely clothed with very short and minute hair. Head broadly sulcate between the eyes and rather definitely punctured, the punctures coalescing into radially arranged striæ anteriorly in the sulcus, a definite crista in front of each eye and about the antennæ; antennæ filiform, almost reaching the middle of the elytra, the second and third segments short though longer than broad and together shorter than fourth, the latter about three times as long as broad and about equal in length to each of the following four though slightly more robust. Prothorax longer than broad, hind angles prominent, acute and slightly diverging, with a fine though long carina on each, the sides from bases of hind angles almost straight or slightly sinuous and converging to apex, the side margin fine, the disk somewhat convex, rather finely, closely punctured and with a well defined impression each side and in front of middle. Scutellum elliptical, slightly concave, and finely punctured and pubescent. Elytra broader at base than prothorax across tips of hind angles, about three times as long as broad, gradually narrowing posteriorly, the disk moderately convex, the striæ finely but in most cases not sharply defined and finely and obscurely punctured, the intervals flat, finely but not distinctly punctured and finely rugose, giving the elytra a dull aspect. Prothorax beneath coarsely, closely punctured, sternum somewhat longitudinally cristate at middle in front of coxæ and concave laterally, spine semicircularly arched and sulcate between coxæ, afterbody rather finely and moderately closely punctured, legs very long. Length 16 mm., breadth 4 mm.

Holotype: Male, No. 3181, Mus. Calif. Acad. Sci., with antennæ somewhat injured, in my collection, from **Mt. Rainier, Wash.** A second specimen, I have seen in the collection of Prof. W. J. Chamberlin at Corvallis, Oregon.

This insect is of about the same length, breadth and color as *pyrrhos* (Hbst.) though it differs in its proportions and

general appearance, in this regard looking more like one of the larger species of *Aplastus*. Such peculiarities as its type of antennæ, frontal carinæ, type of pronotum and prosternum should enable this odd species to be readily recognized.

Ludius nunenmacheri Van Dyke, new species

Rather small, moderately expanded and flattened, black, pronotum orange red except for an irregular V-shaped black marking extending forwards on the disk from near the base, propleuræ, prosternal lobe and elytra yellow, the latter with suture and a diamond shaped area at apex black, mouthparts, two basal segments of antennæ, tibiæ and tarsi testaceous, the surface sparsely clothed with fine, fulvous pile, semi-erect on elytra. Head convex above, flattened in front and sparsely though definitely punctured; the antennæ but slightly serrate and extending about a segment beyond hind angles of prothorax in males and almost to angles in females, the second and third segments small though longer than broad, fourth segment about equal to the preceding two together, the following gradually shorter and narrower. Prothorax about one-fourth longer than broad, spatulate, hind angles well marked, acute, slightly divergent and with carinæ fine and close to margin, the sides almost straight and gradually diverging from base of hind angles to anterior third then broadly rounded to apex, the disk moderately convex, without median canaliculation and rather finely, regularly and not closely punctured. Scutellum elongate-cordate and finely punctured and pilose. Elytra broader at base than prothorax, over twice as long as broad, gradually arcuately widening from base to posterior third then narrowing to apex, disk moderately convex, striæ finely impressed and closely, finely punctured, the intervals flattened and very finely punctured. Prothorax beneath finely and sparsely punctured, hind body very finely but more closely punctured, prosternal sutures double. Length 8.5 mm., breadth 2.5 mm.

Holotype: Male, No. 3182; and *Allotype:* Female, No. 3183, Mus. Calif. Acad. Sci., and one *Paratype* in my collection, received from Mr. F. W. Nunenmacher who collected them in western **Siskiyou Co., Calif.,** June 2, 1911. This pretty little species of course varies somewhat as regards its color pattern. The V-shaped discal mark of the pronotum may be quite faint as in my allotype, the sutural black line of the elytra may disappear, and the apical spot may be much reduced in size.

The species is widely separated in the table from its close relatives. It really belongs with *sulcicollis* (Say) and its

associates, all of which are strictly lignivorous. The size, color pattern and characters given should enable it to be readily recognized when found.

Ludius trivittatus (LeConte)

This conspicuous and easily recognized species seems to have been omitted by Schenkling from his catalogue in Junk's Coleopterorum Catalogus. Though widely separated in the key because of the length of the third antennal segment, it is in reality of the same stock as *semivittatus* (Say) and *fusculus* (Lec.) from the Pacific Coast of our country.

Ludius shastensis Van Dyke, new species

Moderately elongate, subparallel and subcylindrical, the head, antennal segments 4-11, pronotal disk and prosternum, meso- and metasternum and first abdominal segment black, the remaining portions of body rufous, and clothed with coarse though sparsely placed fulvous pile. Head convex, coarsely, closely, cribrately punctured; antennæ moderately serrate, reaching three segments beyond hind angles of prothorax, second segment small, little longer than broad, third about a third longer, subcylindrical and about three-fourths length of fourth, fourth about one-third longer than broad, segments 4-10 distinctly triangular, gradually narrower and just perceptibly shorter. Prothorax slightly longer than broad, hind angles narrow, distinctly divergent, the sides practically straight from bases of hind angles and slightly convergent almost to apex where rounded; disk convex, moderately coarsely but not closely punctured except at sides, median canaliculation but vaguely indicated posteriorly. Scutellum subcordate, finely punctured and pubescent. Elytra broader at base than breadth of prothorax across apices of hind angles, about twice as long as broad, disk convex, the striæ well impressed and rather coarsely, closely punctured, the intervals convex behind, somewhat flattened basally, finely punctured and rugose. Beneath the propleuræ are rather coarsely, closely punctured, the remainder finely, rather sparsely punctured. Length 10 mm., breadth 3.5 mm.

Holotype: Male, No. 3184, Mus. Calif. Acad. Sci., a unique in my collection, collected by Mr. F. W. Nunenmacher in **Shasta Co., Calif.**

This rather inconspicuous species is related to *blaisdelli* but readily separated as is pointed out in the discussion of that species.

Ludius insidiosus (LeConte)

This species has a much more extensive range than has generally been believed. It is now known to range throughout the higher parts of the entire Appalachians and from Maine and eastern Canada to British Columbia and Montana. *Corymbites lutescens* Fall is but the lighter, more western race of the species.

Ludius blaisdelli Van Dyke, new species

Moderately elongate, subparallel and subcylindrical, black, the basal segment of antennæ and elytra rufous, the legs rufotestaceous in the female, the apical, side margin and propleuræ of prothorax and posterior abdominal segments also somewhat rufous, and rather evidently clothed with short cinereous (male) or fulvous (female) pile. Head flattened, coarsely, closely, cribrately punctured; antennæ moderately serrate, reaching several segments beyond hind angles of prothorax in male and to hind angles in female, the second segment short, but about a third longer than broad, the third one-third longer, subcylindrical and but little shorter than the fourth, the last a third longer than broad, the following gradually narrower. Prothorax slightly longer than broad in male, diameters about equal in female, hind angles robust and but slightly divergent, the sides almost straight in male or slightly arcuate in female from hind angles, and slightly convergent to near apex where rounded; the disk convex, coarsely, closely and especially in female cribrately punctured, with well marked median canaliculation from base to middle. The scutellum broadly cordate, finely punctured and pilose and longitudinally impressed in female. Elytra about as broad at base as prothorax, more than twice as long as broad, convex, the striæ finely impressed and rather coarsely, closely punctured, the intervals flat, finely punctured and rugose. Beneath with propleuræ rather coarsely, closely punctured, the prosternum to a lesser degree and the afterbody finely and less closely punctured. Male, length 10 mm., breadth 3.25 mm.; female, length 14 mm., breadth 4.75 mm.

Holotype: Male, No. 3185; and *Allotype:* Female, No. 3186, Mus. Calif. Acad. Sci., in my collection, both collected by me in **Lagunitas Cañon, Marin Co., Calif.**, the first, April 7, 1907, the second March 29, 1908.

As stated previously, this species is no doubt related to *shastensis* but it differs from that in regard to the proportionate lengths of the second and third antennal segments, the more robust and hardly divergent hind angles of prothorax, narrow and markedly divergent in *shastensis,* the much coarser and closer pronotal punctation and pronounced canaliculation,

and the finer elytral striæ and flattened intervals. It, like *shastensis,* is exceedingly rare, the specimens mentioned being the only ones that I have seen. It is named in honor of my good friend, Dr. F. E. Blaisdell, in remembrance of many collecting trips taken together to the region where it was secured.

Ludius falsificus (LeConte)

Ludius falsificus (Lec.) and *Ludius angularis* (Lec.) are but eastern and western representatives of the same species. I have large series of the second from British Columbia and the more mountainous parts of the Pacific States and these typical *angularis,* as shown by critical comparison with the type, cannot be distinguished with any degree of certainty from typical *falsificus* from Maine or New Brunswick. It is in fact but one species which extends along our northern border from the Atlantic to the Pacific as well as throughout the high mountains of the Pacific Coast. On the coast of Oregon as at Cannon Beach, there is a very dark piceous phase of the above, a typical melanotic wet-belt color phase.

Ludius resplendens Eschscholtz

The typical phase of this species extends with slight variations from Alaska across the continent to the Atlantic and into the high mountains of New England and northern New York. It also extends south along the Cascades and very high Sierra Nevada Mountains and into the Rocky Mountains. These more southern specimens are generally shorter, duller and more coppery than the typical form. They are what was described as *Corymbites brewcri* Horn from the high middle Sierra Nevadas. Large series show that they grade gradually into the typical *resplendens.* I have therefore placed it as but a subspecies of the latter.

Ludius appalachius Van Dyke, new species

Elongate, narrow, but moderately convex, shining, dark coppery bronze, the cupreous color most evident on head, prothorax, suture and margins of elytra and beneath, the surface sparsely, though evidently, clothed with fine

white pile. Head slightly convex, coarsely yet not closely punctured; antennæ slightly serrate, not quite reaching hind angles of prothorax, second segment about twice as long as wide and two-thirds the length of third, the latter subcylindrical and barely longer than fourth. Prothorax including angles longer than broad, broadest and subangulate behind middle, the sides sinuate posteriorly and almost straight and convergent anteriorly, the posterior angles prominent, subacute, distinctly divergent and incurved at apices, and with well marked carinæ; the disk moderately convex, with median canaliculation faintly impressed at base, and distinctly but not coarsely or closely punctured except laterally. Scutellum flat and finely punctured. Elytra more than twice as long as prothorax and twice as long as broad, distinctly narrowed, posteriorly and moderately convex, the striæ finely but not always clearly impressed and finely, closely punctured, the intervals flattened or barely convex and finely, somewhat obscurely and sparsely punctured. Beneath the prosternum is shining, rather coarsely and sparsely punctured, the propleuræ finely and very closely punctured giving the surface a granular appearance, and the afterbody finely and sparsely punctured. Length 13 mm., breadth 4 mm.

Holotype: Male, No. 3187, Mus. Calif. Acad. Sci., and one *Paratype* in my collection, the first collected by me on **Mt. Mitchell, North Carolina,** June 1902, the second taken by Mr. Wm. Beutenmueller, July 12, 1912, on the Black Mts. of North Carolina. A third quite typical specimen bearing the label Big Indian Valley, Catskill Mts., N. Y., June 18, 1910, was submitted to me for study by Mr. Charles Schaeffer.

This species has the general facies of a dark specimen of *Ludius resplendens* Esch. and probably comes from the same general stock. It, however, has certain definite features which readily separate it, such as the generally narrower prothorax, broadest behind the middle, the more attenuate elytra, the very evident though sparse pilosity over the entire body, and the very fine and close punctation of the propleuræ contrasting with the coarse and but moderately close punctation of *resplendens*.

Ludius weidti (Angell)

This very rare species which ranges from the higher mountains of British Columbia through the Cascades at least as far south as Mt. Rainier, Wash., can always be readily separated from *resplendens* by its smaller size, much shorter body, fine and sparsely punctured pronotum and very flat elytral inter-

vals. My Mt. Rainier specimens are a brilliant green but I have received others from Mt. Garibaldi, B. C., from Mr. G. A. Hardy, which are a deep blue color.

Ludius divaricatus (LeConte)

The female of this well defined species is without doubt, the *Corymbites crassus* Lec. as first definitely pointed out by Blanchard.[25] Horn[26] unfortunately misquoted him, stating that he said it was the female of *inflatus* (Say). I have a typical *crassus* which I collected in North Carolina along with a large series of *divaricatus* and which has been carefully compared with LeConte's type. *Ludius inflatus* (Say) is perhaps the most widely distributed species of the genus in North America, especially common in all of the Pacific States where the females are about as well known as are the males and not to be distinguished from them except by their generally larger size, more robust appearance and slightly shorter antennæ. They are very distinct from *crassus* in almost every regard.

Ludius rupestris (Germar)

This species has a most interesting distribution, extending from Victoria through British Columbia to the northern part of the Great Basin thence south through this to northern Arizona and ranging east, and west from the Wasatch Mts. of Utah to the Cascades and Sierra Nevadas. It is truly a Great Basin species. I have seen only two specimens, taken on the western flanks of the Sierra Nevadas, both in Sequoia National Park.

Ludius rotundicollis (Say)

This species is to be found on both sides of the continent, the more typical phase in the East. The subspecies *nigricans* (Fall) is a bit larger and generally with the pronotum more

[25] Ent. Amer., 5, 1889, p. 140.
[26] Ent. News, 1, 1890, p. 55.

heavily punctured. It ranges throughout western Washington and Oregon and south along the high Sierra Nevada. The subspecies *diversicolor* (Esch.) is more like the typical form in size and punctation but with the prothorax, except its margins, of a bright red color, both above and below. This is a lowland form, found generally in the late summer or autumn in the San Francisco Bay region and generally around old live oaks in the rotting parts of which it breeds. In various parts of California as near Monterey, as well as farther north in Washington and in the Sierras, *diversicolor* has a black median longitudinal stripe or band on the pronotum as well as a black prosternum.

Ludius rotundicollis (Say) with *sulcicollis* (Say), *rupestris* (Germ.) and my *nunenmacheri* form a peculiar group within the genus characterized by double prosternal sutures, a prothorax broadly expanded in front of the middle, less evident in most *rotundicollis,* and strictly lignivorous habits as larvæ.

Ludius fusculus (LeConte)

The type of this species is much bleached, no doubt as a result of having been collected in alcohol and this allowed to gradually evaporate. As a result it does not look at all like freshly caught specimens which are very black and when perfect about as densely clothed with coarse gray pile as is *inflatus* (Say). It is very closely related to *semivittatus* (Say) and may prove to be but a melanotic phase of that, as I have found is the case with *leucaspis* (Germ.) as compared with *umbripennis* (Lec.). The distribution also somewhat parallels that, for *fusculus* is most often found in the northern Great Basin as in western Alberta, eastern British Columbia and Washington, and extending south through the more inland parts of California as far as the San Francisco Bay region, where, however, it is very rare. Many species which range from the Rocky Mountains through the northern Great Basin to the Pacific seem to have melanotic phases in this hot and dry intermountain area.

Ludius semivittatus (Say)

For a time I believed that this species had a discontinuous distribution, being found along the eastern flanks of the Colorado Rocky Mountains (type locality) and along the coast of middle California. I, however, have a specimen from Wyoming and we have records that it has been taken in Oregon and British Columbia. It appears to extend from British Columbia in two directions, through the northern Great Basin and Wyoming to the eastern foothills of the Rocky Mountains in Colorado and down the Pacific Coast within a few miles of the ocean, to middle California. Possibly the all-black *fusculus* as stated above, is the form that bridges the gap in the north. The Colorado and Wyoming specimens are rather small, those about San Francisco somewhat larger while many of those from near Santa Cruz and northern Sonoma Co., are often of good size with the yellow markings much reduced. I believe that the *oblongoguttatus* (Mots.) is one of these. The description fits nothing else and these are found in the territory from whence Motschulsky secured most of his Elateridæ. The Japanese *vagepictus* Lewis is also very closely related to *semivittatus*.

Ludius morulus (LeConte)

This black species ranges from the Yukon Valley in Alaska southeast to eastern British Columbia, Alberta, and the states to the south of them. I have a specimen from Mt. Rainier, Wash., in which the sides of the prothorax are partly red.

Ludius cruciatus (Linnæus)

Ludius cruciatus (Linn.) may be fairly stable as to appearance in the Old World and in northeastern America but it is most variable in northwestern America. In eastern British Columbia, specimens are often found with vittate elytra, the black sutural and humeral vitta extending to the apices with the cross bars absent, or the elytra may be unicolorous without any black markings at all. In the northwest generally, par-

ticularly in the northern Cascades, the usual color type is to be met with but in the southern Cascades and Sierra Nevada Mountains an entirely black phase appears, which I am calling the subspecies **ater** and designating as a holotype (No. 3188, Mus. Calif. Acad. Sci.), a specimen from **Red Mt., Nevada Co., Calif.**, collected by Chs. Von Geldern, July 3, 1911. Intermediates such as the variety *edwardsi* (Horn) with the prothorax margined with red and with yellow patches near the base of the elytra, sometimes occur, but the usual intermediate has entirely black elytra. An unusual phase is also represented in my collection by a specimen from Meadow Valley, Plumas Co., which is like the typical phase, except that the entire apical half of the elytra is black.

Ludius carbo (LeConte)

The typical *carbo* of the Willamette Valley, Oregon, is of a sooty black color, robust and quite convex. As it ranges eastward towards Utah and south into California it becomes flatter, and in the latter territory has the elytra somewhat metallic. The variety *lateralis* (Lec.) with the sides of the prothorax somewhat rufous is generally found with the typical form. In the middle and southern Sierras of California, this color phase becomes the dominant form only here it is much flattened, not very convex as in the north, and with the elytra as previously stated submetallic. This phase is sometimes very hard to separate from the intermediate phase of *cruciatus* but a proper attention to details will enable it to be done.

Ludius pruininus (Horn)

The typical form of this is almost equal in size to the normal form of the preceding and ranges from Utah west to the middle Sierras of California. Farther north in the Great Basin in eastern Oregon and Washington and the lava beds of northeastern California, it becomes smaller, more depauperized, and a trifle less coarsely sculptured. This is the subspecies *noxius* Hyslop, a form which has become well known as a result of the injury which its larvæ do to crops.

Ludius æreipennis (Kirby)

This is a wide ranging and common though very attractive species. The typical form in eastern Canada and the adjacent states to the south has the elytra very finely punctured and is more apt to be of a bronze color. The subspecies *tinctus* (Lec.) with the elytra more evidently punctured gradually replaces that as one approaches the Pacific. In western British Columbia and Washington it is large, with the elytra brilliantly metallic green or cupreous, but in the high southern Cascades and Sierra Nevadas as well as in the Rocky Mountains, it becomes smaller and generally of a deep violet bronze. In Manitoba, Alberta, eastern British Columbia and the adjacent states to the south, very small or depauperized forms are commonly to be met with. These are often 9 mm. or less in length and quite dull in appearance. In western Canada this species is also rated as quite destructive.

Ludius suckleyi (LeConte)

This species is generally considered quite stable as it is somewhat local, yet it has an all black phase found near **Olympia, Wash.** This I am calling the subspecies **olympiæ** and designating one of my specimens as the *holotype* (No. 3189, Mus. Calif. Acad. Sci.). My specimens were received from my very dear friend, the late Prof. O. B. Johnson of the University of Washington.

Ludius leucaspis (Germar)

Extensive field work has been necessary in order to clear up the status of this species. The typical all black specimens dwell in eastern Washington and Oregon and extend across the Great Basin to Utah. At higher elevations in the Wasatch Mountains of Utah, a phase appears with a light subapical elytral patch, and with the elytral margins sometimes light. In western British Columbia, Washington and Oregon, the well known subspecies *umbripennis* (Lec.) appears. This has yellow elytra ornamented with black sutural and humeral

vittæ, the former enlarged just back of the scutellum and the latter dilated sub-basally as well as postmedially. Farther east in the Cascades and northern Sierra Nevada Mountains, the elytral markings change from vittæ to transverse bars or closely simulate the markings of typical *cruciatus*. The simulation to the latter is also often heightened by their having the sides of the prothorax also reddish. A good series of these last show that they gradually grade on one hand into the coastal *umbripennis* and on the other into the typical *leucaspis*.

Ludius conjungens (LeConte)

This species throughout the greater part of California and most of its area of distribution is of the normal type, black or piceous, of moderate size, 10-12 mm. in length, rather flattened, the pronotum regularly though not closely punctured and the elytral intervals between the rows of punctures smooth and even. In the Sierra Nevada Mountains, variations appear. In Placer Co., specimens with red legs may occur. Farther south in Mariposa Co., the specimens become more convex as well as more generally robust, the prothorax, generally the head as well and often most of the underside of the body, a bright red. This is the variety *lecontei* (Cand.). A similarly colored specimen from Mt. Saint Helena in Sonoma Co., has also been seen, but the more flattened form of this is that of the typical *conjungens*. In the southern Sierras as in the Sequoia National Park, the specimens retain their robust form, are colored much as in the variety *lecontei* but have the pronotum very closely, approximately, and coarsely punctured and the elytra rugose as well as punctate. This extreme is the subspecies *obversus* (Horn).

Ludius nigricollis (Bland)

This species which is rather uncommon, is most often confused with the large western forms of *propola* because of its somewhat similar color pattern. It is always more narrowed both anteriorly and posteriorly, with the antennæ longer and

the third antennal segment much shorter than the fourth, the prothorax proportionally longer with the hind angles unicolorous with the rest of the prothorax or only faintly lighter apically. It is found from Marquette, Mich., to eastern British Columbia, south into the northern Rocky Mountains and along the east flank of the Cascades and Sierra Nevada Mountains as far south as Bishop, California.

Ludius candezei Leng

This pretty little flattened species, black with yellow elytra, having a large cordate black apical patch and densely pilose, is very rare. The only specimens that I have seen were taken near Lake Tahoe, California.

Ludius mirabilis (Fall)

This is a most attractive little species, somewhat suggesting *fallax* but much smaller, blunter, the prothorax broad and deeply sinuate before the sharp and very divergent hind angles, and clothed with beautiful golden pile. The prothorax is generally reddish brown though it may be quite black. It ranges through the Sierra Nevada Mountains from the Yosemite Valley to Sequoia National Park and in the south is most often beaten from *Fremontia californica,* in the brilliant yellow flowers of which it sometimes feeds. It is never common.

Ludius propola (LeConte)

On the Pacific Coast, this species is common and of fair size, 12–14 mm. in length, but in the very high mountains and in the eastern portion of its range we have depauperized forms which average about 8 mm. in length. The color pattern of the elytra also varies greatly even within the same territory. Careful studies of the LeConte types have convinced me that *propola, furcifur,* and *nubilus* are but slight color variations of one species.

Ludius triundulatus (Randall)

As stated by Fall in 1907, his *tigrinus* is but the large Pacific Coast phase or subspecies of *triundulatus*. The variety *nebraskensis* Bland is but a race in which the color pattern of the elytra is almost obliterated. Among the numerous specimens taken in the Rocky Mountain region we may occasionally find a specimen which answers the description of this.

Ludius hoppingi Van Dyke, new species

Short, flattened, black, the elytra straw yellow, and moderately densely clothed with short, fine, fulvous pile. Head slightly convex, finely, closely punctured; antennæ fine, slightly serrate, and about reaching hind angles of prothorax, second segment small, third subcylindrical, about twice the length of second and almost as long as fourth. Prothorax a bit longer than broad, slightly convex, the sides sinuate in front of hind angles, thence arcuate to apex, the hind angles short, broad, blunt at apex, without carinæ but with the outer margin much reflexed; the disk finely, closely punctured and with vague median canaliculation posteriorly. Scutellum finely punctured. Elytra slightly more than twice as long as prothorax and somewhat less than twice as long as broad, the lateral margins broad, sides slightly arcuate at middle and gradually arcuately narrowed to apex, the disk somewhat flattened, striæ finely impressed and finely, somewhat obscurely punctured, the intervals flat, very finely punctured and rugose. Beneath finely, closely punctured, the punctures of propleuræ shallow and approximate. Length 9.5 mm., breadth 3 mm.

Holotype: No. 3190, Mus. Calif. Acad. Sci., and *Paratype* in my collection, from **Revelstroke Mt., B. C.**, July 17, 1925, collected by Mr. Ralph Hopping, and several paratypes in the collection of Mr. Hopping. I also have another specimen collected by myself in Paradise Valley, Mt. Rainier, Wash., July 1905, and have seen another collected by Mr. R. E. Barrett at Lower Labarge, Yukon Terr., Canada, June 4, 1928.

This interesting little species superficially looks like a small and narrow *medianus*. It, however, lacks the robustness of the latter and the well marked carinæ of the hind angles of prothorax, the prothorax being far more suggestive of some of the flatter phases of *lobatus* and its associates. Its legs are black, yellowish in *medianus*, and the elytra more flattened and with much finer striæ.

Ludius (Paranomus) granicollis Van Dyke, new species

In size and general appearance similar to small specimens of *costalis* (Payk.), piceous with æneous lustre, the basal segments of antennæ, tibiæ and tarsi, epipleuræ, and in females the elytra with a basal spot and lateral margin with an approximate subhumeral spot and transverse subapical patch, testaceous. Head convex and finely, closely punctured; antennæ reaching well beyond hind angles of prothorax, second segment about twice as long as broad and approximately three-fourths length of third. Prothorax transverse, hind angles acute and slightly divergent, sides strongly sinuate in front of hind angles in male, less so in female, arcuate at middle and gradually narrowed to apex, the disk finely, closely and more or less regularly punctured over entire area. Elytra about four times the length of prothorax, slightly arcuate at sides in males, more broadly so in females, the disk with striæ vaguely defined at center as usual in subgenus *Paranomus* and finely, moderately closely punctured. Beneath rather finely and sparsely punctured.

Holotype: Male, No. 3191; and *Allotype:* Female, No. 3192, Mus. Calif. Acad. Sci., and six *Paratypes* collected by myself in **Paradise Valley, Mt. Rainier, Wash.,** July 14-31, 1905. I have also taken it in the Yakima Indian Forest Reservation, Mt. Adams, Wash., June 30 and July 1, 1925, and on Mt. Hood, Oregon, June 25, 1925.

This species resembles *estriatus* (Lec.) as regards the small male prothorax and antennæ but differs from this as well as from *costalis* (Payk.) by the much finer and closer punctation of head and pronotum which gives them a granular appearance.

BIBLIOGRAPHY

Ludius virens (Schrank) (Elater), Berl. Ges. Nat. Freunde, II, 1781, p. 317.
æneicollis (Oliv.) (Elater), Jour. Hist. Natur., I, 1792, p. 264, t. 14, f. 3; (Corymbites), Cand., Mon. Elat., IV, 1863, p. 94.
castaneus (Scop.) (Elater), Ent. Carn., 1763, p. 93.
signatus (Panz.) (Elater), Fn. Germ., 1801, nr. 5, p. 77.
virescens (Gmel.) (Elater), *in* Linn. Syst. Nat., ed. 13, IV, 1789, p. 1906.
kendalli (Kirby) (Ctenicerus), Faun. Bor. Am., IV, 1837, p. 149, pl. II, fig. 7; Lec., (Corymbites), Tr. Am. Phil. Soc., X, 1853 (n. s.), p. 444, 33.
anchorago (Rand.) (Elater), Boston Jour. Nat. Hist., II, 1838, p. 5.
Ludius vernalis (Hentz) (Elater), Jour. Acad. Nat. Sci. Phila., V, 1827, p. 374, t. 13, f. 2; Say, Tr. Am. Phil. Soc., VI, 1836, p. 172; Germ., (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 56; Lec., Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 444, Cand., Mon. Elat., 1863, p. 101; Blatchley, Col. Ind., 1910, p. 763, f. 290.

Ludius sjaelandicus (Miller) (Elater), Fn. Fried., 1764, p. 21.

‖*tessellatus* (Fab.) (*nec.* Linn.) (Elater), Syst. Ent., 1775, p. 211; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 104.

nubilus (Schrank) (Elater), Bayersche Reise, 1786, p. 46.

viridis (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 255.

cuprascens (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 444.

Ludius cribrosus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 443, Cand., Mon. Elat., IV, 1863, p. 107; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 391.

subcanaliculatus (Mots.) (Pristilophus), Bull. Mosc., XXXII, 1859, IV, p. 375; Schwarz (Corymbites), *in* Wytsman, Gen. Ins., fasc. 46, 1907, p. 224.

maurus (Lec.) ♀ (Corymbites), Tr. Am. Phil. Soc., X, 1853, p. 444; Cand., Mon. Elat., IV, 1863, p. 182; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 395.

Ludius cribrosus var. colossus (Lec.) ♀ (Corymbites), Tr. Am. Phil. Soc., X, 1853, p. 444; Cand., Mon. Elat., IV, 1863, p. 184; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 394.

? Ludius cribrosus var. rufipes (Mots.) (Corymbites), Bull. Mosc., XXXII, 1859, p. 377.

Ludius signaticollis (Melsh.) (Diacanthus), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 216; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 443; Cand., Mon. Elat., IV, 1863, p. 113; Blatchley, Col. Ind., 1910, p. 764; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 392.

Ludius uliginosus n. sp.

Ludius obscurus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.), X, 1853, p. 442; Cand., Mon. Elat., IV, 1863, p. 107; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 392.

Ludius silvaticus n. sp.

Ludius protractus (Lec.) (Corymbites), Proc. Acad. Nat. Sci. Phila., 1859, p. 85; Cand., Mon. Elat., IV, 1863, p. 108; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 392.

Ludius protractus var. jouteli (Dow) (Corymbites), Bull. Brookl. Ent. Soc., VIII, 1913, p. 77; Leng, (Ludius), Cat. Col., 1920, p. 169; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 392.

Ludius aplastoides n. sp.

Ludius anthrax (Lec.) (Corymbites), Proc. Acad. Nat. Sci. Phila., 1861, p. 348; Cand., Mon. Elat., IV, 1863, p. 184; Schenkling, *in* Junk's Col. Cat., Pars. 88, 1927, p. 394.

Ludius atlas, n. sp.

Ludius dolorosus n. sp.

Ludius fulvipes (Bland) (Corymbites), Tr. Ent. Soc. Phila., I, 1863, p. 354.

Ludius exilis Notman, Jour. N. Y. Ent. Soc., XXVIII, 1920, p. 30-31.

Ludius pyrrhos (Hbst.) (Elater), Käfer, X, 1806, p. 30, t. 160, f. 11; Say, Tr. Am. Phil. Soc., VI, 1836, p. 167; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 447; Cand., Mon. Elat., IV, 1863, p. 108; Blatchley, Col. Ind., 1910, pp. 764, 767.

æqualis Melsh. ♀ (Athous), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 153.

pyrrhicus Hald. ♀ (Athous), Proc. Acad. Nat. Sci. Phila., I, 1843, p. 303.

vagrans Melsh. (Athous), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 153.

Ludius macer (Fall) (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 133.

Ludius tenellus n. sp.

Ludius jaculus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 447; Cand., Mon. Elat., IV, 1863, p. 106.

teres (Lec.) ♀ (Corymbites), Proc. Acad. Nat. Sci. Phila., 1866, p. 392.

Ludius horni Schwarz, *in* Wytsman, Gen. Ins., fasc. 46, 1907, p. 316.

‖*longicornis* (Horn) (nec. Boh.) (Corymbites), Tr. Am. Ent. Soc., III, 1870, p. 79.

Ludius patricius n. sp.

Ludius linearis (Fall) (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 132.

Ludius bivittatus (Melsh.) (Campylus), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 215; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 447; Cand., Mon. Elat., IV, 1863, p. 109; Blatchley, Col. Ind., 1910, pp. 764, 767.

