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PROCEEDINGS

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I

# NOTES ON A FAUNA OF THE VIGO GROUP AND ITS BEARING ON THE EVOLUTION OF MARINE MOLLUSCAN FAUNAS

BY

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The rate of evolution of a marine invertebrate fauna in the tropics when compared with that of faunas of the temperate zones brings out some interesting results. During the past year, 1919-1920, the writer has had the opportunity and rare good fortune to collect some excellently preserved fossils from the Vigo group of the Philippine Islands incidental to some economic investigations in which he was engaged. After several years spent in study of the Tertiary faunal problems of the Pacific Coast of North America, the writer naturally had acquired to a certain extent a point of view of the worker in temperate climes. However, many interesting problems in the Eocene of California, Oregon, and Washington suggested that Eocene marine molluscan faunas did not evolve as rapidly as those of the Miocene and Pliocene and that the same "yardstick" in the Tertiary geological time scale could not be applied. Many problems of the Eocene are directly connected with the rate of evolution of a tropical fauna, and, as the Eocene faunas of California, Oregon, and Washington are essentially tropical or sub-tropical, the writer was glad to devote spare time to the study of a tropical fauna.

Does the Lyell percentage system apply to tropical invertebrate faunas? In answering this question one must bear in mind that this scale is really an expression of the time rate of evolution of Tertiary molluscan faunas based upon the study of the Tertiary of Europe. Briefly, this scale, as now generally applied, is: Eocene, 0%; Oligocene, 3%; Miocene, 25%; Pliocene, 60%; and Pleistocene, 90%. Practically all the Eocene molluscan genera exist today in the Recent faunas of the tropical and temperate zones. Great was our surprise to find that our collections from the upper Vigo shales and the Canguinsa formation, regarded by Pratt[1] and Smith as being of Lower Miocene and Oligocene age, yielded a molluscan fauna containing 75% Recent species. The results of these preliminary studies indicate, that a negative answer must be given to the rhetorical question asked above. An essential modification of the Lyell percentage scale seems necessary to the writer for the proper interpretation of the Tertiary faunas of the tropics. If this hypothesis be true, then evidently marine molluscan faunal changes take place with far less rapidity in the tropics than in the temperate zones. Now this conclusion is apparently in direct contradiction to the fact that the recent molluscan fauna of the Philippines is specifically far more numerous than a recent fauna from a temperate region. Hidalgo[2] reports 4300 to 4500 terrestrial, fluvial, and marine testaceous mollusca, and, of these, fully two-thirds are marine. This anomaly will be considered after the presentation of the data.

Professor K. Martin[3] in "Tertiarschichten auf Java" recognized in a general way that the percentage system of Deshayes (and Lyell) did not strictly apply in Java and that climatic variation was a prime cause of this difference.

## BRIEF STATEMENT OF GEOLOGICAL HISTORY

The fauna upon which this paper is based was collected from the southern half of the Bondoc Peninsula from strata referred

[1] Pratt, W. E., and Smith, W. D., "The Geology and Petroleum Resources of the Southern Part of Bondoc Peninsula," Tayabas Province, P. I., Phil. Jour. Sci., Vol. VIII, 1913, Sec. A, No. 5, p. 312.

[2] Hidalgo, J. G., Catalogo de los Moluscos Testaceous de las Islas Filipinas, Jolo y Marianas, p. 389, Madrid, 1904-1905.

[3] Martin, K., Die Tertiarschichten auf Java, p. 22-24, Die Lagerunas vethaeltnisse, Leiden, 1880.

by Pratt and Smith to the Canguinsa formation and Vigo group. In order that the reader may appreciate the significance of this assemblage of mollusca, a brief resumé of the geologic history of this region is necessary. The southern half of the Bondoc Peninsula consists almost entirely of marine sedimentary rocks which have been highly folded and faulted. The oldest rocks here recognized consist of shales and sandstones 3000 to 4000 feet in thickness, the Vigo group and its uppermost member, the Canguinsa formation. The strata as exposed in the vicinity of the Vigo River are steeply dipping, black, organic shales, subordinate sandstones, and minor lignitic strata which are unconformably overlain by the Malumbang formation.*

The Malumbang formation, consisting of coralline limestone and associated marls, varies in thickness from small residuals to 1000 feet. From what is known of the rate of growth of reef corals this formation must represent a long time interval. In a few places in the Bondoc Peninsula—notably in the vicinity of San Andreas—marine terraces truncate the Malumbang strata. These terraces are in places thickly mantled with coralline limestone of Pleistocene age. Some of the limestone four miles east of Mulanay at an elevation of 500 feet may represent high Pleistocene terraces, as terraces at this height occur in Leyte and at much greater elevations in Cebu where the same geological horizons are also found.

These horizons exhibit in northwest Leyte the same essential conditions and are beautifully exemplified in the vicinity of Toledo, Cebu, as well. The Vigo group in all probability occurs in the region north of Fort Pickett in Mindanao so that we are not dealing with local conditions but with general ones which existed over the site of these islands. The conditions of deposition during Malumbang and Pleistocene time resemble those existing today in the vicinity of the Bondoc Peninsula and essentially the same mollusca occur in the coral reef facies of all three. The deposition during Vigo time was in marked contrast with these later times in that the contributing land masses consisted largely of diorites, schists, and serpentines or

*Note.—The writer's view concerning the stratigraphy of this region differs in this regard from that of Pratt and Smith, but a full discussion of this important point can not be made here.

peridotites from which they were probably derived. At times the material contained in the Vigo sandstones is very coarse, and conglomerates occur locally in the Bondoc Peninsula and on a great scale in northwest Leyte, east of the barrio of Tababunga, where they in part resemble characteristic desert conglomerates closely. Such materials could not have been transported great distances and it is probable that a land mass or masses lay to the east of the site of the Bondoc Peninsula and northwestern Leyte. In other words the sediments of the Vigo group were deposited in the moderately deep waters of an inland sea with high mountainous islands to the east. The total time represented since the beginning of the Vigo is evidently long, and, on these grounds as well as faunal, the Vigo group appears to be as old as the Miocene, and the Malumbang probably represents at least a portion of the Pliocene. The time represented by the unconformity between these horizons was sufficiently long to reduce many of the mountains formed at the close of Vigo time to nearly base level before the region was again gradually lowered to receive its great load of Malumbang coralline limestone and associated marls in the clear, warm, shallow waters of a tropical Pliocene sea. Likewise the orogenic movements which ended Malumbang time and the erosion interval which preceded the formation of Pleistocene terraces were not brief. The age of the Vigo group will be discussed at length after its fauna is considered.

## FAUNA

The fauna upon which this paper is based was obtained from the Bahay River vicinity (2X, 3X, 4X, 5X); the canyon of Dumalog Creek (9X); and from Sapa Tubigbinukot, the northern extension of the Amoguis (Amougis), Agipot, Pagsanhan* River (11X), from strata which are all unmistakably members of the Vigo group and unconformably below the Malumbang formation.

The following notes upon the collection localities and their fossils are given in detail as there are but few places in these beautiful islands where good collections are obtained from

* Different local names for same stream.

localities with satisfactory stratigraphy. "Locality 2 X, Philippine Islands, Luzon, Tayabas Province, Bondoc Peninsula, west shore of Ragay Gulf, 600 meters up stream from Bureau of Lands Benchmark No. 1 (Bahay Oil Co., Well No. 1), on N. E. bank of Bahay River in a 50-foot cliff of yellow sandstone and bluish clayey sandstone disturbed by minor faulting. Coll. Roy E. Dickerson."

The Malumbang limestone is found in the hill 100 yards to the northeast, and from the general relations in the field it is clearly unconformable upon the underlying Canguinsa formation. The following fauna was obtained from this locality:

**Locality 2 x**

Actæon.
Architectonica pictum (Philippi); living.
Bullaria.
Cancellaria crenifera Sowerby; living.
Cerithium herklotsi K. Martin.
Cerithium jenkinsi K. Martin.
Cerithium monoliferum Kiener; living.
Conus ornatissimus K. Martin.
Conus, new species??
Conus lividus Hwass; living.
Conus, sp.
Cyclonassa.
Drillia.
Haminea.
Mitra javana K. Martin.
Mitra cf. jenkinsi K. Martin.
Mitra junghuhni K. Martin.
Nyctilochus.
Mangilia.
Nassa crenulata; living.
Nassa dispar Adams; living.
Nassa gemmulata (Lamarck); living.
Nassa globosa minor; living.
Nassa immersa Carpenter; living.
Nassa quadrasi Hidalgo; living.

Nassa thersites, variety; living.
Natica albumen Lamarck; living.
Natica.
Natica spadicea Reeve; living.
Natica mamilla Lamarck; living.
Nerita funiculata Reeve; living.
Olivella.
Ranella subgranulosa Beck; living.
Ranella.
Ranella tuberculata Broderip; living.
Strombus canarium Linnæus; living.
Strombus swainsoni Reeve; living.
Turris (Surcula) flavidus Lamarck; living.
Turris garnonsi Reeve; living.
Turris deshayesi (Doumet); living.
Turris carinata woodwardi K. Martin; living.
Terebra.
Terebra bicincta K. Martin.
Terebra javana K. Martin.
Arca cornea Reeve; living.
Cardium.
Corbula socialis K. Martin.
Corbula.
Chione chlorotica.
Ostrea.
Pleuronectia pleuronecta Linnæus; living.
Placuna placenta; living.
Psammobia cf. lessoni Blainville.
Pinna.
Solen.
Tellina.
Dentalium.
Coral.
Coral.
Echinoid.

The predominance of littoral species and the character of the strata indicate that these forms lived in the shallow inshore waters of an inland sea.