Ludius humboldti n. sp.

Ludius trunculentus (Cand.) (Corymbites), Ann. Soc. Ent. Belg., XXXIII, 1889, p. 50.

Ludius volitans Esch., *in* Thon. Ent. Arch., II, 1, 1829, p. 34; Mann., (Diacanthus), Bull. Mosc., XVI, 1843, p. 261; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 114.

Ludius volitans subsp. umbricola Esch., *in* Thon. Ent. Arch., II, 1, 1829, p. 34; Mann., (Diacanthus), Bull. Mosc., XVI, 1843, p. 242; Germ. (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 65; Cand., Mon. Elat., IV, 1863, p. 115.

Ludius volitans subsp. spinosus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 447; Cand., Mon. Elat., IV, 1863, p. 121.

Ludius volitans subsp. vulneratus (Lec.) (Corymbites), Smiths. Misc. Coll., VI, No. 167, 1863, p. 86.

Ludius rufipennis (Fall) (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 134.

Ludius lobatus (Esch.) (Elater), Entomogr., 1822, p. 69; Mann., (Diacanthus), Bull. Mosc., XVI, 1843, p. 243; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 116.

caricinus (Germ.) (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 63.

rudis (Mots.) (Corymbites), Bull. Mosc., XXXII, 1859, IV, p. 376.

telum (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 445.

Ludius lobatus subsp. tarsalis (Melsh.) (Athous), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 157; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 445; Cand., Mon. Elat., IV, 1863, p. 120; Blatchley, Col. Ind., 1910, pp. 763, 765.

Ludius lobatus subsp. pygmæus n. subsp.

Ludius lobatus subsp. moerens (Lec.) (Corymbites), Proc. Acad. Nat. Sci. Phila., 1866, p. 392.

Ludius lobatus var. xanthomus (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 319.

Ludius elongaticollis (Ham.) (Corymbites), Can. Ent., XXV, 1893, p. 305.

Ludius tahoensis n. sp.

Ludius atropurpureus (Melsh.) (Corymbites), Proc. Acad. Nat. Sci. Phila., II, 1846, p. 215; Lec., Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 442; Cand., Mon. Elat., IV, 1863, p. 106.

Ludius limoniiformis (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 320.

Ludius opaculus (Lec.) (Corymbites), Proc. Acad. Nat. Sci. Phila., 1866, p. 392.

? *serricornis* (Mann.) (Diacanthus), Bull. Mosc., XVI, 1843, p. 241.

Ludius appressus (Rand.) (Elater), Boston Jour. Nat. Hist., II, 1838, p. 11; Lec. (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 446; Cand., Mon. Elat., IV, 1863, p. 114.

mirificus (Lec.) (Corymbites), *in* Agassiz, Lake Superior, 1850, p. 228.

Ludius angusticollis (Mann.) (Diacanthus), Bull. Mosc., XVI, 1843, p. 241; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 136.

spectabilis (Mann.) ♀ (Corymbites), Bull. Mosc., XXV, 1852, p. 328.

Ludius angusticollis var. fraternus (Lec.) (Corymbites), Ann. Mag. Nat. Hist., (4) IV, 1869, p. 379.

Ludius sagiticollis Esch., *in* Thon, Ent. Arch., II, 1, 1829, p. 34; Germ., (Pristolophus), Zeits. f. d. Ent., IV, 1843, p. 91; Mann., (Diacanthus), Bull. Mosc., XVI, 1843, p. 242; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 135.

Ludius rainieri n. sp.

Ludius ochreipennis (Lec.) (Corymbites), Smiths. Misc. Coll., VI, No. 167, 1863, p. 85.

Ludius trivittatus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 443.

Ludius shastensis n. sp.

Ludius insidiosus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 448; Cand., Mon. Elat., IV, 1863, p. 122.

Ludius insidiosus var. lutescens Fall (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 134.

Ludius blaisdelli n. sp.

Ludius falsificus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 448; Cand., Mon. Elat., IV, 1863, p. 122.

Ludius falsificus var. angularis (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 449; Cand., Mon. Elat., IV, 1863, p. 183.

Ludius mendax (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 448; Cand., Mon. Elat., IV, 1863, p. 183.

Ludius monticola (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 319.

gracilis (Cand.) (Corymbites), Ann. Soc. Ent. Belg., XXX, 1889, p. 51; Horn, Ent. News, I, 1890, p. 54; Schwarz, *in* Wytsman, Gen. Ins., fasc. 46, 1907, p. 225.

Ludius furtivus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 442; Cand., Mon. Elat., IV, 1863, p. 112.

Ludius cylindriformis (Hbst.) (Elater), Käfer, X, 1806, p. 93, t. 155, f. 9; Germ., (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 64; Cand., Mon. Elat., IV, 1863, p. 110; Packard, Guide Study Insects, ed. 1870, p. 462; Blatchley, Col. Ind., 1910, pp. 764, 765.

appressifrons ♂ (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 267; Harris, Ins. Inj. Veg., 1841; p. 49; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 442; Emmons, (Ludius), Agr., N. Y., V, 1854, p. 88.

brevicornis (Say) ♀ (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 265.

parallelipipedus Germ., ♀ Zeits. f. d. Ent., IV, 1843, p. 66.

submetallicus (Germ.) ♀ (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 72.

Ludius resplendens Esch., *in* Thon. Ent. Arch., II, 1, 1929, p. 34; Mann., (Diacanthus), Bull. Mosc., XVI, p. 241; Germ., (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 60; Cand., Mon. Elat., IV, 1863, p. 103; Heyne, Tachenb., Exot. Käfer, 1908, p. 162, t. 25, f. 46.

ærarius (Rand.) (Elater), Boston Jour. Nat. Hist., II, 1838, p. 7; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 441.

racinei (Chevr.) (Diacanthus), Rev. Mag. Zool., 1852, p. 578.

ab. *junki* (Schenk.) (Corymbites), Junk, Col. Cat., pars. 88, 1927, p. 392.

viridis (Germ.) (nec. Say 1825) (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 61.

Ludius resplendens subsp. breweri (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 321.

Ludius appalachius n. sp.

Ludius weidti (Angell) (Corymbites), Ent. News, III, 1892, p. 84.

Ludius copei (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 319; Blatchley, Col. Ind., 1910, pp. 764, 765.

Ludius divaricatus (Lec.) ♂ (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 446; Cand., Mon. Elat., IV, 1863, p. 112.

crassus (Lec.) ♀ (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 440; Cand., Mon. Elat., IV, 1863, p. 169; Blanchard, Ent. Amer., V, 1889, p. 140; Schwarz, *in* Wytsman Gen. Ins., fasc. 46, 1907, p. 222.

Ludius sulcicollis (Say) (Elater), Tr. Am. Phil. Soc., VI, 1836, p. 168; Lec. (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 441; Cand., Mon. Elat., IV, 1863, p. 133; Horn, Tr. Am. Ent. Soc., VII, 1878 (1879), Proc., p. XVI, Blatchely, Col. Ind., 1910, pp. 764, 768.

parallelus (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 256.

Ludius rupestris (Germ.) (Corymbites), Zeits. f. d. Ent., IV, 1843, p. 66; Horn, Tr. Am. Ent. Soc., VII, 1878 (1879), Proc., p. XVI.

Ludius rotundicollis (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., 1825, p. 259; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 440; Cand., Mon. Elat., IV, 1863, p. 168; Blatchley, Col. Ind., 1910, pp. 764, 767.

sticticus (Germ.) (Diacanthus), Zeits. f. d. Ent. IV, 1843, p. 74; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 441.

Ludius rotundicollis var. russicollis (Germ.) (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 74; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 444.

Ludius rotundicollis subsp. diversicolor Esch., *in* Thon, Ent. Arch., II, 1, 1829, p. 34; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 180; Horn, Tr. Am. Ent. Soc., III, 1871, p. 323.

Ludius rotundicollis subsp. nigricans (Fall) (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 135.

Ludius nunenmacheri n. sp.

Ludius fusculus (Lec.) (Corymbites), Smiths. Misc. Coll., VI, No. 140, 1863, p. 48.

angustulus Mots., Bull. Mosc., XXXII, 1859, p. 373.

Ludius semivittatus (Say) (Elater), Jour. Acad. Nat. Sci. Phila., III, 1823, p. 174; Tr. Am. Phil. Soc., VI, 1836, p. 168.

tristis (Cand.) (Corymbites), Mon. Elat., IV, 1863, p. 172; Cat. Elat., 1891, p. 173.

? oblongoguttatus (Mots.) (Prosternon), Bull. Mosc., XXXII, 1859, p. 373.

Ludius inflatus (Say) (Elater), Ann. Lyc. Nat. Hist. N. Y., I, 1825, p. 258; Tr. Am. Phil. Soc., VI, 1836, p. 174; Germ., (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 77; Lec. (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 438; Cand., Mon. Elat., IV, 1863, p. 163; Blatchley, Col. Ind., 1910, pp. 764, 767.

glaucus (Germ.) (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 76; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 163; Leng, Cat. Col., 1920, p. 170, note 1.

simillisinus Mots., (Hadromorphus), Bull. Mosc., XXXII, IV, 1859, p. 374.

Ludius morulus Lec., (Corymbites), Smiths. Misc. Coll., VI, No. 167, 1863, p. 85; Horn, Tr. Am. Ent. Soc., III, 1871, p. 323.

Ludius morulus var. brunnipes (Bland) (Corymbites), Proc. Ent. Soc. Phil., III, 1864, p. 67; Cand., Cat. Elat., 1891, p. 169.

Ludius cruciatus (Linn.) (Elater), Syst. Nat., ed. 10, I, 1758, p. 404; Esch., (Ludius), *in* Thon, Ent. Arch., II, 1, 1829, p. 34, etc. Henshaw (Corymbites), List. Col., p. 71; Leng, (Ludius), Cat. Col., 1920, p. 170.

pulcher (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 440.

festivus (Lec.) (Corymbites), Rep. Surv. R. R. Route Miss. to Pac., XII, 3, 1857, p. 46; Horn, Tr. Am. Ent. Soc., III, 1871, p. 323.

Ludius cruciatus var. edwardsi (Horn). (Corymbites), Trans. Am. Ent. Soc., III, 1871, p. 324.

Ludius cruciatus subsp. ater n. subsp.

Ludius carbo (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 439; Cand., Mon. Elat., IV, 1863, p. 165; Horn, Tr. Am. Ent. Soc., III, 1871, p. 323.

Ludius carbo var. lateralis (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 439; Cand., Mon. Elat., IV, 1863, p. 164; Horn, Tr. Am. Ent. Soc., III, 1871, p. 323.

Ludius pruininus (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 320.

‖*pruinosus* (Schwarz) (Corymbites), *in* Wytsman, Gen. Ins., fasc. 46, 1907, p. 226.

pruinosulus (Schwarz) (Corymbites), *in* Wytsman, Gen. Ins., fasc. 46, 1907, p. 316.

Ludius pruininus subsp. noxius (Hyslop) (Corymbites), Proc. Biol. Soc. Wash., XXVII, 1914, p. 69; Contr. Bur. Ent., Bull. 156, U. S. Dept. Agr., 1915, p. 12, fig. 4*a*; Walton, Farmers' Bull. 835, U. S. Dept. Agr., 1917, p. 22, fig. 14*a*.

Ludius æripennis (Kirby) (Aphotistus), Fauna Bor. Am., IV, 1837, p. 150; Germ., (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 82; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 439; Cand., Mon. Elat., IV, 1863, p. 157; Packard, Guide Study Ins., ed. 2, 1870, p. 462.

appropinquans (Rand.) (Elater), Boston Jour. Nat. Hist., II, 1837, p. 5.

Ludius æripennis subsp. tinctus (Lec.) (Corymbites), Proc. Acad. Nat. Sci. Phila., 1859, p. 85; Cand., Mon. Elat., IV, 1863, p. 158.

semimetallicus (Walk.) (Diacanthus), Nat. in Vanc., II, 1866, p. 325; Lec., Ann. Mag. Nat. Hist., (4) VI, 1870, p. 401.

Ludius splendens (Ziegler) (Diacanthus), Proc. Acad. Nat. Sci. Phila., II, 1844, p. 44; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 439; Cand., Mon. Elat., IV, 1863, p. 158; Blatchley, Col. Ind., 1910, pp. 764, 768.

Ludius suckleyi (Lec.) (Corymbites), Rept. Expl. R. R. Route Miss. to Pac., XII, 3, 1857, p. 46; Cand., Mon. Elat., IV, 1863, p. 171.

Ludius suckleyi olympiæ n. subsp.

Ludius leucaspis (Germ.) (Diacanthus), Zeits. f. d. IV, 1843, p. 73; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 153.

Ludius leucaspis subsp. umbripennis (Lec.) (Corymbites), Rep. Surv. R. R. Route Miss. to Pac., XII, 3, 1857, p. 46, Ins., p. 17; Cand., Mont. Elat., IV, 1863, p. 182.

gracilior (Lec.) (Corymbites), Smiths. Misc. Coll., VI, No. 140, 1863, p. 49.

‖*nubilipennis* (Lec.) (Corymbites), Lec., Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 441; Rep. Surv. R. R. Route Miss. to Pac., XII, 3, 1857, p. 17.

Ludius aratus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 438; Cand., Mon. Elat., IV, 1863, p. 161.

Ludius nigricornis (Panzer) (Elater), Fauna Germ., 61, 1799, no. 5; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 159, etc.

metallicus (Payk.) (Elater), Fauna Suec., III, 1800, p. 19; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 159, etc.

nitidulus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 438.

Ludius æthiops (Hbst.) (Elater), Käfer, X, 1806, p. 70, t. 164, f. 4; Germ., (Pristolophus), Zeits. f. d. Ent., IV, 1843, p. 86; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 443; Cand., Mon. Elat., IV, 1863, p. 137; Heyne, Taschenb. Exot. Käfer, 1908, p. 163, t. 25, f. 53; Blatchley, Col. Ind., 1910, pp. 764, 766.

lævigatus (Hbst.) (Elater), Käfer, X, 1806, p. 45, t. 162, f. 1.

nigrans Cast., Hist. Nat. Ins. Col., I, 1840, p. 241.

Ludius conjungens (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 440; Cand., Mon. Elat., IV, 1863, p. 165.

præses (Cand.) (Drasterius), Mem. Acad. Sci. Brux, XVII, 1864, p. 28; Cand., (Corymbites), Cat. Elat., 1891, p. 173; Horn, Tr. Am. Ent. Soc., III, 1871, p. 321.

Ludius conjungens var. lecontei (Cand.) (Corymbites), Mem. Soc. Sci. Liege, 2d Ser., IX, 1881, p. 94.

Ludius conjungens subsp. obversus (Horn) (Corymbites), Tr. Am. Ent. Soc., III, 1871, p. 322.

Ludius planulus (Lec.) (Corymbites), Proc. Am. Phil. Soc., XVII, 1878, p. 460.

Ludius fallax (Say) (Elater), Tr. Am. Phil. Soc., VI, 1836, p. 170; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 446; Cand., Mon. Elat., IV, 1863, p. 152.

bombycinus (Germ.) (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 70.

semilutens (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 445; Cand., Mon. Elat., IV, 1863, p. 173; Cat. Elat., 1891, p. 171.

Ludius medianus (Germ.) (Diacanthus), Zeits. f. d. Ent., IV, 1843, p. 71; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 145.

rubidipennis Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 437; Cand., Mon. Elat., IV, 1863, p. 146.

Ludius nigricollis (Bland) (Corymbites), Proc. Ent. Soc. Phil., III, 1764, p. 68; Horn, Tr. Am. Ent. Soc., III, 1871, p. 322.

Ludius candezei Leng, Jour. N. Y. Ent. Soc., XXVI, 1918, p. 205.

‖*elegans* (Cand.) (nec. Kirby), Mem. Soc. Ent. Liege, (2) IX, 1881, p. 97.

Ludius mirabilis (Fall) (Corymbites), Tr. Am. Ent. Soc., XVII, 1901, p. 306.

Ludius hamatus (Say) (Elater), Tr. Am. Phil. Soc., VI, 1836, p. 172; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 437; Cand., Mon. Elat., IV, 1863, p. 173; Packard, Guide Study Ins., ed. 2, 1870, p. 462, f. 424; Blatchley, Col. Ind., 1910, pp. 764, 766.

Ludius hieroglyphicus (Say) (Elater), Tr. Am. Phil. Soc., VI, p. 172; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 437; Cand., Mon. Elat., IV, 1863, p. 173.

Ludius propola (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 437; Cand., Mon. Elat., IV, 1863, p. 144.

Ludius propola var. furcifer (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 438.

Ludius propola var. nubilus (Lec.) (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 438.

Ludius exclamationis (Fall) (Corymbites), Tr. Am. Ent. Soc., XXXVI, 1910, p. 135.

Ludius triundulatus (Rand.) (Elater), Boston Jour. Nat. Hist., II, 1838, p. 12; Lec., (Corymbites), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 437; Ann. Mag. Nat. Hist., (4) IV, 1869, p. 379; Cand., Mon. Elat., IV, 1863, p. 145; Packard, Guide Study Ins., ed. 2, 1870, p. 462.

Ludius triundulatus var. nebraskensis (Bland) (Corymbites), Proc. Ent. Soc. Phila., I, 1863, p. 355.

Ludius triundulatus subsp. tigrinus (Fall) (Corymbites), Tr. Am. Ent. Soc., XXVII, 1901, p. 306; Ent. News, XVIII, 1907, p. 176.

Ludius hoppingi n. sp.

Subgenus **Paranomus** Kiesnw.

Ludius costalis (Payk.) (Elater), Fauna Suec., III, 1800, p. 37; Kiesnw., (Paranomus), Naturges. Ins. Deutsch., Col., IV, 1858, p. 303, note 1; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 177.

maculipennis (Lec.) (Eanus), Smiths. Misc. Coll., VI, No. 167, 1863, p. 85.

pictus (Cand.) (Corymbites), Mon. Elat., IV, 1863, p. 177.

vagus (Lec.) (Limonius), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 434.

decoratus (Mann.) (Diacanthus), Bull. Mosc., XXVI, 1853, III, p. 229; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 179.

Ludius estriatus (Lec.) (Limonius), Tr. Am. Phil. Soc., (n. s.) X, 1853, p. 434; Lec., (Eanus), Smiths. Misc. Coll., III, 1861, Classif. Col. N. Am., p. 171; Cand., (Corymbites), Mon. Elat., IV, 1863, p. 178.

Ludius granicollis n. sp.

Genus **Hemicrepidius** Germar

This genus is exclusively American and with one exception is limited to North America. It is generally placed close to *Ludius (Corymbites)* on account of the incompletely margined clypeus yet it is more nearly allied to *Athous* as shown by the long first tarsal segment and lobed second and third segments. In several of the species the clypeus is also completely margined though not projected forwards as is usual in *Athous*. In Dr. Horn's most excellent revision,[27] considerable emphasis is laid upon the fact that in certain species the posterior part of the propleuræ is quite smooth. Larger series than Horn had access to have shown that this character is a variable one and not always to be completely relied upon. The clypeus and mesosternum are also somewhat variable within the limits of a species.

Hemicrepidius tumescens (Lec.) was first taken on Santa Cruz Island, off the coast of southern California. The specimens more recently collected have been taken along the seashore of Humboldt Co., Calif., and at Waldport and Cannon Beach, Oregon, I found it in numbers under driftwood logs

[27] Notes on the species of *Asaphes* of Boreal America, by George H. Horn, Tr. Am. Ent. Soc., vol. VIII, 1880, pp. 69-75.

above the line of summer high tides. I have not seen specimens collected from the seashore of middle California. *Asaphes hirtus* Cand., a related though readily separated species, is, however, fairly common at times in the sand dunes south of San Francisco. The type of *tumescens* was a female. The males are, as usual in the genus, much smaller, and generally much darker, quite piceous, resembling very much the darker phases of *decoloratus* Say.

Hemicrepidius lecontei (Cand.) is a species founded upon males. The females are quite different in appearance, resembling somewhat the females of *tumescens*. For this reason, it has at times been stated that *lecontei* was but the male of *tumescens*. That is, however, incorrect. *Hemicrepidius lecontei* (Cand.), is a distinct species, differing not only by having shorter pile and of a more uniform length throughout, but by having the prosternal mucro flexed and the mesosternal lobes not prominent. The females are usually brown or piceous but the males generally have each elytron ornamented with a broad yellow vitta. This species is also a more inland one being commonest in the Willamette Valley of Oregon and the Puget Sound region of Washington.

Hemicrepidius soccifer (Lec.) is also a species about which there has been some confusion. It extends from New Mexico into Arizona. I have seen large females from Mt. Lemon, Santa Catalina Mts., Ariz., and a fair series of males from the high Chiricahua Mts. of Ariz. When fully pigmented the males are very dark brown or even piceous in color and look not unlike more elongate specimens of the dark phase of *decoloratus*. Aside from the characters given by Horn, they also have the front quite definitely sulcate and the clypeal margin practically complete, thus closely simulating an *Athous*.

Genus **Melanactes** LeConte

Melanactes agrypnoides, Van Dyke, new species

Large, robust, dull black, antennæ and legs rufopiceous. Head broadly, shallowly sulcate in front, rather coarsely, somewhat closely punctured; antennæ about reaching hind angles of prothorax, second segment small, slightly longer than broad, third longer and apically dilated, fourth to tenth broadly serrate, the fourth broader than long, the following gradually narrower, the eleventh elongate and suddenly constricted before apex. Prothorax from apices of hind angles to apex, longer than broad, sides evenly, rather broadly arcuate from hind angles and narrowed toward apex, hind angles prominent, distinctly divergent and blunt at apex, carinate, the carinæ long and close to margin, the marginal groove extending but slightly beyond the middle, the disk convex, not flattened, rather coarsely, moderately closely punctured in front and at sides, more finely at middle and behind, without evident median canaliculation but with prominent prescutellar tubercle. Scutellum subquadrate, with margins well elevated and disk rather finely punctured. Elytra almost twice as long as broad, sides slightly arcuate and gradually narrowed from anterior third to apex, disk convex, the striæ well impressed at base, elsewhere indicated only by series of fine, moderately closely placed punctures, the intervals flat except at base and very finely punctured, the humeri prominent, the ninth interval very prominent, almost carinate at basal half and with deep groove between it and margin. Beneath the prosternum and metasternum coarsely not closely punctured, the propleuræ more finely and closely and elsewhere very finely punctured. Length 28 mm., breadth 9 mm.

Holotype: No. 3193, Mus. Calif. Acad. Sci., a unique in my collection, collected at **Nogales, Ariz.,** Aug. 14, 1906, by F. W. Nunenmacher.

This fine species as its name indicates looks very much like an *Agrypnus* and quite unlike any of the other species of *Melanactes*. Aside from its peculiar facies and dull appearance, the distinctive features are the markedly serrate antennæ, the rather small third segment, longer than fourth in other species, prominent prescutellar tubercle, and subcarinate ninth elytral interval.

Genus **Agriotes** Eschscholtz

This genus is well represented in western North America and many of the species are quite variable as to color, dichromatism being common as it is with the eastern species *stabilis, fucosus,* and to a lesser degree in *pubescens.* In *ferruginei-*

pennis, the species is dichromatic in some localities, in others polychromatic. A study of a very large series of this variable species leads me to place it as but a western subspecies at most of *fucosus* and with it I would also place *brunneus* Schfr. There are no distinctive morphological characters to separate them. *Agriotes nevadensis* Lec., also appears in two distinctive color phases, the typical rufous phase as well as a lark piceous or black phase, the latter superficially very much resembling *hispidus* Lec. A number of new species have also been found in recent years which will now be described.

Agriotes cylindricus Van Dyke, new species

Elongate, subcylindrical; brown or reddish brown. Each elytron generally with a broad testaceous vitta, the anterior margin of prothorax and hind angles, basal segment of antennæ and legs also testaceous; and sparsely clothed with fine, short pile. Head coarsely, closely punctured; antennæ reaching slightly beyond hind angles of prothorax, second segment two and a half times as long as broad, third much smaller, and each evidently shorter than fourth. Prothorax somewhat less than one-fourth longer at middle than broad, spatulate, very convex, sides broadly arcuate in front, sinuate posteriorly, hind angles moderately prominent and hardly divergent, carina fine, slightly more than one-third length of prothorax, feebly divergent from lateral margin, the lateral margin very fine and generally interrupted at middle though often complete, disk coarsely, deeply and rather closely punctured in front, gradually more finely behind, rather definitely canaliculate at middle behind. Elytra about two and a half times the length of the prothorax as well as its own breadth, sides parallel in front, gradually narrowing and rounded towards apex, the disk convex, striæ distinct and rather coarsely, closely punctured, especially at sides, the intervals flat and but little wider than the strial punctures, finely punctured and transversely rugose. Beneath coarsely punctured in front, gradually finer towards apex, the punctures of propleuræ slightly finer and better spaced than those of prosternum, those of metasternum quite close, the hind coxal plates narrow and very gradually dilated inwardly. Length 7 mm., breadth 2 mm.

Holotype: Male, No. 3194, Mus. Calif. Acad. Sci., and numerous designated *Paratypes* from a series of over forty specimens collected near **Camp Potwisha, Sequoia National Park, Calif.**, during May and June, 1929.

This species belongs close to *sparsus* Lec. and is about of the same length but narrower, more parallel, more convex, with the prothorax proportionally longer and its discal punc-

tures coarser and somewhat closer, the strial punctures of the elytra much coarser, more rounded, and the intervals narrower. In *sparsus,* the punctures of the propleuræ are close together and of the prosternum rather sparse and widely spaced.

Agriotes bivittatus Van Dyke, new species

Subcylindrical, short and obtuse at both extremities; opaque, black, each elytron with a dull yellow vitta, three intervals wide, extending in an oblique direction from humeral angle almost to apex, the tibiæ and tarsi slightly testaceous, and clothed with short golden pubescence. Head coarsely, closely punctured; antennæ short, not reaching apices of hind angles of prothorax, second segment about three-fourths length of fourth, the third slightly shorter, outer segments moderately serrate, the fourth segment the longest and broadest, the following gradually narrower. Prothorax longer than broad, quite convex, sides gradually convergent, almost straight from in front of hind angles until near apex where slightly rounded, lateral margin sharply defined and complete, hind angles not divergent, moderately long and with carina well marked and divergent forwards from margin; the disk slightly flattened posteriorly and with a moderate canaliculation which ends in a distinct basal tubercle, the surface coarsely, deeply and densely punctured. Elytra about twice as long as prothorax, widest at middle, gradually arcuately narrowed to blunt apices, disk with striæ finely impressed and rather finely, closely punctured, the intervals flattened, very finely punctured and rugose, the surface presenting a granular appearance. Beneath with the prosternum rather coarsely and moderately closely punctured, the propleuræ coarsely and shallowly punctured and the abdomen rather finely punctured, the hind coxal plates somewhat suddenly dilated within. Length 5.5 mm., breadth 1.75 mm.

Holotype: No. 3195, Mus. Calif. Acad. Sci., and two *Paratypes,* one 5.5 and the other 6.5 mm. long, from **Corvallis, Oregon.**

This very distinct little species would come in LeConte's table after *nevadensis* Lec. and before *apicalis* Lec., to the latter of which it is no doubt somewhat related as shown by its opaqueness and general features.

Agriotes criddlei Van Dyke, new species

Small, compact, rather blunt at both extremities, opaque, black, elytra dark brown, legs somewhat testaceous, and clothed with short fulvous pile. Head closely, coarsely punctured; antennæ barely reaching apices of hind angles of prothorax, second and third segments of about equal length and each a bit

more than three-fourths the length of fourth, the intermediate segments distinctly serrate, the sixth the broadest. Prothorax longer than broad, sides straight, just perceptibly converging forwards and rounded at apex; hind angles well marked, not divergent and with distinct carina which diverges markedly from margin forwards, lateral margin sharply defined and complete, disk coarsely, umbilicately and rather closely punctured, canaliculate posteriorly at middle, and with slight tubercle in front of scutellum. Elytra slightly more than twice as long as broad, with sides almost parallel in front, gradually arcuately narrowed posteriorly to apices, disk with striæ finely impressed, the striæ finely, closely punctured, coarser near base, the intervals flattened, minutely punctured, finely rugose and granular. Prosternum coarsely, deeply but not closely punctured, the propleuræ coarsely and shallowly punctured and the abdomen rather finely punctured, the hind coxal plates rather suddenly dilated within. Length 4.5 mm., breadth 1.25 mm.

Holotype: No. 3196, Mus. Calif. Acad. Sci., and two *Paratypes* in my collection, taken near **Aweme, Manitoba, Canada,** June 10, 1909, by Mr. Norman Criddle, and by him kindly presented to me. Three other specimens are in my collection, two collected at Medicine Hat, Alberta, May 3, 1924, by Mr. F. S. Carr, and one from the Grand Teton National Park, Wyoming, June 21, 1930, collected by myself. This species is named after Mr. Criddle as a mark of regard for numerous favors received.

This, the smallest species in our fauna, bears considerable resemblance to *bivittatus* and is without doubt closely related to it. It should follow that in our lists. Neither are closely related to *montanus* Lec., the general facies, opaqueness and variolate type of pronotal punctures distinctly separating them.

Agriotes porosus Van Dyke, new species

Elongate, subcylindrical; black, antennæ and legs somewhat piceous. Head coarsely, closely punctured; antennæ reaching slightly beyond hind angles of prothorax, second and third segments about equal in length and each three-fourths length of fourth. Prothorax slightly longer than broad, very convex, sides parallel behind, broadly rounded and convergent in front, hind angles moderately prominent, not divergent, the carina distinct, slightly divergent from sides anteriorly and somewhat more than one-fourth length of prothorax, lateral margin complete and sharply defined, disk with vague canaliculation at middle, posteriorly coarsely, deeply and closely punctured. Elytra slightly more than twice as long as prothorax, parallel in front, gradually arcuately narrowing from middle to apex, the striæ fine, rather closely, coarsely punctured in front, more finely posteriorly, intervals flat, finely punctured and

slightly transversely rugose, especially towards base. Beneath rather coarsely, closely punctured on prosternum, more finely and closely on propleuræ, giving granular appearance, and very finely and closely on both metasternum and ventral segments. Length 8 mm., breadth 2 mm.

Holotype: No. 3197, Mus. Calif. Acad. Sci., a unique collected by myself in the **Black Mountains** of **North Carolina,** during June, 1902.

This species is of about the same size as *avulsus* Lec. but the latter is shining, has the second and third antennal segments almost equal in length to the fourth, the prothorax quite narrowed in front, with diverging hind angles and disk not closely punctured, as well as having distinctly red antennæ and legs. From the two Pacific Coast species with which it might be confused, it can be separated as follows: *Agriotes hispidus* Lec. has longer and more erect pile, pronotal punctures less coarse, the lateral margin often incomplete, the prosternal punctures finer and the legs generally more reddish; and the black phase of *nevadensis* Lec. has the second and third antennal segments shorter, the prothorax more flattened, more narrowed in front and more finely and sparsely punctured, as is also the prosternum. According to the LeConte table[28] it would be placed next to *nevadensis* Lec.

Agriotes blaisdelli Van Dyke, new species

Elongate, subdepressed, testaceous, clothed with short pubescence. Head coarsely, shallowly punctured, antennæ long and filiform, reaching at least three segments beyond hind angles of prothorax, second segment about twice as long as broad, third one-half longer, fourth one-third longer than third, the following gradually shorter. Prothorax perceptibly longer than broad, sides sinuate in front of hind angles, evenly arcuate in front, broadest at middle and narrowest at apex, hind angles acute, slightly divergent, carinate, disk slightly convex, coarsely, shallowly and moderately closely punctured, and with an evident yet not distinct canaliculation at middle. Elytra over three times as long as prothorax, sides slightly arcuate, apex subacute, disk moderately convex, striæ very fine, often obscure, and finely punctured, intervals minutely punctured and finely granulose. Prothorax punctured beneath in same manner as above. Abdomen finely punctured, the hind coxal plates moderately dilated inwardly and with hind margin of expanded portion truncate posteriorly. Length 4.5 mm., breadth 1.25 mm.

[28] Tr. Am. Entom. Soc., XII, 1884, p. 16.

Holotype: No. 3198, Mus. Calif. Acad. Sci., and several designated *Paratypes* from a series of fifteen specimens collected at **Shasta Retreat, Siskiyou Co., Calif.,** alt. 2416 ft., July 3, 1905, by Dr. F. E. Blaisdell. A large series in the possession of Dr. Blaisdell has also been examined, besides a single individual collected by myself at Bubbs Creek, Kings River region, Fresno Co., Calif., alt. 9700 ft., July 7, 1910, and three specimens from Santa Cruz Co., Calif., June, 1896, collected by Mr. F. W. Nunenmacher.

This small and entirely testaceous species could not possibly be confused with any of the various phases of *Dolopius lateralis* Esch. nor with any of the species of *Agriotes.* Its somewhat flattened appearance would lead one to place it in *Dolopius* but the lateral margin of the prothorax is clearly that of *Agriotes* and not the other. This character is, however, a very weak one and as it is the only one that separates the two genera, they may some day have to be united.

Betarmon bigeminatus Randall

In the eastern part of our country this species appears to be quite stable as to size and coloration but from the Rocky Mountains west to Vancouver Island, there appears a race which is distinctly larger, fully 1 mm. longer than the average eastern individual, more shining, and occasionally with the yellow markings of the elytra running together so that the elytra are almost entirely yellow as is the case with two specimens which I have examined from Nanaimo, British Columbia. I have specimens of this large race from near Longs Peak, Colorado, the southern part of Yellowstone Park, and from two places on Vancouver Island. *Betarmon californicus* Schfr. is even more variable as to color, the elytra varying from entirely black, through the usual phase with suture and apices black, to others where they are entirely yellow. The head always remains black but the pronotum though usually yellow or orange may have a black discal patch or vitta.

Genus **Sericus** Eschscholtz

Sericus rugosus Van Dyke, new species

Elongate, narrowed in front and behind, subopaque, reddish brown to dark brown, sparsely clothed with short, fine pile, somewhat denser beneath. Head rather coarsely, densely, umbilicately punctured, mouthparts conspicuously prognathous, labrum large and transverse; antennæ extending a segment and a half beyond hind angles of prothorax in male, just reaching the same in female, second and third segments small, about equal in length and a little longer than broad, together equal to fourth segment in male, the third a little longer than second in female and together longer than fourth, fourth to tenth distinctly serrate. Prothorax including hind angles a third longer than broad, distinctly narrowed in front, hind angles long and acute, finely carinate, sides barely arcuate in male, distinctly so in female, disk convex, coarsely, densely, and umbilicately punctured, faintly canaliculate at middle behind. Scutellum elongate, slightly convex and densely punctured. Elytra two and a half times as long as prothorax, gradually narrowed from behind humeri in male, from about middle in female, disk convex, striæ fine and finely, closely punctured, intervals flat, finely, irregularly punctured and finely, transversely rugose. Beneath coarsely, not closely punctured on prosternum, densely and shallowly on propleuræ, finely and very densely on metasternum, and finely, more sparsely on basal segments of abdomen. Length 9-10 mm., breadth 2 mm. in male to 2.5 mm. in female.

Holotype: No. 3199; and *Allotype:* No. 3200, Mus. Calif. Acad. Sci., and several designated *Paratypes* in my collection, the first collected by myself in the **Yosemite Valley**, June 7, 1921, the second collected in Eldorado Co., Calif., June 11, 1906, by Mr. F. W. Nunenmacher. Among the other nine specimens are representatives from Siskiyou, Shasta, Trinity and Mariposa counties.

This very distinct and somewhat opaque species is perhaps most closely related to *incongruus* Lec. but differs by being proportionately longer and narrower, more coarsely punctured, with finer carinæ on hind angles of prothorax, and of a more uniform color. It superficially resembles some of the smaller specimens of *Agriotes ferrugineipennis* Lec.

Subfamily **Plastocerinæ**

The members of this group are entitled to subfamily rank but no more. As stated by LeConte they grade gradually into the true Elateridæ. The gap between *Eniconyx,* of the former.

and *Aptopus* of the latter is but slight. It is characteristic of our southwest though not limited to that region, for certain members are to be found in Mexico and South America and even in the Old World. The genus *Euplastius* established in 1903 by O. Schwarz, I am inclined to believe will some day be found not to belong to our fauna. It seems strange that two species of a genus, one supposedly collected in California, the other in Alabama, should find their way into the hands of a European institution, while none of the many excellent collectors who have worked in both California and Alabama should run across either. Horn[29] in 1881, described and figured females of a number of our species in the genera *Euthysanius* and *Aplastus*, showing that they were not only wingless but with elytra greatly reduced and abdomens much enlarged especially in *Euthysanius*. He believed that in *Plastocerus* the female was like the male in all regards except in having the antennal appendages shorter. What he figured as *Plastocerus frater* Lec., he stated was "undoubtedly a female." Five specimens in my collection which agree with this in every regard are shown by an examination of the genitalia to be males. I also have a true female which is more extreme in its degree of degeneration than is any female *Euthysanius*. The elytra are reduced to mere transverse pads, about two-thirds the length of the prothorax, and the eight-segmented abdomen is over three and a half times as long as the entire forebody (head, pro-, meso- and metathorax). The species are all so unstable and variable as to outline and sculpturing that one needs to have many specimens in order to make determinations at all certain.

Fall,[30] Schaeffer[31] and Tanner[32] have added to the number of species originally made known by LeConte and Horn. In my collection are also a number of new species. These I will now describe.

---

[29] Tr. Am. Ent. Soc., IX, 1881, pp. 76-81, pl. 1 & 2.
[30] Psyche, 35, 1928, pp. 139-146.
[31] Journal N. Y. Ent. Soc., 24, 1916, p. 266.
[32] Pan-Pacific Ent., 2, 1926, pp. 188-190.

Genus **Euthysanius** LeConte

SYNOPTIC TABLE FOR MALES

1. Pronotum coarsely, more or less densely punctured..... 2
   Pronotum finely, somewhat sparsely punctured..... 3

2. Large, 18-25 mm. in length, robust, reddish brown; terminal segment of antennæ decidedly shorter than appendage of eleventh segment; pronotum coarsely, closely punctured at sides, more finely and less closely at middle, the disk shining, sides rounded in front but distinctly divergent posteriorly. Southern Calif.....*lautus* Lec.
   Smaller, 16 mm. in length, subcylindrical, rufotestaceous; terminal segment of antennæ about as long as appendage of eleventh segment; pronotum, coarsely and cribrately punctured over entire surface, the disk subopaque, sides slightly arcuate in front and gradually divergent posteriorly. Mts. of Tulare Co., Calif.....*cribricollis* n. sp.

3. More or less rufotestaceous in color..... 4
   Dark brown or piceous in color, 18 mm. in length, rather robust; last antennal segment not quite as long as appendage of eleventh segment; prothorax broader than long, disk distinctly though variably punctured, sides slightly arcuate in front, thence slightly divergent to widely diverging hind angles. San Mateo Co., Calif.....*piceus* n. sp.

4. Moderately large and rather robust species, 17-19 mm. in length, rufotestaceous; last antennal segment almost as long as appendages of eleventh..... 5
   Narrower and more graceful or smaller species, rufotestaceous.. 6

5. Prothorax longer than broad, trapezoidal; rufopiceous; elytra elongate, distinctly narrowed behind and with striæ barely impressed except towards sides and apex; length 17 mm. Owens Valley, Calif.....*horni* Fall
   Prothorax fully as broad as long; rufocastaneous; elytra but little narrowed behind and with striæ deeply impressed; length 17-19 mm. Western foothills of the Sierra, Calif.....*pretiosus* Lec.

6. Species with large eyes, hemispherical; last segment of antennæ about as long as appendage of eleventh; prothorax longer than broad, sides almost straight and diverging posteriorly; elytra distinctly narrowed posteriorly; 17-18 mm. long.... 7
   Species with eyes much reduced in size; last segment of antennæ very distinctly shorter than appendage of eleventh; prothorax about as wide as long, subcampanulate; elytra with sides parallel in basal two-thirds, striæ feebly impressed; length 15.5 mm. White Mts., Gila Co., Ariz.....*imparoculatus* Fall

7. Upper surface clothed with an evident sparse, fine pile giving it a dull appearance; prothorax about as long at middle as broad, disk very finely punctured; the sides straight and slightly diverging posteriorly to base of hind angles which are rather long, narrow and abruptly divergent; the elytra with striæ shallowly impressed and vaguely punctured; length 18 mm. Zion Nat. Pk. and St. George, Utah..... *blaisdelli* Tanner

Euthysanius cribricollis Van Dyke, new species

Elongate, subparallel, rufotestaceous, subopaque, conspicuously clothed with a fine, short, suberect fulvous pile. Head triangularly impressed in front, coarsely, cribrately punctured, and conspicuously clothed with fulvous pile; eyes prominent, hemispherical; antennæ about reaching hind angles of prothorax, outer segments pectinate as usual but with appendages rather short, about three times length of segments, the last segment distinctly shorter and more robust than appendage of eleventh segment. Prothorax subcampanulate, distinctly longer at middle than broad, the front margin conspicuously lobed; sides arcuate, gradually divergent, the hind angles prominent, robust, subacute at apex, divergent from sides and carinate; disk very convex, coarsely, closely, umbilicately and cribrately punctured over entire surface, median impression shallow but distinct and complete. Scutellum elongate, concave, finely punctured and evenly rounded posteriorly. Elytra almost three times as long as broad, sides gradually narrowing posteriorly, convex, the striæ well impressed and rather coarsely, closely punctured, the intervals convex and finely, irregularly punctured. Beneath, propleuræ coarsely, rather closely punctured, prosternum less coarsely punctured and carinate at middle, afterbody more finely punctured, hind tibiæ emarginate on anterior margin. Length 18 mm., breadth 4.5 mm.

Holotype: Male, No. 3201, Mus. Calif. Acad. Sci., and thirteen *Paratypes* collected near **Kaweah, Tulare Co., Calif.,** July 15, 1930, by Mr. Roy S. Wagner. The holotype and a couple of paratypes are in the collection of the California Academy of Sciences through the courtesy of Mr. Wagner, the remainder in Mr. Wagner's collection. Another specimen collected at Three Rivers, near the Sequoia National Park, is in my collection.

The coarse and cribrate prothoracic punctation and rather short appendages should readily distinguish this species from its fellows.

Euthysanius piceus Van Dyke, new species

Robust, subparallel, piceous, the antennæ, legs, metasternum and abdomen somewhat rufous, body slightly shining though sparsely clothed with a short, fulvous pile. Head broadly, somewhat triangularly impressed in front and rather coarsely and closely punctured; eyes only moderately prominent, not hemispherical, the interocular area greater than their common breadth; antennæ almost reaching hind angles of prothorax, the appendages of median segments more than three times the length of the segments, the last segment slightly shorter than the appendage of the eleventh. Prothorax broader than long at middle; front margin slightly lobed; sides somewhat arcuate though often straight and slightly divergent to hind angles which are short, robust, obliquely truncate at apex, carinate and divergent from the side margin; disk somewhat convex, moderately not closely and irregularly punctured, median impression not generally present (well defined in one specimen). Scutellum elongate, flattened, longitudinally carinate at middle, punctured and with apical notch. Elytra somewhat more than two and a half times as long as broad, sides very slightly narrowing posteriorly, convex, the striæ sometimes finely but generally well impressed and somewhat coarsely and closely punctured, the intervals flat or convex, finely, irregularly punctured and rugulose. Beneath, propleuræ punctured in front and at sides, smooth and shining behind, prosternum sparsely punctured and carinate at middle, the afterbody finely and sparsely punctured, except at apex of last segment where rather close, the hind tibiæ straight and without emarginations. Length 18 mm., width 5 mm.

Female, similar to specimen figured as No. 5, Plate 1, by Horn.[33] The "Coast region of Cal. south of San Francisco" is the territory where this species lives. *E. pretiosus* Lec. is always found in the interior and never near the coast. My female was taken at Burlingame, June 19, 1909. It is somewhat rufopiceous, the terminal segments of the antennæ missing, otherwise in perfect agreement with the description given by Horn for the female of *pretiosus*, its description therefore need not be repeated.

The males of this species might be taken for darker phases of *E. pretiosus* Lec. They are, however, somewhat shorter and stockier, have less prominent eyes (almost hemispherical in *pretiosus*), the distance between the eyes greater, the antennal appendages much shorter and the terminal segment shorter than the appendage of the eleventh, about equal in the others, generally more robust prothorax, with sides more arcuate and hind angles shorter and more suddenly divergent,

[33] Tr. Am. Ent. Soc., IX, 1881, p. 81, Plate 1, fig. 5.

the scutellum also with a well defined carina in most of my specimens.

Holotype: Male, No. 3202, Mus. Calif. Acad. Sci., and nine male *Paratypes* in my collection, taken at **Burlingame, San Mateo Co., Calif.,** July 17, 1909, by Mr. H. Kusche.

Euthysanius pretiosus LeConte, Female

I have a specimen of what is probably this species. It differs from the female of *piceus* primarily in having a longer abdomen, approaching in this regard the females of *lautus,* in having the sides of the pronotum more arcuate, and the hind angles shorter, more robust and not divergent. In my two female specimens of *E. lautus* Lec., one has the hind angles divergent as in the specimen figured by Horn (Pl. I, fig. 3) but not to such a degree, the other has them much as in my specimen of *pretiosus,* not divergent. In these degenerate females, variations occur to such a degree that one cannot determine the species by characters alone. The same thing applies to the females of *Pleocoma.*

Euthysanius blaisdelli Tanner

Specimens collected at St. George, Utah, by Mr. Warren Knaus have the prothorax somewhat more narrowed in front and the sides less arcuate than are those from the type locality, Zion National Park.

Genus **Plastocerus** LeConte

Though all the species are variable as regards the shape of the prothorax, general sculpturing, and even the presence or absence of a prosternal carina, there is a certain sum of characters which will readily enable the species to be separated especially if one has a series of specimens. As indicated previously, I consider all winged individuals as males, there-

fore differ from Horn as to the status of the three which he discussed. *Plastocerus frater* Lec. I consider a well defined species because of the short antennal appendages. All specimens that I have seen come from near Los Angeles. *Plastocerus schaumi* Lec. is the most variable of all the species and is the most widely distributed, extending from San Diego and Imperial to Kern Co. *Plastocerus macer* Lec., should for the present, because of its shorter and less divergent hind prothoracic angles and more pronounced pronotal punctation, be kept separate from the preceding though it may later on be proven to be but a variety of it as stated by Horn. *Plastocerus megalops* Fall and *granti* Schfr. are of course good species and the one which I am describing is equally distinct.

TABLE FOR SEPARATION OF MALES

1. Appendages of outer segments of antennæ three to four times length of segment 2

   Appendages of outer segments of antennæ less than three times length of segment, pronotum coarsely and densely punctured 6

2. Hind angles of prothorax strongly divergent and carinate 3

   Hind angles hardly divergent, feebly carinate 5

3. Eyes less prominent, not quite hemispherical, elytra somewhat shining 4

   Eyes very prominent, hemispherical, elytra finely rugulose and dull; Claremont, Calif. ..... *megalops* Fall

4. Sides of prothorax arcuate in front at most, pronotum rather finely not deeply punctured; southern Calif. ..... *schaumi* Lec.

   Sides of prothorax suddenly expanded in front into wing-like processes, pronotum coarsely, somewhat cribrately punctured; Coalinga, Calif. ..... *amplicollis* n. sp.

5. Sides of prothorax feebly arcuate in front, pronotum densely punctured; southern Calif. ..... *macer* Horn

6. Hind angles of prothorax carinate, prosternum not carinate, length 10-11 mm.; southern Calif. ..... *frater* Lec.

   Hind angles of prothorax non-carinate, prosternum carinate at middle, length 9 mm.; southwest Texas ..... *granti* Schfr.

Plastocerus amplicollis Van Dyke, new species

Elongate, subparallel, rufotestaceous, underside and legs lighter, and sparsely clothed with a rather coarse fulvous pile. Head very coarsely and densely punctured, broadly, shallowly sulcate in front; eyes almost hemispherical, the width of pair not quite equalling the interocular diameter; antennæ about reaching base of hind angles of prothorax, the appendages of the median segments almost four times the length of the segments, and the eleventh segment about equal in length to the appendage of the tenth but more robust. Prothorax broader than long, front margin distinctly lobed; the sides broadly and rather abruptly expanded in front into wing-like processes, thence deeply emarginate posteriorly to the long, narrow and divergent hind angles; disk coarsely, closely, and somewhat cribrately punctured, the median impression well marked. Elytra three times as long as broad, slightly narrowed towards apex, striæ finely yet distinctly impressed and somewhat regularly punctured, the intervals slightly convex behind. Beneath: Prosternum rather coarsely and sparsely punctured, with prominent carina at center, the propleuræ more shallowly punctured, elsewhere very finely punctured, the hind tibiæ shallowly emarginate on anterior margin. Length 12 mm., breadth 3 mm.

Holotype: Male, No. 3203, Mus. Calif. Acad. Sci., and one *Paratype,* the first collected on the **Los Gatos Divide** of the Mt. Diablo Range northwest of **Coalinga, Fresno Co., Calif.,** June 6-8, 1907, the second from near Coalinga, Calif., June 9, 1907, by Prof. J. C. Bradley and kindly presented to me many years ago.

The prothorax with its wing-like expansions and coarsely punctured disk will enable this species to be easily recognized.

Genus **Aplastus** LeConte

KEY FOR SEPARATION OF MALES[34]

1. Third segment of antennæ long, almost equalling fourth in length and breadth; the antennæ as a whole slender, feebly serrate, the basal three segments only pilose; sides of prothorax parallel, not margined, hind angles strongly divergent; length 15 mm. San Diego, Calif. ..... *angusticollis* Horn

   Third segment of antennæ short, never approaching fourth in length, outer segments with short erect hair 2

2. Sides of prothorax without well defined margin or with but a short one near hind angles (a narrow smooth line or even a narrow groove may, however, exist laterally) 3

   Sides of prothorax with well defined margin, at least in basal area. 7

[34] Modified from that given by Horn, Tr. Am. Ent. Soc., 9, 1881, p. 77.

3. Antennæ delicate yet strongly serrate, the segments narrow at base, rather suddenly dilating towards apex, segments 2-3 small, the third but little larger at most than second, together slightly longer than half the fourth..... 4

Antennæ more robust and strongly serrate, the outer segments more triangular, gradually dilating from base to apex, third segment more than twice as long as second, the two together nearly as long as fourth; length 15 mm. Southern Calif. ..*speratus* Lec.

4. Elytra scarcely striate; eyes not prominent, prothorax slightly broader than long, sides straight and slightly diverging backwards to somewhat more divergent and acute hind angles, the disk rather sparsely and finely punctured; color piceous or rufopiceous; length 11-12 mm. Mojave Desert and adjacent arid territory to Nevada.....*tenuiformis* Horn

Elytra finely though definitely striate, at least near suture..... 5

5. Prothorax about as broad as long, the disk coarsely or moderately coarsely punctured..... 6

Prothorax distinctly longer than broad, sides straight and barely divergent backwards to distinctly divergent and acute hind angles, the disk sparsely and finely punctured; eyes not prominent, color rufopiceous; length 13-14 mm. Salt Lake Valley, Utah.....*cylindricus* n. sp.

6. Eyes not prominent, median segments of antennæ very slightly dilating to middle then more suddenly to apex, pronotum rather coarsely and closely punctured, elytral striæ finely and sharply impressed, color rufopiceous; length 12 mm. Pasadena and Mojave Desert, Calif.....*corymbitoides* Horn

Eyes moderately prominent, almost hemispherical, median segments of antennæ subcylindrical basally, the apical expansion appearing almost as an appendage, pronotum moderately finely and closely punctured, elytral striæ finely but not sharply impressed, color rufotestaceous; length 13 mm. Northern Ariz.....*arizonicus* n. sp.

7. Rufous or reddish brown; third antennal segment always distinctly larger than second, intermediate antennal segments strongly serrate, the segments more or less triangular; elytral striæ well impressed..... 8

Brown or piceous; third antennal segment but little if at all larger than second segment; elytral striæ finely or feebly impressed..... 11

8. Rufous or reddish brown species, pubescence more or less fine and inconspicuous..... 9

Robust, piceous species, pubescence rather long, coarse and more or less conspicuous; third antennal segment considerably larger than second and triangular; prothorax with sides almost parallel and abruptly divergent hind angles; length 13 mm. Merced Co., Calif. ..... *pilosus* n. sp.

9. Rather robust and moderately long species, about four times as long as broad; prothorax generally distinctly longer at middle than broad 10

Narrow and very elongated species, considerably more than four times as long as broad; prothorax slightly broader than long at middle; outer segments of antennæ about twice as long as broad; length 14.5-17 mm. Tulare, Fresno and Inyo Cos., Calif. ..... *productus* Fall

10. Intermediate segments of antennæ strongly produced at apex; length 16 mm. Sierra Nevada Mts. from near Oroville to Tulare Co. ..... *piceicollis* Fall

Intermediate segments of antennæ quite triangular, hardly if at all produced at apex; length 14-16 mm. San Francisco Bay counties, Calif. ..... *optatus* Lec.

11. Elytral striæ fine but distinct, intervals very finely punctate and scabrous; eyes feebly prominent; length 12-13 mm. San Francisco Bay counties, Calif. ..... *molestus* Horn

Elytral striæ feeble, somewhat obsolete, intervals densely scabrous punctate; length 16 mm. Camp Nelson, Tulare Co., Calif. ..... *scabripennis* Fall

Aplastus cylindricus Van Dyke, new species

Narrow, elongate, piceous, legs and antennæ rufopiceous, rather sparsely clothed with short, gray pile. Head channeled between the eyes, coarsely, rather densely punctured; eyes not prominent; antennæ long, seventh segment reaching hind angles of prothorax, second and third segments small, transverse, together about two-thirds length of fourth, segments 4-10 distinctly serrate, each segment narrow and subcylindrical at basal half or two-thirds, then suddenly expanded with free angle prolonged at apex. Prothorax over two and one-half times as long at middle as broad, subcylindrical in front, the sides straight and parallel, hind angles acute and strongly divergent, lateral margin absent though a slight longitudinal lateral impression is evident, disk finely, rather sparsely punctured, median canaliculation fine and vague. Elytra almost three times as long as broad, sides almost straight and gradually narrowing from humeri backwards, the disk with striæ evident and fine near suture, elsewhere somewhat vague, the intervals flattened, finely punctured and finely scabrous. Beneath, prosternum carinate at middle, sulcate between

coxæ and rather coarsely punctured, propleuræ more finely punctured, the afterbody rather finely and sparsely punctured. Length 12 mm., breadth 3 mm.

Holotype: Male, No. 3204, Mus. Calif. Acad. Sci., and several designated *Paratypes* from a series of forty specimens collected by the late Mr. Tom Spalding at **Eureka** and neighboring regions of **Utah,** during the month of June of various years from 1912-1924.

This species is closely related to *tenuiformis* and looks like it. It differs from that primarily in having a longer and more cylindrical prothorax, and in having the median antennal segments with the apical dilation more suddenly expanded and appendix like, the segments in *tenuiformis* being quite triangular.

Aplastus arizonicus Van Dyke, new species

Narrow, elongate, rufotestaceous, legs lighter, sparsely clothed with short fulvous pile. Head coarsely, closely punctured, broadly, shallowly sulcate in front; eyes moderately prominent; antennæ long, middle of eighth segment reaching apex of hind angles of prothorax, second and third segments small, the latter the larger, together about two-thirds length of fourth, segments 4-10 serrate, each segment narrow and subcylindrical in basal half, thence gradually dilating towards apex with the free angle produced in the form of an appendage. Prothorax about as broad as long at middle, sides almost straight and slightly diverging from apex to base of hind angles which are acute and divergent, lateral margin evident near hind angles, disk moderately coarsely and sparsely punctured, the median canaliculation distinct and complete. Elytra about three times as long as broad, sides almost straight and gradually narrowing towards apex, the disk with striæ evident though poorly defined, and finely punctured, the intervals flattened, finely punctured and scabrous. Beneath, the prosternum carinate at middle, sulcate between coxæ and coarsely, closely punctured, propleuræ more finely punctured and somewhat shining, the afterbody rather finely sparsely punctured. Length 13 mm., breadth 3.5 mm.

Holotype: Male, No. 3205, Mus. Calif. Acad. Sci., and two *Paratypes,* the first and one of the paratypes from near **Prescott, Ariz.,** June 1910, collected by Mr. J. August Kusche, the second paratype from Flagstaff, Ariz., July 11, 1911, collected by Prof. H. F. Wickham.

This species looks like *corymbitoides* but differs by having much more prominent eyes, the median segments of the an-

tennæ slightly less triangular, the prothorax a bit broader, less coarsely and densely punctured and with a fine yet distinct lateral margin at the sides of the hind angles. In this last regard it shows an approach to the larger and more robust species, all of which have a well defined lateral margin.

Aplastus pilosus Van Dyke, new species

Elongate, robust, piceous, rather densely clothed with coarse, semi-erect pile. Head flattened in front, coarsely, densely punctured; eyes only moderately prominent; antennæ robust, eighth segment reaching apex of hind angles of prothorax, second segment small, as long as broad, third one-third longer and triangular, segments 4-10 strongly serrate, the individual segments triangular with outer margin almost straight and free angle but little produced, the segments gradually diminishing in breadth. Prothorax as broad as long at middle, anterior margin definitely lobed and notched at middle, sides barely arcuate from apex to base of hind angles and slightly divergent, the hind angles robust, strongly divergent, the lateral margin defined at basal half but not distinctly; disk convex, rather coarsely, closely punctured, the median canaliculation faintly defined at center. Elytra about two and one-half times as long as broad, sides almost straight and parallel and broadly rounded at apex, the striæ sharply impressed near suture, finer outwardly, the intervals flat, rather coarsely punctured and scabrous. Beneath, the prosternum longitudinally convex, with a transverse arcuate impression near front margin, and coarsely, closely punctured, the propleuræ similarly punctured in front but smoother behind, the hind body more finely punctured. Length 14 mm., breadth 4 mm.

Holotype: No. 3206, Mus. Calif. Acad. Sci., a unique in my collection, collected in **Merced Co., Calif.**, June 19, 1914, by Mr. F. W. Nunenmacher. The left antenna is abnormal in that there are but ten segments, the sixth and seventh being united into one very large segment.

This is the shortest proportionally and one of the darkest and most robust of our species. The long and coarse pile and rather coarse punctation will also assist in its separation.

Aplastus productus Fall

The characters of the last ventral segment mentioned by Fall, the very marked lateral emargination with a more or less truncate apex, is a variable character. In a specimen in the Blaisdell collection from Huntington Lake, Fresno Co., Calif.,

collected July 17, 1919, this character is well marked, whereas in a specimen in my own collection from Inyo Co., July 15, 1917, the sides of the last ventral are rather evenly arcuate and the apex notched. I have found that the shape of this segment also varies with other species.

Aplastus piceicollis Fall

If I am right in my interpretation of this species it is as usual a most variable one. The usual color is unicolorous rufotestaceous, those with darker forebody being the exception as are those uniformly dark. It also has a wide range being found on the western flanks of the Sierra from Tulare Co. to Plumas Co. In the Blaisdell collection there is a good series from Sutter Creek, Amador Co., July 25, 1901, in the collection of Mr. Roy S. Wagner is a good series including three females from Kaweah, Tulare Co., July 16, 1930, and I have numbers from intermediate territory. The shape of the intermediate segments of the antennæ is one of the most distinctive features.

Family CEBRIONIDÆ

Cebrio knausi Van Dyke, n. sp.

Moderately elongate, parallel, brown above, antennæ, legs and abdomen testaceous, forebody beneath rufotestaceous, and very sparsely clothed with very short and fine pile. Head rather coarsely, moderately closely punctured, more or less impressed between the eyes; labrum broadly emarginate in front; eyes prominent, almost hemispherical; antennæ somewhat serrate, eighth segment reaching hind angle of prothorax, second segment small, third almost twice as long, two-thirds the length of the following and somewhat triangular, median segments about twice as long as wide and gradually shorter and narrower towards apex. Prothorax about as broad as long at middle, sides straight and feebly diverging towards base, rounded near apex, the hind angles rather small but strongly divergent, disk finely, closely punctured. Elytra over twice as long as wide, striæ feebly impressed, strial punctures not separable, intervals slightly convex, finely closely punctured, the general surface somewhat granulate. Beneath: Prosternum of moderate breadth and triangular between the coxæ; propleuræ moderately finely, closely punctured and scabrous, meta-

sternum rather finely, densely punctured, the abdomen very finely, somewhat sparsely punctured, the last abdominal segment rounded at apex. Length 13 mm., breadth 4 mm.

Holotype: No. 3207, Mus. Calif. Acad. Sci., and one *Paratype* in my collection, collected by Mr. Warren Knaus at **St. George, Utah,** May 22-June 12, 1919. Paratypes are also in the collection of Mr. Knaus.

This is one of our smallest species and belongs in the division with *bicolor* Fab. and *emarginatus* Schfr., characterized by having a rather broad intercoxal prosternal process. From both of these it differs by being much smaller; from the former by having less strongly serrate antennæ, smaller and narrower prothorax, smaller and finer hind angles, the elytra with the striæ less sharply defined and the punctures not evident, the general surface also quite dull and granular; and from *emarginatus* by being darker, by having a smaller and more rectangular prothorax with small hind angles, more coarsely and closely punctured pronotum, as well as by a more closely punctured metasternum. Other species are separated by the narrow intercoxal prosternal process.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 10, pp. 467-469 DECEMBER 30, 1932

X

AGONOSTOMUS HANCOCKI Seale. sp. nov.

BY

ALVIN SEALE

Superintendent of the Steinhart Aquarium

A new species of Mugilidæ from the fresh water stream on Chatham Island of the Galapagos Group.

Head 4.3 to end of caudal vertebra, 5.4 in total length. Depth 4. Dorsal IV, 1.8. Anal II, 10. Scales 44 to end of the caudal vertebra, counted on a well marked striate line extending from upper axil of pectoral to base of caudal. 13 scales in a cross series at the origin of dorsal. The scales on the anterior median portion of the sides are decidedly enlarged. Head bluntly pointed, the jaws extending on side of head to below the anterior margin of pupil. The maxillary is hidden when the mouth is closed, its tip ending on a line with the anterior margin of pupil. Upper lip thick in the center and becoming slim distally, its thickness in the center being 1.5 in the eye. Lower lip rounded at margin and not particularly thick. It has a slight fold, no trace of knob at center. Both lips are smooth without papillæ or teeth. Length of lower jaw 2.5 in head. Teeth present in wide villiform bands on both jaws, vomer, palatines, and pterygoids. The teeth are small, pointed and dis-

tinct, each patch separate and well defined. Lower jaw with 4 large distinct mucous pores on each ramus. Gillrakers slim, 23 on lower limb, the longest slightly less than width of pupil. Interorbital space rounded and twice the width of eye, being 2.4 in head. Posterior nostril a wide clear opening, the anterior one fringed. Cheeks, from angle of preopercle to eye, with 5 rows of scales, 2 rows only directly below the pupil. The angle and posterior margin of the preorbital finely denticulate. Origin of spinous dorsal mid-way between pupil and the posterior axile of soft dorsal, being much nearer tip of snout than to base of caudal; its longest spine is equal to that portion of the head posterior of the orbit, and is much less than the longest ray of soft dorsal. There are 19 rows of scales in front of the dorsal fin, and 15 rows of scales between the origin of the spinous and soft dorsal. The origin of the soft dorsal is on a line with the base of the third anal ray. Soft dorsal and anal similar, the anal slightly longer, the base being equal to head posterior of orbit. Caudal peduncle long and deep, its least depth 1.7 in its length. Caudal fin well notched, its upper lobe the longer, greater than length of head. Pectoral fins on a line with the orbit, their tips extending to the 9th scale of the lateral line, their length about equal to ventrals. Origin of the ventrals mid-way between the tip of snout and the origin of the anal, their length 1.2 in head. Elongated pointed scales at side of spinous dorsal and pectorals. The lower portion of soft dorsal and anal lightly scaled.