"Locality 3x, Philippine Islands, Luzon, Tayabas Province, Bondoc Peninsula, west shore of Ragay Gulf, Bahay River, up stream 800 meters from Bureau of Lands Benchmark No. 1 (Bahay Oil Co., Well No. 1), on southwest bank of stream in a stiff, dark gray shale. 8/25/19. Colls. Roy E. Dickerson and Mark Fuken. The following species were collected here:

**Locality 3x**

Actæon, species.
Architectonica pictum (Philippi); living.
Cancellaria elegans Sowerby; living.
Cerithium herklotsi K. Martin.
Cerithium monoliferum Kiener; living.
Cerithium jenkinsi K. Martin.
Cerithidea (Pyrazus) cf. sulcatus Brugiere; living.
Columbella bandongensis K. Martin.
Cypræa cf. tigris Linnæus; living.
Conus, new species?
Conus, species.
Conus ornatissimus K. Martin.
Distortio clathrata Lamarck; living.
Melania asperata; living.
Nassa thersites leptospira (Brugiere); living.
Nassa thersites immersa Carpenter; living.
Nassa quadrasi Hidalgo; living.
Nassa globosa minor Quoy; living.
Nassa crenulata (Brugiere); living.
Nassa canaliculata Lamarack; living.
Nassa dispar Adams; living.
Natica mamilla Lamarck; living.
Natica lacernula d'Orbigny; living.
Melania cf. asperata inquinata Quadras; living.
Mitra junghuhni K. Martin.
Mitra javana K. Martin.
Murex endivia Lamarck; living.
Olivella.
Phos.
Ranella tuberculata Broderip; living.
Rostellaria ficus; living.

Rostellaria crispata; living.
Strombus canarium; living.
Strombus, species a.
Strombus, species b.
Telescopium telescopium Linnæus; living.
Terebra.
Triton pfeifferianum Reeve; living.
Trivia.
Turris garnonsi Reeve; living.
Turris flavidula (Lamarck); living.
Turris deshayesi Doumet; living.
Turris carinata woodwardi K. Martin.
Turris coronifer K. Martin.
Vicarya callosa (?) Jenkins.
Arca ferruginea Reeve; living.
Arca granosa Linnæus; living.
Arca cornea Reeve; living.
Barbatia fusca (Brugiere); living.
Chione chlorotica Philippi; living.
Corbula socialis K. Martin.
Corbula.
Dosinia cf. lenticularis; living.
Placuna placenta; living.
Psammobia, species; living.
Paphia textrix Deshayes; living.
Ostrea.
Spisula, species.
Tellina, species.
Coral.
Coral.

This fauna flourished in slightly deeper water, or at least quieter water, as one specimen of the fragile *Placuna placenta* with both valves splendidly preserved shows that the specimen was not within strong wave action. The preservation of the other species is remarkably fine. The strata at this locality are nearly vertical, a good dip and strike being obtainable in the middle of the stream.

The following species were obtained from "Locality 4x, Philippine Islands, Luzon, Tayabas Province, Bondoc Peninsula, west side of Ragay Gulf, Bahay River, 320 meters east of mouth of Apad Creek, in road cut 60 feet above the river in yellow sandstone about 50 feet stratigraphically above the brackish-water fauna in the lignitic strata of Locality 5. Colls. Roy E. Dickerson and Mark Fuken."

**Locality 4x**

Architectonica pictum Philippi; living.
Conus ornatissimus K. Martin.
Cypræa.
Columbella bandongensis K. Martin.
Cerithidea cf. ornata Hinds; living.
Cerithium bandongensis K. Martin.
Delphinula??
Delphinula.
Eburna ambulacrum Sowerby; living.
Marginella.
Mitra bucciniformis K. Martin.
Mitra junghuhni K. Martin.
Mitra javana K. Martin.
Melania asperata.
Nassa costellifera A. Adams; living.
Nassa crenulata (Brugiere); living.
Operculum of Natica spadicea; living.
Phos roseatus Hinds; living.
Ranella tuberculata Broderip; living.
Rostellaria fusus Linnæus; living.
Rostellaria crispata Kiener; living.
Strombus, species a.
Turris marmorata; living.
Turris flavidula Lamarck; living.
Thais (or Ricinula) spectrum; living.
Terebra javana K. Martin.
Terebra bicincta K. Martin.
Trochus, species.
Arca ferruginea Reeve; living.
Corbula socialis K. Martin.
Chione chlorotica Philippi; living.
Glycimeris viteus Lamarck; living.

Pecten cf. pseudolima Sowerby; living.
Pecten cf. cristularis Adams & Reeve; living.
Pecten cf. radula Linnæus; living.
Pecten (Pleuronectia) pleuronecta Linnæus; living.
Placuna placenta Lamarck; living.
Solecurtus quoyi; living.
Spondylus, species.
Trochocyathus burnsi J. Haime (Cyclolites).

"Locality 5x, Philippine Islands, Luzon, Tayabas Province, Bondoc Peninsula, west side of Ragay Gulf, Bahay River; 300 meters east of the mouth of Apad Creek in lignitic gray sandstone which was deposited in brackish water. Coll. Roy E. Dickerson" yielded the species listed below:

Cassidaria.
Conus loroisii Kiener; living.
Cerithium jenkinsi K. Martin.
Strombus?
Telescopium telescopium Linnæus; living.
Vicarya callosa Jenkins.
Arca tenebrica Reeve; living.
Chione ?
Ostrea, species.
Amber and petrified wood.

This fauna was made up largely of *Cerithium jenkinsi* K. Martin, *Vicarya callosa* Jenkins and *Ostrea*, species. The other forms are represented by only one or two specimens which were probably carried across the sand bar by small crabs which lived on the sands of the Vigo sea. The abundance of carbonaceous material and the occurrence of amber and petrified wood also indicate that conditions of deposition here differed from those of the previously described localities.

"Locality 9x, Philippine Islands, Luzon, Tayabas Province, Bondoc Peninsula, on Dumalog Creek, about five miles northwest of San Narciso, three-quarters of a mile down stream from the Mulanay-San Narciso Trail in uppermost Vigo, just conformably below Canguinsa sandstone in black shale.

10/17/19. Colls. Roy E. Dickerson and Mark Fuken." The list of species is given below:

**Locality 9x**

Conus striatellus Jenkins.
Conus hardi K. Martin.
Nassa crenulata (Brugiere); living.
Strombus fusus K. Martin (probably Clavella).
Arca cf. cœlata Reeve; living.
Arca ferruginea Reeve; living.
Clementia hyalina Reeve=C. papyracea; living.
Dosinia cretacea Philippi; living.
Tellina.

This fauna though meager is not distinct in any way from faunas listed above. As Pratt[4] and Smith point out there is no evidence of any notable stratigraphic break here, and the stream in its meanderings so exposes the strata that exact observations are possible. Their tentative evidence of an unconformity between the Canguinsa and Vigo in Cambagaco ridge near the Vigo River is interpreted by the writer as a result of faulting.

"Locality 11x, Philippine Islands, Luzon, Tayabas Province, Bondoc Peninsula, on west bank of Sapa Yaknas, in soft yellow sandstone of Canguinsa age. 10/31/19. Coll. Roy E. Dickerson." The strata at this point dip west about 20° while the overlying Malumbang a few hundred feet west has a gentle dip of 2° to 3°, and at other places in this vicinity a notable unconformity separates these two formations. The fauna listed below is especially noteworthy as being composed of 85 to 90% living species. Here again, the stratigraphy is very satisfactory.

**Locality 11x**

Architectonica pictum (Philippi); living.
Cancellaria elegans Sowerby; living.
Cyprœa, species.

[4] Pratt, W. E., and Smith, W. D., Phil. Jour. Sci., Vol. VIII, 1913, Sec. A, No. 5, page 317.

Cerithidea near dohrni but detail differs.
Ficus reticulata (Lamarck); living.
Harpa articularis Lamarck; living.
Nassa thersites (Brugiere); living.
Nassa crenulata (Brugiere); living.
Nassa reussi K. Martin??; may be N. costellifera Adams.
Natica spadicea Reeve; living.
Natica cumingsiana Recluz; living.
Randella tuberculata Broderip; living.
Strombus swainsoni Reeve; living.
Terebra bicincta K. Martin.
Turris marmorata (Lamarck); living.

### Pelecypoda

Cardita antiquata Linnæus; living.
Cardium attenuatum Sowerby; living.
Cardium unicolor Sowerby; living.
Clementia hyalina Philippi = C.papyracea; living.
Glycimeris viteus (Lamarck); living.
Glycimeris angulatus (Lamarck); living.
Ostrea.
Pecten pseudolima Sowerby; living.
Spisula, species.
Vermetus javanus K. Martin ???.

### Anthozoa

Trochocyathus burnsi J. Haime ??

For comparison and summary purposes the fossils from these various localities have been combined in one list.

PARTIAL LIST OF SPECIES FROM VIGO GROUP

| | 2× | 3× | 4× | 5× | 9× | 11× | living |
|---|---|---|---|---|---|---|---|
| Architectonica pictum Philippi | + | + | + | .. | .. | + | + |
| Actæon, species | + | + | .. | .. | .. | .. | .. |
| Bullaria | + | .. | .. | .. | .. | .. | .. |
| Cancellaria crenifera Sowerby | + | .. | .. | .. | .. | .. | + |
| " elegans Sowerby | .. | + | .. | .. | .. | + | + |
| Cassidaria | .. | .. | .. | + | .. | .. | .. |
| Cerithium jenkinsi K. Martin | + | + | .. | + | .. | .. | .. |
| " monoliferum Kiener | + | + | .. | .. | .. | .. | + |
| " herklotsi K. Martin | + | + | .. | .. | .. | .. | .. |
| " bandongensis K. Martin | .. | .. | + | .. | .. | .. | .. |
| Cerithidea (Pyrazus) cf. sulcatus Brugiere | .. | + | .. | .. | .. | .. | + |
| " cf. ornata Hinds | .. | .. | .. | .. | .. | .. | + |
| " near dohrni ??? | .. | .. | .. | .. | .. | + | .. |
| Conus ornatissimus K. Martin | + | + | + | .. | .. | .. | .. |
| " new species ?? | + | + | .. | .. | .. | .. | .. |
| " species | + | + | .. | .. | .. | .. | .. |
| " lividus Hwass | + | .. | .. | .. | .. | .. | + |
| " loroisii Kiener | .. | .. | .. | + | .. | .. | + |
| " hardi K. Martin | .. | .. | .. | .. | + | .. | .. |
| " striatellus Jenkins | .. | .. | .. | .. | + | .. | .. |
| Columbella bandongensis K. Martin | .. | .. | + | .. | .. | .. | .. |
| Cyclonassa | + | .. | .. | .. | .. | .. | .. |
| Cypræa cf. tigris Linnæus | .. | + | .. | .. | .. | .. | + |
| " species | .. | .. | + | .. | .. | + | .. |
| Drillia | + | .. | .. | .. | .. | .. | .. |
| Delphinula ?? | .. | .. | + | .. | .. | .. | .. |
| " | .. | .. | + | .. | .. | .. | .. |
| Distortio clathrata Lamarck | .. | + | .. | .. | .. | .. | + |
| Eburna ambulacrum Sowerby | .. | .. | + | .. | .. | .. | + |
| Ficus reticulata (Lamarck) | .. | .. | .. | .. | .. | + | + |
| Haminea | + | .. | .. | .. | .. | .. | .. |
| Harpa articularis Lamarck | .. | .. | .. | .. | .. | + | + |
| Mitra javana K. Martin | + | .. | + | .. | .. | .. | .. |
| " cf. jenkinsi K. Martin | + | .. | .. | .. | .. | .. | .. |
| " junghuhni K. Martin | + | .. | + | .. | .. | .. | .. |
| " bucciniformis K. Martin | .. | .. | + | .. | .. | .. | .. |
| Mangilia | + | .. | .. | .. | .. | .. | .. |
| Murex endivia Lamarck | .. | + | .. | .. | .. | .. | + |
| Marginella | .. | .. | + | .. | .. | .. | .. |
| Melania asperata | .. | + | + | .. | .. | .. | + |
| Nassa crenulata | + | + | + | .. | + | + | + |
| " dispar Adams | + | + | .. | .. | .. | .. | + |
| " gemmulata (Lamarck) | + | .. | .. | .. | .. | .. | + |
| " globosa minor | + | + | .. | .. | .. | .. | + |
| " thersites immersa Carpenter | + | + | .. | .. | .. | .. | + |
| " thersites leptospira (Brugiere) | + | + | .. | .. | .. | + | + |
| " quadrasi Hidalgo | + | + | .. | .. | .. | .. | + |
| " canaliculata Lamarck | .. | + | .. | .. | .. | .. | + |
| " costellifera A. Adams | .. | .. | + | .. | .. | .. | + |
| " reussi K. Martin (may = N. costellifera) | .. | .. | .. | .. | .. | + | + |