Color in life: the back is olive green shading into orange on the sides. Belly white. Cheeks orange. Upper portion of pectoral base and axil of pectoral black, the webs yellow. Anal yellowish with dark shadings on posterior half. Ventrals lemon yellow. Spinous dorsal orange anteriorly with dark spines. Soft dorsal dusky with slight trace of orange. Caudal dusky with wash of orange. Color in alcohol: back dull grayish green becoming lighter on sides, the large scales of the sides being white with dark margins. Belly and lower sides white. Pectorals with upper base and axil black, a trace of dusky on posterior third of fin. Spinous dorsal grayish, the webs lighter.

Soft dorsal dusky. Anal white with large dark area on posterior half. Ventrals white. Head and snout dark, cheeks and throat whitish.

Type is No. 838 in the collection of the California Academy of Sciences. This type and one co-type were secured about one-half mile up a fresh water stream which empties into freshwater bay on the south side of Chatham (or San Christobal by chart name) in the Galapagos archipelago. Length of type 13.5 inches of co-type 13.5 in. Secured by Alvin Seale Jan. 1, 1932. G. Allan Hancock Expedition to the Galapagos 1931-1932. Named in honor of G. Allan Hancock, patron of science.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 11, pp. 471-472 NOVEMBER 16, 1933

XI

DESCRIPTION OF SALMO SELENIRIS A NEW CALIFORNIA TROUT

BY

JOHN OTTERBEIN SNYDER

Leland Stanford Jr. University

A cutthroat trout worthy of specific recognition has been found in certain headwaters of Silver King Creek, a tributary of East Carson River, which is a part of the Lahontan drainage area.[1] The habitat of the species is restricted by an impassable fall to the creeks of Fish Valley[2] in the high Sierra of California.

The form here described is an isolated variant of *S. henshawi,* differing markedly in the absence of spots from the body, the retention of parr marks to maturity, and the relatively smaller and more numerous scales.

The differentiation of this form from the more generally distributed parent species is directly parallel with that of the golden trouts west of the Sierra, as they differ from the rainbow in a reduction of the spots, the retention of parr marks, and a notable increase of the number of scales.

[1] The Fishes of the Lahontan System of Nevada and Northwestern California; Bulletin Bureau of Fisheries, XXXV, 1915-16.

[2] Reference is directed to the Dardanelles Quadrangle of the U. S. Geological Survey.

The form may be known as *Salmo seleniris*.[3] The type, No. 212, California Academy of Sciences, is characterized as follows—

Length to base of caudal 176 millimeters; head .24 of the length; depth of the body .19; depth caudal peduncle .10; length snout .06; maxillary .13; diameter eye .045; interorbital space .075; depth head .16; snout to occiput .16; to dorsal .50; to ventral .55; height dorsal .14; length anal .13; pectoral .16; ventral .13; length caudal to tip .18; to center .12; scales lateral series 171; above lateral line 30. Major parr marks 10 in number, the first immediately bordering the gill opening, the last at end of caudal peduncle; all crossed by the lateral line, the posterior ones bisected by it, the anterior ones two thirds below. Of the secondary row, 16 in number, every alternate spot dips between the nearby primary ones. No black spots on the body; 3 on the base of caudal, 3 on edge of upper caudal support, 5 on adipose, 16 or so on dorsal, other fins immaculate.

The body is comparatively round, long and slender, the fins rather thin and weak.

The color is pale, the whole body much suffused with yellow. The upper surface is pale yellowish olive or greenish olive in some lights; lateral stripe light coral red; region below rich ivory; ventral surface clear white; head light brownish above, the cheeks red like the lateral stripe; dorsal fins and caudal suffused with yellow and pink; lower fins pink. The entire body exhibits evanescent opaline reflections, and the skin is translucent, so much so that the dorsal cranial bones are partly outlined through the overlying tissue.

Numerous examples exhibit little variation from the type. Many paratypes are in the collection of the Academy and some are deposited in the Natural History Museum of the Leland Stanford Jr. University.

---

[3] Thomas R. Hanna who first directed the writer's attention to this fish suggests the common name Piute Trout. Specimens were collected by Mrs. Lynn Llewellyn and sent to the State Division of Fish and Game. Later Roland Dobler and J. W. Thornburg caught and packed out alive one hundred specimens, the paratypes.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 12, pp. 473-482 DECEMBER 31, 1940

XII

REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1931*

BY

C. E. GRUNSKY

President of the Academy

Owing to the financial stringency of the last few years the publication funds of the California Academy of Sciences have been seriously limited. In view of this deplorable condition it was deemed advisable to restrict the publications issued to scientific papers only, leaving Annual Reports and the usual statistical matter to more favorable times. The lacking ones will be issued as rapidly as possible.—EDITOR.

It is with particular satisfaction and pleasure that I present this annual report—this being the end of a 20 year period during which I have been honored with the presidency of the Academy. It has been a pleasure to be permitted during these years to assist in planning the Academy's research and other activities and to find its usefulness constantly extending. The latest evidence of progress we note is the fact that this annual meeting is the first general meeting of the Academy in our newly completed main unit of an East Wing.

Why, it may be asked, was this building erected at this time when everybody is economizing? The explanation is simple, but should perhaps be prefaced with the remark that, contrary to the general practice, public institutions and governments should spend more and not less in periods of business depression so as to stimulate the flow of money; so as to make for more not for less employment; so as to increase not decrease consumption, thereby giving the retailer and the property owner better opportunity to secure incomes and

---

* Printed from the John W. Hendrie Publication Endowment.

to pay taxes than under the reverse policy. It was in part the desire to thus accelerate the flow of money which prompted favorable action on a building program, but the main reason after all was the fact that the research activities of the Academy were in sore need of more room and that, as a contribution toward this building which is to house a goodly part of the African material which Mr. Leslie Simson is collecting, Mr. Simson placed in escrow for the Academy, properties worth about $150,000 subject to the sole condition that the Academy accept his offer to collect specimens of wild life in Africa, and that income from his property donation should go to him during his lifetime.

As the Academy has heretofore been putting aside on capital account from $10,000 to $15,000 a year the Board of Trustees, in the circumstances, deemed it wise to make a loan of $255,000. It is with this borrowed money that this building has been erected. In view of the large capital donation by Mr. Simson, and the specimens of African wild life which he is supplying at his own cost, and in view of the adequate accommodations thus made available for the Academy's administrative staff and the splendid facilities provided on the second floor for the Departments of Entomology and of Exhibits, the facilities for the Department of Fishes in the basement, and the magnificent storage spaces in various parts of the building it was then determined that the amount placed in recent years in capital account should now, for a time at least, be disbursed in operating expenses.

However, the installation of the African material in the alcoves provided for the same remains to be made. For the very large waterhole group at the end of the Simson Hall there should be about $15,000 donated by some friend of the Academy. For the ten large alcoves about $4000 each will be needed, and for the thirteen smaller alcoves about $1000 each.

It is a pleasure to announce in this connection that the Chief of Exhibits, Mr. Frank Tose, has offered to paint the background of one group as a donation; Dr. Barton W. Evermann proposes to contribute one group, and your President will attempt the painting of one background as a donation, with consequent cost reduction of the group, if his work should prove acceptable.

As will appear from the reports of the various members of the Academy's scientific staff the interest of the public in the exhibits at the Museum and in the Aquarium has continued unabated. The same need for more tank and floor space at the Aquarium as pointed out a year ago still exists. However, it seems hopeless to expect the needed funds from the city during the present business depression. Despite space limitation, however, the Aquarium maintains its reputation as one of the foremost in the world in the matter of the variety of the exhibits and in excellence of their display.

The various departments have made satisfactory progress, as will appear from the reports of the Director of the Museum and of the

several curators, despite the fact that because of the increase of expenses resulting from the addition of a new building, the retrenchment in department expenditures has already made itself felt.

Mr. McAllister has again contributed the sum of $100 to the Committee on the Conservation of Wild Life. For some years past he has made a like contribution.

For the special lecture courses, of which two with four lectures each were held during the year in the Auditorium of the Pacific Gas and Electric Company, 245 Market Street, the un-named friend of the Academy donated $250 on February 10th and $500 on August 24th.

Legal services were contributed by Mr. Edward Hohfeld, as well as by Mr. Francis Hutchens of the staff of Morrison, Hohfeld, Foerster, Shuman, and Clark. These services have been of particular value in connection with the planning and construction of the Academy's East Wing of its Museum Buildings.

The contract for the erection of this East Wing was awarded to Cahill Brothers on March 11th, 1931 and the building was accepted on December 10th, 1931. The cost of the building is indicated by the following payments:—

Cahill Brothers, prior to Dec. 31, 1931	$169,733.04
Architect's Commission	15,739.17
Agent's Salary	3,496.15
Insurance	461.22
Miscellaneous expenses	875.52
Total in 1931	$190,305.10
Cahill Bros. final payment in Jan. 1932	59,396.74
Total Cost of Building	$249,701.84

Among other improvements made during the year there are to be noted a new sewer for the Museum Buildings and the Aquarium; and a new filter for the Aquarium.

The transfer of the Administrative offices, of the Departments of Entomology, of Fishes, and of the Department of Exhibits in part into the East Wing allowed more space in the West Wing for the Departments of Botany, Paleontology, Ornithology and Mammalogy, and also for the Library.

Since October 24th the heat for the West Wing is being supplied from the new heating system in the East Wing.

Dr. David Starr Jordan, President Emeritus and Chancellor Emeritus of Leland Stanford, Jr. University, deceased September 19th, 1931, became a member of the Academy on October 5th, 1891, soon after his arrival in California. He was elected an honorary life member on January 3rd, 1898. He served the Academy as President for three periods, namely:—from January 6th, 1896 to January 3rd, 1898; from January 2nd, 1900, to January 5th, 1903; and from

January 4th, 1909, to January 3rd, 1912. Between these periods the Academy had as Presidents Dr. Wm. E. Ritter, Wm. Alvord, and E. J. Molera.

The Academy will ever revere Dr. Jordan's memory, even as those of us who knew him have appreciated his giving of his time and his ability to the work on which the Academy is engaged.

Mr. Joseph W. Hobson, deceased November 23rd, 1931, was first elected a member of the Academy on February 15th, 1869. He was called into service for the institution as its Recording Secretary on January 6th, 1902, and served in that capacity until February 19th, 1930, when failing eyesight forced his retirement. He, too, endeared himself to those who worked with him. He served the Academy long and well.

Because the Academy is still without an adequate auditorium, its stated meetings are being held in the Auditorium of the Public Library at the Civic Center, and the special lecture course was given in the Auditorium of the Pacific Gas and Electric Company on Market Street. The use of these audience halls has been granted to the Academy without charge, a courtesy which in both cases is sincerely appreciated.

Concerning the membership the following facts are of interest. The membership is made up of:—

Patrons	20
Honorary Members	14
Life Members	92
Fellows	61
Members	954
Junior Members	12
Total	1153

Of these:—

5 Life Members are also Fellows	5	
5 Patrons are also Life Members	5	
1 Fellow is also an Honorary Member	1	
3 Fellows are also Patrons	3	
Total		14
Actual Membership on Jan. 1, 1932, of		1139

On Jan. 1, 1931, the number of members stood at		1108
New Members were added during the year	90	
Members lost by death	31	
Members resigned	25	
Members dropped (non-payment of dues)	3	
	59	
Gain in membership during year		31
Leaving the membership on Jan. 1, 1932, at		1139

The Academy carries on its list of Benefactors the following names:

Deceased

Mr. James Lick
Mr. Ignatz Steinhart

The Academy carries on its list of Patrons the following names:

Living

Mr. George C. Beckley
Dr. Frank E. Blaisdell
Mr. William B. Bourn
Mr. Templeton Crocker
Hon. William H. Crocker
Mr. Peter F. Dunne
Miss Alice Eastwood
Dr. Barton Warren Evermann
Mr. Herbert Fleishhacker
Hon. Joseph D. Grant
Mr. Edward Hohfeld
Mrs. Albert Koebele
Mr. A. Kingsley Macomber
Mr. John W. Mailliard
Mr. Joseph Mailliard
Mr. M. Hall McAllister
Mr. G. Frean Morcom
Mr. William C. Van Antwerp
Mr. Edward P. Van Duzee
Dr. E. C. Van Dyke

Deceased

Mr. William Alvord
Mr. Charles Crocker
Mr. W. M. Giffard
Mr. John W. Hendrie
Mr. William F. Herrin
Mr. Henry M. Holbrook
Mrs. Charlotte Hosmer
Mr. Ogden Mills
Mr. Alexander F. Morrison
Mr. Amariah Pierce
Hon. Leland Stanford
Dr. John Van Denburgh

Academy members who were called by death in 1931 are as follows:

Mr. Edward A. Beals	Member	December 29, 1931
Mr. William Burd	Member	May 16, 1931
Dr. Ng Poon Chew	Member	March 13, 1931
Prof. John Henry Comstock	Honorary Member	March 20, 1931
Dr. Paolo De Vecchi	Life Member	May 30, 1931
Mr. George S. Garritt	Member	August 20, 1931
Dr. William C. Hassler	Member	August 1, 1931
Mr. Joseph W. Hobson	Life Member	November 23, 1931
Dr. David Starr Jordan	Honorary and Life Member	September 19, 1931
Dr. William E. Keith	Life Member	January 16, 1931
Mr. Giles H. Lambson	Member	June 1, 1931
Mr. J. Eugene Law	Member	November 14, 1931
Mr. Robert Newton Lynch	Member	June 4, 1931
Dr. Marsden Manson	Member	February 21, 1931
Mr. Elliott McAllister	Member	August 3, 1931
Mr. Donald McKee	Member	March 14, 1931
Mr. Frank Malloye	Member	June 9, 1931
Dr. Albert Abraham Michelson	Honorary Member	May 9, 1931

Dr. William H. Nicols	Member	February 21, 1931
Dr. L. H. Pammell	Member	March 23, 1931
Mr. James E. Power	Member	April 6, 1931
Mr. V. J. A. Rey	Life Member	April 22, 1931
Dr. H. J. Ring	Member	1931
Mr. Max L. Rosenberg	Member	May 18, 1931
Mr. Arthur T. Shay	Member	May 9, 1931
Dr. James Perrin Smith	Fellow and Life Member	January 1, 1931
Mr. George W. Stewart	Member	September 6, 1931
Mr. James P. Taylor	Member	October 23, 1931
Dr. Harry L. Tevis	Member	July 19, 1931
Mr. E. A. Walcott	Member	January 1, 1931
Mr. George B. Willcutt	Member	September 17, 1931

In the year 1931 eleven free lectures were delivered at the stated meetings of the Academy, as follows:

JANUARY 7. "The Causes of the San Francisco Bay Fogs." Illustrated. By Maj. E. H. Bowie, District Forecaster, Weather Bureau, San Francisco.

MARCH 4. "Remarks on the Natural Resources and Geology of Southern Alberta." By Dr. Leo G. Hertlein, Assistant Curator, Department of Paleontology, California Academy of Sciences.

APRIL 1. "The Growth of the Earth as an Abode of Land Life." Illustrated. By Dr. Bailey Willis, Professor Emeritus of Geology, Stanford University.

MAY 6. "Relation of Fossils to the Oil Industry." By Mr. C. C. Church, Associated Oil Company, San Francisco.

JUNE 3. "Zones of Plant Life in Arizona." By Miss Alice Eastwood, Curator, Department of Botany, California Academy of Sciences.

JULY 1. "Collecting in Chiriqui." Illustrated. By Mrs. M. E. McLellan Davidson, Assistant Curator, Department of Ornithology and Mammalogy, California Academy of Sciences.

AUGUST 5. "The Managua Earthquake and the Nicaragua Canal." By Mr. C. B. Lastreto, San Francisco.

SEPTEMBER 2. "Rambles in Central America—Stories of Personal Experiences from Seventeen Years of Travel far from the Beaten Trail." Illustrated. By Mr. John M. Nicol, Consulting Engineer, San Francisco.

OCTOBER 7. "The Grasses in Nature and in Human Life." Illustrated. By Mr. Morris Halperin, Research Assistant in Agronomy, University of California.

NOVEMBER 4. "The History and Migration of the Monterey Pine Forest." Illustrated. By Mr. H. L. Mason, Associate in Botany, University of California.

DECEMBER 2. "Impressions Resulting from a Trip Through Africa." Illustrated with motion pictures. By Dr. Kaspar Pischel, San Francisco.

Sunday afternoon lectures were given in the auditorium in the Museum Building in Golden Gate Park as follows:

JANUARY 4. "Fort Ross." Illustrated. By Dr. E. O. Essig, Professor of Entomology, University of California, Berkeley.

JANUARY 11. "Alaska and the Reindeer Industry." Illustrated. By Mr. Carl Lomen, President of the Reindeer Corporation.

JANUARY 18. "Experiences with the Trumpeter Swan." Illustrated. By Mr. Joseph Dixon, Economic Mammalogist, Berkeley.

JANUARY 25. "Disease in California Forest Trees." Illustrated. By Dr. E. P. Meinecke, U. S. Bureau of Plant Industry.

FEBRUARY 1. "Peculiar Intrusive Forms of Sedimentary Rocks." Illustrated. By Dr. Olaf P. Jenkins, Chief Geologist, California State Division of Mines, San Francisco.

Sunday afternoon lectures were delivered in the Assembly Hall of the Public Library, Civic Center as follows:

FEBRUARY 8. "Alaska Salmon Canning Industry." Illustrated. By Mr. Perry Bruce Clark, Assistant Chemist, United States Food, Drug and Insecticide Administration, San Francisco.

FEBRUARY 15. "A Museum Preparator's Experiences in Africa." Illustrated. By Mr. Frank Tose, Chief of Exhibits, California Academy of Sciences.

FEBRUARY 22. "Grasses and Man." Illustrated. By Mr. Morris Halperin, Research Assistant in Agronomy, University Farm, Davis.

MARCH 1. "Earthquakes and the Interior of the Earth." Illustrated. By Dr. Perry Byerly, Assistant Professor of Seismology, University of California, Berkeley.

MARCH 8. "The Mourning Dove in California." Illustrated. By Mr. Leo K. Wilson, Acting Director, Bureau of Education and Research, Division of Fish and Game, San Francisco.

MARCH 15. "My Trip to Iceland." Illustrated. By Dr. George Haley, Professor of Biology, University of San Francisco, San Francisco.

MARCH 22. "Mount Shasta." Illustrated. By Mr. Pierre J. Denand, Associated Oil Company, San Francisco.

MARCH 29. "Geology of Coakuila, Mexico." Illustrated. By Dr. Leo G. Hertlein, Assistant Curator, Department of Paleontology, California Academy of Sciences.

APRIL 5. "Tramping and Climbing in the High Sierra." Illustrated. By Mr. Francis P. Farquhar, San Francisco.

APRIL 12. "The Pioneer Movement Toward the Pacific Coast." By Mr. Harold Stein, Field Executive, Boy Scouts of America, San Francisco.

APRIL 19. "What About the Philippines?" Illustrated. By Mr. Alvin Seale, Superintendent, Steinhart Aquarium of the California Academy of Sciences.

APRIL 26. "Experiences with the Desert Big Horn Sheep." Illustrated with motion pictures. By Mr. Donald McLean, Field Naturalist, California Fish and Game Commission, San Francisco.

MAY 3. "The Paleontological History of the Coast Range Forest." By Mr. H. L. Mason, Associate in Botany, University of California, Berkeley.

MAY 10. "Modern Methods in Museum Exhibition." Illustrated. By Mr. Frank Tose, Chief of Exhibits, California Academy of Sciences.

MAY 17. "The Study of Pools." Illustrated. By Mr. H. Walton Clark, Assistant Curator, Department of Fishes, California Academy of Sciences.

MAY 24. "Insects in Relation to Public Health." Illustrated. By Prof. W. B. Herms, Entomologist in the Experiment Station, University of California, Berkeley.

MAY 31. "How to Keep Fishes in the Home." By Mr. Robert J. Lanier, Assistant Superintendent, Steinhart Aquarium of the California Academy of Sciences, San Francisco.

The total attendance for these afternoon lectures was 1568. They were not continued owing to the lack of a suitable auditorium in the Academy buildings.

The special lecture courses during the year were made possible through the donation, already noted, of a public-spirited citizen. They were given in the Auditorium of the Pacific Gas and Electric Company, 245 Market Street. These lectures were as follows:—

SPECIAL LECTURE COURSE NO. 1.

APRIL 1. "The Growth of the Earth as an Abode of Land Life." By Dr. Bailey Willis, Professor Emeritus of Geology, Stanford University.

APRIL 8. "The Age of the Earth as Taught by the Grand Canyon of the Colorado." By Dr. William Morris Davis, Professor Emeritus of Geology, Harvard University.

APRIL 15. "The Origin and Development of Land Plants." By Dr. Douglas Houghton Campbell, Professor Emeritus of Botany, Stanford University.

APRIL 22. "The Origin, Distribution and History of the Giant Sequoias, the Oldest Living Things in the World." By Dr. Willis Linn Jepson, Professor of Botany, University of California.

SPECIAL LECTURE COURSE NO. 2.

SEPTEMBER 16. "The Story of the Ancient Reptiles." Illustrated. By Dr. Charles L. Camp, Professor of Paleontology, University of California.

SEPTEMBER 24. "The Ancestors of Our Forests." Illustrated. By Dr. Ralph W. Chaney, Chairman, Department of Paleontology, University of California.

SEPTEMBER 30. "The Mammals of the Pleistocene Age as Illustrated by the Species found in the Asphaltum Beds of California." Illustrated. By Dr. Chester Stock, Professor of Paleontology, California Institute of Technology, Pasadena, California.

OCTOBER 7. "The Grasses in Nature and in Human Life." Illustrated with stereopticon slides and motion pictures. By Mr. Morris Halperin, Research Assistant in Agronomy, University of California, Berkeley.

The total attendance for the first and second series of special lectures was 2869.

The Academy publications in 1931 were the following:—

PROCEEDINGS, FOURTH SERIES

Vol. XIX, No. 12, pp. 217-397, 134 text figs. PELAGIC MAMMALS FROM THE TEMBLOR FORMATION OF THE KERN RIVER REGION, CALIFORNIA, By Remington Kellogg. (Issued January 30, 1931.)

Vol. XIX, No. 13, pp. 399-410 and No. 14, pp. 411-482. No. 13—REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1930. By C. E. Grunsky. No. 14—REPORT OF THE DIRECTOR OF THE MUSEUM AND OF THE AQUARIUM FOR THE YEAR 1930. By Barton Warren Evermann. (Issued May 29, 1931.)

Vol. XX, No. 1, pp. 1-7, 3 text figures—GEOGRAPHIC VARIATION IN THE RICHARDSON GROUSE. By Harry S. Swarth. (Issued May 22, 1931.)

Vol. XX, No. 2, pp. 9-104—THE FLORA OF THE REVILLAGIGEDO ISLANDS. By Ivan M. Johnston. (Issued November 18, 1931.)

Vol. XX, Nos. 3 and 4, pp. 105-134, plate 1. No. 3, pp. 105-128, plate 1—THE GENUS POGOGYNE. By John Thomas Howell. No. 4, pp. 129-134—A GREAT BASIN SPECIES OF PHYSOCARPUS. By John Thomas Howell. (Issued December 18, 1931.)

Vol. XX, No. 5, pp. 135-160—NEW SPECIES OF PLANTS FROM WESTERN NORTH AMERICA. By Alice Eastwood. (Issued December 18, 1931.)

OCCASIONAL PAPERS

No. XVII, 162 pp., 17 pl.—LOG OF THE SCHOONER "*Academy*" ON A VOYAGE OF SCIENTIFIC RESEARCH TO THE GALAPAGOS ISLANDS, 1905-1906. By Joseph R. Slevin. (Issued February 14, 1931.)

No. XVIII, 299 pp., 57 text figs., 1 pl.—THE AVIFAUNA OF THE GALAPAGOS ISLANDS. By Harry S. Swarth. (Issued June 29, 1931.)

The Academy again tenders its sincere thanks to Mr. Edward Hohfeld and his associates for legal advice generously extended during the year.

The activities of the Academy in further detail will appear in the accompanying reports of the Director of the Museum, the Superintendent of the Aquarium, the Chief of Exhibits, and the Curators of the several Departments to all of whom thanks for able and faithful service is hereby extended.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 13, pp. 483-491 DECEMBER 31, 1940

XIII

REPORT OF THE DIRECTOR OF THE MUSEUM AND OF THE AQUARIUM FOR THE YEAR 1931*

BY

BARTON WARREN EVERMANN

Director of the Museum and of the Aquarium

The Annual Report of the Director for the year 1930 was presented to the Annual Meeting, February 18, 1931. The present report, submitted at this Annual Meeting, February 17, 1932, sets forth briefly the scientific and educational activities of the Academy for the calendar year 1931.

PERSONNEL

The employees of the Museum as of January 1, 1932, were as follows: Dr. Barton Warren Evermann, Director and Executive Curator of the Museum and of the Aquarium, and Editor of the Academy publications; Susie M. Peers, Secretary to the Board of Trustees; Annie G. Hobson, Recording Secretary of the Academy; Alice Eastwood, Curator, John Thomas Howell, Assistant Curator, and Kate E. Phelps, assistant, Department of Botany; Edward P. Van Duzee, Curator, Dr. Edwin C. Van Dyke, Curator Emeritus, Dr. Frank R. Cole, Associate Curator in Dipterology, Dr. Frank E. Blaisdell Sr., Research Associate, J. O. Martin and Amy Williamson, assistants, Department of Entomology; Frank Tose, Chief, John Adams, Jenness Richardson, Mammal Taxidermists, J. Stuart Rowley, Marietta Edwards, Richard Cayzer, and Mrs. Clara Rice, Installation and Accessories, William B. Hayden and Cecil Tose, assistants, Department of Exhibits; Dr. Barton Warren Evermann,

* Printed from the John W. Hendrie Publication Endowment.

Curator, and H. Walton Clark, Assistant Curator, Department of Fishes; Joseph R. Slevin, Curator, Department of Herpetology; Dr. Walter K. Fisher, Curator, Department of Invertebrate Zoology; Thomas Cowles, Assistant Librarian, and Veronica J. Sexton, Library Assistant; Harry S. Swarth, Curator, Mrs. Mary E. McLellan Davidson, Assistant Curator, and Joseph Mailliard, Curator Emeritus, Department of Ornithology and Mammalogy; Dr. G. Dallas Hanna, Curator, Dr. Leo George Hertlein, Assistant Curator, Dr. Frank M. Anderson, Honorary Curator, M. Vonsen, Honorary Curator in Mineralogy, Dr. Roy E. Dickerson and C. C. Church, Research Associates, Mrs. Winifred Morrison and John L. Nicholson, Jr., Assistants, Department of Paleontology; Constance W. Campbell, stenographer, part time, Evelyn Larsen, office assistant, part time; Raymond L. Smith, general assistant; Mabel E. Phillips, check-room attendant; William C. Lewis, janitor; Hugh Jones, assistant janitor; Charles F. Baldock, engineer and janitor; Allen Weatherwax, lecture attendant; Archie McCarte, night watch; Nellie Marshall, attendant, part time; Fred Tanaka, janitor, part time.

The Aquarium staff and employees as of January 1, 1932, were as follows: Dr. Barton Warren Evermann, Director; Susie M. Peers, Secretary, part time; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Alvin Seale, Superintendent; Robert J. Lanier, Assistant Superintendent; Phyllis Beardslee, doorkeeper; Clynt S. Martin, chief engineer; B. T. Culleton, first assistant engineer; John A. Dwyer, second assistant engineer; Clyde E. Guidry, chief attendant; Jack Solini, first assistant attendant; L. R. Solini, second assistant attendant; Leon Maxwell, third assistant attendant; Frank J. Maxwell, relief engineer and attendant; S. J. Shenefield, carpenter and general utility man; Patrick O'Neill, janitor; Patrick McArdle, assistant janitor; Frank Haley, day watch.

James Campbell was employed for a short time as a temporary assistant in the Department of Fishes.

Cooperation with Public and Private Schools, other Institutions and Individuals

The Museum has continued its service to schools, other institutions, and individuals in their educational and scientific work. Classes from schools, and other groups have been afforded as complete cooperation as possible on their visits to the Museum and Aquarium. Several loans have been made for educational purposes to schools, and a large number for purposes of scientific research to institutions and individuals. The Department research collections are being steadily increased as is shown in the list of accessions and in the Department Reports. Facilities for special study and research

in the laboratories of the different departments have been afforded numerous investigators from time to time during the year.

The usual flow of inquiries for information upon scientific subjects has continued unabated, and considerable time has been devoted to their proper answer by the Director or the Curator of the Department concerned.

Visitors to the Museum in organized groups have been frequent. The largest of these have been classes from public and private schools, conducted by their teachers. It is our policy to give such classes every aid possible and to provide them with guides when feasible, though these must be taken from our regular staff otherwise employed. The employment of at least two such tactful and sympathetic guides or docents whose duties are to aid in interpreting to the visitor the lessons taught by the exhibits is an extremely desirable addition to our force as soon as financial conditions make it possible.

During the year 1931 the number of all visitors to the Museum has been 446,245; to the Steinhart Aquarium 1,003,753; the grand total since the opening of the Museum in 1916 has been 6,922,868; the grand total for the Steinhart Aquarium since the opening in 1923 has been 8,349,572.

A careful detailed list of schools, grades, teachers, number of pupils, and dates of visits has been kept for 1931 as before, and is on file in the office of the Academy. The following summaries present the most important facts.

SCHOOLS VISITING THE MUSEUM IN 1931

Schools of San Francisco:		
Total Number of Pupils	5795	5795
Total Number of Teachers	179	
Total Number of Classes	104	
Schools Outside of San Francisco:		
Total Number of Pupils	1683	1683
Total Number of Teachers	44	
Total Number of Classes	49	
		7478

SCHOOLS VISITING STEINHART AQUARIUM IN 1931

Schools of San Francisco:	
Number of Visiting Pupils	4912
Number of Visiting Teachers	159
Number of Visiting Classes	181
Schools Outside of San Francisco:	
Number of Visiting Pupils	1863
Number of Visiting Teachers	65
Number of Visiting Classes	82

BUILDING ACTIVITIES

Early in the year the architect's plans were approved and contract was let for a new addition to the Academy's museum. This new building will be known as the East Wing of the Museum. In a general way it follows the lines of the West Wing. The principal unit in the East Wing is the *Simson African Mammal Hall*, in which will be displayed 24 habitat groups of some 29 species of African mammals. Mr. Leslie Simson is still in Africa collecting the animals needed for the groups. We have already received from him more than 100 skins and skeletons, and Mr. Tose and his assistants are very busy preparing the groups. It is expected the Simson Hall will be ready for formal opening to the public by next December.