Partial List of Species—Continued.

| | 2× | 3× | 4× | 5× | 9× | 11× | living |
|---|---|---|---|---|---|---|---|
| Natica albumen Lamarck | .. | + | .. | .. | .. | .. | + |
| " ? | + | .. | .. | .. | .. | .. | .. |
| " spadicea Reeve | + | + | .. | .. | .. | + | + |
| " mamilla Lamarck | + | + | .. | .. | .. | .. | + |
| " lacernula d'Orbigny | .. | + | .. | .. | .. | .. | + |
| " cummingsiana Recluz | .. | .. | .. | .. | .. | + | + |
| Nerita funiculata Reeve | + | .. | .. | .. | .. | .. | .. |
| Olivella | + | + | .. | .. | .. | .. | .. |
| Phos | + | + | .. | .. | .. | .. | .. |
| Ranella | + | .. | .. | .. | .. | .. | .. |
| Ranella subgranulosa Beck | + | .. | .. | .. | .. | .. | + |
| " tuberculata Broderip | + | + | + | .. | .. | + | + |
| Rostellaria ficus | .. | + | + | .. | .. | .. | + |
| " crispata Kiener | .. | + | + | .. | .. | .. | + |
| Strombus canarium Linnæus | + | + | .. | .. | .. | .. | + |
| " species a | .. | + | + | . | .. | .. | .. |
| " species b | .. | + | .. | .. | .. | .. | .. |
| " swainsoni Reeve | + | .. | .. | .. | .. | + | + |
| " ? | .. | .. | .. | + | .. | .. | .. |
| Turris (Surcula) flavidus Lamarck | + | + | + | .. | .. | .. | + |
| " garnonsi Reeve | + | + | + | .. | .. | .. | + |
| " deshayesi (Doumet) | + | + | .. | .. | .. | .. | + |
| " carinata woodwardi K. Martin | + | + | .. | .. | .. | .. | + |
| " coronifera (K. Martin) | .. | + | .. | .. | .. | .. | .. |
| " marmora (Lamarck) | .. | .. | .. | .. | .. | + | + |
| Thais (or Ricinula) spectrum | .. | .. | + | .. | .. | .. | + |
| Terebra bicincta K. Martin | + | .. | .. | .. | .. | .. | .. |
| " javena K. Martin | + | .. | + | .. | .. | .. | .. |
| " | + | + | .. | .. | .. | .. | .. |
| Triton pfeifferianum Reeve | .. | + | .. | .. | .. | .. | + |
| Trochus | .. | .. | + | .. | .. | .. | .. |
| Telescopium telescopium Linnæus | .. | .. | .. | + | .. | .. | + |
| Vicarya callosa Jenkins | .. | + | .. | .. | .. | .. | .. |

Partial List of Species from the Vigo Group.

| Pelecypoda | 2× | 3× | 4× | 5× | 9× | 11× | living |
|---|---|---|---|---|---|---|---|
| Arca cornea Reeve | + | + | .. | .. | .. | .. | + |
| " ferruginea Reeve | .. | + | .. | .. | + | .. | + |
| " granosa Linnæus | .. | + | .. | .. | .. | .. | + |
| " cf. cœlata Reeve | .. | .. | .. | .. | + | .. | + |
| " tenebrica Reeve | .. | .. | .. | + | .. | .. | + |
| Barbatia fusca (Brugiere) | .. | + | .. | .. | .. | .. | + |
| Cardium | + | .. | .. | .. | .. | .. | .. |
| " attenuatum Sowerby | .. | .. | .. | .. | .. | + | + |
| " unicolor Sowerby | .. | .. | .. | .. | .. | + | + |
| Cardita antiquata Linnæus | .. | .. | .. | .. | .. | + | + |
| Chione chlorotica Philippi | + | + | + | .. | .. | .. | + |
| " ?? | .. | .. | .. | + | .. | .. | .. |
| Corbula socialis K. Martin | + | + | + | .. | .. | .. | .. |
| Clementia hyalina Philippi = C. papyracea | .. | .. | .. | .. | + | + | + |
| Dosinia cf. lenticularis | .. | .. | .. | .. | .. | .. | + |
| " cretacea Philippi | .. | .. | .. | .. | .. | .. | + |
| Glycimeris viteus (Lamarck) | .. | .. | + | .. | .. | + | + |
| " angulatus (Lamarck) | .. | .. | .. | .. | .. | + | + |
| Ostrea | + | + | .. | . | .. | + | .. |
| Pecten (Pleuronectia) pleuronecta Linnæus | + | .. | + | .. | .. | .. | + |
| " cf. radula Linnæus | .. | .. | + | .. | .. | .. | + |
| " cf. pseudolima Sowerby | .. | .. | + | .. | .. | .. | + |
| " pseudolima Sowerby | .. | .. | .. | .. | .. | + | .. |
| " cf. cristularis Adams & Reeve | .. | .. | .. | .. | .. | .. | + |
| Placuna placenta | + | + | + | .. | .. | .. | + |
| Psammobia cf. lessoni Blainville | + | .. | .. | .. | .. | .. | .. |
| Psammobia, species | .. | + | .. | .. | .. | .. | .. |
| Pinna, species | + | .. | .. | .. | .. | .. | .. |
| Paphia textrix Deshayes | + | .. | .. | .. | .. | .. | + |
| Solen, species | + | .. | .. | .. | .. | .. | .. |
| Spisula, species | .. | + | .. | .. | .. | + | .. |
| Solecurtus quoyi | .. | .. | + | .. | .. | .. | + |
| Spondylus, species | .. | .. | + | .. | .. | .. | .. |
| Tellina | + | .. | .. | .. | + | .. | .. |
| Tellina, species | .. | + | .. | .. | .. | .. | .. |
| Vermetus javanus ? K. Martin | .. | .. | .. | .. | .. | + | .. |
| **Anthozoa** | | | | | | | |
| Trochocyathus burnsi J. Haime | .. | .. | + | .. | .. | + | .. |
| Coral | .. | .. | + | .. | .. | .. | .. |
| " | .. | .. | + | .. | .. | .. | .. |

## Age of the Vigo Group

In the foregoing list there are 87 forms which are specifically determined, and, of these, 66 are living species (75 per cent.) an astonishing number when the geologic history of the region yielding these forms is considered. In addition, the extinct forms are practically all common to the Upper Miocene of Java according to K. Martin[5].

*Cerithium jenkinsi* is from Martin's locality Z; *Cerithium herklotsi* and *Cerithium bandongensis* from his locality O; *Conus hardi* and *Conus striatellus,* locality O; *Columbella bandongensis,* locality O; *Mitra junghuhni* and *M. javana,* locality O; *M. jenkinsi,* locality K; *M. bucciniformis,* locality R; *Turris coronifer,* locality O; *Terebra javana* and *T. bicincta,* locality K; *Vicarya callosa,* localities O and P; *Vermetus javanus,* localities I and P. According to Martin, most of these forms are characteristic of the Upper Miocene of Java.

In a very excellent paper entitled "Concerning Tertiary Fossils in the Philippines" by Prof. Karl Martin, there is listed a series of faunas from the Cagayan Valley of northern Luzon which apparently belong to this same horizon. Concerning this series he gives the following discussion:

"Now, in reviewing Semper's collection, I was at once struck with *Vicarya callosa* Jenk., which is known from Java and is described in detail below; and this induced me to make a closer comparison between the fossils of the Philippines and those of the Indian Archipelago, whereby it at once became apparent that a whole series of species, especially of the Javanese Tertiary, is common to both regions. Thus far, indeed, I have been unable to make a complete study of Semper's collection, and for the time being it has little further interest, because statements as to stratigraphical position are entirely lacking and the equivalent deposits of neighboring regions are still very insufficiently known. After completion of my monograph on the fossils of Java, however, I hope to undertake a more thorough study of the Philippine fossils, and to supplement this preliminary communication."

Martin lists the following from Luzon:

1. Minanga; right bank of the Catalangan.

Fusus verbeeki Mart. ........................ M;P.
Tritonidea ventriosa Mart. .................. M.
Murex brevispina Lam. ...................... M.(?);P;L.

[5] Martin, K., Tertiarschichten auf Java, p. 44-51, Leiden, 1880.

| | |
|---|---|
| Murex pinnatus Wood | M;L. |
| Ranella raninoides Mart. | M. |
| Rostellaria javana Mart. | M. |
| Natica mamilla Lam. | M;L. |
| Cardita decipiens Mart. | P. |
| Venus squamosa Lam. | P;L. |

2. Minanga; right bank of the Ilaroen.

| | |
|---|---|
| Terebra jenkinsi Mart. | M. |
| Terebra bandongensis Mart. | M. |
| Fusus verbeeki Mart. | M;P. |
| Murex grooti Jenk. | M. |
| Ranella gyrina Linn. | L. |
| Rostellaria javana Mart. | M. |
| Vicarya callosa Jenk. | M. |
| Cardita decipiens Mart. | P. |

3. Right bank of the Ilaroen, 4 miles above Minanga.

| | |
|---|---|
| Fusus verbeeki Mart. | M;P. |
| Murex brevispina Lam. | M.(?);P;L. |
| Ranella raninoides Mart. | M. |
| Rostellaria javana Mart. | M. |
| Natica mamilla Lam. | M;L. |

4. Left bank of the Ilaroen, 1¼ miles above Goroen.

| | |
|---|---|
| Murex djarianensis Mart. | M. |
| Murex brevispina Lam. | M.(?):P;L. |
| Murex microphyllus Lam. | M;L. |
| Murex grooti Jenk. | M. |
| Ranella spinosa Lam. | M;L. |
| Potamides jenkinsi Mart. | P. |
| Natica mamilla Lam. | M;L. |
| Cardita decipiens Mart. | P. |

5. Left bank of the Ilaroen, 4 miles above Goroen.

| | |
|---|---|
| Conus sinensis Sow. | P;L. |
| Conus palabuanensis Mart. | J. |
| Fusus verbeeki Mart. | M;P. |
| Ranella gyrina Linn. | L. |

6. Foothills in front of Aringay.

Conus loroisii Kien. ........................M;P;L.
Pleurotoma gendinganensis Mart. ..........P.
Nassa verbeeki Mart. ........................P.
Natica mamilla Lam. ........................M;L.

7. Hills close to Aringay.

Pleurotoma carinata ........................P;L.

8. Dicamui Brook.

Vicarya callosa Jenk. ........................M.

9. Satput.

Cypræa smithi Mart. ........................M.
Rostellaria javana Mart. ....................M.

The appended initials indicate the occurrence of the species in the Tertiary of other parts of the Indian Archipelago, as well as among the fauna of the present day. Thus E denotes Eocene; M, Miocene; P, Pliocene; J, later Tertiary in general; Q, Quaternary; L, living species.

The fossils in Martin's list come from nine different localities and the largest number of species from any one locality is ten. The strata in the vicinity of Minanga are, according to Martin, essentially the same horizon and he says: "Judging from all these facts, the strata at Minanga are to be classed with the Upper Miocene bed which exists in Java in the locality denoted by Junghuhn by O, and at Selatjan on the Tjilongan." As was indicated above, many of the fossils from the Bondoc Peninsula are common to this locality O in Java, and the equivalence of the Upper Vigo beds with these Javan beds is evident. Upon the basis of Martin's work, the age of the Vigo beds is Upper Miocene.

Martin lists the distinctive foraminifera, *Cyloclypeus communis* Martin, from his (and Junghuhn's) localities K, L, O and P. *Orbitoides gigantea* Martin is from locality L, and *O. radiata* Martin is from locality K. These localities all represent about the same horizon in Java and it is important to note these forms here as they are regarded as excellent horizon determiners.

Dr. W. D. Smith[6], on the strength of the occurrence of *Cycloclypeus communis* K. Martin, and *Lepidocyclina richthofeni* Smith, refers the Canguinsa sandstone to the Middle or Lower Miocene. His exact statement is as follows:

"......The limestone from Mount Morabi (fossil locality 62) contains *Cycloclypeus communis* K. Martin, which represents the middle Miocene, and large lepidocyclinas some of which are 45 millimeters in diameter and 5 millimeters broad in the thickened central portion. *Lepidocyclina richthofeni* Smith was identified among these. This species has been referred by Douvillé to the lower Miocene.

"No definite age determinations can be made from the fossils in the Canguinsa sandstone proper. The fossils in the included limestone, however, are well known and have been used in correlation by various authorities. From their presence it is concluded that the Canguinsa sandstone should be placed in the middle Miocene, extending, perhaps, into the lower Miocene."

In a recent publication, "Notes on a Lepidocyclina-Limestone from Cebu," by Prof. H. Yabe[7], a full discussion of correlation of these equivalent beds in Cebu is given, and Smith's and Douvillé's[8] correlation tables are quoted.

It is noteworthy that beds under discussion are classified by Douvillé as Aquitanian. All who have studied the large foraminifera from the Philippine Islands agree that one of the characteristic genera is *Lepidocyclina.* Cushman[9] in a recent paper makes the following significant statement: "Because in general *Orbitoides,* with some modifications to be noted in a future paper, is Cretaceous, *Orthophragmina* Eocene, and *Lepidocyclina* Oligocene, much importance is attached to these organisms in the investigation of problems of geologic correlation."

[6] Pratt, W. E., and Smith, W. D., Phil. Jour. Sci., Vol. VIII, 1913, No. 5, Sec. A, p. 330.

[7] Yabe, H., Science Reports, Tohoku Imperial University, 2nd Series, (Geol.), Vol. V, No. 2, 1919, p. 40.

[8] Douvillé, H., Les foraminifères dans le Tertiaire des Philippines. Phil. Jour. Sci., Vol. VI, 1911, No. 2, Sec. D, pp. 53-80.

[9] Cushman, J. A., Orbitoid Foraminifera of the Genus Orthophragmina from Georgia and Florida. U. S. G. S. Prof. Paper 108, 1918, p. 115.

From another point of view the age of the beds in question might depend upon the age determination of the overlying Malumbang formation. Concerning the age of this formation, Smith[10] states the case as follows:

"The most conclusive evidence as to the age of the Malumbang series is found in the Lower limestone, which, on the basis of the fossil *Lithothamnium ramosissimum* Reuss (fossil locality 25) may be assigned to the Miocene. The upper beds in the series are apparently as young as the Upper Miocene or the Pliocene. The formation is similar to the "étage marneux" which Verbeek assigns to the middle stage of the upper Tertiary for Java."

Concerning the range of this species, Prof. H. Yabe[11] notes the following:

"This reef building organism is very often cited from the limestone of the Oligocene and Miocene ages of the Indo-Pacific region, its occurrence being known from Japan, the Philippines, Borneo, Timor, Amboina, New Guinea and adjacent islands, New Hebrides, Victoria, the Christmas Islands, etc.

"In Japan, it is found not only in Lepidocyclina and Miogysina-limestones and similar and equivalent rocks of Formosa, Botel-tobako, the Riukiu-Islands and Ogasawara-jima, but also in 1. the Lepidocyclina and Miogypsina-limestones of the provinces of Sagami and Kai; 2. the Lithothamnium-limestones of Ogami-yama and Megami-yami near Sagara, province of Tōtōmi; 3. the Lithothamnium-limestone intercalated in an oil-bearing Tertiary complex of Echigo; 4. the Lithothamnium-limestone of Shiroiwa, Mukatsuka-mura, Otsu-göri, pro. of Nagato."

It is evident from these references that this form has considerable range in the Miocene.

From all the evidence Canguinsa and Upper Vigo beds may be assigned to some stage of the Miocene, and the evidence of Lepidocyclina indicates a still greater age, the Oligocene.

[10] Op. cit., 327.

[11] Yabe, H., Notes on a *Carpenteria*-Limestone from B. N. Borneo. Science Reports, Tohoku Imperial University, 2nd Series (Geol.), Vol. V, No. 1, 1918, p. (28) 14.

## Importance of Guide Fossils

Good guide fossils are far more difficult to select in connection with tropical Tertiary faunas of the Philippines than in the Californian Tertiary owing to the great predominance of recent mollusca. As will be seen from a study of the fauna cited above, most of the forms which are extinct were originally described from a correlative horizon in Java. Of these, the writer is inclined to think that *Cerithium jenkinsi, C. herklotsi, C. bandongensis; Mitra javana, M. jenkinsi, M. junghuhni, M. bucciniformis; Turris coronifer; Terebra bicincta, T. javana; Vicarya callosa; Vermetus javanus* will probably prove reliable guides among the mollusca. These species are all representatives of highly organized genera and their extinction during the post-Miocene time was probably due to their inability to obtain life conditions suited to their highly specialized needs.

Corals, echinoderms, and the more highly organized foraminifera will probably prove to be even better horizon determiners, but their comparative infrequence in strata of the Philippines will at times preclude their use. The writer has not yet attempted to identify the corals and the echinoderms in the collections made, but their value will no doubt prove to be great. It seems that their rate of evolution may have been greatly retarded, but much study will be required in this connection. For stratigraphic work in the tropics large and complete collections are necessary to obtain results of any value, as the geologic and paleontologic history is read, even with the best data available, with much difficulty. Much comparative material, both recent and fossil, should be accumulated as subspecific differences will be recognized only through comparative studies. These subspecific differences are exceedingly important for minute separation and discrimination of strata deposited under tropical conditions.

## Factors Promoting Evolution of Pelecypods and Gastropods

The changes in conditions of environment of marine pelecypods and gastropods—in salinity, temperature, depth of water, character of the bottom, food, oceanic currents—determine the existence of individuals, and, in all probability, species also. Many marine forms are quite delicately adjusted to their environment and even slight changes may cause their extinction in certain localities. Of these conditions, change in temperature is probably the most important. The annual temperature range of the waters in the tropics is far less than similar ranges in the temperate zones. Likewise variations in salinity are probably less, as this is a secondary factor dependent in large part upon temperature. The influence of oceanic currents is intimately connected with temperature and salinity. Depth of bottom and the character of the bottom may be altered by changes in the volume of sediments brought into the ocean from the neighboring land and by epirogenic—continent building—movements which have caused a restriction or enlargement of a continental shelf. Epirogenic movements vitally affect food conditions of pelecypods and gastropods, for, if the continental shelf is greatly reduced by uplift, the feeding areas are thus reduced, and, if the competition among gastropods and pelecypods is too great, a species may rapidly become extinct. All of these changes are probably far less under tropical conditions than under temperate or arctic conditions.