Other units that are provided for in the East Wing are the Director's offices and the general offices of the Academy, the Department of Entomology, the Department of Fishes, and, temporarily, certain work rooms for the Department of Exhibits. There are also in the East Wing several special rooms such as supply room, janitor's room, cold-storage hide room, fumigation room, dark room, lavatories, rest rooms, Academy publications store room, etc.

The rooms in the West Wing formerly occupied by the Department of Entomology have been added to the Department of Paleontology; the three rooms formerly occupied by the general office and the Director have been assigned to the Department of Botany. All the research collections of fishes have been transferred from the Aquarium basement to the new quarters which the Department of Fishes now has in the basement of the East Wing. These quarters consist of the main Research Collection Room, 132 ft. long by 30 ft. wide, a Laboratory 51 ft. by 20 ft., and 3 offices 22 ft. 6 in. by 11 ft. 6 in., 15 ft. 6 in. by 11 ft. 6 in., and 14 ft. by 11 ft. 6 in., respectively, or a total of 5678 sq. ft., to which can be added 2068 sq. ft. in the publications store room (making a total of 7746 square feet of floor space when needed). This will house a collection of fishes much larger than any now existing in America. It is our ambition to make the collection the largest in America.

ACKNOWLEDGMENTS

Friends of the Academy continue to show their appreciation of what we are doing for the community and for science by donating to the Museum and the Aquarium desirable natural history specimens and other objects of interest.

To all who have thus shown their interest in our work grateful thanks are extended. Through the field activities of our scientific staff, the exchange, donation and purchase of specimens the research collections have continued to increase.

A complete list of these accessions is on file in the offices of the Academy.

As in the past, the Academy is greatly indebted to the Southern Pacific Company, the Atchison, Topeka and Santa Fe Railway System, the Matson Navigation Company, and the Los Angeles Steamship Company for many courtesies that have aided so materially in our field work. Their cooperation is greatly appreciated.

FINANCIAL STATEMENTS

REPORT OF THE TREASURER

For the fiscal year ending December 31, 1931

January 1, 1931, Balance due Crocker First National Bank		$ 3,228.25
Receipts:		
Dues	$ 3,298.00	
Charles Crocker Scientific Fund Endowment Income	1,797.04	
James Lick Endowment Income	72,404.40	
General Income	19,911.30	
John W. Hendrie Endowment Income	868.87	
Post Card Sales	687.35	
Publication	545.55	
Interest	875.85	
Bills Payable	106,000.00	
Bills Receivable	77,000.00	
Bills Receivable Ignatz Steinhart Trust	1,000.00	
Ignatz Steinhart Trust Interest	245.07	
Duplicate Sales Account	2.50	
W. G. Wright Fund	12.00	
Park Birds Handbook Fund	183.30	
Wild Life Protection Fund	100.00	
Lecture Fund Donation	750.00	
Total Receipts		$285,681.23
		$282,452.98
Expenditures:		
East Wing Construction	$190,305.10	
Sewer Construction	2,685.29	
Interest	11,959.45	
Contingent Fund	418.73	
Salary Expense General	20,379.83	
Department Salaries	22,965.51	
Earthquake Insurance Sinking Fund	1,200.00	
Steinhart Aquarium Equipment	1,325.32	
Insurance	1,184.91	
Museum Department Appropriations	25,100.20	
Post Cards	600.00	
Publication	7,499.07	
Library	4,114.13	
Sundry Creditors	209.10	
Expense	3,133.13	
Lecture Expense	416.24	
Total Expenditures		$293,496.01
January 1, 1932, Balance due Crocker First National Bank		$ 11,043.03

F. W. BRADLEY, *Treasurer.*

Examined and found correct,

PACE, GORE & MCLAREN, *Certified Public Accountants.*

San Francisco, Calif., February 11, 1932.

INCOME AND OPERATING EXPENSES

For the fiscal year, January 1, 1931, to December 31, 1931

Income:		
Charles Crocker Scientific Fund Endowment Income	$ 1,797.04	
James Lick Endowment Income	72,404.40	
General Income	19,911.30	
Dues	3,293.00	
Interest on Temporary Investments	875.85	
Profit on Post Card Sales	514.25	
Duplicate Sales Account	2.50	
Total Income		$ 98,798.34
Expenditures:		
General Expense	$ 3,207.99	
Salaries	43,441.59	
Interest	12,429.08	
Insurance	1,184.91	
Total Expenditures:		$ 60,263.57
Net Income Transferred to Surplus Account		$ 38,534.77

SUMMARY OF SURPLUS ACCOUNT

December 31, 1931

Balance January 1, 1931		$595,531.23
Additions:		
Net Income for the year ended December 31, 1931	$ 38,534.77	
Transfer from John W. Hendrie Endowment Income equal to the amount expended for certain publications	4,137.90	
Total Additions to Surplus		$ 42,672.67
		$638,203.90
Deductions:		
Depreciation	$ 16,403.66	
Transfer to Earthquake Insurance Sinking Fund Reserve	1,200.00	
Correction of erroneous charge to Furniture and Fixtures	77.00	
Total Deductions from Surplus		$ 17,680.66
Surplus, December 31, 1931		$620,523.24

BALANCE SHEET

December 31, 1931

Assets

Property:			
Real Estate, 831-833 Market Street			$600,000.00
Commercial Building, 833 Market Street	$516,818.66		
Less: Reserve for Depreciation	121,452.34	395,366.32	
Real Estate, Jessie Street		8,083.65	
			$1,003,449.97
Museum, Golden Gate Park:			
Building Construction	192,025.92		
Less: Reserve for Depreciation	45,119.37	146,906.55	
East Wing—under construction		190,305.10	
Sewer—under construction		2,687.19	
General Collections		239,482.23	
Library and Equipment		167,937.23	
Tools and Equipment	50,871.29		
Less: Reserve for Depreciation	11,996.34	38,874.95	
Office Furniture	6,401.89		
Less: Reserve for Depreciation	3,719.31	2,682.58	
			$788,875.83
Investment Securities			8,703.42
Ignatz Steinhart Trust:			
Bills Receivable		$ 5,000.00	
Steinhart Aquarium Construction		263,390.29	
Steinhart Aquarium Equipment		35,668.40	
Steinhart Aquarium Revolving Fund		5,000.00	
Uninvested Cash on Hand		98.13	
			$309,156.82
Current Assets:			
Bills Receivable		2,000.00	
Postcards in Stock		1,677.23	
Cash on Hand		186.48	
Advances to employees doing field work		500.00	
			$ 4,363.71
Total			$2,114,549.75

BALANCE SHEET—Continued

Liabilities

Endowments:		
James Lick Endowment	$804,902.31	
Charles Crocker Scientific Fund Endowment	20,000.00	
John W. Hendrie Endowment	32,770.85	
		$857,673.16
Funds Held for Special Purposes:		
Alvord Bequest Botanical	$ 5,000.00	
John W. Hendrie Endowment Income	4.71	
Earthquake Insurance Sinking Fund Reserve	8,603.42	
W. G. Wright Fund	54.57	
Park Birds Handbook Fund	296.60	
Wild Life Protection Fund	111.10	
Lecture Fund	274.65	
		$ 14,345.05
Ignatz Steinhart Trust:		
Principal	$250,000.00	
Interest	59,156.82	
		$309,156.82
Notes and Accounts Payable:		
Bills Payable	$301,000.00	
Accounts Payable	710.32	
Due Crocker First National Bank (Overdraft)	11,141.16	
		$312,851.48
Surplus		$620,523.24
Total		$2,114,549.75

SUSIE M. PEERS,
Secretary Board of Trustees.

We have examined the foregoing Balance Sheet, together with the books and accounts of the California Academy of Sciences, and in our opinion, it is properly drawn up so as to exhibit a true and correct view of the Academy's affairs, as shown by the books.

PACE, GORE & MCLAREN,
Certified Public Accountants.

San Francisco, Calif.
February 11, 1932.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 14, pp. 493-521 DECEMBER 31, 1940

XIV

REPORT OF THE PRESIDENT OF THE ACADEMY AND ACTING DIRECTOR OF THE MUSEUM AND THE AQUARIUM FOR THE YEAR 1932 WITH DEPARTMENTAL REPORTS FOR THE TWO YEARS 1931 AND 1932*

BY

C. E. GRUNSKY

President and Acting Director of the Museum and Aquarium

When in August 1932 it became apparent that on account of ill health Dr. Evermann would have to be temporarily released from active duty as Director and Executive Curator, it naturally fell to the President to carry on the work of the Academy with which he had been in intimate touch throughout Dr. Evermann's entire administration. For the time being, therefore, he has accepted the responsibility of Acting Director of the Museum and of the Steinhart Aquarium.

Dr. Evermann was forced in June to seek rest for a time at Stanford Hospital. Unfortunately it was found, despite his robust appearance, that his physical disabilities were not as trifling as his friends had hoped, and there was a gradual loss of strength until, on September 27 at his home in Berkeley, the end came.

It was my privilege as President of the Academy and member of its Council and Board of Trustees to have a voice in authorizing the employment by the Academy of a salaried director, and it was my privilege, too, to have a voice in the selection of Dr. Evermann for the newly created position. Our relations at once became intimate,

---

* Printed from the John W. Hendrie Publication Endowment.

and throughout the eighteen years of close association in Academy work which then followed there was never an unpleasant occurrence to interfere with whole-hearted cooperation.

The passing of Dr. Evermann was keenly felt by all connected with Academy affairs; but natural science in general is the greatest sufferer. He was an indefatigable worker, always ambitious to acquire new information and ever intolerant of those who imagined their education was complete. He took great pride in his former connections with educational pursuits, and always endeavored in every possible way to advance the educational phase of the Academy's activity. A class of school children being led through the exhibition halls was given as much consideration as a group of naturalists. The enquiring mind of youth was to him one of the most inspiring of nature's phenomena.

He was born on a farm near Lovilia, Monroe County, Iowa, October 24, 1853. His father was Andrew Everman. His mother's maiden name was Nety Gardner. The family moved to a farm in Carroll County, Indiana, when Barton Warren was a young boy, and in that state he grew up, acquired his education and married Meade Hawkins on October 24, 1875. He graduated from Indiana University in 1886, received the degree of Master of Arts in 1888, and Doctor of Philosophy in 1891. He was honored by receiving the degree of Doctor of Laws from the University of Utah in 1922, and from Indiana University in 1927.

He became interested in natural history as have many young farmer boys, and early began making a collection of birds and eggs. This love for ornithology never left him and he was a prolific writer on the subject.

He taught in the public schools of Indiana and California during 1871-1881; was County School Superintendent of Carroll County, Indiana, during 1883-1885, and head of the Department of Biology of the Indiana State Normal School from 1886 to 1891. From 1891 to 1914 he held various responsible positions with the U. S. Bureau of Fisheries, and it was during this period that some of his most valuable publications on fishes were issued.

The fame of Dr. Evermann rests largely upon his work in systematic Ichthyology, but he did not by any means confine his efforts to that one subject. His card index of titles at the time of his death contained 387 entries. A hurried classification of these show 196 papers on fishes, 59 on birds, 30 on mammals, and the remainder on miscellaneous subjects.

Much of his material for publication was prepared while at the same time he attended to the strenuous duties of an administrative position. His official correspondence was largely carried on by rapid fire dictation, but many personal letters and his manuscripts were slowly and carefully written in long hand.

Rarely indeed does a man leave behind so little unfinished work. A paper on the fishes of the Revillagigedo Islands Expedition of

1925 (co-author with H. Walton Clark), and his annual Academy report for 1931 were completed, but unpublished, at the time of his death.

His trips to the field to study or collect specimens were his greatest recreation, and his enthusiasm upon such occasions was contagious. On these excursions he was in the habit of keeping detailed notes on various subjects. A series of books of these observations has been left to the Academy. Often he kept lists of birds observed, even on short automobile journeys. Even up to the time when he had reached the age of 75 he could easily maintain his place on fishing and collecting trips, and in camp he insisted upon doing more than his share of the routine tasks.

Because of valuable gifts and contributions to the Academy's natural history material and to its library, Dr. Evermann became a "Patron" of the Academy on March 26, 1921. His interest in the African Hall of the Academy, which is made possible by the generosity of Mr. Leslie Simson, prompted Dr. Evermann to become sponsor for one of its smaller exhibits, and he presented the Academy with $1,000 to cover the cost of the installation of the Dik-Dik habitat group.

By bequest, and by the generosity of his son Toxaway Bronte Evermann and his daughter Mrs. Edith Evermann Humphrey, most of Dr. Evermann's scientific books and papers have become the property of the Academy to which he had devoted so much of his life and energy.

As announced at our last Annual Meeting on February 17, 1932, our First Vice-President, Mr. Otto von Geldern, that day reelected, succumbed to heart trouble.

Otto von Geldern, the son of Gustav von Geldern, was born in Berlin, Germany, on September 6, 1852. He was brought to the United States as a child, spending his youth at Sonoma, California. He was educated in part in this country, and in part at gymnasia and technical schools in Germany.

His first professional experience was with his father who was an engineer and architect. In 1872, Mr. von Geldern returned to California, from Germany, and served as an Assistant Engineer on the construction of the Mare Island Dry Dock. Thereafter until 1889 he was almost continuously an hydrographic assistant with the United States Coast and Geodetic Survey, or an engineer assistant with the United States Army Engineers. He thereupon established himself in general engineering practice in San Francisco.

Because of his experience on the harbors of the Pacific Coast, Mr. von Geldern had become thoroughly familiar with the ebb and flow of the tides, and his knowledge of this subject, and of the problems connected with a delimitation of shore areas, made him an authority on tide-marsh and ocean-front ownerships. Of valuation matters,

too, he made a specialty, his advice being frequently called for in proceedings before rate-fixing authorities and in the Courts.

He had great command of language, delighting in producing occasional short poems and highly meritorious accounts of early California life and customs. It would have been an easy transition for him from engineer to poet and philosopher, but he found his principal pleasure and relaxation in solving intricate mathematical problems.

His mathematical ability served him well when he was called upon to assist the government in locating defense armament about San Francisco Bay. In this connection, Mr. von Geldern invented a new and practical method of adjusting a modern coast defense gun, an account of which was published at the Artillery School, Fortress Monroe, Virginia, upon command of Major General Arthur MacArthur, U. S. A., in January 1905. This method included, in the complete adjustment of large guns and mortars, the determination of errors in azimuth, elevation, and verticality, as well as the errors of the telescopic gun-sight.

In professional circles Mr. von Geldern will be remembered as an able engineer and a member of that fine old school of practitioners who hold the ethics of their calling above gain. He was known and respected, however, far beyond the boundaries of professional fields. In his youth, he knew personally many of the men whose names made California history during the period of transition from Mexican to American control. Among others, he was acquainted with General Vallejo—as a youth knows older men—and was intimate with his family. More than any other, perhaps, he is responsible for clearing the General's record of the charge of opportunism made by inaccurate or prejudiced historians. In the course of the studies undertaken in the interest of General Vallejo's history, Mr. von Geldern developed into one of the best authorities on the history of the so-called Sonoma District of Mexican California, the Kearny "filibuster," and the frequently exaggerated episode that men refer to as the "Bear Flag Republic."

He was married on July 10, 1884, to Mathilda Schildt, by whom he is survived. He is also survived by his three sons: Dr. Charles E., Edward B., and Dr. Hans S. von Geldern, and by seven grandchildren.

Mr. von Geldern became a member of the Academy in 1896 and was made a life member in 1921. He was elected Second Vice-President in 1904 and First Vice-President in 1931. He was also a Past-President of the Astronomical Society of the Pacific, was a member of various other scientific organizations, and served for many years as a Trustee of the Mechanics' Institute of San Francisco, being its President at the time of his death, and as such also a Regent of the University of California.

Mr. von Geldern's life was a full one, and not restricted to the attainment of his own selfish ambitions. He was an asset to his

State and an example of the type of citizen on whom the country must depend for the maintenance of its best traditions.

The vacancy in the First Vice-Presidency caused by the death of Mr. von Geldern was filled by the election of Dr. F. M. MacFarland by the Council. Dr. E. P. Meinecke was elected to the position of Corresponding Secretary theretofore held by Dr. MacFarland.

During this year there has also passed away Mr. E. J. Molera, who was President of the Academy from 1903 to 1909. Mr. Molera was long active on the Pacific Coast as a civil engineer. He was born at Vich in Spain on November 14, 1846. He received his technical education at the Royal Academy of Engineers at Madrid from which he was graduated in 1867.

As early as 1870 he came to San Francisco and found employment with the United States Engineers on harbor work, his name being connected with surveys of Blossom Rock preceding its removal as an obstruction to navigation in San Francisco Bay. Thereafter until 1876 he was the Assistant Lighthouse Engineer of the 12th District with headquarters at San Francisco. He then established himself permanently in private practice as a consultant civil engineer at San Francisco, making topographic surveys, planning irrigation works and the like. He was called to Mexico in 1881 by President Gonzales to outline a project for the drainage of the Valley of Mexico. A few years later he was employed by a syndicate of capitalists as consultant on the completion of the Tehuantepec Railroad. This work included studies for the harbor terminals upon both the Atlantic and Pacific oceans. His professional practice covered not only a wide range in engineering, but extended also into the architectural field.

Mr. Molera was a student of early Mexican history, and from time to time gave delightful accounts of the results of his studies to his favorite technical organization—the Technical Society of the Pacific Coast.

He was married on April 28, 1875, to Miss Amelia Cooper (deceased) of Monterey, California. Of his two children, Andrew J. and Frances M., the former passsed away a few months before his father's death.

The Simson African Hall

Work on the installation of the groups of wild life in the hall on the main floor of the Academy's new East Wing has been pushed forward as rapidly as the resources of the Academy would permit.

By holding down the field work in the Academy's several research departments to a minimum, it was found possible to keep a small force at work in the Department of Exhibits. This is done, of course, in anticipation of a refund when generous friends of the Academy come forward with contributions as sponsors of individual groups.

There will be ten of the large groups, 13 intermediate, smaller ones, and one very large group at the far end of the hall. It is hoped and expected that the Academy can dedicate these several groups to individuals, in return for contributions adequate to cover the cost of their installation.

Such installations of habitat groups in the West Wing were made possible by donations from William van Antwerp, W. B. Bourn, J. D. Grant, Herbert Fleishhacker, William H. Crocker and others. For the work in the East Wing, except for several of the painted backgrounds, only a single donation of $1,000 for one of the smaller groups is thus far to be reported.

The circumstances which led the Academy to erect its new East Wing and to undertake the installation of the habitat groups of African Wild Life are sufficiently set forth in the President's report for the year 1930. It was hoped a year ago that there would certainly be enough outside financial assistance to keep our organization of a Department of Exhibits together. But this hope has not thus far been realized. Instead of finding ourselves in a position to open the African Hall to the public at least for part time in April, 1933, the opening will have to be indefinitely postponed.

The Templeton Crocker Expedition of the California Academy of Sciences, 1932

The offer to Director Evermann by Mr. Templeton Crocker to conduct a scientific expedition to the Galapagos Islands and other places in the Pacific Ocean, devoting himself and his yacht *Zaca* completely to the service of the Academy for a period of more than five months, was gratefully accepted. Thereupon the yacht was suitably outfitted and departed from San Francisco on March 10. The expedition returned to the same port on September 1. An account of this expedition and of its contributions to our knowledge of the fauna and flora of the coast and islands of the Pacific Ocean will be published in Volume XXI of the Proceedings of the Academy.

The Trustees and the Council in joint session on September 19 formally expressed their appreciation to Mr. Crocker of his generous contributions to the study of natural history problems and declared him to be a "Benefactor" of the Academy.

Academy Membership

The following information relating to the membership and membership changes during 1932 will be of interest.

The members at the end of 1932 were classified as follows:

Benefactor	1
Patrons	18
Honorary Members	19
Life Members	88
Fellows	60
Members	846
Junior Members	19
Total	1051

Of these:

5 Life Members are also Fellows	5	
6 Patrons are also Life Members	6	
1 Fellow is also an Honorary Member	1	
3 Fellows are also Patrons	3	
1 Benefactor is also a Patron	1	
Total		16
Actual Membership		1035

On January 1, 1932, the number of members stood at		1139
New Members were added during the year	34	
Members lost by death	28	
Members resigned	45	
Members dropped (non-payment of dues)	65	
	138	
Net loss during year		104
Leaving the membership on January 1, 1933, at		1035

The Academy carries on its list of Benefactors the following names:

Living

Mr. Templeton Crocker

Deceased

Mr. James Lick
Mr. Ignatz Steinhart

The Academy carries on its list of Patrons the following names:

Living

Dr. Frank E. Blaisdell
Mr. William B. Bourn
Mr. Templeton Crocker
Hon. William H. Crocker
Mr. Peter F. Dunne
Miss Alice Eastwood
Mr. Herbert Fleishhacker
Hon. Joseph D. Grant
Mr. Edward Hohfeld
Mrs. Albert Koebele
Mr. A. Kingsley Macomber
Mr. John W. Mailliard
Mr. Joseph Mailliard
Mr. M. Hall McAllister
Dr. Walter B. Scaife
Mr. William C. Van Antwerp
Mr. Edward P. Van Duzee
Dr. E. C. Van Dyke

Deceased

Mr. William Alvord
Mr. George C. Beckley
Mr. Charles Crocker
Dr. Barton Warren Evermann
Mr. W. M. Giffard
Mr. John W. Hendrie
Mr. William F. Herrin
Mr. Henry M. Holbrook
Mrs. Charlotte Hosmer
Mr. Ogden Mills
Mr. G. Frean Morcom
Mr. Alexander F. Morrison
Mr. Amariah Pierce
Hon. Leland Stanford
Dr. John Van Denburgh

Academy members who were called by death in 1932 are as follows:

Mr. George C. Beckley	Patron	December 15, 1932
Mr. Robert I. Bentley	Member	February 22, 1932
Mr. Richard Cayzer	Member	March 3, 1932
Mr. Frank J. Devlin	Member	February 6, 1932
Mr. Donald R. Dickey	Member	April 13, 1932
Mr. Frederick T. Duhring	Member	January 23, 1932
Mr. W. J. Dutton	Member	August 23, 1932
Mr. Samuel Cary Evans	Member	December 31, 1932
Dr. Barton Warren Evermann	Patron	September 27, 1932
Professor Rufus L. Green	Fellow	November 17, 1932
Dr. Harvey Monroe Hall	Fellow	March 11, 1932
Mr. Alexander Hamilton	Member	October 14, 1932
Mr. Thomas A. Hays	Member	April 5, 1932
Miss Anna Head	Member	December 24, 1932
Mr. Ralph Hoffmann	Member	July 21, 1932
Mr. Edward Jesurun	Life Member	October 29, 1932
Mr. Walter Loewy	Member	February 11, 1932
Mr. E. J. Molera	Life Member	January 14, 1932
Mr. Charles C. Moore	Member	April 17, 1932
Mr. George W. Moore	Member	July 28, 1932
Mr. G. Frean Morcom	Patron	March 25, 1932
Mr. Ransom Pratt	Life Member	March 30, 1932
Mr. F. A. Robbins	Member	May 27, 1932
Mr. Andrew W. Rose	Life Member	April 16, 1932
Mr. John Spencer	Member	December 31, 1932
Mr. Miles Standish	Member	June 22, 1932
Professor Edwin C. Starks	Life Member	December 29, 1932
Mr. Otto von Geldern	Life Member	February 17, 1932

LECTURES

During the year 1932 eleven free lectures were delivered at the stated meetings of the Academy, as follows:

JANUARY 6. "The Philippines." Illustrated. By Dr. Albert W. Herre, Curator of the Zoological Museum, Stanford University.

MARCH 2. "Guadalupe Island, Its Animals and Plants and Its Geology." A Symposium, participated in by Captain Garland Rotch, Mr. John Thomas Howell, and others. Illustrated with moving pictures.

APRIL 6. "Dr. Henry Power, Early English Microscopist, Friend and Contemporary of Sir Thomas Browne, with Selections from His Experimental Philosophy." By Mr. Thomas Cowles, Assistant Librarian, California Academy of Sciences.

MAY 4. "The Science of Taxation." By Mr. E. R. Zion.

JUNE 1. "Up the Amazon and over the Andes." Illustrated. By Mrs. Ynes Mexia, San Francisco.

JULY 6. "Flags; Facts and Fallacies." By Mr. C. B. Lastreto, San Francisco.

AUGUST 3. "Major Business Cycles." By Dr. C. E. Grunsky, President, California Academy of Sciences.

SEPTEMBER 7. "Wild Life on the Great Rivers of Yellowstone Park." Illustrated. By Mr. George M. Wright, Field Naturalist, National Park Service.

OCTOBER 5. "Account of the Templeton Crocker Expedition: The Birds." Illustrated. By Mr. Harry S. Swarth, Curator, Department of Ornithology and Mammalogy, California Academy of Sciences.

NOVEMBER 2. "The Templeton Crocker Expedition of the California Academy of Sciences." A symposium participated in by the following: Templeton Crocker: Account of the Expedition. Captain Garland Rotch: The *Zaca* and Her Crew. Harry S. Swarth, Curator of the Department of Ornithology: Birds. H. Walton Clark, Assistant Curator of the Department of Fishes: Tidepools and Their Inhabitants. John Thomas Howell, Assistant Curator of the Department of Botany: Plants. Robert J. Lanier, Assistant Superintendent of the Steinhart Aquarium: Live Fishes and Deep-Sea Dredging. E. P. Van Duzee, Curator of the Department of Entomology: Insects. Dr. Albert E. Larsen, Medical Officer of the Expedition: Plankton and Termites. This symposium was also one of the Academy's Fall course of four lectures on the general subject "The Beauties of Nature."

DECEMBER 7. "Account of the Templeton Crocker Expedition: The Plants." Illustrated. By Mr. John Thomas Howell, Assistant Curator of Botany, California Academy of Sciences.

The free lectures on the general subject "The Beauties of Nature," four in the spring and four in the fall, made possible by the generosity of a friend of the Academy, were continued as follows:

SPECIAL LECTURE COURSE NO. 3

MAY 11. "Our National Park System: What the Federal Government is doing to conserve and make known the Beauties of Nature." Illustrated with colored slides and motion pictures. By Colonel John R. White, Superintendent, Sequoia and General Grant National Parks.

MAY 18. "Western American Scenery As Exemplified In Our National Parks." Illustrated with colored slides. By Francis P. Farquhar, Vice President of the Sierra Club.

MAY 25. "Off the Track in Central America; the History, the Peoples, and the Natural Beauties of Those Little-known Countries." Illustrated with stereopticon slides. By John Malcom Nicol, mining engineer and traveler.

JUNE 1. "Spiritual Values in the Appreciation of Nature." By Dr. John C. Merriam, President of the Carnegie Institution of Washington.

SPECIAL LECTURE COURSE NO. 4

OCTOBER 19. "Up the Amazon and Over the Andes": An account of a trip for the collection of botanical specimens secured for the California Academy of Sciences, the University of California and other institutions. Illustrated with lantern slides. By Mrs. Ynes Mexia.

OCTOBER 26. "The Music of the Out-of-Doors." Illustrated with hand-colored slides. By Bert Harwell, Park Naturalist of the Yosemite National Park.

NOVEMBER 2. "The Templeton Crocker Expedition of the California Academy of Sciences." A symposium; illustrated. Templeton Crocker: Account of the Expedition. Captain Garland Rotch: The *Zaca* and Her Crew. Harry S. Swarth, Curator of the Department of Ornithology: Birds. H. Walton Clark, Assistant Curator of the Department of Fishes: Tidepools and Their Inhabitants. John Thomas Howell, Assistant Curator of the Department of Botany: Plants. Robert J. Lanier, Assistant Superintendent of the Steinhart Aquarium: Live Fishes and Deep-sea Dredging. E. P. Van Duzee, Curator of the Department of Entomology (not a member of the Expedition): Insects. Dr. Albert E. Larsen, Medical Officer of the Expedition: Plankton and Termites.

NOVEMBER 9. "Glaciation of the Sierra Nevada." Illustrated. By Dr. Eliot Blackwelder, Professor of Geology, Stanford University.

In this connection grateful acknowledgment is made not alone to the Academy's unnamed friend, but also to the Pacific Gas and Electric Company whose auditorium was placed at the disposal of the Academy for these lecture courses.

ACADEMY PUBLICATIONS IN 1932

Owing to the urgent need for economy the Academy has been forced to hold its publications to a minimum. Even the annual reports of its President and Director have been postponed to a more favorable season.

PROCEEDINGS, FOURTH SERIES

Vol. XX, No. 6, pp. 161-263, plates 2-18—THE DIATOMS OF SHARKTOOTH HILL, KERN COUNTY, CALIFORNIA. By G. Dallas Hanna. (Issued January 8, 1932.)

Vol. XX, No. 7, pp. 265-267—A NEW SUBSPECIES OF CORAL SNAKE FROM GUATEMALA. By Karl P. Schmidt. (Issued January 8, 1932.)

Vol. XX, No. 8, pp. 269-290—Birds and Mammals from the Kootenay Valley, Southeastern British Columbia. By Joseph Mailliard. (Issued January 8, 1932.)

Vol. XX, No. 9, pp. 291-465—Miscellaneous Studies in the Elateridae and Related Families of Coleoptera. By Edwin C. Van Dyke. (Issued March 3, 1932.)

Vol. XX, No. 10, pp. 467-469—Agonostomus Hancocki Seale, sp. nov. By Alvin Seale. (Issued December 30, 1932.)

Personnel

The personnel connected with the Academy at the beginning of the year 1933 either as paid employees, or as accredited research associates or assistants, sometimes, of course, without compensation, are here enumerated. Those who are noted as part time employees are being paid in part out of funds received from the City for the operation of the Aquarium, their duties being divided between the Museum and the Aquarium.

Dr. C. E. Grunsky, Acting Director and Executive Curator of the Museum and of the Aquarium, and Editor of the Academy publications; Susie M. Peers, Secretary to the Board of Trustees; Annie G. Hobson, Recording Secretary of the Academy; Alice Eastwood, Curator, John Thomas Howell, Assistant Curator, and Kate E. Phelps, Assistant, Department of Botany; Edward P. Van Duzee, Curator, Dr. Edwin C. Van Dyke, Honorary Curator, Dr. Frank R. Cole, Associate Curator in Dipterology, Dr. Frank E. Blaisdell, Research Associate, and Amy Williamson and J. O. Martin, assistants, Department of Entomology; Frank Tose, Chief of Exhibits, J. Stuart Rowley, Jenness Richardson, Marietta Edwards, J. M. Barclay, William B. Hayden, John Adams, and Cecil Tose as Assistants and Grace M. Betts and Captain Charles B. Hudson, artists, Department of Exhibits; H. Walton Clark, Curator, Department of Fishes; Joseph R. Slevin, Curator, Department of Herpetology; Veronica J. Sexton, Library Assistant; Harry S. Swarth, Curator, Mary E. McLellan Davidson, Assistant Curator, and Joseph Mailliard, Curator Emeritus, Department of Ornithology and Mammalogy; Dr. G. Dallas Hanna, Curator, Dr. Leo George Hertlein, Assistant Curator, Dr. Frank M. Anderson, Honorary Curator, and M. Vonsen, Honorary Curator in Mineralogy, Dr. Roy E. Dickerson and Dr. C. C. Church, Research Associates, Department of Paleontology; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Raymond L. Smith, general assistant; Mabel E. Phillips, checkroom attendant; William C. Lewis, janitor; Raymond Jones, assistant janitor; Allen Weatherwax, lecture attendant; Frank Haley, day watch; Archie McCarte, night watch; Nellie Marshall, attendant, part time, C. F. Baldock, engineer and janitor, East Wing.