## Comparison of Life Conditions During Vigo Miocene Time With the Recent

The close relationship between the Vigo Miocene fauna of the Philippines and the recent fauna of these same waters, indicates that change in living conditions since the beginning of Miocene time has been but slight. Apparently change in temperature has not had any notable influence. It can be shown from general geological evidence that an archipelagic condition existed during Miocene, Pliocene and Pleistocene times. Salinity during the last half of the Tertiary and Recent has probably altered but little and this only locally. Oceanic currents and changes in character of ocean bottom were probably different during Vigo-Miocene time than during Malumbang-Pleistocene or Recent time, as is evidenced by the absence of reef building corals from the Vigo and the argillaceous and sandy character of the sediments of this group. A study of Vigo sedimentation indicates that an extensive land area stretched from north to south near the outer border of the continental shelf of the Philippines unbroken by straits like the San Bernardino of the present. Diorites, schists, serpentines and associated metamorphic and igneous rocks composed this land mass and the mud-laden, westerly-flowing streams deposited their loads in the Philippine inland sea of Miocene age. Judging from the coarse agglomeratic character of the basal Vigo beds in Leyte, high grade, torrential streams descended to a semi-arid lowland from a high, mountainous terrane to the east. The absence of many reef building corals from the Vigo fauna is probably due to the presence of muddy waters and the lack of strong currents, because the waters were quite warm enough for coralline growth, judging from the presence of many tropical species. From the character of both the sediments and fauna, the waters of the Vigo sea were not too deep for the existence of reef-building corals. During Malumbang time marine life conditions were very similar to those prevailing in the Philippines today, but the continental shelf was apparently far wider and the islands much smaller, since coralline limestone covered more extensive areas during the Pliocene than now. During the Pleistocene, the islands were outlined about as at present but many local changes took place during this time. Cebu for example was probably greatly restricted during the Pleistocene as well as during the Pliocene, and it was probably represented by several small islets then. Recent and Pleistocene faulting on a great scale seems to have largely controlled the physiography of this island. The northwestern peninsula of Leyte, 40 miles east, has not only a clear cut record in its terraced sides registering a series of uplifts, but an equally clear record of Recent or Pleistocene submergence on its west side. This last event is evidenced by a series of beautiful small bays, drowned valleys of small westward flowing antecedent streams. Such local movements did not seem to affect the species very materially on the whole. It is quite possible that some forms had to seek other quarters, but with such a great variety of neighborhoods from which to choose, every clam could find its proper mud flat and each snail its own dugout. The possible tendency of a species to have within itself the power to evolve into a higher form, or a form still better suited to its environment, is not apparently present in the case of the tropical pelecypods and gastropods, and the slow changes of fauna are apparently produced by slight changes in temperature, depth, salinity, and food. In other words, the "wonderful stability of protoplasm" seems to be exhibited in these marine tropical invertebrates except when environmental changes impress alterations upon this vital life substance.

## Crowding of Species and the Recent Fauna of the Philippines

A seeming objection to the main thesis of this paper is found in connection with the great abundance of species in the marine waters surrounding the Philippine Islands. As was mentioned above, climatic zones were by no means as sharply differentiated during the early as during the later portion of the Tertiary. Practically all Recent tropical genera were initiated in the Eocene, and many of the species representing these genera had, during this period, an exceedingly wide geographic range, particularly as respects latitude. During this time tropical species flourished in high latitudes. To use a simple comparison, the tropical life "accordion" was extended to its greatest limit. The exact nature of the change which caused a separation of remarkable distinctness between the Oligocene faunas of the Pacific Coast of North America from the Eocene is not fully understood. It seems probable however that the time represented by unconformity between Oligocene and Eocene was long. The distribution of land masses on the earth was profoundly affected, and it seems quite probable that the climate during this ep-Oligocene time was decidedly cooler than in the Eocene or the Oligocene which followed. It seems quite probable that the life "accordion" was compressed and many species which ranged far to the north in Eocene time were compelled to seek the more genial climes of the tropic seas. When the faunas during the Oligocene again had a chance to expand into higher latitudes, they encountered new conditions of environment and were nearly all specifically changed. The Oligocene faunas of Oregon, Washington, and California are distinctly set off from the Miocene and similar changes may have taken place during ep-Miocene time. Again many of the species succeeded in making a strategic retreat. Even more pronounced were the "accordion"-like changes during the Pliocene, and during the Pleistocene "jig-time" was in vogue.

As was pointed out above, archipelagic conditions prevailed in the Philippines during the Tertiary, although the record for the Miocene is missing or extremely meager. An archipelago located in the tropics offers a great variety of habitat, and a new species entering such a region could on this account find suitable conditions for existence.

From Miocene to Recent in the tropics molluscan faunas have changed but little, and but slight specific alterations have occurred as well. Since a tropical or sub-tropical climate prevailed over California, Oregon, and Washington during upper Eocene time, the great geographic and stratigraphic ranges of certain species of Tejon (Upper Eocene) age is due to nearly uniform conditions and other factors mentioned. The great stratigraphic range of many Tejon Eocene species is probably due to uniformity in climate during long periods of time and slight faunal changes have greater significance in the Upper Eocene than corresponding changes in the Miocene, Pliocene, and Pleistocene time and these variations probably required a much longer time for their production as well. Uniformity in oceanic temperature enabled many species to range far to the north, and, in fact, far west of California to the Eocene of Japan where *Perissolax blakei, Pholadomya nasuta* or their near relatives occur[12].

The Eocene time then must not be measured by the same faunal "yardstick" as Pliocene and Miocene time, but a much finer scale is required. It is the writer's opinion, based upon such considerations, that Eocene time is far longer than any of the other divisions of the Tertiary.

## Summary

The tentative conclusion of the writer is that in the study of Tertiary faunas of the tropics, a different percentage scale must be used. For the later Tertiary, Miocene, Pliocene, and Pleistocene the percentages which apply in the temperate re-

[12] Yokoyama, M., Some Tertiary Fossils from the Miike Coal-field. Journal of the College of Science, Imperial University of Tokyo, Vol. XXVII, 1911, Art. 20.

gions to the Pliocene are roughly adaptable to the Miocene, and similarly the percentages which apply in the temperate regions to the Pleistocene are apparently those of the Pliocene of the tropics. The reasons for this apparent lack of faunal differentiation during the Tertiary in the tropics are those due to uniformity of temperature, salinity, food, and other life essentials. From another viewpoint the rate of evolution of Gastropoda and Pelecypoda in the tropics during the Tertiary was far less than during this same time in the more rigorous environs of the temperate zones. The tropical or sub-tropical faunas of the Eocene of the Pacific Coast of North America exhibit but slight differences compared to the faunas of Miocene and Pliocene age of this same region, and the writer ascribes this to uniformity of life conditions which prevailed during Eocene time. The amount of faunal change must not be used as a measure of time in the whole of the Tertiary, but differently marked scales are necessary for measurement in tropical and sub-tropical faunas of the Eocene and Oligocene than for the Miocene, Pliocene, and Pleistocene. It is particularly noteworthy that the Japanese paleontologists are now searching for comparisons with the Pacific Coast of North America and Australia rather than with Europe. In other words, many problems of the tropical Orient will be solved only when conditions on both sides of the Pacific become better known.

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II

# A LIST OF THE AMPHIBIANS AND REPTILES OF NEVADA, WITH NOTES ON THE SPECIES IN THE COLLECTION OF THE ACADEMY

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No list of the reptiles and amphibians of Nevada as a whole has yet been published. In order that one may be available we have undertaken the preparation of that which follows. This list is based upon the published records as well as upon the collections of the California Academy of Sciences. It has been drawn upon the same lines as our previous lists of the amphibians and reptiles of Arizona (1913) and of Utah (1915). It is thought to include all species now definitely known to live in Nevada. Those which the Academy has not yet received from within the borders of that state are indicated by a star preceding the number in the list. Following this list are given notes on the species represented in the Academy's collections. Our specimens from Nevada were nearly all secured by Mr Slevin in 1913 and 1916.

## LIST OF THE AMPHIBIANS AND REPTILES OF NEVADA

1. Scaphiopus hammondii
2. Bufo compactilis
3. Bufo boreas boreas
4. Bufo boreas halophilus
*5. Bufo woodhousii
6. Hyla regilla
7. Rana pipiens
*8. Rana pretiosa
9. Rana onca
*10. Coleonyx variegatus
*11. Dipsosaurus dorsalis dorsalis
12. Sauromalus ater
13. Crotaphytus collaris baileyi
14. Crotaphytus wislizenii
15. Callisaurus ventralis ventralis
16. Callisaurus ventralis myurus
*17. Uta ornata ?
*18. Uta graciosa
19. Uta stansburiana stansburiana
20. Sceloporus graciosus graciosus
21. Sceloporus occidentalis biseriatus
22. Sceloporus magister
*23. Phrynosoma douglassii
24. Phrynosoma platyrhinos
*25. Heloderma suspectum
*26. Xantusia vigilis
27. Cnemidophorus tessellatus tessellatus
*28. Plestiodon skiltonianus
29. Charina bottæ bottæ
30. Coluber constrictor mormon
31. Coluber flagellum piceus
32. Coluber tæniatus
33. Salvadora hexalepis
34. Pituophis catenifer deserticola
*35. Lampropeltis getulus boylii
*36. Hypsiglena ochrorhynchus ochrorhynchus

*Species which the Academy has not yet received from Nevada.

*37. Thamnophis sirtalis infernalis
38. Thamnophis ordinoides elegans
39. Thamnophis ordinoides vagrans
40. Thamnophis ordinoides couchii
41. Sonora semiannulata
42. Crotalus oreganus
*43. Crotalus tigris
*44. Crotalus cerastes
*45. Gopherus agassizii

### 1. **Scaphiopus hammondii** Baird

Nos. 40911 to 40924 are fourteen specimens of this spadefoot toad taken at dusk in pools of water in the beach of Pyramid Lake, July 3 to 9, 1916. None was seen after these dates.

### 2. **Bufo compactilis** Wiegmann

Although this toad has been found in Arizona and Utah, we believe its presence in Nevada has not been recorded. Specimens (Nos. 36959, 36960, 36968) are at hand from Las Vegas, Clark County, and (Nos. 37330-37507), from Caliente, Lincoln County.

### 3. **Bufo boreas boreas** (Baird & Girard)

We refer to this subspecies two specimens (Nos. 40946, 40947) from Elko, Elko County, and a fairly large series (Nos. 40878 to 40910) from Pyramid Lake, Washoe County. The toads from Pyramid Lake were found at Sutcliffe, at the Pyramids, and on Anaho Island.

### 4. **Bufo boreas halophilus** (Baird & Girard)

Three toads (Nos. 38013 to 38015) collected near Glenbrook, Douglas County, on the shore of Lake Tahoe, seem to represent this southern subspecies.

*Species which the Academy has not yet received from Nevada.

### 6. **Hyla regilla** Baird & Girard

One hundred and three Hylas (Nos. 36856 to 36958) were secured at Las Vegas, Clark County, Nevada, May 1 and August 10 to 13, 1913. They were found in grass along the edges of a stream. The webs between the toes are small in these specimens.

While this seems to be the only tree-toad as yet collected in Nevada, there can be little doubt that *Hyla arenicolor* occurs along the Colorado River.

### 7. **Rana pipiens** Schreber

From Nevada, we have a series of one hundred and fifty-seven specimens of this frog. Twelve (Nos. 37318 to 37329) were collected at Caliente, Lincoln County, Nevada, August 14-21, 1913. Others (Nos. 37859 to 37990) were secured at Elko, Elko County, Nevada, July 14 to 16, 1913, and (Nos. 40948 to 40959) July 19, 1916. One frog (No. 40935) was taken at Carlin, Elko County, July 17, 1916.

### 9. **Rana onca** Cope

*Rana onca* was described by Cope from a single female specimen collected by Dr. H. C. Yarrow, in 1872, and labeled merely Utah. There seems to be no doubt that this is the same species which Dr. Stejneger later described as *Rana fisheri,* basing his description on specimens collected in Vegas Valley, Nevada. Our collections include ninety-nine specimens (Nos. 36757 to 36855) from Las Vegas, Clark County, Nevada, collected May 1 and August 10 to 13, 1913. These frogs were all caught in a small stream from a flowing well about a mile northwest of the town of Las Vegas. *Rana pipiens* was not found in this vicinity although it was taken at Caliente less than one hundred and fifty miles away. We have not found *Rana onca* elsewhere.

### 12. **Sauromalus ater** Duméril

Three specimens (Nos. 37509 to 37511) were secured at Rhyolite, Nye County, August 3 to 9, 1913. They were found on rocks in a railroad cut. No. 37511 has 16-16 femoral pores.

### 13. **Crotaphytus collaris baileyi** (Stejneger)

Our Nevada collections include forty-three specimens of this lizard. Eight (Nos. 37044 and 37055 to 37061) were collected at Caliente, Lincoln County, May 4 to 8, and August 21, 1913. Thirty-four (Nos. 37693 to 37726) were secured at Tonopah, Nye County, July 23 to 27, 1913. No. 37514 was shot at Rhyolite, Nye County, August 3 to 9, 1913. The central head scales are in two series in all these specimens.

Femoral pores in forty-two specimens vary from 14 to 20; being 14 once, 15 twice, 16 seventeen times, 17 thirty-three times, 18 nineteen times, 19 eight times, and 20 four times.

### 14. **Crotaphytus wislizenii** Baird & Girard

Eighty-one of these lizards were collected in Nevada in 1913 and 1916. Of these, forty (Nos. 37014 to 37043 and 37045 to 37054) were secured at Caliente, Lincoln County, May 4 to 8, and August 4 to 21; five (Nos. 37688 to 37692) were taken at Tonopah, Nye County, July 23-27; two (Nos. 37512 and 37513) were shot at Rhyolite, Nye County, August 3-9; one (No. 37801) was secured at Goldfield, Esmeralda County, July 29; one (No. 37996) was caught in Smoky Valley, Nye County, July 22; and two (Nos. 38016, 38017) were collected near Reno, Washoe County, Sept. 11; twenty-nine (Nos. 40507 to 40535) were taken near Sutcliffe, Pyramid Lake, Washoe County, June 30 to July 13, 1916; and one (No. 40933) was shot at Carlin, Elko County, July 16, 1916.

Femoral pores in forty-nine specimens vary from 14 to 23; being 14 once, 15 nine times, 16 twelve times, 17 eighteen times, 18 eighteen times, 19 thirteen times, 20 ten times, 21 ten times, 22 twice, and 23 five times.

### 15. **Callisaurus ventralis ventralis** (Hallowell)

Twenty-nine (Nos. 37062 to 37069 and 37070 to 37090) were shot at Caliente, Lincoln County, May 4 to 8, and August 14 to 21, 1913. Thirty (Nos. 37518 to 37547) were taken at Rhyolite, Nye County, August 3 to 9, 1913.

Femoral pores in fifty-seven of these specimens vary from 11 to 18; being 11 once, 12 four times, 13 eight times, 14 twenty-nine times, 15 twenty-seven times, 16 thirty times, 17 twelve times, and 18 three times; average 15.01. These counts are intermediate between those of Arizona (average 15.8, 16.5, 17.6) and Pyramid Lake specimens (average 13.76).

### 16. **Callisaurus ventralis myurus** Richardson

One hundred and ninety-two (Nos. 40596 to 40786 and No. 40877) were secured in the vicinity of Pyramid Lake, Washoe County, July 1 to 13, 1916. Twelve of these (Nos. 40689 to 40700) were shot at the Indian Agency whence came the type of Richardson's *Callisaurus ventralis myurus*. The others were obtained near Sutcliffe, Pyramid Lake.

Femoral pores in fifty of these specimens vary from 11 to 17; being 11 three times, 12 eleven times, 13 twenty-eight times, 14 thirty times, 15 twenty-two times, 16 five times, and 17 once; average 13.76.

The number of femoral pores on 206 thighs of specimens from Pyramid Lake is shown by the dotted line in the following chart (Figure 1), while 248 counts from Arizona specimens of *C. ventralis ventralis* are represented by the continuous

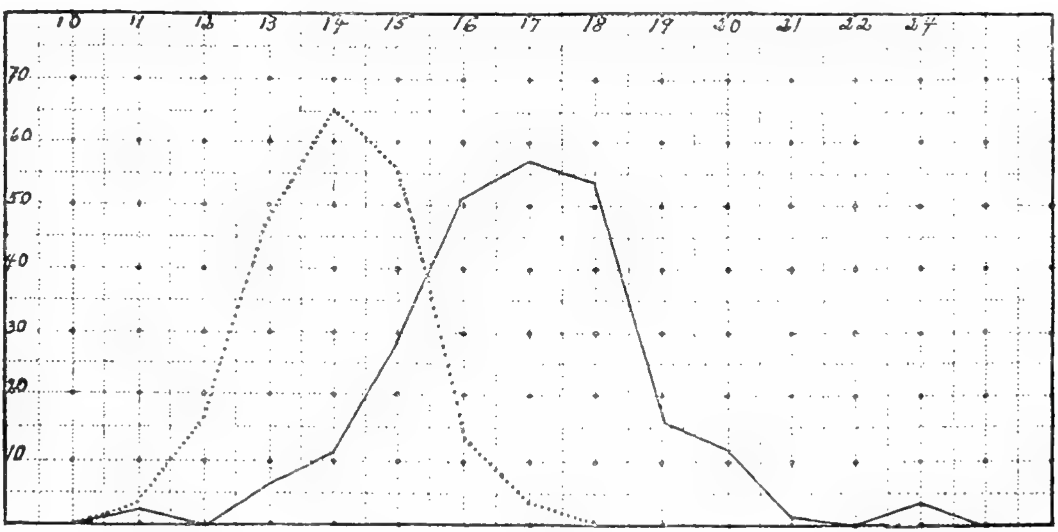


Fig. 1—FEMORAL PORES IN CALLISAURUS

248 counts Arizona.——————— 206 counts Pyramid Lake..............

line. However, the average number of pores varies in specimens from various parts of Arizona, as is shown in the following table:

| Locality | Specimens Examined | Femoral Pores | | Ratio Body and Tail Length | |
|---|---|---|---|---|---|
| | | Extremes | Average | Extremes | Average |
| Pyramid Lake........ | 45 Richardson | 12—17 | 14.2 | 0.727—0.864 | 0.807 |
| Pyramid Lake........ | 50 C. A. S | 11—17 | 13.77 | 0.713—0.961 | 0.815 |
| Arizona (all parts).... | 50 C. A. S. | 14—22 | 17.53 | 0.705—0.916 | 0.805 |
| Catalina Mts., Arizona | 50 C. A. S. | 14—21 | 17.54 | 0.754—0.985 | 0.855 |
| Cave Creek, Arizona.. | 50 C. A. S. | 15—23 | 14.27 | 0.744—0.905 | 0.828 |
| Yuma, Arizona....... | 50 C. A. S. | 11—21 | 15.89 | 0.620—0.870 | 0.728 |
| Yuma and California.. | Richardson | 12—20 | 15.9 | 0.678—0.826 | 0.728 |

19. **Uta stansburiana stansburiana** (Baird & Girard)

Two hundred and ninety Nevada specimens are at hand. One hundred and one (Nos. 37548 to 37648) are from Rhyolite, Nye County, August 3-9, 1913. Sixty (Nos. 37727 to 37786) were collected at Tonopah, Nye County, July 23-27, 1913. Eleven (Nos. 37787 to 37797) were shot at Round Mountain, Nye County, July 21, 1913. Three (Nos. 37805 to 37807) were taken at Goldfield, Esmeralda County, July 29-31, 1913. Fifteen (Nos. 36741 to 36755) were secured at Las Vegas, Clark County, May 1-2, and August 10-13, 1913. Ninety-seven (Nos. 37100 to 37196) were collected at Caliente, Lincoln County, May 4-8 and August 14-21, 1913. In 1916, two (Nos. 40796 and 40797) were secured at Sutcliffe, Washoe County, July 1 and 8, 1916, and one (No. 40798) on Anaho Island, Pyramid Lake, July 6, 1916.

Femoral pores in two hundred and forty-five specimens vary from 11 to 17; being 11 once, 12 forty-one times, 13 one hundred and thirty-five times, 14 one hundred and eighty-five times, 15 ninety-eight times, 16 twenty-six times, and 17 four times; an average of 13.86 pores per thigh.

20. **Sceloporus graciosus graciosus** (Baird & Girard)

Only sixteen lizards of this species were collected. Two (Nos. 37993, 37994) were secured at Wells, Elko County, July 9, 1913. One (No. 37841) was shot at Elko, Elko County, July 16, 1913. Ten (Nos. 37819 to 37828) were collected at Austin, Lander County, July 17-19, 1913. Two (Nos.