The Aquarium staff and employees as of January 1, 1933, were as

follows: Dr. C. E. Grunsky, Acting Director; Susie M. Peers, Secretary, part time; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Alvin Seale, Superintendent; Robert J. Lanier, Assistant Superintendent; Phyllis Beardslee, doorkeeper; B. T. Culleton, first assistant engineer; John A. Dwyer, second assistant engineer; Frank J. Maxwell, relief engineer; S. J. Shenefield, carpenter and general utility man; C. E. Guidry, chief attendant; Jack Solini, first assistant attendant; Leon Maxwell, third assistant attendant; Willard R. Martin, assistant collector; Patrick McArdle, assistant janitor; L. R. Solini and Lloyd Shebley, assistants, part time; and Frank Haley, day watch.

During 1932 the following changes in personnel took place.

Dr. Walter K. Fisher resigned his position as Curator of the Academy's inactive Department of Invertebrate Zoology on November 26, 1932.

William B. Hayden, an assistant in the Department of Exhibits, resigned on February 1, and John Adams, an assistant in the same Department, on August 2, 1932. This Department lost Richard Cayzer, an assistant, by death on March 3, 1932. From January 2 to July 19, 1932, the Library had the free services of Edwin J. Coman, a student of library methods. In March the services of Fred Tanaka as janitor's assistant were dispensed with. Part-time service as an assistant in the Department of Ornithology and Mammalogy was rendered by A. E. Borell covering February 15 to 19 and March 7 to 29.

The Academy makes grateful acknowledgment, too, of the part-time work by Hamilton Peers, as a voluntary assistant during October and November in the listing of books and pamphlets, bequeathed to the Academy by the late Dr. Evermann.

The Academy has suffered from the general business depression of the last few years and in consequence been forced to curtail activities. This has resulted in a reduced output of scientific publications and in the making of other retrenchments resulting in the reduction of the number of employees. Among those whose services were dispensed with are Thomas Cowles, Assistant Librarian, January 1, 1933; Louis Solini, second assistant attendant at the Steinhart Aquarium, June 30; Clynt S. Martin, Chief engineer at the Steinhart Aquarium, June 1; and Patrick O'Neill, janitor at the Aquarium, June 30, 1932. Hugh R. Jones, janitor, became ill in February and, not being able to return, his place was filled by his son, Raymond L. Jones. John L. Nicholson, Jr., has been employed part-time at intervals during the year in the Department of Paleontology and in the Library. Winifred Morrison was employed part-time in the Department of Paleontology from January to the middle of March.

ITEMS OF INTEREST

Full information relating to the receipts and expenditures by the Academy during the year 1932 is presented in the Treasurer's Report here annexed.

The income received and available for research activities and for operation of the Academy's Natural History Museum has fallen about $6,000 short of what had been estimated. Nevertheless, the Academy has carried on without reducing salaries, though with enforced curtailment of published output. How the insufficient allowance by the City for the Steinhart Aquarium has impaired the display of aquatic life is apparent to all who visit the same.

The Annual Meeting of February 17, 1932 was the first Academy meeting to be held in the new East Wing.

The Academy was invited to participate in the Captain G. Allan Hancock Expedition to the coast of Mexico, Central America, Malpelo Islands, Cocos Island, and the Galapagos Islands from December 1, 1931 to March 1, 1932, and was represented by Mr. Alvin Seale, Superintendent of the Steinhart Aquarium, and by Dr. Leo G. Hertlein, Assistant Curator of the Department of Paleontology.

Dr. C. C. Church was made Research Associate in the Department of Paleontology on February 27, 1932.

The Academy received an endowment of $10,000 from its unnamed friend who is sponsoring lecture courses on the general subject "The Beauties of Nature." The income from this endowment assures the continuance of these lectures, which have now been made a regular activity of the Academy.

Mr. Templeton Crocker has made a donation of $1,000 to the Academy's publication fund.

Mr. M. Hall McAllister has again contributed $100 to further activities relating to the preservation of wild life.

Mr. Leslie Simson returned from Africa early in January 1933, having completed the collection of 220 specimens of African mammals for the Academy's "Simson African Mammal Hall." Six of the painted backgrounds for the large groups in the African Hall are nearing completion and two small ones are complete.

Regardless of the fact that San Francisco should have the finest and best equipped aquarium in the world the operation of the Academy's Steinhart Aquarium was sadly crippled by an inadequate maintenance by the City. The Academy's request for $50,000 was cut by the Mayor in his recommendation to the Board of Supervisors to $45,000 and, despite the earnest representations of the Director and of the President of the Academy, the Supervisors made a second ten percent deduction from our needs, cutting down the budget allowance to $40,500.

The Academy was treated as though it were a city department, and the fact was ignored that any reduction of the requested allowance meant a crippling of our institution. There was no remedy.

To meet the situation the outside pools were closed down and the ten seals were sent to different parts of the country. The Bureau of Fisheries, too, was notified that we could not accept additional fur seals, for which arrangements had been made. Several employees were discharged and others put on part time. It is hoped that this year the Academy will be permitted to again operate at its established program.

MUSEUM ATTENDANCE FOR 1932

Cooperation with schools and other organizations and groups interested in natural history has been continued. Without listing each such school or group it is to be noted that during the year 1932 the Academy's Museum was visited by

Schools of San Francisco:

Total Number of Pupils	5769
Total Number of Teachers	206
Total Number of Classes	118

Schools Outside of San Francisco:

Total Number of Pupils	2165
Total Number of Teachers	64
Total Number of Classes	76

The total number of visitors to the Museum during 1932 was 381,559.

AQUARIUM ATTENDANCE IN 1932

Without listing each such school or group it is to be noted that during the year 1932 the Academy's Aquarium was visited by

Schools of San Francisco:

Total Number of Pupils	5706
Total Number of Teachers	199
Total Number of Classes	229

Schools Outside of San Francisco:

Total Number of Pupils	2598
Total Number of Teachers	72
Total Number of Classes	76

The total number of visitors to the Academy's Steinhart Aquarium during 1932 was 910,052, which together with the Museum attendance for the same year makes a grand total of 1,291,611 persons who derived pleasure and instruction from the free exhibits maintained by the California Academy of Sciences.

A large number of gifts of museum, aquarium, and library material have been received during the year, detailed lists of which are on file in the Academy offices. The thanks of the Academy are here

extended to the generous donors for their interest in the welfare of the institution.

The Academy again makes grateful acknowledgment to Mr. Edward Hohfeld and Mr. Francis C. Hutchens for valuable legal services furnished gratuitously, as also to the Southern Pacific Company, to the Santa Fe Railway Company, and to the Matson Steamship Company for courtesies which have facilitated the work of the Academy, and which are sincerely appreciated by its officers and staff of scientists.

On behalf of the Council I am sure that I may say that the service rendered and the work done in the several departments has been satisfactory with noteworthy results giving promise of sustained future progress.

DEPARTMENT REPORTS FOR THE YEARS 1931 AND 1932

DEPARTMENT OF BOTANY

The herbarium of the California Academy of Sciences now numbers over 200,000 mounted sheets, thousands of specimens not yet mounted, and thousands of duplicates to be used for exchange. In 1931, 4446 specimens were received in exchange and in 1932, 2221. They came from the following institutions and individuals: Stanford University; University of California, University of California at Los Angeles; Arnold Arboretum and Gray Herbarium of Harvard University; University of Sweden; University of Montana; Missouri Botanical Garden; University of Pennsylvania; Field Museum; J. W. Thompson, Seattle; J. Ewan, Los Angeles; L. C. Wheeler, La Verne, California. In 1931, 951 specimens were sent as exchanges and in 1932, 4668. They were received by the following institutions and individuals: Pomona College, Gray Herbarium, Missouri Botanical Garden, Field Museum, Stanford University, University of California, University of California at Los Angeles, New York Botanical Garden, University of Sweden, University of Montreal, Arnold Arboretum, U. S. National Herbarium, University of Asiae Mediae, Royal Herbarium, Kew, England, Ralph Hoffman, and J. Ewan.

In 1931 the Academy purchased 1960 specimens, consisting of 50 mosses from Mr. A. Grout, 100 Patagonian plants from A. Donat, 297 west American plants from C. L. Hitchcock, 206 Californian from Mrs. E. C. Van Dyke, and 1329 west American plants from the estate of Dr. P. B. Kennedy. The numerous duplicates of the last which were distributed in 1932 are not included. In 1932 the Academy purchased 100 plants collected in Patagonia by A. Donat, 404 collected in Texas by J. A. Moore and J. A. Steyermark, and 60 collected by A. C. Brade in Brazil.

In 1931, 4120 specimens were received as gifts from 12 correspondents and in 1932, 6378 from 20 correspondents. This does not include the collection of Hepaticæ donated by Mrs. E. C. Sutliffe, consisting of 77 specimens received by her in exchange from Miss C. C. Haynes, nor a collection purchased by the Curator from F. Verdoon, Utrecht, Holland, consisting of 233 specimens, including 94 isotypes and costing $57.77. The Curator also paid for the binding of 35 volumes of Engler's Pflanzenreich at a cost of $57.75 and 100 specimens from A. Donat, Patagonian plants, the cost being $22.00.

The most notable gifts have been as follows: Miss Louise A. Boyd gave a collection of 109 specimens collected by herself and Mr. Robert H. Menzies on her 1932 expedition to eastern Greenland. Mr. George Haley of the University of San Francisco donated 108 specimens collected on a trip to Iceland. Mr. Eric Walther has added altogether 700 exotics from Californian gardens and parks. The greatest donation has been made by Mr. Lewis S. Rose, who has also helped in the herbarium

by arranging and distributing specimens. In 1931 he donated 2902 and in 1932 over 4000 specimens. He exchanges Californian species which he collects in sets with botanists throughout the world, Australia, New Zealand, Africa, Palestine, South America, Europe, and the western United States are among the countries represented in his exchanges.

The collections made in 1925 by H. L. Mason on the Revillagigedo Expedition of the Academy were incorporated in the herbarium in 1931. Over 140 specimens were added to the herbarium and the duplicates were distributed as exchanges.

In 1931, the curator at her own expense spent two weeks around Kingman, Arizona, collecting 704 numbers as well as duplicates. In 1932 she joined Mrs. Susan Delano McKelvey on a week's trip in the desert region of Southern California, collecting 200 specimens. During 1931 Mr. Howell collected about 2600 specimens. More than 1700 of this number were obtained on a trip through the western United States and Canada with Mr. and Mrs. Clarence Elliott of Stevenage, England. During the spring and fall, Mr. Howell made shorter trips to various places, notable being a trip with Mr. E. P. Van Duzee through the south coast ranges, with the late Ralph Hoffmann to Santa Cruz Island, and with Mr. Templeton Crocker to Guadalupe Island, Lower California. In 1932, Mr. Howell accompanied the Templeton Crocker Expedition of the California Academy of Sciences as botanist. About 2600 specimens of vascular plants were collected besides large collections of seaweeds and liverworts, with smaller collections of lichens, fungi, and mosses. The number of specimens among these nonvascular plants will not be known until specialists working on the different groups have completed their studies. After his return to the Academy in September, Mr. Howell made several local collecting trips on which more than a hundred specimens were obtained.

For the publication of new species, interesting notes on introductions to the flora, and other matters of general botanical interest, Mr. J. T. Howell and I started in 1931 "Leaflets of Western Botany," a small quarterly botanical publication. We hope to make it the leading botanical magazine of the west. At present the subscribers are not sufficient for its support. Mr. Howell and I assume all responsibility, financial and otherwise.

The California Botanical Club now numbers 68 members and has either a meeting in the herbarium or an excursion generally once a week.

The exhibition of native and cultivated flowers in the vestibule of the Museum is one of the most popular educational features of the Academy. My assistant, Mrs. George H. Phelps, besides doing all the mounting, much of the distributing and attending to the drying and pressing of fresh specimens that are continually being added, looks after this exhibition. Over 2000 species are exhibited in the course of a year, each labelled with both scientific and common name, the exotics having their native country given and the native species the locality. Mr. Eric Walther has been most faithful in collecting exotics for the exhibition.

Mrs. E. C. Sutliffe brought in wild flowers from Marin County every week in 1931. Besides she takes complete care of our collection of Hepaticæ which is continually increasing. Other members of the Botanical Club help to keep the flower show beautiful and interesting. Mrs. J. H. Morrison sent beautiful wild flowers for the show from Butte County in 1932.

ALICE EASTWOOD, *Curator.*

DEPARTMENT OF ENTOMOLOGY

The moving of the Department of Entomology from its old cramped quarters into the new commodious rooms in the East Wing dominated its activities throughout the year 1931.

The work of transferring this Department to the new rooms was done early in December, but at the end of the month much was still to be done before the collections and books were in shape so efficient work could be carried on. We are now located in excellent quarters, conveniently arranged for work. The entrance

is through the Department office, beyond which is a laboratory room 30x75 feet in size. This has been divided into three compartments or alcoves, the first of which is devoted to the order of Lepidoptera, the intermediate alcove has the Hemiptera on one side, and a store room for supplies on the other side, the third alcove contains the Hymenoptera, Diptera, Orthoptera and the Neuroptera. Beyond, at the eastern end, is a room 30 x 36 feet devoted to the Coleoptera. In these laboratories large tables have been placed between the rows of cases, and the lighting is all that could be desired. The entomological library has been divided so that books devoted to one order of insects are shelved in the alcove with those insects, periodicals and general works being placed in the middle alcove. The metal insect cases have been finished in dark green, so the rooms look neat and attractive as well as being very convenient for study. The Department of Entomology is now admirably housed and with a moderate allowance each year for additional cases the collection can be gotten into shape as rapidly as the limited personnel will allow.

Additions to the collections during 1931 number 9200 specimens, but to this number must be added between three and four thousand beetles taken by Dr. Van Dyke that will be numbered with his collection. Among the more important items in the list of additions to this Department are 1069 insects taken by Dr. O. H. Swezey about Lake Tahoe, and generously presented to the Academy by him; 962 Hawaiian insects presented by Dr. F. X. Williams; 787 insects other than beetles from Dr. E. C. Van Dyke, taken during field work in northern California; 664 Texan insects from Mr. Gorton Linsley, and 2435 taken by the Curator in several short field trips. Smaller but especially valuable lots were received from Dr. L. I. Hewes, Mr. G. Stuart Walley, Mr. C. M. Dammers, Dr. S. F. Light, The Museum of Comparative Zoology, and from the Templeton Crocker expedition to the Guadalupe Islands collected by J. T. Howell. The material from Dr. Hewes and the Museum of Comparative Zoology were types or co-types. Material purchased includes 800 Hungarian insects from Dr. Chas. Sajo and 962 Diptera from M. C. Van Duzee, including 196 types or allotypes. Mr. L. S. Slevin has continued to send us material from Carmel, adding many interesting species.

Use of this Department by students has shown a marked increase during the year. Aside from casual visitors 85 students have made use of our collections, most of them more than once, some many times. Dr. Van Dyke and Dr. Blaisdell have continued to devote one or more days each week to the study and arrangement of our material, and Mr. Martin has devoted his part-time work to the arrangement of the Coleoptera and to the rearrangement of our types and allotypes, that now number 3600. The publication of the Pan-Pacific Entomologist has been continued. Mr. E. R. Leach has kindly consented to act as Treasurer for this publication and has a desk in the Department's office. Through his efficient efforts all indebtedness of the journal has been cleared up. No. 1 of Vol. IX will appear as the January, 1933, number and in the future the volumes will run concurrently with the calendar year, a change that will greatly facilitate bibliographic work with the journal.

The year 1932 was the first for this Department in the new and larger quarters and much of the work of the staff for the first few months was the rearrangement of the material in certain badly over crowded groups and in getting settled in the new rooms. The time of the Curator that could be spared from the general care of the collection, for taxonomic work, was largely devoted to the Hemiptera and Lepidoptera, and considerable headway was made in determining and arranging material in these orders of insects. Preliminary arrangement of the Hemiptera was nearly completed and several families of the butterflies were put in order. In the Coleoptera Dr. F. E. Blaisdell continued to spend about two days a week in systematic work. During the early months of the year Mr. J. O. Martin worked on the arrangement of several families and Dr. E. C. Van Dyke completed his preliminary arrangement of the Elateridae and helped much in the arrangement of certain other families, and later Mr. Linsley Gressitt began work on our oriental Cerambycidae, or longhorn beetles. In the Hymenoptera Mr. H. S. Gentry has helped us in the determination of our fossorial families. Unfortunately there were

no cases available for the arrangement of the Diptera of which order the Academy now has a really fine collection of the North American forms.

Additions to the collections of the Department of Entomology during 1932 number 44,950 specimens. The largest and most important item was the Millard C. Van Duzee collection of about 30,000 specimens. This collection, obtained by purchase at a nominal figure, was largely Diptera, of which order there were 18,000 specimens including an unusually full series of such obscure forms as the Dolichopodidæ and Mycetophylidæ. The Hymenoptera, with 6,500 specimens, was a good second, the balance of the collection being Coleoptera. Most of this large collection was of determined eastern American species which well supplemented our own material and made the collection of special value to the Academy. Other important additions made during the year were the following:

From J. O. Martin 4,683 specimens of insects from Texas; from Mr. Templeton Crocker 2,417 insects taken on his Galapagos Island Expedition, and including probably the best series of Hemiptera as yet taken out of these islands; the Curator added 2,192 specimens in his field work. By bequest from Mr. W. W. Funge we received 1,170 insects from the Möjberg collection; Mr. A. J. Bassinger gave us 919 insects from Alaska; from Mr. Charles Sajo we purchased 765 determined European insects; Mrs. Mexia gave us 405 brazilian insects in addition to a larger number that came to us through the Van Dyke Collection, and from Mr. Otto Swezey we received 252 determined Hawaiian Delphacidae from the Giffard collection. Dr. Van Dyke and Mr. Louis Slevin have continued to collect assiduously for the Academy; Mr. C. M. Dammers has sent us many beautiful bred Lepidoptera of southern California and from Dr. John A. Comstock we have received others. Smaller lots have come in from other friends of the Academy that have added valuable species to the collection.

EDWARD P. VAN DUZEE, *Curator.*

DEPARTMENT OF EXHIBITS

The writer returned from Africa December 25, 1930, and commenced arrangements for the mounting of the collection of African animals donated to us by Mr. Leslie Simson. In February the auditorium was turned over to the Department to be used as a workshop and the work of adopting it to its purpose was commenced immediately. The staff of the department was added to until it numbered eight. For various reasons, mainly financial, this number has been reduced to four.

The energies of the Department have been expended almost entirely upon the construction of the exhibits for the Simson African Mammal Hall, and, in spite of adverse financial conditions, the work has proceeded well. Forty-seven large mammals have been mounted (14 of these under contract by Jonas Brothers of Yonkers, New York). The foreground construction for 10 large groups is being roughed in. The accessory department has made a great quantity of plants and other materials for the groups.

In addition, eight backgrounds are either completed or almost so. Four of these are by Captain Charles Bradford Hudson, two by Dr. C. E. Grunsky, two by Miss Grace M. Betts, and one by the writer.

We had hoped to be able to open the Hall to the public on April 4, 1933. Under existing conditions this will be impossible. However, it may yet be possible to open some time before the end of the year.

Mr. Leslie Simson has made several trips to Africa to secure material for the Hall and has practically completed the collection. To date we have received from him 220 specimens of large mammals.

Much of the writer's time was taken up attending to details connected with the construction of the new building, particularly the Hall, which is to contain the habitat groups of African mammals. This was done in cooperation with the other members of the building committee and Mr. Eugene L. Grunsky, Superintendent of Construction for the Academy. The results seem to have justified this course of action.

In addition much routine work has been accomplished, some of the items being the polishing and reinstallation of the large section of Sequoia giganteae, the making of a quantity of bird skins from the Templeton Crocker expedition and the mounting of a large Giant Black Marlin, which was presented to the Academy by Mr. Crocker. This specimen has been placed in the Steinhart Aquarium.

FRANK TOSE, *Chief of Exhibits.*

DEPARTMENT OF FISHES

The first part of the year was spent assisting Dr. Evermann in collecting data and references, and preparation of a manuscript on a Distributional List of the California Freshwater Fishes. This was later published as Fish Bulletin No. 35 of the State of California Division of Fish and Game.

In order to have a basis for the obtaining of a complete collection of California fishes, both freshwater and marine, and with a view of possibly preparing at some future time a complete handbook of the same, a card catalogue was prepared, consisting of a list of 474 names.

The question concerning the threatened extermination of certain species of whales, and the desirability of their conservation having arisen, at Dr. Evermann's request I spent considerable time looking up records and preparing tables showing facts and their relationship involved in the history of the Pacific whaling industry. The results of this work were later turned over to the U. S. Bureau of Fisheries for its use.

During the summer of 1931, when an assistant (James A. Campbell) was available, the bottles containing the Indiana Fish Collection were removed from the cartons in which they were shipped, as far as time permitted. The bottles were cleaned, placed on shelves in the basement of the Aquarium, alcohol was added where needed, and a card catalog prepared. At the beginning of the year 1932 the collection was shelved in its new quarters in the basement of the East Wing.

From August 26 to September 27, 1931, was spent afield and enroute to and from the region about Lake Maxinkuckee, Indiana, collecting fishes for the Aquarium and Museum. The month of September, 1931, was abnormally hot in Indiana, making the task of bringing the fishes back alive difficult, but it was accomplished with but few losses on the way. While at the Lake notes and comparisons were made regarding changes in the flora and fauna of the region since former visits. A number of turtles were captured and brought to the Aquarium, among them a peculiar hybrid of unusual interest. One species of fish in the lake, the straw-colored minnow, *Hybopsis blennius*, which ran in immense schools, was badly infected with furuncles, about 90 per cent being attacked. This disease had not been noted during the survey of the lake, but had become fairly common by 1927 or 1928. It seems to affect no other species.

From March 10 to September 1, 1932, was spent on the Templeton Crocker Expedition, collecting specimens of marine animals for the Museum. Much of the time since the return has been spent in preliminary work upon the fishes. While on the trip many life history notes of the species observed were made to be incorporated in the report. A great assemblage of many sorts of small creatures including fishes and crustacea, mollusks and worms, were collected about a submerged electric light. The task of sorting out these organisms is being undertaken by Mr. Kenneth Stanton, who is also of great assistance in arranging the collection of fishes. Up to date 3097 specimens have been tagged, and there is left only small collections obtained about the lights, most of them young fishes. Soon as this is finished identification of species will begin. The shell collection was sorted out and transferred to the Department of Paleontology.

As much time as can be spared has been devoted to the preparation of Biological Abstracts, and the editing of abstracts sent in, as well as the answering of queries that arise. To facilitate prompt answering of queries the list of genera kept on file is being kept up to date with proper notations added.

H. WALTON CLARK, *Curator.*

DEPARTMENT OF HERPETOLOGY

During the years 1931-32 progress has been made in building up the collection of the Department. The months of April and May and the first week of June, 1931, were spent in making a field trip to the Death Valley Region of California, an important locality from which the collection had no material whatever. This expedition resulted in the gathering of 577 specimens including some of our rarer Californian snakes, including specimens of the Panamint Rattlesnake, and added new records in distribution. An excellent representation of the reptile fauna of that very interesting region is now available for study.

As rattlesnakes have, of late, become of special interest to many students of herpetology an effort was made to build up the series of these snakes, and through purchase and exploration 90 specimens were secured. The collection of rattlesnakes now numbers over 480 specimens, and includes, with one exception, representatives of all of the species found within the borders of the United States, and also some of the species inhabiting Mexico and Central America.

The motion picture films, made in the spring of 1930, showing the various specimens of rattlesnakes found in the state of California have proved of great interest, and have been borrowed by the American Association for the Advancement of Science, for its meetings in Pasadena, and by the Northwest Scientific Association at Cheney, Washington.

Of the 1,387 specimens added to the collection during the past two years the outstanding accession is the carapace, bones and part of a skull of the extinct Charles Island Tortoise (*Testudo galapagoensis*), donated by the New York Zoological Society through Dr. C. H. Townsend, of the New York Aquarium. The acquisition of this specimen gives the Academy's collection of the giant land tortoises of the Galapagos Islands the one species which it lacked and makes it the largest and most complete in the world. Mr. L. M. Klauber, of the San Diego Zoological Society, donated a specimen of a Night Lizard (*Xantusia arizonæ*), a species recently described by him. Besides the Charles Island Tortoise a number of donations were received from the many friends of the Department; the principal ones being 148 specimens from Howard K. Gloyd collected in the middlewest and eastern states, and from the Museum of Comparative Zoology, Cambridge, Massachusetts, 32 specimens from Mexico and Central America. An excellent specimen of *Rana goliath*, the largest known frog, was received in exchange from that institution. Over one hundred photographs pertaining to the herpetology of the Galapagos Islands were received from the Templeton Crocker Expedition.

The routine work of the Department was carried on as usual, and 2,006 specimens from various accessions have been labeled, card catalogued and installed in the collection, besides 976 specimens which have been labeled only. A study of the reptiles and amphibians collected while on field work in Guatemala is in progress, and all of the reptiles, numbering 2,896 specimens, 630 of which are snakes, have been labeled. All of the snakes have been scale-counted and card catalogued. The growth of the collection of amphibians and of certain genera of lizards and snakes makes re-arrangement, and will call for much of the available shelf space.

As in the past the collections of the department have been made use of by students from our own and eastern states.

Owing to the many inquiries from the general public in regard to our snakes and lizards, and especially from the Boy Scouts who are endeavoring to obtain a merit badge for reptile study, a handbook of our west coast reptiles and amphibians has been prepared and presented for publication. The necessary information for a Scout to pass an examination for his merit badge, as well as general information for the casual observer is given, and the illustrations and line drawings will aid in the identification of the various reptiles and amphibians. For those who wish to consider the subject more deeply a bibliography is included which will give the reader all the literature necessary to become thoroughly acquainted with our reptile fauna.

JOSEPH R. SLEVIN, *Curator.*

DEPARTMENT OF LIBRARY

The accessions to the Academy Library in 1931 and 1932 are tabulated below, and represent a slightly smaller total than normal in certain respects, to be accounted for by the lessened funds available for purchases. The figures are as follows:

1931

	BD. VOLS.	UNBD. VOLS.	PARTS OF VOLS.	PAMPHLETS	MAPS
Exchange....	31	118	4295	28	278
Gift.....	46	56	2318	411	11
Purchase.....	245	132	1166	36	72
	322	306	7779	475	361

The number of exchanges added was 21. The titles catalogued were 407, only the shelf-list and temporary cards being made; these entries covered 507 volumes.

1932

	BD. VOLS.	UNBD. VOLS.	PARTS OF VOLS.	PAMPHLETS	MAPS
Exchange....	37	152	4080	94	219
Gift.....	167	223	2537	2754	27
Purchase.....	45	9	1086	3	29
	249	384	7703	2851	275

The number of exchanges added was 10. The titles catalogued were 1090, only the shelf-list and temporary cards being made; these entries covered 1449 volumes.

The work of the Library continues to be hampered by lack of sufficient personnel to take care even of the routine detail, so no progress was made on the most important task that should receive first attention—namely, the recataloguing of the collection. The congestion of material to be shelved was disposed of during a few weeks in the Spring of 1931 by the temporary assistance of Mrs. Barbara Cowles, and in the first six months of 1932 by the voluntary assistance of Edwin T. Coman, Jr., and by the temporary assistance of John L. Nicholson, Jr., for a few weeks in the Fall. This permitted the accumulation of accessions awaiting cataloguing to receive temporary catalogue entries and to be distributed to their shelf destinations.

Final cataloguing of new accessions will have to be postponed until the recataloguing as a whole can be undertaken.

The assistant librarian was privileged to attend the national meeting of the Special Libraries Association in Cleveland in June 1931. At the sessions of the Museum Group there the survey of art and science museum libraries in the country was discussed and the questionnaire prepared by the survey committee, of which he had served as a member during the preceding year, was adopted. He was then appointed chairman of this committee, the chief job of which during 1931-1932 was the collection of data for a published survey, compilation of which is now under way. Opportunity was taken during the trip to visit the museum libraries of Cleveland and Chicago, the John Crerar Library in Chicago, and that of the California Institute of Technology in Pasadena during the meeting of the American Association for the Advancement of Science the following week.

The Assistant Librarian wishes to express his appreciation to the Council for permitting him to continue on part-time duty the last three years in order to pursue graduate study in bibliography and the history of science at the University of California. Additional professional honors were accorded him during the two years, in addition to the chairmanship of the Museum Group survey committee; he was named on the ways-and-means committee of the national Special Libraries Association after the Cleveland meeting; he was elected vice-chairman of the Museum

Group in the Summer of 1932; he was appointed on the publications committee of the National Association in the Fall of 1932; he was asked to compile a manual on the organization and administration of local chapters and groups in the national Association in December 1932; and he was chairman of the Special Libraries Section of the California Library Association for 1931-1932. The library assistant, Miss Sexton, served as sub-editor on the bulletin of the Special Libraries Association of San Francisco, in charge of the review of current literature, for several months.

THOMAS COWLES, *Assistant Librarian.*

DEPARTMENT OF ORNITHOLOGY AND MAMMALOGY

Curatorial work of the usual routine nature continues to take a large share of our time, needed work upon the collection making heavy demands upon Curator and Assistant Curator. We have been obliged to discontinue one minor public service, the loan of specimens to the schools, partly from the increasing amount of time that it required, but largely because material set aside for this purpose had become so badly worn from rough handling that it could no longer be used. The general collection has reached a dangerous stage of congestion; in the present crowded condition of our rooms, specimens can no longer be stored so as to be readily available for study. In fact, the collections of small birds and mammals are no longer in a satisfactory condition even as regards safe keeping. Damage has ensued from crowding and further deterioration will be hard to avoid. Books, too, have suffered from the manner in which they must be kept. Our large mammal skins, however, are well cared for, as in the construction of the newly completed east wing of the Academy there was included a refrigerating room for storage of such specimens. This happily permitted the abandonment of the old hide room, which had always been an unsatisfactory make-shift. This part of the collection is now properly stored, both as regards safety and accessibility; some work remains to be done in arrangement. The decision of the authorities of the De Young Memorial Museum to discontinue all exhibits and other activities pertaining to the natural sciences, and to turn over all such material of theirs to the Academy resulted in this department receiving some hundreds of desirable specimens, many of great bulk. This accession, valuable as it is, still further accentuates our congested condition. In 1931 field work was carried on in the Atlin region, British Columbia, and in Panama. The Curator spent the time from June 23 to October 31 on the Atlin trip, following up field studies begun in previous years. The Assistant Curator returned in January from a three months' stay in Panama, and she was in the same country again, October 13, 1931 to February 5, 1932. In 1932 the Curator, as a member of the Templeton Crocker Expedition, spent the time from March 10 to July 10 on this trip to the Galapagos Islands. These expeditions have resulted in important additions of species and specimens to our collection. Mr. Mailliard, Curator Emeritus, has systematically continued the banding of birds at Woodacre, Marin County, California, but is principally engaged in rearranging and checking over the Mailliard collection of some 15,000 specimens of birds and 3500 sets of birds' eggs. On June 29, 1931, there was published "The Avifauna of the Galapagos Islands" based upon the Academy collection, preparation of which had occupied much of the Curator's time during the previous four years. This is mentioned here because since the appearance of this study we have received from many sources requests for the exchange of Galapagos birds, on the assumption that we would no longer need to keep our large series, all of which requests have been refused. The Curator wishes to place on record his strong conviction that this entire large collection should be kept intact; that it would be a grave mistake to part with any of it. As a unit it forms an important feature of our institution, and it is certain to increase in importance and usefulness in future years. The 49th Stated Meeting of the American Ornithologists' Union, held in Detroit, October 19-22, 1931, was attended by Mrs. Davidson. This she did while en route to the Atlantic port from which she sailed to Panama, taking advantage at the same time of the opportunity to pursue bird studies in several of the large eastern Museums. The Sixth Annual Meeting of the Cooper Ornithological

Club, held in Berkeley, May 15 and 16, 1931, was attended by all members of the department, as well as by others of the Academy. The 50th Stated Meeting of the American Ornithologists' Union, held at Quebec, October 18-21, 1932, was attended by the Curator, who presented a paper entitled "The Galapagos Avifauna Today."

Details of accessions for 1931: Birds. *Gift:* Templeton Crocker, 2; C. W. Edge, 37; E. W. Gifford, 5; Golden Gate Park Aviary, 1; Louis Hartmenn, 20; Forest Ranger J. B. Herschel, 1; W. J. Jackson, 1; J. Mailliard, 14; Carrol McGettigan, 2; James Moffitt, 1; Mori Bird Company, 1; A. W. Robison, 1; Gene M. Simpson, 5; J. W. Steinbeck, 3; Steinhart Aquarium, 2; Mr. Sutro, 2; L. R. Wolfe, 5. *Permanent Loan:* Memorial Museum, 344. *Expedition:* M. E. Davidson, 433; H. S. Swarth, 217. *Transfer:* Department of Exhibits, California Academy of Sciences, 8. *Purchase:* 7. Bird skulls and skeletons. *Permanent Loan:* Memorial Museum, 707.

Eggs. *Gift:* G. Dallas Hanna, 1 set; O. J. Millard, 1 set and nest. *Expedition:* H. S. Swarth, 1 set.

Mammals. *Gift:* G. Dallas Hanna and C. C. Church, 8; Joseph Mailliard, 1; Milton S. Ray, 1; U. S. and California Quarantine Service, 2. *Expedition:* M. E. Davidson, 7; H. S. Swarth, 217. *Transfer:* Department of Exhibits, California Academy of Sciences, 3. *Purchase:* 6.

Mammal skulls and skeletons. *Permanent loan:* Memorial Museum, 157.

Details of accessions for 1932: Birds. *Gift:* Mr. Ward Austin, 1; Mr. F. E. Booth, 7; Miss Louise A. Boyd, 14; Mr. J. A. Brock, 1; The Templeton Crocker Scientific Expedition, 1932, 483; Forest Ranger Herschel, 1; Mr. E. C. Jacot, 1; Mr. C. E. Kruger, 3; Mr. J. D. Lewis, 1; Mr. M. E. Lombardi, 2; Mr. John W. Mailliard, Jr., 1; Mr. Joseph Mailliard, 14; Mr. John McLaren, 1; Mr. J. V. Patton, 1; Mr. Warren Phillips, 1; Mr. Milton S. Ray, 5; Mr. A. W. Robison, 19; Mr. J. W. Steinbeck, 4; Dr. J. M. Stowell, 2; Mr. Henry Trost, 1. *Exchange:* Steinhart Aquarium, 1. *Purchase:* Mr. H. G. Deignan, 35; Mr. James Moffitt, 2; Mr. W. F. H. Rosenberg, 1; Mr. H. S. Swarth, 2. *Expedition:* Mrs. M. E. Davidson, 321.

Eggs. *Gift:* The Templeton Crocker Scientific Expedition, 1932, 6 sets; Dr. George Haley, 1.

Mammals. *Gift:* Mr. Wallace Adams, 52; The Templeton Crocker Scientific Expedition, 1932, 6; Mr. Spencer Grant, 1; Mr. Hole, 1; Mr. Adolf Holm, 1; Mr. H. E. Jager, 1; Ranger McBeen, 1; Mr. J. S. Rowley, 96.

H. S. SWARTH, *Curator.*

DEPARTMENT OF PALEONTOLOGY

Two large collections were secured during the biennium 1931-1932. The first was the result of the G. Allan Hancock Expedition to the Galapagos Islands, Panama, and other west coast points. Dr. L. G. Hertlein accompanied this expedition as a representative of the Academy, and he succeeded in securing a large number of marine mollusca by dredging and shore collecting. These help greatly in rounding out the Department's west coast collection because localities were visited which have long been classical in conchological literature. Dr. Hertlein also secured some land shells and fossils at various stopping places.

The other large accession was the material collected by the Templeton Crocker Expedition of 1932. Due to the interest and enthusiasm of Mr. Crocker and the assistance of all members of the party the Department of Paleontology fared exceedingly well. A great deal of dredging was done, which brought up a rich store of valuable material from many places along the west coast, south as far as the Galapagos Islands. Land shells were also collected at numerous places.

As a result of these two expeditions the Department's collection of mollusca, living and fossil, from the west coast of Mexico and Central America has become one of the most complete in existence.

Dr. F. M. Anderson has continued with his collections and studies of the Cretaceous of California.

Numerous valuable additions to the collection of microscopical fossil material, particularly diatoms and foraminifera, were made during the biennium through the efforts of Mr. C. C. Church and other members of the geological department of the Associated Oil Company.

Mr. M. Vonsen made excursions into the desert region of California and succeeded in securing some additional, excellent specimens of rare minerals. He gave special attention to investigations in and about Death Valley.

Much of the energy of the staff has been utilized in the arrangement of the collections in systematic and orderly manner, a work which is of equal importance to the acquiring of new material. The incorporation of the D. D. Baldwin collection into the regular series was completed largely through the efforts of Mrs. Winifred B. Morrison.

A rearrangement of the land and fresh water mollusca (over 80,000 specimens) has been completed by Mr. J. L. Nicholson. The work extended through several years and involved the making of card indexes of all species and genera, and the shifting of collections into systematic order. During the summer of 1932 Mr. Nicholson was employed to make plaster casts of type specimens in other institutions, and over 600 of these were added to the collection.

The assignment of the space formerly occupied by the Department of Entomology to the Department of Paleontology for research purposes has greatly relieved the congestion which has been so detrimental for several years.

The Academy's collection of diatoms, and its exceptional library upon the subject have attracted the interest of institutions and individuals throughout this and many foreign countries. It is fitting that such a center should be located in California because these minute microscopic plants have become to be of very great economic value, and the deposits of the state are far larger than those of all the remainder of the world. The quarries of the state supply the most of the demand. It has been said that diatoms are the most valuable single group of fossils in existence, and that they are probably the source of most of the petroleum in California. They are used in cement; for insulation wherever a highly efficient non-conductor of heat is needed; in filtration; and as an abrasive in hundreds of kinds of polishes and other substances. The quantity of California Diatoms used in filtration alone has been estimated at 50,000 tons annually in recent years. The value of fossil diatoms in determining the geological age of sedimentary strata is now well established, and this application has been worked out very largely at the Academy during the last few years.

G. DALLAS HANNA, *Curator.*

DEPARTMENT OF STEINHART AQUARIUM

The Annual Reports of the Steinhart Aquarium of the California Academy of Sciences for the years 1931 and 1932 are here presented in consolidated form. That part relating to 1931 was filed by Mr. Robert J. Lanier, Assistant Superintendent, in the absence of Superintendent Alvin Seale, at the time with the scientific expedition of Captain G. Allan Hancock's motor cruiser *Velero III* to the Galapagos Islands. Items relative to 1932 were prepared by Superintendent Seale.

The exhibits of the Steinhart Aquarium have constantly increased to such an extent that we have reached our limits for proper display, and the need for more space and large tanks has become more and more evident. Of fresh water tropical fishes we now have 4,432 specimens of 59 species in our balanced aquarium room and in the greenhouse, and no more increase is possible without over-crowding. The capacity of the aquaria used for breeding purposes in the greenhouse is also exhausted, so we are forced to curtail this interesting phase of our work. It is hoped that it may be possible to increase these facilities in the near future through favorable action of the San Francisco Board of Supervisors.

Owing to economic conditions, our budget received a severe cut for 1932, which made it imperative to reduce expenditures. The Council and Board of Trustees

regretfully ordered a reduction of three members of the aquarium staff and the disposal of all our seals and sea lions. This has caused much adverse comment from the thousands of people who visit the Aquarium.

On the other hand, the Aquarium has been fortunate in its friends who have presented 3,072 gifts during 1932.

The total number of specimens in the Steinhart Aquarium of the California Academy of Sciences at the end of 1932 was 13,185, and the number of separate species represented was 469. A gratifying decrease in mortality has been shown during the two years.

The attendance for 1931 was 1,003,753 visitors; that for 1932, 910,052, the grand total of all visitors since the Aquarium was opened being 9,259,424, testifying to the great popular interest and educational value of the exhibits.

On December 9, 1931, Captain G. Allan Hancock of Los Angeles, very kindly invited the Academy to send two men to accompany a scientific expedition on his yacht *Velero III* to Central America and the Galapagos Islands. Dr. Leo Hertlein, of the Department of Paleontology, and the Superintendent of the Aquarium, were selected. After three months in the field this expedition returned with a large amount of material, including more than a thousand specimens of fishes and some valuable fossils. One unique find was a new species of fresh water fish from Chatham Island, of the Galapagos. A small number of fishes from these islands were brought alive to the Aquarium, thus proving they could be carried this great distance if proper equipment is provided.

On March 10, 1932, Mr. Templeton Crocker of San Francisco, a patron of the Academy, organized and carried out a scientific expedition covering much of the same territory as the above. This expedition was participated in by the Assistant Superintendent of the Aquarium, Mr. Robert Lanier, and three members of the Academy staff. After six months of active work and exploration they returned with a vast amount of material, including 331 specimens of live fish representing 56 species. These are now in the Aquarium tanks.

The Matson Navigation Company has been most helpful and generous to the Aquarium during the past year. Two large plate glass tanks with cast bronze frames have been loaned to this institution for an indefinite period. This company has also given permission for us to install a circulating system on their steamship, *Mariposa*, and will continue to bring us live fishes from Fiji and Australia, serving the Aquarium without charge, because we, as a free institution, contribute to the interest and education of the travelling public they serve.

A noteworthy improvement was completed near the close of 1931, the installation of pressure filters for the water of the out-door seal pools, thus rendering them so clear that the movements of the animals may be readily followed while swimming beneath the surface. All the salt water of the aquaria is now filtered into the salt water reservoirs below ground. All waste water lines from the building and the seal pools are now directly connected with the new sewer, thus obviating the previous necessity and expense of pumping.

Complete lists of gifts to the Aquarium, exchanges, and statistics concerning the fishes and other animals exhibited, mortality tables, etc., will be found in the accompanying detailed report.

ALVIN SEALE, *Superintendent*,
ROBERT J. LANIER, *Assistant Superintendent*.

FINANCIAL STATEMENTS

REPORT OF THE TREASURER

For the fiscal year ending December 31, 1932

January 1, 1932 Balance due Crocker First National Bank		$ 11,043.03
Receipts:		
Dues	$ 3,105.00	
Rentals	85,946.04	
Notes Payable	78,500.00	
Notes Receivable	2,000.00	
Notes Receivable Ignatz Steinhart Trust	1,000.00	
Lecture Endowment	10,000.00	
Templeton Crocker Endowment	1,000.00	
Barton Warren Evermann Endowment	1,000.00	
Lecture Fund Income	500.00	
Publication	336.67	
Post Card Sales	348.93	
Ignatz Steinhart Trust Interest	170.53	
Interest	163.12	
Park Birds Handbook Fund	59.00	
W. G. Wright Fund	15.00	
Total Receipts		$184,144.29
		$173,101.26
Expenditures:		
East Wing Construction	$ 59,664.96	
West Wing Additions	1,593.23	
Interest	20,391.83	
Investment of Lecture Endowment Fund	10,012.50	
Notes Payable	6,000.00	
Earthquake Insurance Sinking Fund	1,200.00	
Museum Department Appropriations	24,149.74	
Salary Expense General	19,462.50	
Department Salaries	22,900.00	
Insurance	2,026.86	
Sundry Creditors	2,831.17	
Library	1,265.56	
Steinhart Aquarium Equipment	978.62	
Contingent Fund	754.04	
Publication	341.92	
Lecture Expense	316.20	
Expense	4,330.04	
Post Cards	3.97	
Total Expenditures		$178,223.14
December 31, 1932 Balance due Crocker First National Bank		$ 5,121.88

F. W. BRADLEY, *Treasurer.*

Examined and found correct,

MCLAREN, GOODE & CO., *Certified Public Accountants.*
San Francisco, California, February 11, 1933.

INCOME AND OPERATING EXPENSES

For the fiscal year, January 1, 1932 to December 31, 1932

Income:		
Charles Crocker Scientific Fund Endowment Income	$ 1,788.80	
James Lick Endowment Income	72,026.30	
General Income	14,297.64	
Dues	3,200.00	
Interest Received	328.40	
Profit on Post Card Sales	197.53	
Total Income		$ 91,838.67
Expenditures:		
General Expenses	$ 4,151.57	
Salaries	44,467.61	
Interest	21,732.81	
Insurance	2,488.08	
Total Expenditures		$ 72,840.07
Net Income Transferred to Surplus Account		$ 18,998.60

SUMMARY OF SURPLUS ACCOUNT

December 31, 1932

Balance January 1, 1932		$620,523.24
Additions:		
Net Income for the year ended December 31, 1932	$ 18,998.60	
Transfer of B. W. Evermann Donation to be expended for exhibits	1,000.00	
Total Additions to Surplus		$ 19,998.60
		$640,521.84
Deductions:		
Depreciation	$ 22,122.38	
Transfer to Earthquake Insurance Sinking Fund	1,200.00	
Total Deductions from Surplus		$ 23,322.38
Surplus, December 31, 1932		$617,199.46

BALANCE SHEET

December 31, 1932

Assets

Property:			
Real Estate 831-833 Market Street—pledged...		$600,000.00	
Commercial Building, 833 Market Street—pledged.....	$516,818.66		
Less: Reserve for Depreciation....	131,788.71	385,029.95	
Real Estate, Jessie Street.....		8,083.65	
			$993,113.60
Museum, Golden Gate Park:			
West Wing.....	$193,619.15		
Less: Reserve for Depreciation....	48,991.75		
		$144,627.40	
East Wing.....	$252,184.72		
Less: Reserve for Depreciation....	5,025.06	247,159.66	
General Collections.....		261,127.41	
Library and Equipment.....		172,080.28	
Tools and Equipment.....	$ 52,325.44		
Less: Reserve for Depreciation....	14,019.63		
		38,305.81	
Office Furniture.....	6,600.64		
Less: Reserve for Depreciation....	4,584.59	2,016.05	
			865,316.61
Investment Securities.....			20,226.21
Ignatz Steinhart Trust:			
Notes Receivable.....		$ 4,000.00	
Steinhart Aquarium Construction.....		263,390.29	
Steinhart Aquarium Equipment.....		36,647.02	
Steinhart Aquarium Revolving Fund.....		5,000.00	
Uninvested Cash on Hand.....		290.04	
			309,327.35
Current Assets:			
Rent Receivable.....		$ 2,166.70	
Post Cards in Stock.....		1,529.80	
Cash on Hand.....		143.60	
Advance to employee doing field work.....		100.00	
			3,940.10
Total.....			$2,191,923.87

BALANCE SHEET—Continued

Liabilities

Endowments:		
James Lick Endowment	$804,902.31	
Charles Crocker Scientific Fund Endowment	20,000.00	
John W. Hendrie Endowment	32,770.85	
		$857,673.16
Funds Held for Special Purposes:		
Alvord Bequest Botanical	$ 5,000.00	
John W. Hendrie Endowment Income	1,345.08	
Earthquake Insurance Sinking Fund	10,126.21	
Templeton Crocker Publication Fund	1,000.00	
Lecture Fund	10,000.00	
Lecture Fund Income	188.06	
Park Birds Handbook Fund	355.60	
W. G. Wright Fund	69.57	
Wild Life Protection Fund	16.10	
		28,100.62
Ignatz Steinhart Trust:		
Principal	$250,000.00	
Interest	59,327.35	
		309,327.35
Notes and Accounts Payable:		
Mortgage note and other notes payable	$373,500.00	
Accounts Payable	711.36	
Due Crocker First National Bank	5,411.92	
		379,623.28
Surplus		617,199.46
Total		$2,191,923.87

SUSIE M. PEERS, *Secretary*
Board of Trustees.

We have examined the foregoing Balance Sheet, together with the books and accounts of the California Academy of Sciences, and in our opinion, it is properly drawn up so as to exhibit a true and correct view of the Academy's affairs, as shown by the books.

McLAREN, GOODE & CO.
Certified Public Accountants

San Francisco, Calif.,
February 11, 1933

INDEX TO VOLUME XX, FOURTH SERIES

New names in **heavy-faced** type

ERRATA

Page 27. Fourth line of table: for *Erichloa* read *Eriochloa*.

Page 182. Line 26: for *Coscinodiscus novozealandicus* Grove, read *Coscinodiscus novazealandicus* Grove.

Page 182. Line 28: for *novo-zealandica* Grove, read *nova-zealandica* Grove.

Page 200. Line 14: for .447 mm., read .0447 mm.

Page 205. Line 2: for plate 13, fig. 8, read plate 13, figs. 8, 9.

Page 213. Line 2: for plate 15, figs. 5, 6, 7, read plate 15, figs. 6, 7, and 8.

Page 227. Line 2: for plate 18, figs. 5, 6, read plate 18, figs. 6, 7.

Page 244. Line 6: for *Coscinodiscus zealandicus* Grove, read *Coscinodiscus novazealandicus* Grove.

Page 260. Line 6: for *Triceratum*, read *Triceratium*.

Page 289. Tenth line from top: for *Eutamias ruficaudus simulans* Howell, read *Eutamias affinis affinis* Allen.

Page 289. Fifth line from bottom: for *Neotoma cinera drummondi* (Richardson), read *Neotoma cinera cinera* (Baird).

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 2, pp. 9-104 NOVEMBER 18, 1931

II

The Flora of the Revillagigedo Islands

BY

IVAN M. JOHNSTON

Gray Herbarium of Harvard University

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1931

TRUSTEES, OFFICERS, COUNCIL, AND MUSEUM STAFF OF THE CALIFORNIA ACADEMY OF SCIENCES

BOARD OF TRUSTEES

WILLIAM H. CROCKER, *President* . . . . . Term expires 1935
JOSEPH D. GRANT, *Vice-President* . . . . . Term expires 1932
LOUIS F. MONTEAGLE . . . . . Term expires 1933
MRS. ALEXANDER F. MORRISON . . . . . Term expires 1934
NORMAN B. LIVERMORE . . . . . Term expires 1936
DR. C. E. GRUNSKY,
President of the Academy and ex-officio member . . . Term expires 1932
F. W. BRADLEY,
Treasurer of the Academy and ex-officio member . . . Term expires 1932
SUSIE M. PEERS, *Secretary to the Board*

OFFICERS AND COUNCIL

DR. C. E. GRUNSKY, *President of the Academy*
OTTO VON GELDERN, *First Vice-President*
DR. WM. E. RITTER, *Second Vice-President*
DR. F. M. MACFARLAND, *Corresponding Secretary*
ANNIE G. HOBSON, *Recording Secretary*
F. W. BRADLEY, *Treasurer*
DR. EMMET RIXFORD, *Librarian*
DR. BARTON WARREN EVERMANN,
Director of the Museum and of the Steinhart Aquarium, and Executive Curator

STAFF

DR. BARTON WARREN EVERMANN, *Director and Executive Curator*

Department of Botany . . . ALICE EASTWOOD, *Curator*
JOHN THOMAS HOWELL, *Assistant Curator*
KATE E. PHELPS, *Assistant*
Department of Entomology . EDWARD P. VAN DUZEE, *Curator*
AMY WILLIAMSON, *Assistant*
DR. EDWIN C. VAN DYKE, *Honorary Curator*
DR. F. R. COLE, *Associate Curator in Dipterology*
DR. F. E. BLAISDELL, SR., *Research Associate*
Department of Exhibits. . . FRANK TOSE, *Chief*
Department of Fishes . . . DR. BARTON WARREN EVERMANN, *Curator*
H. WALTON CLARK, *Assistant Curator*
Department of Herpetology . JOSEPH R. SLEVIN, *Curator*
Department of Invertebrate Zoology
DR. WALTER K. FISHER, *Curator*
Library . . . . . DR. EMMET RIXFORD, *Librarian*
THOMAS COWLES, *Assistant Librarian*
VERONICA J. SEXTON, *Library Assistant*
Department of Ornithology and Mammalogy
HARRY S. SWARTH, *Curator*
M. E. MCLELLAN DAVIDSON, *Assistant Curator*
JOSEPH MAILLIARD, *Curator Emeritus*
Department of Paleontology . DR. G. DALLAS HANNA, *Curator*
DR. LEO GEORGE HERTLEIN, *Assistant Curator*
DR. FRANK M. ANDERSON, *Honorary Curator*
M. VONSEN, *Honorary Curator in Mineralogy*
DR. ROY E. DICKERSON, *Research Associate*
Steinhart Aquarium . . . . DR. BARTON WARREN EVERMANN, *Director*
ALVIN SEALE, *Superintendent*
ROBERT J. LANIER, *Assistant Superintendent*

COMMITTEE ON PUBLICATION

DR. BARTON WARREN EVERMANN, *Chairman and Editor*
DR. C. E. GRUNSKY DR. WM. E. RITTER

PROCEEDINGS

Fourth Series

VOLUME XVIII

PROCEEDINGS

Fourth Series

VOLUME XIX

Pages 1–6. I. Marine Mollusca of Guadalupe Island, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)
Pages 7–12. II. Marine Mollusca of the Revillagigedo Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)
Pages 13–22. III. Marine Mollusca of the Tres Marias Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) $0.50

Pages 23–40. IV. Some Rissoid Mollusca from the Gulf of California. Plate 1; 4 text figures. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*)
Pages 41–56. V. Some Mollusca of the Family Epitoniidæ from the Gulf of California. Plates 2 and 3. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*) .50

Pages 57–64. VI. Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. (*Issued July 15, 1930*) ..... .15

Pages 65–83. VII. Geology of Sharktooth Hill, Kern County, California. 3 text figures. By G. Dallas Hanna. (*Issued July 15, 1930*) ..... .25

Pages 85–93. VIII. Fossil Bird Remains from the Temblor Formation near Bakersfield, California. 7 text figures. By Alexander Wetmore. (*Issued July 15, 1930*) ..... .15

Pages 95–104. IX. The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. 1 text figure. By George Sprague Myers. (*Issued July 15, 1930*) ..... .15

Pages 105–108. X. Contributions to Oriental Herpetology.—IV. Hokushu or Yezo. By Joseph R. Slevin. (*Issued July 15, 1930*) .10

Pages 109–215. XI. Marine Algæ of the Revillagigedo Expedition of 1925. Plates 4-15. By William Albert Setchell and Nathaniel Lyon Gardner. (*Issued December 30, 1930*) 1.50

Pages 217–397. XII. Pelagic Mammals from the Temblor Formation of the Kern River Region, California. 134 text figures. By Remington Kellogg. (*Issued January 30, 1931*) 1.25

Pages 399–410. XIII. Report of the President of the Academy for the year 1930. By C. E. Grunsky
Pages 411–482. XIV. Report of the Director of the Museum and of the Aquarium for the year 1930. By Barton Warren Evermann. (*Issued May 29, 1931*) .25

VOLUME XX

Pages 1-7. I. Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Text figure 3. (*Issued May 22, 1931*)... $0.15

Pages 9-104. II. The Flora of the Revillagigedo Islands. By Ivan M. Johnston. (*Issued November 18, 1931*) 1.25

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, Nos. 3 and 4, pp. 105-134, plate 1 DECEMBER 18, 1931

No. 3, pp. 105-128, plate 1

The Genus Pogogyne

BY

JOHN THOMAS HOWELL

Assistant Curator, Department of Botany

No. 4, pp. 129-134

A Great Basin Species of Physocarpus

BY

JOHN THOMAS HOWELL

Assistant Curator, Department of Botany

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1931

TRUSTEES, OFFICERS, COUNCIL, AND MUSEUM STAFF OF THE CALIFORNIA ACADEMY OF SCIENCES

BOARD OF TRUSTEES

WILLIAM H. CROCKER, *President* . . . . . Term expires 1935
JOSEPH D. GRANT, *Vice-President* . . . . . Term expires 1932
LOUIS F. MONTEAGLE . . . . . Term expires 1933
MRS. ALEXANDER F. MORRISON . . . . . Term expires 1934
NORMAN B. LIVERMORE . . . . . Term expires 1936
DR. C. E. GRUNSKY,
President of the Academy and ex-officio member . . . Term expires 1932
F. W. BRADLEY,
Treasurer of the Academy and ex-officio member . . . Term expires 1932
SUSIE M. PEERS, *Secretary to the Board*

OFFICERS AND COUNCIL

DR. C. E. GRUNSKY, *President of the Academy*
OTTO VON GELDERN, *First Vice-President*
DR. WM. E. RITTER, *Second Vice-President*
DR. F. M. MACFARLAND, *Corresponding Secretary*
ANNIE G. HOBSON, *Recording Secretary*
F. W. BRADLEY, *Treasurer*
DR. EMMET RIXFORD, *Librarian*
DR. BARTON WARREN EVERMANN,
Director of the Museum and of the Steinhart Aquarium, and Executive Curator

STAFF

DR. BARTON WARREN EVERMANN, *Director and Executive Curator*

Department of Botany . . . ALICE EASTWOOD, *Curator*
JOHN THOMAS HOWELL, *Assistant Curator*
KATE E. PHELPS, *Assistant*
Department of Entomology . EDWARD P. VAN DUZEE, *Curator*
AMY WILLIAMSON, *Assistant*
DR. EDWIN C. VAN DYKE, *Honorary Curator*
DR. F. R. COLE, *Associate Curator in Dipterology*
DR. F. E. BLAISDELL, SR., *Research Associate*
Department of Exhibits. . . FRANK TOSE, *Chief*
Department of Fishes . . . DR. BARTON WARREN EVERMANN, *Curator*
H. WALTON CLARK, *Assistant Curator*
Department of Herpetology . JOSEPH R. SLEVIN, *Curator*
Department of Invertebrate Zoology
DR. WALTER K. FISHER, *Curator*
Library . . . . . DR. EMMET RIXFORD, *Librarian*
THOMAS COWLES, *Assistant Librarian*
VERONICA J. SEXTON, *Library Assistant*
Department of Ornithology and Mammalogy
HARRY S. SWARTH, *Curator*
M. E. MCLELLAN DAVIDSON, *Assistant Curator*
JOSEPH MAILLIARD, *Curator Emeritus*
Department of Paleontology . DR. G. DALLAS HANNA, *Curator*
DR. LEO GEORGE HERTLEIN, *Assistant Curator*
DR. FRANK M. ANDERSON, *Honorary Curator*
M. VONSEN, *Honorary Curator in Mineralogy*
DR. ROY E. DICKERSON, *Research Associate*
Steinhart Aquarium . . . . DR. BARTON WARREN EVERMANN, *Director*
ALVIN SEALE, *Superintendent*
ROBERT J. LANIER, *Assistant Superintendent*

COMMITTEE ON PUBLICATION

DR. BARTON WARREN EVERMANN, *Chairman and Editor*
DR. C. E. GRUNSKY DR. WM. E. RITTER

PROCEEDINGS

Fourth Series

VOLUME XVIII

PROCEEDINGS

Fourth Series

VOLUME XIX

Pages 1–6. I. Marine Mollusca of Guadalupe Island, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) Pages 7–12. II. Marine Mollusca of the Revillagigedo Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) Pages 13–22. III. Marine Mollusca of the Tres Marias Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)	$0.50
Pages 23–40. IV. Some Rissoid Mollusca from the Gulf of California. Plate 1; 4 text figures. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*) Pages 41–56. V. Some Mollusca of the Family Epitoniidæ from the Gulf of California. Plates 2 and 3. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*)	.50
Pages 57–64. VI. Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. (*Issued July 15, 1930*)	.15
Pages 65–83. VII. Geology of Sharktooth Hill, Kern County, California. 3 text figures. By G. Dallas Hanna. (*Issued July 15, 1930*)	.25
Pages 85–93. VIII. Fossil Bird Remains from the Temblor Formation near Bakersfield, California. 7 text figures. By Alexander Wetmore. (*Issued July 15, 1930*)	.15
Pages 95–104. IX. The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. 1 text figure. By George Sprague Myers. (*Issued July 15, 1930*)	.15
Pages 105–108. X. Contributions to Oriental Herpetology.—IV. Hokushu or Yezo. By Joseph R. Slevin. (*Issued July 15, 1930*)	.10
Pages 109–215. XI. Marine Algæ of the Revillagigedo Expedition of 1925. Plates 4-15. By William Albert Setchell and Nathaniel Lyon Gardner. (*Issued December 30, 1930*)	1.50
Pages 217–397. XII. Pelagic Mammals from the Temblor Formation of the Kern River Region, California. 134 text figures. By Remington Kellogg. (*Issued January 30, 1931*)	1.25
Pages 399–410. XIII. Report of the President of the Academy for the year 1930. By C. E. Grunsky Pages 411–482. XIV. Report of the Director of the Museum and of the Aquarium for the year 1930. By Barton Warren Evermann. (*Issued May 29, 1931*)	.25

VOLUME XX

Pages 1-7. I. Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Text figures 3. (*Issued May 22, 1931*)	$0.15
Pages 9-104. II. The Flora of the Revillagigedo Islands. By Ivan M. Johnston. (*Issued November 18, 1931*)	1.25
Pages 105–128. III. The Genus Pogogyne. Plate 1. By John Thomas Howell. (*Issued December 18, 1931*). Pages 129–134. IV. A Great Basin Species of Physocarpus. By John Thomas Howell. (*Issued December 18, 1931*).	.40

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 5, pp. 135-160 DECEMBER 18, 1931

V

New Species of Plants From Western North America

BY

ALICE EASTWOOD

Curator, Department of Botany

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1931

TRUSTEES, OFFICERS, COUNCIL, AND MUSEUM STAFF OF THE CALIFORNIA ACADEMY OF SCIENCES

BOARD OF TRUSTEES

WILLIAM H. CROCKER, *President* . . . . . Term expires 1935
JOSEPH D. GRANT, *Vice-President* . . . . . Term expires 1932
LOUIS F. MONTEAGLE . . . . . Term expires 1933
MRS. ALEXANDER F. MORRISON . . . . . Term expires 1934
NORMAN B. LIVERMORE . . . . . Term expires 1936
DR. C. E. GRUNSKY,
President of the Academy and ex-officio member . . . Term expires 1932
F. W. BRADLEY,
Treasurer of the Academy and ex-officio member . . . Term expires 1932
SUSIE M. PEERS, *Secretary to the Board*

OFFICERS AND COUNCIL

DR. C. E. GRUNSKY, *President of the Academy*
OTTO VON GELDERN, *First Vice-President*
DR. WM. E. RITTER, *Second Vice-President*
DR. F. M. MACFARLAND, *Corresponding Secretary*
ANNIE G. HOBSON, *Recording Secretary*
F. W. BRADLEY, *Treasurer*
DR. EMMET RIXFORD, *Librarian*
DR. BARTON WARREN EVERMANN,
Director of the Museum and of the Steinhart Aquarium, and Executive Curator