37799, 37800) were taken at Round Mountain, Nye County, July 21, 1913. One (No. 40934) was collected at Carlin, Elko County, July 16, 1916.

Femoral pores in thirteen specimens vary from 11 to 16; being 11 once, 12 three times, 13 four times, 14 eight times, 15 six times, and 16 four times.

### 21. **Sceloporus occidentalis biseriatus** (Hallowell)

We have one hundred and ninety-two Nevadan specimens from the following localities: Nos. 37197 to 37301 from Caliente, Lincoln County, May 4-8 and August 15-21, 1913; Nos. 37685 to 37687 from Tonopah, Nye County, July 23-27, 1913; No. 37798 from Round Mountain, Nye County, July 21, 1913; No. 37992 from Snell Canyon, Ruby Mountains, Elko County, July 12, 1913; Nos. 37809 to 37818 from Austin, Lander County, July 17-19, 1913; No. 37804 from Goldfield, Esmeralda County, July 29, 1913; Nos. 38024 to 38030 from Reno, Washoe County, Sept. 11, 1913; Nos. 38003 to 38012 from Glenbrook, Douglas County, August 25-31, 1913; Nos. 40822 to 40875 from vicinity of Pyramid Lake, Washoe County, July 1-13, 1916.

Femoral pores in one hundred and thirty-two specimens vary from 13 to 19; being 13 twice, 14 five times, 15 forty-six times, 16 seventy-one times, 17 seventy-nine times, 18 forty-eight times, and 19 thirteen times.

### 22. **Sceloporus magister** Hallowell

Forty-three Nevadan specimens are at hand. Sixteen of these (Nos. 37302 to 37317) were collected at Caliente, Lincoln County, May 4-8 and August 15-21, 1913. Three (Nos. 37515 to 37517) were secured at Rhyolite, Nye County, August 3-9, 1913. These were all found on rocks on the hillsides. In the vicinity of Pyramid Lake, Washoe County, they were usually found on the ground under thorn bushes. Here, Nos. 40799 to 40812 and 40876 were secured at Sutcliffe, July 1 to 13, 1916; Nos. 40819 to 40821 were shot near the Indian Agency, July 5, 1916; Nos. 40813 to 40817 were taken from boulders on Anaho Island in Pyramid Lake, July 6, 1916; and No. 40818 was collected on one of the Pyramids near the north end of the lake July 8, 1916. Those taken under the thorn bushes were bright green and very wild.

### 24. **Phrynosoma platyrhinos** Girard

Twenty-two horned toads of this species were secured in Nevada in 1913 and nine in 1916. Nine (Nos. 37091 to 37099) are from Caliente, Lincoln County, May 4-8, and August 15-21. No. 36756 was caught at Las Vegas, Clark County, August 10-13. Three (Nos. 37673 to 37675) were collected at Rhyolite, Nye County, August 3-9. Two (Nos. 37676 and 37677) were found at Tonopah, Nye County, July 23-27. No. 37803 was picked up near Goldfield, Esmeralda County, July 29. Six were secured near Reno, Washoe County, September 11. Nine (Nos. 40787 to 40795) were taken in the vicinity of Sutcliffe, Washoe County, June 30 to July 12, 1916.

The femoral pores in thirteen of these specimens vary from 7 to 11, being 7 five times, 8 six times, 9 seven times, 10 six times, and 11 twice.

### 27. **Cnemidophorus tessellatus tessellatus** (Say)

Our Nevada collections include one hundred and fifty-nine lizards of this kind. Of these, thirty-seven (Nos. 36977 to 37013) were secured at Caliente, Lincoln County, May 4-8 and August 15-21, 1913. Twenty-three (Nos. 36718 to 36740) were collected at Las Vegas, Clark County, May 1-2, and August 10-13, 1913. Twenty-four (Nos. 37649 to 37672) were shot at Rhyolite, Nye County, August 3-9, 1913. Seven (Nos. 37678 to 37684) were collected at Tonopah, Nye County, July 23-27, 1913. One (No. 37802) was shot at Goldfield, Esmeralda County, July 29, 1913. Seven (Nos. 40926 to 40932) were taken at Carlin, Elko County, July 16, 17, 1916. Forty-four (Nos. 40536 to 40576 and 40593 to 40595) are from Sutcliffe, the Indian Agency and Pyramid, all near Pyramid Lake, Washoe County, June 30 to July 13, 1916. Sixteen (Nos. 40577 to 40592) were shot on Anaho Island in Pyramid Lake, July 6, 1916.

The femoral pores in eighty-eight specimens from Nevada vary from 15 to 26, being 15 once, 16 once, 17 twice, 18 ten times, 19 thirty-five times, 20 forty-nine times, 21 thirty-nine times, 22 twenty times, 23 ten times, 24 four times, 25 four times, and 26 once.

### 29. **Charina bottæ bottæ** (Blainville)

No. 37998 is a female boa of this species which was found at Glenbrook, Douglas County, Nevada, August 25, 1913. The scales are in 47 rows, gastrosteges 207, urosteges 33, supralabials 9-10, infralabials 13-12, loreal 1-1.

### 30. **Coluber constrictor mormon** (Baird & Girard)

The only racer of this kind secured in Nevada is a male, No. 37991. It was caught in Snell Canyon, Ruby Mts., Elko County, July 12, and has scales in 17 rows, gastrosteges 172, urosteges 93, supralabials 7-7, infralabials 8-8, preoculars 1-1, postoculars 2-2, loreal 1-1, temporals 2+2+2–2+2+2.

The fact that more than half the specimens of the yellow-bellied racer taken west of the Rocky Mountains have eight labials, while those secured farther east usually have seven, causes us to continue to regard them as distinct subspecies. The oldest name applied to the western subspecies appears to be *Coluber mormon* Baird & Girard, 1852, based upon a young specimen from the Valley of the Great Salt Lake, Utah.

### 31. **Coluber flagellum piceus** (Cope)

One female racer shot at Las Vegas, Clark County, May 1, 1913, is No. 36717. The scales are in 17 rows, gastrosteges 195, urosteges 111, supralabials 8-9, infralabials 10-9, preoculars 2-2, postoculars 2-2, loreal 1-1, temporals 2+2–2+3.

### 32. **Coluber tæniatus tæniatus** (Hallowell)

No. 36976 was secured at Caliente, Lincoln County, Nevada, May 4-8, 1913. It is a female with scales in 15 rows, gastrosteges 211, urosteges 134, supralabials 8-8, infralabials 10-10, preoculars 2-2, postoculars 2-2, loreal 1-1, temporals 2+2+2–2+2+2.

No. 40505 was found July 4, 1916, on the ground under thick brush in a little cañon near Sutcliffe, Pyramid Lake, Washoe County. It is a male with scales in 15 rows, gastrosteges 214, urosteges 130c, anal divided, supralabials 8-8, infralabials 10-10, preoculars 2-2, postoculars 2-2, loreal 1-1, temporals 2+2+2–2+2+2.

33. **Salvadora hexalepis** (Cope)

Our only Nevadan specimen of this snake (No. 40506) was taken near Sutcliffe, Pyramid Lake, Washoe County, July 7, 1916. It is a female with scale counts as follows: 17 scale-rows, gastrosteges 191, urosteges 80c, anal divided, supralabials 9-9, infralabials 11-11, preoculars 1-1, postoculars 3-3, loreal 1-1, temporals 2+3–2+3.

This snake was found on the ground under a sage bush at about five o'clock in the afternoon.

34. **Pituophis catenifer deserticola** Stejneger

Only two gopher snakes are in our Nevada collection. No. 37808 is a male caught at Austin, Lander County, Nevada, July 17-19, 1913. Its scales are in 29 rows, gastrosteges 226, urosteges 66, supralabials 8-8, infralabials 13-13, preoculars 1-1, postoculars 2-2, loreal 1-1, temporals 4+4–3+4.

No. 40504, a male, was secured near Sutcliffe, Washoe County, July 13, 1916. Its scales are in 31 rows, gastrosteges 242, urosteges 66c, anal single, supralabial 8-8, infralabials 14-12, preoculars 1-1, postoculars 3-3, loreal 1-1, temporals 3-3. This snake was found on a shelf in a kitchen closet.

38. **Thamnophis ordinoides elegans** (Baird & Girard)

In Nevada, we found these snakes only at Glenbrook, Douglas County, Nevada, where they were caught along a small creek near Lake Tahoe, August 25-31, 1913. Three specimens were collected here with only one *T. o. couchii* (No. 37999).

These specimens are of the *T. o. elegans* type of coloration without dorsal spots and without dark markings on the gastrosteges.

39. **Thamnophis ordinoides vagrans** (Baird & Girard)

Our collection includes twenty-three specimens from Nevada. No. 37995 was taken in Smoky Valley, in the northwestern part of Nye County, July 20, 1913. The other twenty-two were collected at Elko, Elko County, July 14-16, 1913, and July 19, 1916. These snakes all show the typical coloration in which the lateral lines are absent, the dorsal line indistinct, and the dark markings on the gastrosteges less evident than in typical specimens. The Elko specimens had been eating larvae of *Rana pipiens.*

### 40. **Thamnophis ordinoides couchii** (Kennicott)

A single specimen (No. 37999) from Glenbrook, Lake Tahoe, was referred to this subspecies. The lateral lines are absent, the dorsal line indistinct, and the dark markings on the gastrosteges less evident than in *T. o. vagrans.* This specimen is a female.

### 41. **Sonora semiannulata** Baird & Girard

One specimen (No. 37508) was found just before dark, crawling over the surface of the desert near Rhyolite, Nye County, August 3-9, 1913. Its scales are in 15 rows, gastrosteges 171, urosteges 48, supralabials 7-7, infralabials 6-6, preocular 1-1, postoculars 2-2, loreal 1-1, temporals 1+2–1+2.

There are 27 black bars on the body and nine black rings on the tail. The entire dorsal region between the black bars is pinkish orange, increasing in intensity toward the tail, on which it is bright orange. The lateral regions are yellowish white, but many of the lateral scales show central or basal black spots. This specimen agrees in coloration with No. 17550 from Cave Creek, Maricopa County, Arizona, except in the number of its dark cross-bars.