STAFF

DR. BARTON WARREN EVERMANN, *Director and Executive Curator*

Department of Botany . . . ALICE EASTWOOD, *Curator*
JOHN THOMAS HOWELL, *Assistant Curator*
KATE E. PHELPS, *Assistant*
Department of Entomology . EDWARD P. VAN DUZEE, *Curator*
AMY WILLIAMSON, *Assistant*
DR. EDWIN C. VAN DYKE, *Honorary Curator*
DR. F. R. COLE, *Associate Curator in Dipterology*
DR. F. E. BLAISDELL, SR., *Research Associate*
Department of Exhibits. . . FRANK TOSE, *Chief*
Department of Fishes . . . DR. BARTON WARREN EVERMANN, *Curator*
H. WALTON CLARK, *Assistant Curator*
Department of Herpetology . JOSEPH R. SLEVIN, *Curator*
Department of Invertebrate Zoology
DR. WALTER K. FISHER, *Curator*
Library . . . . . DR. EMMET RIXFORD, *Librarian*
THOMAS COWLES, *Assistant Librarian*
VERONICA J. SEXTON, *Library Assistant*
Department of Ornithology and Mammalogy
HARRY S. SWARTH, *Curator*
M. E. MCLELLAN DAVIDSON, *Assistant Curator*
JOSEPH MAILLIARD, *Curator Emeritus*
Department of Paleontology . DR. G. DALLAS HANNA, *Curator*
DR. LEO GEORGE HERTLEIN, *Assistant Curator*
DR. FRANK M. ANDERSON, *Honorary Curator*
M. VONSEN, *Honorary Curator in Mineralogy*
DR. ROY E. DICKERSON, *Research Associate*
Steinhart Aquarium . . . . DR. BARTON WARREN EVERMANN, *Director*
ALVIN SEALE, *Superintendent*
ROBERT J. LANIER, *Assistant Superintendent*

COMMITTEE ON PUBLICATION

DR. BARTON WARREN EVERMANN, *Chairman and Editor*
DR. C. E. GRUNSKY DR. WM. E. RITTER

PROCEEDINGS

Fourth Series

VOLUME XVIII

PROCEEDINGS

Fourth Series

VOLUME XIX

Pages 1–6. I. Marine Mollusca of Guadalupe Island, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*).....
Pages 7–12. II. Marine Mollusca of the Revillagigedo Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) } $0.50
Pages 13–22. III. Marine Mollusca of the Tres Marias Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)

Pages 23–40. IV. Some Rissoid Mollusca from the Gulf of California. Plate 1; 4 text figures. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*)
Pages 41–56. V. Some Mollusca of the Family Epitoniidæ from the Gulf of California. Plates 2 and 3. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*) } .50

Pages 57–64. VI. Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. (*Issued July 15, 1930*)..... .15

Pages 65–83. VII. Geology of Sharktooth Hill, Kern County, California. 3 text figures. By G. Dallas Hanna. (*Issued July 15, 1930*)..... .25

Pages 85–93. VIII. Fossil Bird Remains from the Temblor Formation near Bakersfield, California. 7 text figures. By Alexander Wetmore. (*Issued July 15, 1930*)..... .15

Pages 95–104. IX. The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. 1 text figure. By George Sprague Myers. (*Issued July 15, 1930*)..... .15

Pages 105–108. X. Contributions to Oriental Herpetology.—IV. Hokushu or Yezo. By Joseph R. Slevin. (*Issued July 15, 1930*) .10

Pages 109–215. XI. Marine Algæ of the Revillagigedo Expedition of 1925. Plates 4-15. By William Albert Setchell and Nathaniel Lyon Gardner. (*Issued December 30, 1930*)..... 1.50

Pages 217–397. XII. Pelagic Mammals from the Temblor Formation of the Kern River Region, California. 134 text figures. By Remington Kellogg. (*Issued January 30, 1931*)..... 1.25

Pages 399–410. XIII. Report of the President of the Academy for the year 1930. By C. E. Grunsky
Pages 411–482. XIV. Report of the Director of the Museum and of the Aquarium for the year 1930. By Barton Warren Evermann. (*Issued May 29, 1931*) } .25

VOLUME XX

Pages 1–7. I. Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Text figures 3. (*Issued May 22, 1931*).... $0.15

Pages 9–104. II. The Flora of the Revillagigedo Islands. By Ivan M. Johnston. (*Issued November 18, 1931*)..... 1.25

Pages 105–128. III. The Genus Pogogyne. Plate 1. By John Thomas Howell. (*Issued December 18, 1931*).
Pages 129–134. IV. A Great Basin Species of Physocarpus. By John Thomas Howell. (*Issued December 18, 1931*). } .40

Pages 135–160. V. New Species of Plants from Western North America. By Alice Eastwood. (*Issued December 18, 1931*)..... .50

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 6, pp. 161-263, plates 2-18 JANUARY 8, 1932

VI

The Diatoms of Sharktooth Hill, Kern County, California

BY

G. DALLAS HANNA, *Curator*
Department of Paleontology
California Academy of Sciences

SAN FRANCISCO
PUBLISHED BY THE ACADEMY
1932

TRUSTEES, OFFICERS, COUNCIL, AND MUSEUM STAFF OF THE CALIFORNIA ACADEMY OF SCIENCES

BOARD OF TRUSTEES

WILLIAM H. CROCKER, *President* . . . . . Term expires 1935
JOSEPH D. GRANT, *Vice-President* . . . . . Term expires 1932
LOUIS F. MONTEAGLE . . . . . Term expires 1933
MRS. ALEXANDER F. MORRISON . . . . . Term expires 1934
NORMAN B. LIVERMORE . . . . . Term expires 1936
DR. C. E. GRUNSKY,
President of the Academy and ex-officio member . . . Term expires 1932
F. W. BRADLEY,
Treasurer of the Academy and ex-officio member . . . Term expires 1932
SUSIE M. PEERS, *Secretary to the Board*

OFFICERS AND COUNCIL

DR. C. E. GRUNSKY, *President of the Academy*
OTTO VON GELDERN, *First Vice-President*
DR. WM. E. RITTER, *Second Vice-President*
DR. F. M. MACFARLAND, *Corresponding Secretary*
ANNIE G. HOBSON, *Recording Secretary*
F. W. BRADLEY, *Treasurer*
DR. EMMET RIXFORD. *Librarian*
DR. BARTON WARREN EVERMANN,
Director of the Museum and of the Steinhart Aquarium, and Executive Curator

STAFF

DR. BARTON WARREN EVERMANN, *Director and Executive Curator*

Department of Botany . . . ALICE EASTWOOD, *Curator*
JOHN THOMAS HOWELL, *Assistant Curator*
KATE E. PHELPS, *Assistant*
Department of Entomology . EDWARD P. VAN DUZEE, *Curator*
AMY WILLIAMSON, *Assistant*
DR. EDWIN C. VAN DYKE, *Honorary Curator*
DR. F. R. COLE, *Associate Curator in Dipterology*
DR. F. E. BLAISDELL, SR., *Research Associate*
Department of Exhibits. . . FRANK TOSE, *Chief*
Department of Fishes . . . DR. BARTON WARREN EVERMANN, *Curator*
H. WALTON CLARK, *Assistant Curator*
Department of Herpetology . JOSEPH R. SLEVIN, *Curator*
Department of Invertebrate Zoology
DR. WALTER K. FISHER, *Curator*
Library . . . . . DR. EMMET RIXFORD, *Librarian*
THOMAS COWLES, *Assistant Librarian*
VERONICA J. SEXTON, *Library Assistant*
Department of Ornithology and Mammalogy
HARRY S. SWARTH, *Curator*
M. E. MCLELLAN DAVIDSON, *Assistant Curator*
JOSEPH MAILLIARD, *Curator Emeritus*
Department of Paleontology . DR. G. DALLAS HANNA, *Curator*
DR. LEO GEORGE HERTLEIN, *Assistant Curator*
DR. FRANK M. ANDERSON, *Honorary Curator*
M. VONSEN, *Honorary Curator in Mineralogy*
DR. ROY E. DICKERSON, *Research Associate*
Steinhart Aquarium . . . . DR. BARTON WARREN EVERMANN, *Director*
ALVIN SEALE, *Superintendent*
ROBERT J. LANIER, *Assistant Superintendent*

COMMITTEE ON PUBLICATION

DR. BARTON WARREN EVERMANN, *Chairman and Editor*
DR. C. E. GRUNSKY DR. WM. E. RITTER

PROCEEDINGS

Fourth Series

VOLUME XVIII

PROCEEDINGS

Fourth Series

VOLUME XIX

Pages 1–6. I. Marine Mollusca of Guadalupe Island, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) Pages 7–12. II. Marine Mollusca of the Revillagigedo Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) Pages 13–22. III. Marine Mollusca of the Tres Marias Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)	$0.50
Pages 23–40. IV. Some Rissoid Mollusca from the Gulf of California. Plate 1; 4 text figures. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*) Pages 41–56. V. Some Mollusca of the Family Epitoniidæ from the Gulf of California. Plates 2 and 3. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*)	.50
Pages 57–64. VI. Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. (*Issued July 15, 1930*)	.15
Pages 65–83. VII. Geology of Sharktooth Hill, Kern County, California. 3 text figures. By G. Dallas Hanna. (*Issued July 15, 1930*)	.25
Pages 85–93. VIII. Fossil Bird Remains from the Temblor Formation near Bakersfield, California. 7 text figures. By Alexander Wetmore. (*Issued July 15, 1930*)	.15
Pages 95–104. IX. The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. 1 text figure. By George Sprague Myers. (*Issued July 15, 1930*)	.15
Pages 105–108. X. Contributions to Oriental Herpetology.—IV. Hokushu or Yezo. By Joseph R. Slevin. (*Issued July 15, 1930*)	.10
Pages 109–215. XI. Marine Algæ of the Revillagigedo Expedition of 1925. Plates 4-15. By William Albert Setchell and Nathaniel Lyon Gardner. (*Issued December 30, 1930*)	1.50
Pages 217–397. XII. Pelagic Mammals from the Temblor Formation of the Kern River Region, California. 134 text figures. By Remington Kellogg. (*Issued January 30, 1931*)	1.25
Pages 399–410. XIII. Report of the President of the Academy for the year 1930. By C. E. Grunsky Pages 411–482. XIV. Report of the Director of the Museum and of the Aquarium for the year 1930. By Barton Warren Evermann. (*Issued May 29, 1931*)	.25

VOLUME XX

Pages 1-7. I. Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Text figures 3. (*Issued May 22, 1931*)	$0.15
Pages 9-104. II. The Flora of the Revillagigedo Islands. By Ivan M. Johnston. (*Issued November 18, 1931*)	1.25
Pages 105–128. III. The Genus Pogogyne. Plate 1. By John Thomas Howell. (*Issued December 18, 1931*). Pages 129–134. IV. A Great Basin Species of Physocarpus. By John Thomas Howell. (*Issued December 18, 1931*).	.40
Pages 135–160. V. New Species of Plants from Western North America. By Alice Eastwood. (*Issued December 18, 1931*)	.50
Pages 161-263. VI. The Diatoms of Sharktooth Hill, Kern County, California. Plates 2-18. By G. Dallas Hanna. (*Issued January 8, 1932*)	1.50

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 8, pp. 269-290 JANUARY 8, 1932

VIII

Birds and Mammals from the Kootenay Valley, Southeastern British Columbia

BY

JOSEPH MAILLIARD, *Curator Emeritus*
Department of Ornithology and Mammalogy
California Academy of Sciences

SAN FRANCISCO
PUBLISHED BY THE ACADEMY
1932

TRUSTEES, OFFICERS, COUNCIL, AND MUSEUM STAFF OF THE CALIFORNIA ACADEMY OF SCIENCES

BOARD OF TRUSTEES

WILLIAM H. CROCKER, *President* . . . . . Term expires 1935
JOSEPH D. GRANT, *Vice-President* . . . . . Term expires 1932
LOUIS F. MONTEAGLE . . . . . Term expires 1933
MRS. ALEXANDER F. MORRISON . . . . . Term expires 1934
NORMAN B. LIVERMORE . . . . . Term expires 1936
DR. C. E. GRUNSKY,
President of the Academy and ex-officio member . . . Term expires 1932
F. W. BRADLEY,
Treasurer of the Academy and ex-officio member . . . Term expires 1932
SUSIE M. PEERS, *Secretary to the Board*

OFFICERS AND COUNCIL

DR. C. E. GRUNSKY, *President of the Academy*
OTTO VON GELDERN, *First Vice-President*
DR. WM. E. RITTER, *Second Vice-President*
DR. F. M. MACFARLAND, *Corresponding Secretary*
ANNIE G. HOBSON, *Recording Secretary*
F. W. BRADLEY, *Treasurer*
DR. EMMET RIXFORD, *Librarian*
DR. BARTON WARREN EVERMANN,
Director of the Museum and of the Steinhart Aquarium, and Executive Curator

STAFF

DR. BARTON WARREN EVERMANN, *Director and Executive Curator*

Department of Botany . . . ALICE EASTWOOD, *Curator*
JOHN THOMAS HOWELL, *Assistant Curator*
KATE E. PHELPS, *Assistant*
Department of Entomology . EDWARD P. VAN DUZEE, *Curator*
AMY WILLIAMSON, *Assistant*
DR. EDWIN C. VAN DYKE, *Honorary Curator*
DR. F. R. COLE, *Associate Curator in Dipterology*
DR. F. E. BLAISDELL, SR., *Research Associate*
Department of Exhibits. . . FRANK TOSE, *Chief*
Department of Fishes . . . DR. BARTON WARREN EVERMANN, *Curator*
H. WALTON CLARK, *Assistant Curator*
Department of Herpetology . JOSEPH R. SLEVIN, *Curator*
Department of Invertebrate Zoology
DR. WALTER K. FISHER, *Curator*
Library . . . . . DR. EMMET RIXFORD, *Librarian*
THOMAS COWLES, *Assistant Librarian*
VERONICA J. SEXTON, *Library Assistant*
Department of Ornithology and Mammalogy
HARRY S. SWARTH, *Curator*
M. E. MCLELLAN DAVIDSON, *Assistant Curator*
JOSEPH MAILLIARD, *Curator Emeritus*
Department of Paleontology . DR. G. DALLAS HANNA, *Curator*
DR. LEO GEORGE HERTLEIN, *Assistant Curator*
DR. FRANK M. ANDERSON, *Honorary Curator*
M. VONSEN, *Honorary Curator in Mineralogy*
DR. ROY E. DICKERSON, *Research Associate*
Steinhart Aquarium . . . . DR. BARTON WARREN EVERMANN, *Director*
ALVIN SEALE, *Superintendent*
ROBERT J. LANIER, *Assistant Superintendent*

COMMITTEE ON PUBLICATION

DR. BARTON WARREN EVERMANN, *Chairman and Editor*
DR. C. E. GRUNSKY DR. WM. E. RITTER

PROCEEDINGS

Fourth Series

VOLUME XVIII

Pages 1-27. I. A New Species of Corambe from the Pacific Coast of North America. By Frank M. MacFarland and Charles H. O'Donoghue. Plates 1–3. (*Issued January 29, 1929*)..... $0.65

Pages 29–43. II. A New Bird Family (Geospizidæ) from the Galapagos Islands. By Harry S. Swarth. Text figures 6. (*Issued January 29, 1929*)..... .25

Pages 45–71. III. A Contribution to Our Knowledge of the Nesting Habits of the Golden Eagle. By Joseph R. Slevin. Plates 4–7. (*Issued January 29, 1929*)..... .40

Pages 73–213. IV. Marine Miocene and Related Deposits of North Colombia. By Frank M. Anderson. Plates 8–23. (*Issued March 29, 1929*)..... 1.50

Page 215. V. A New Pecten from the San Diego Pliocene. By Leo George Hertlein. Plate 24, Figures 10–11. (*Issued April 5, 1929*)
Pages 217–218. VI. A New Species of Land Snail from Kern County, California. By G. Dallas Hanna. Plate 24, figures 7, 8, 9. (*Issued April 5, 1929*)
Pages 219–220. VII. A New Species of Land Snail from Coahuila, Mexico. By G. Dallas Hanna and Leo George Hertlein. Plate 24, figures 5–6. (*Issued April 5, 1929*) .25
Pages 221–227. VIII. Some Notes on Oreohelix. By Julius Henderson. Plate 24, figures 1–4. (*Issued April 5, 1929*)

Pages 229–243. IX. Notes on the Northern Elephant Seal. By M. E. McLellan Davidson. Plates 25–26. (*Issued April 5, 1929*) .25

Pages 245–260. X. On a small collection of Birds from Torres Strait Islands, and from Guadalcanar Island, Solomon Group. By M. E. McLellan Davidson. (*Issued April 5, 1929*)..... .15

Pages 261–265. XI. The Generic Relationships and Nomenclature of the California Sardine. By Carl L. Hubbs. (*Issued April 5, 1929*) .10

Pages 267–383. XII. The Faunal Areas of Southern Arizona: A Study in Animal Distribution. By Harry S. Swarth. Plates 27–32, text figures 7. (*Issued April 26, 1929*)..... 1.00

Pages 385–391. XIII. The Escallonias in Golden Gate Park, San Francisco, California, with Descriptions of New Species. By Alice Eastwood. (*Issued September 6, 1929*)..... .25

Pages 393–484. XIV. Studies in the Flora of Lower California and Adjacent Islands. By Alice Eastwood. Plates 33–34. (*Issued September 6, 1929*)..... 1.00

Pages 485–496. XV. Drepania: A Genus of Nudibranchiate Mollusks new to California. By F. M. MacFarland. Plate 35. (*Issued October 4, 1929*)..... .40

Pages 497–530. XVI. Some Upper Cretaceous Foraminifera from near Coalinga, California. By J. A. Cushman and C. C. Church. Plates 36–41. (*Issued October 4, 1929*)..... .75

Pages 531–541. XVII. Report of the President of the Academy for the year 1929. By C. E. Grunsky
Pages 542–586. XVIII. Report of the Director of the Academy for the year 1929. By Barton Warren Evermann. (*Issued April 8, 1930*) .25

Pages 587–601 Title Page Contents and Index. (*Issued May 8, 1930*)..... .10

PROCEEDINGS

Fourth Series

VOLUME XIX

Pages 1–6. I. Marine Mollusca of Guadalupe Island, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*).....
Pages 7–12. II. Marine Mollusca of the Revillagigedo Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) $0.50
Pages 13–22. III. Marine Mollusca of the Tres Marias Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)

Pages 23–40. IV. Some Rissoid Mollusca from the Gulf of California. Plate 1; 4 text figures. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*)
Pages 41–56. V. Some Mollusca of the Family Epitoniidæ from the Gulf of California. Plates 2 and 3. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*) .50

Pages 57–64. VI. Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. (*Issued July 15, 1930*)..... .15

Pages 65–83. VII. Geology of Sharktooth Hill, Kern County, California. 3 text figures. By G. Dallas Hanna. (*Issued July 15, 1930*)..... .25

Pages 85–93. VIII. Fossil Bird Remains from the Temblor Formation near Bakersfield, California. 7 text figures. By Alexander Wetmore. (*Issued July 15, 1930*)..... .15

Pages 95–104. IX. The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. 1 text figure. By George Sprague Myers. (*Issued July 15, 1930*)..... .15

Pages 105–108. X. Contributions to Oriental Herpetology.—IV. Hokushu or Yezo. By Joseph R. Slevin. (*Issued July 15, 1930*) .10

Pages 109–215. XI. Marine Algæ of the Revillagigedo Expedition of 1925. Plates 4-15. By William Albert Setchell and Nathaniel Lyon Gardner. (*Issued December 30, 1930*)..... 1.50

Pages 217-397. XII. Pelagic Mammals from the Temblor Formation of the Kern River Region, California. 134 text figures. By Remington Kellogg. (*Issued January 30, 1931*)..... 1.25

Pages 399–410. XIII. Report of the President of the Academy for the year 1930. By C. E. Grunsky
Pages 411–482. XIV. Report of the Director of the Museum and of the Aquarium for the year 1930. By Barton Warren Evermann. (*Issued May 29, 1931*) .25

VOLUME XX

Pages 1–7. I. Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Text figures 3. (*Issued May 22, 1931*).... $0.15

Pages 9–104. II. The Flora of the Revillagigedo Islands. By Ivan M. Johnston. (*Issued November 18, 1931*)..... 1.25

Pages 105–128. III. The Genus Pogogyne. Plate 1. By John Thomas Howell. (*Issued December 18, 1931*).
Pages 129–134. IV. A Great Basin Species of Physocarpus. By John Thomas Howell. (*Issued December 18, 1931*). .40

Pages 135–160. V. New Species of Plants from Western North America. By Alice Eastwood. (*Issued December 18, 1931*)..... .50

Pages 161-263. VI. The Diatoms of Sharktooth Hill, Kern County, California. Plates 2-18. By G. Dallas Hanna. (*Issued January 8, 1932*)..... 1.50

Pages 265-267. VII. A new Subspecies of Coral Snake from Guatemala. By Karl P. Schmidt. (*Issued January 8, 1932*)..... .15

Pages 269-290. VIII. Birds and Mammals from the Kootenay Valley, Southeastern British Columbia. By Joseph Mailliard. (*Issued January 8, 1932*)..... .25

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 9, pp. 291-465 MARCH 3, 1932

IX

Miscellaneous Studies in the Elateridæ and Related Families of Coleoptera

BY

EDWIN C. VAN DYKE

University of California

Berkeley, California

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1932

TRUSTEES, OFFICERS, COUNCIL, AND MUSEUM STAFF OF THE CALIFORNIA ACADEMY OF SCIENCES

BOARD OF TRUSTEES

WILLIAM H. CROCKER, *President* . . . . . Term expires 1935
JOSEPH D. GRANT, *Vice-President* . . . . . Term expires 1932
LOUIS F. MONTEAGLE . . . . . Term expires 1933
MRS. ALEXANDER F. MORRISON . . . . . Term expires 1934
NORMAN B. LIVERMORE . . . . . Term expires 1936
DR. C. E. GRUNSKY,
President of the Academy and ex-officio member . . . Term expires 1932
F. W. BRADLEY,
Treasurer of the Academy and ex-officio member . . . Term expires 1932
SUSIE M. PEERS, *Secretary to the Board*

OFFICERS AND COUNCIL

DR. C. E. GRUNSKY, *President of the Academy*
OTTO von GELDERN, *First Vice-President*
DR. WM. E. RITTER, *Second Vice-President*
DR. F. M. MacFARLAND, *Corresponding Secretary*
ANNIE G. HOBSON, *Recording Secretary*
F. W. BRADLEY, *Treasurer*
DR. EMMET RIXFORD, *Librarian*
DR. BARTON WARREN EVERMANN,
Director of the Museum and of the Steinhart Aquarium, and Executive Curator

STAFF

DR. BARTON WARREN EVERMANN, *Director and Executive Curator*

Department of Botany . . ALICE EASTWOOD, *Curator*
JOHN THOMAS HOWELL, *Assistant Curator*
KATE E. PHELPS, *Assistant*
Department of Entomology EDWARD P. VAN DUZEE, *Curator*
AMY WILLIAMSON, *Assistant*
DR. EDWIN C. VAN DYKE, *Curator Emeritus*
DR. F. R. COLE, *Associate Curator in Dipterology*
DR. F. E. BLAISDELL, SR., *Research Associate*
Department of Exhibits. . FRANK TOSE, *Chief*
Department of Fishes . . DR. BARTON WARREN EVERMANN, *Curator*
H. WALTON CLARK, *Assistant Curator*
Department of Herpetology JOSEPH R. SLEVIN, *Curator*
Department of Invertebrate Zoology
DR. WALTER K. FISHER, *Curator*
Library . . . . . DR. EMMET RIXFORD, *Librarian*
THOMAS COWLES, *Assistant Librarian*
VERONICA J. SEXTON, *Library Assistant*
Department of Ornithology and Mammalogy
HARRY S. SWARTH, *Curator*
MARY E. McLELLAN DAVIDSON, *Assistant Curator*
JOSEPH MAILLIARD, *Curator Emeritus*
Department of Paleontology DR. G. DALLAS HANNA, *Curator*
DR. LEO GEORGE HERTLEIN, *Assistant Curator*
DR. FRANK M. ANDERSON, *Honorary Curator*
M. VONSEN, *Honorary Curator in Mineralogy*
DR. ROY E. DICKERSON, *Research Associate*
Steinhart Aquarium . . . DR. BARTON WARREN EVERMANN, *Director*
ALVIN SEALE, *Superintendent*
ROBERT J. LANIER, *Assistant Superintendent*

COMMITTEE ON PUBLICATION

DR. BARTON WARREN EVERMANN, *Chairman and Editor*
DR. C. E. GRUNSKY DR. WM. E. RITTER

PROCEEDINGS

Fourth Series

VOLUME XVIII

Pages 1-27. I. A New Species of Corambe from the Pacific Coast of North America. By Frank M. MacFarland and Charles H. O'Donoghue. Plates 1–3. (*Issued January 29, 1929*)..... $0.65

Pages 29–43. II. A New Bird Family (Geospizidæ) from the Galapagos Islands. By Harry S. Swarth. Text figures 6. (*Issued January 29, 1929*)..... .25

Pages 45–71. III. A Contribution to Our Knowledge of the Nesting Habits of the Golden Eagle. By Joseph R. Slevin. Plates 4–7. (*Issued January 29, 1929*)..... .40

Pages 73–213. IV. Marine Miocene and Related Deposits of North Colombia. By Frank M. Anderson. Plates 8–23. (*Issued March 29, 1929*)..... 1.50

Page 215. V. A New Pecten from the San Diego Pliocene. By Leo George Hertlein. Plate 24, Figures 10–11. (*Issued April 5, 1929*)
Pages 217–218. VI. A New Species of Land Snail from Kern County, California. By G. Dallas Hanna. Plate 24, figures 7, 8, 9. (*Issued April 5, 1929*)
Pages 219–220. VII. A New Species of Land Snail from Coahuila, Mexico. By G. Dallas Hanna and Leo George Hertlein. Plate 24, figures 5–6. (*Issued April 5, 1929*) .25
Pages 221–227. VIII. Some Notes on Oreohelix. By Julius Henderson. Plate 24, figures 1–4. (*Issued April 5, 1929*)

Pages 229–243. IX. Notes on the Northern Elephant Seal. By M. E. McLellan Davidson. Plates 25–26. (*Issued April 5, 1929*) .25

Pages 245–260. X. On a small collection of Birds from Torres Strait Islands, and from Guadalcanar Island, Solomon Group. By M. E. McLellan Davidson. (*Issued April 5, 1929*)..... .15

Pages 261–265. XI. The Generic Relationships and Nomenclature of the California Sardine. By Carl L. Hubbs. (*Issued April 5, 1929*) .10

Pages 267–383. XII. The Faunal Areas of Southern Arizona: A Study in Animal Distribution. By Harry S. Swarth. Plates 27–32, text figures 7. (*Issued April 26, 1929*)..... 1.00

Pages 385–391. XIII. The Escallonias in Golden Gate Park, San Francisco, California, with Descriptions of New Species. By Alice Eastwood. (*Issued September 6, 1929*)..... .25

Pages 393–484. XIV. Studies in the Flora of Lower California and Adjacent Islands. By Alice Eastwood. Plates 33–34. (*Issued September 6, 1929*)..... 1.00

Pages 485–496. XV. Drepania: A Genus of Nudibranchiate Mollusks new to California. By F. M. MacFarland. Plate 35. (*Issued October 4, 1929*)..... .40

Pages 497–530. XVI. Some Upper Cretaceous Foraminifera from near Coalinga, California. By J. A. Cushman and C. C. Church. Plates 36–41. (*Issued October 4, 1929*)..... .75

Pages 531–541. XVII. Report of the President of the Academy for the year 1929. By C. E. Grunsky
Pages 542–586. XVIII. Report of the Director of the Academy for the year 1929. By Barton Warren Evermann. (*Issued April 8, 1930*) .25

Pages 587–601 Title Page Contents and Index. (*Issued May 8, 1930*)..... .10

PROCEEDINGS
Fourth Series

VOLUME XIX

Pages 1–6. I. Marine Mollusca of Guadalupe Island, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*).....
Pages 7–12. II. Marine Mollusca of the Revillagigedo Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*) } $0.50
Pages 13–22. III. Marine Mollusca of the Tres Marias Islands, Mexico. By A. M. Strong and G. D. Hanna. (*Issued June 4, 1930*)

Pages 23–40. IV. Some Rissoid Mollusca from the Gulf of California. Plate 1; 4 text figures. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*)
Pages 41–56. V. Some Mollusca of the Family Epitoniidæ from the Gulf of California. Plates 2 and 3. By Fred Baker, G. D. Hanna and A. M. Strong. (*Issued July 15, 1930*) } .50

Pages 57–64. VI. Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. (*Issued July 15, 1930*)..... .15

Pages 65–83. VII. Geology of Sharktooth Hill, Kern County, California. 3 text figures. By G. Dallas Hanna. (*Issued July 15, 1930*)..... .25

Pages 85–93. VIII. Fossil Bird Remains from the Temblor Formation near Bakersfield, California. 7 text figures. By Alexander Wetmore. (*Issued July 15, 1930*)..... .15

Pages 95–104. IX. The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. 1 text figure. By George Sprague Myers. (*Issued July 15, 1930*)..... .15

Pages 105–108. X. Contributions to Oriental Herpetology.—IV. Hokushu or Yezo. By Joseph R. Slevin. (*Issued July 15, 1930*) .10

Pages 109–215. XI. Marine Algæ of the Revillagigedo Expedition of 1925. Plates 4-15. By William Albert Setchell and Nathaniel Lyon Gardner. (*Issued December 30, 1930*)..... 1.50

Pages 217–397. XII. Pelagic Mammals from the Temblor Formation of the Kern River Region, California. 134 text figures. By Remington Kellogg. (*Issued January 30, 1931*)..... 1.25

Pages 399–410. XIII. Report of the President of the Academy for the year 1930. By C. E. Grunsky
Pages 411–482. XIV. Report of the Director of the Museum and of the Aquarium for the year 1930. By Barton Warren Evermann. (*Issued May 29, 1931*) } .25

VOLUME XX

Pages 1–7. I. Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Text figures 3. (*Issued May 22, 1931*).... $0.15

Pages 9–104. II. The Flora of the Revillagigedo Islands. By Ivan M. Johnston. (*Issued November 18, 1931*)..... 1.25

Pages 105–128. III. The Genus Pogogyne. Plate 1. By John Thomas Howell. (*Issued December 18, 1931*).
Pages 129–134. IV. A Great Basin Species of Physocarpus. By John Thomas Howell. (*Issued December 18, 1931*). } .40

Pages 135–160. V. New Species of Plants from Western North America. By Alice Eastwood. (*Issued December 18, 1931*)..... .50

Pages 161-263. VI. The Diatoms of Sharktooth Hill, Kern County, California. Plates 2-18. By G. Dallas Hanna. (*Issued January 8, 1932*)..... 1.50

Pages 265-267. VII. A new Subspecies of Coral Snake from Guatemala. By Karl P. Schmidt. (*Issued January 8, 1932*)..... .15

Pages 269-290. VIII. Birds and Mammals from the Kootenay Valley, Southeastern British Columbia. By Joseph Mailliard. (*Issued January 8, 1932*)..... .25

Pages 291–465. IX. Miscellaneous Studies in the Elateridæ and Related Families of Coleoptera. By Edwin C. Van Dyke. (*Issued March 3, 1932*)..... 1.00

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XX, No. 12, pp. 473-482
VOL. XX, No. 13, pp. 483-491
VOL. XX, No. 14, pp. 493-521

DECEMBER 31, 1940

XII

Report of the President of the Academy For the Year 1931

BY

C. E. GRUNSKY

President of the Academy

XIII

Report of the Director of the Museum and of the Aquarium for the Year 1931

BY

BARTON WARREN EVERMANN

Director of the Museum and of the Aquarium

XIV

Report of the President of the Academy and Acting Director of the Museum and The Aquarium for the Year 1932 With Departmental Reports for the Two Years 1931 and 1932

BY

C. E. GRUNSKY

President and Acting Director of the Museum and Aquarium

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1940