### 42. **Crotalus oreganus** Holbrook

One male rattlesnake (No. 37997) was sent to us by Mr. R. L. Kennedy, who caught it near Lamoille, Elko County, June 10, 1913. It is typical in coloration. The scales are in 23 rows, gastrosteges 180, urosteges 20, supralabials 15-14, infralabials 15-16, preoculars 2-2, postoculars 3-3, loreal 1-1.

A second specimen was secured on Anaho Island, Pyramid Lake, Washoe County, Nevada, where the species is said to be common.

**PROCEEDINGS**

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III

# LIST OF THE AMPHIBIANS AND REPTILES OF IDAHO, WITH NOTES ON THE SPECIES IN THE COLLECTION OF THE ACADEMY

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We do not know of any published list of the amphibians and reptiles of Idaho. The little that is known regarding the occurrence and distribution of various species of these classes within this state is scattered rather widely through a number of publications and is not readily available to the student. In recording the Idaho material which is now in the museum of the California Academy of Sciences, we, therefore, present also a list similar to those already published for the states of Arizona, Utah and Nevada. This list is thought to include all species now definitely known to live in Idaho. Those which are not yet represented in the Academy's collections by specimens collected in Idaho are indicated by a star preceding the number in the list. Following this list are given notes on the species in the Academy's collections. Most of our Idaho specimens were secured by Mr. Richard P. Erwin and Mr. Joseph R. Slevin.

1. Ambystoma macrodactylum
2. Ambystoma tigrinum
3. Scaphiopus hammondii
4. Bufo boreas boreas
*5. Pseudacris triseriata.
6. Hyla regilla
7. Rana catesbeiana
8. Rana pipiens
9. Rana pretiosa
*10. Crotaphytus collaris baileyi
11. Crotaphytus wislizenii
*12. Uta stansburiana stansburiana
13. Sceloporus graciosus graciosus
14. Sceloporus occidentalis biseriatus
15. Phrynosoma douglassii
16. Phrynosoma platyrhinos
17. Cnemidophorus tessellatus tessellatus
18. Plestiodon skiltonianus
*19. Charina bottae utahensis
20. Coluber constrictor mormon
21. Coluber taeniatus taeniatus
22. Pituophis catenifer stejnegeri ?
*23. Rhinocheilus lecontei
*24. Thamnophis sirtalis parietalis
25. Thamnophis sirtalis concinnus
26. Thamnophis ordinoides vagrans
*27. Crotalus confluentus
*28. Crotalus oreganus

### 1. **Ambystoma macrodactylum** Baird

Cope's *A. epixanthum* was described from specimens collected near the head of South Boise River, on the south side of the Sawtooth Mountain range, Idaho. Sixty-four salamanders from Boise County seem to us to be indistinguishable from numerous specimens of *A. macrodactylum* collected in Washington, Oregon and California. Cope, himself, recorded salamanders from Montana under the latter name. Of our specimens, twenty-one were secured at Payette Lake, Boise County,

*Species which the Academy has not yet received from Idaho.

(Nos. 41580 and 41581) on September 5, 1916, and (Nos. 43539 to 43557) between August 11 and 21, 1917. Forty-three (Nos. 45821-45863) were found at McCall, Boise County, August 6 to 14, 1918.

### 2. **Ambystoma tigrinum** (Green)

Cope (Bull. U. S. Nat. Mus., No. 34, 1889, p. 83) has recorded this salamander from Market Lake, Jefferson County. The species is represented in our collections by six larvæ collected by Mr. Brighton C. Cain in Bear Lake County. No. 47745 is from Bear Lake. The other five (Nos. 47746-47750) were caught in Deep Lakes, Bloomington Canyon.

### 3. **Scaphiopus hammondii** Baird

Fourteen specimens from Boise, Ada County, are at hand. Of these, six (Nos. 43533-43538) were collected July 9, 1917, one (No. 45739) May 6, 1918, and seven (Nos. 45740-45746) July 19, 1917.

### 4. **Bufo boreas boreas** (Baird & Girard)

Thirty-two toads from Idaho are in our collections. Fifteen of these (Nos. 41521-41535, and 45747-45756) are from Boise, Ada County. Five (Nos. 41571-41575) were collected at Payette Lake, Boise County, September 3-11, 1916, and one (No. 45820) at McCall, Boise County, August 8, 1918. One (No. 47744) was caught at Deep Lakes, Bloomington Canyon, Bear Lake County, July 29, 1920.

### 6. **Hyla regilla** Baird & Girard

Two tree-toads (Nos. 41540-41541) were taken at Payette Lake, Boise County, Sept. 2-4, 1916. Two hundred and seventeen (Nos. 41536-41539, 43532, 45527-45738) were collected at Boise, Ada County, in August, 1916, July 9, 1917, and May 6 to August 26, 1918.

### 7. **Rana catesbeiana** Shaw

Mr. Slevin was told that this frog had been introduced into Idaho some years before his visit and was spreading rapidly.

Eighty-three specimens were collected near Boise, Ada County, (Nos. 41453-41510) on August 23 and 24, 1916, and (Nos. 45451 to 45475) between May 23 and September 2, 1918.

### 8. **Rana pipiens** Schreber

One hundred and seventy-four specimens of this frog are included in our Idaho collections. Forty-six of these (Nos. 41307-41352) were taken at Fort Hall, Bingham County, August 12 to 16, 1916. One (No. 47742) was caught by Mr. Brighton C. Cain at Bear Lake, Bear Lake County, July 22, 1920, and another (No. 47743) at Deep Lakes, Bloomington Canyon, Bear Lake County, July 29, 1920. All the other specimens were collected near Boise, Ada County, (Nos. 41388-41452 and 41511-41520) in August and September, 1916, and (Nos. 45476-45526) from July 18 to September 2, 1918.

### 9. **Rana pretiosa** Baird & Girard

One hundred and twenty-five frogs of this species were secured in Idaho, as follows:

Twenty-eight (Nos. 41542-41570) at Payette Lake, Boise County, September 5 to 9, 1916.

Fifty-six (Nos. 41584-41639) at Guyer Hot Springs, Blaine County, September 18 and 19, 1916.

Forty-one (Nos. 45779-45819) at McCall, Boise County, August 6 to 11, 1918.

### 11. **Crotaphytus wislizenii** Baird & Girard

Two (Nos. 41275-41276) were taken at Fort Hall, Bingham County, August 11, 1916. Seventeen were collected near Boise, Ada County, as follows: three (Nos. 45421-45423) from May 22 to August 16, 1914; six (Nos. 41366-41371) from August 25 to 29, 1916; three (Nos. 45418-45420) August 21 to 26, 1916; four (Nos. 45424-45427) June 24, 1917; and one (No. 45417) July 15, 1918.

The femoral pores in nineteen specimens vary from sixteen to twenty; being 16 once, 17 six times, 18 eleven times, 19 thirteen times, and 20 seven times. The average of the thirty-eight thighs is 18.5.

### 13. **Sceloporus graciosus graciosus** (Baird & Girard)

The collections contain fifty-four specimens from Idaho. Of these, two (Nos. 20947, 20948) were collected at Pocatello, Bannock County; one (No. 20949) is from Idaho Falls, Bonneville County; thirty-eight (Nos. 41110-41119 and 41277-41304) were secured at Fort Hall, Bingham County, August 11-16, 1916; and thirteen (Nos. 41385, 45435-45446) were found at Boise, Ada County, in August and September.

The femoral pores in fifty-four specimens vary from eleven to seventeen; being 11 twice, 12 nine times, 13 twenty-five times, 14 thirty-two times, 15 twenty-two times, 16 sixteen times, and 17 twice. The average of the one hundred and eight thighs is 14.1.

### 14. **Sceloporus occidentalis biseriatus** (Hallowell)

All our Idaho specimens were secured near Boise, Ada County. Here two (Nos. 45449, 45450) were taken September 9, 1914, thirteen (Nos. 41372-41384) August 25-28, 1916, and two (Nos. 45447, 45448) August 16, 1918.

The femoral pores in seventeen specimens vary from thirteen to seventeen; being 13 six times, 14 six times, 15 fourteen times, 16 four times, and 17 four times. The average of the thirty-four thighs is 14.8.

### 15. **Phrynosoma douglassii** (Bell)

Our three Idaho specimens of this horned-toad were taken one (No. 41305) at Fort Hall, Bingham County, August 11, 1916, and two (Nos. 45433, 45434) at Boise, Ada County, in July and August, 1916.

### 16. **Phrynosoma platyrhinos** Girard

One specimen (No. 20932) from Bliss, Gooding County, is in the collection. Its femoral pores are 11-11.

### 17. **Cnemidophorus tessellatus tessellatus** (Say)

Only six Idaho specimens are at hand. These are one (No. 20944) from Upper Salmon Falls, Twin Falls County, and five from Boise, Ada County, where they were taken (No.

41386) on August 26, 1916, and (Nos. 45429-45432) between May 30 and September 30, 1918.

The femoral pores in six specimens vary from eighteen to twenty-two; being 18 four times, 19 three times, 20 twice, 21 once, and 22 twice. The average of the twelve thighs is 19.5.

### 18. **Plestiodon skiltonianus** Baird & Girard

The two specimens of this skink probably furnish the first record of this species in Idaho. They were taken (No. 41306) at Fort Hall, Bingham County, August 12, 1916, and (No. 41387) at Boise, Ada County, August 29, 1916.

### 19. **Charina bottæ utahensis** Van Denburgh

Two specimens from Blue Lake and Hood's Valley, Kootenai County, in the collection of Stanford University have been recorded in these Proceedings (Series 4, Vol. X, No. 3, 1920, p. 32).

### 20. **Coluber constrictor mormon** (Baird & Girard)

The collections include nineteen of these racers from Boise, Ada County. Nine specimens (Nos. 41353-41361) were collected August 26 and 27, 1916; one (No. 45410) May 30, and one (No. 43530) June 21, 1917. Eight specimens (Nos. 45402-45409) were taken June 3 to Sept. 2, 1918.

| Number | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Temporals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 41353 | ♀ | 17 | 177 | 86c | ÷ | 8—8 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 41354 | ♀ | 17 | 179 | 68+ | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+1—2+1 |
| 41355 | ♀ | 17 | 177 | 85c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—1+2 |
| 41356 | ♂ | 17 | 175 | 95c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 41357 | ♂ | 17 | 178 | 81c | ÷ | 7—8 | 8—8 | 2—2 | 2—2 | 1—1 | 2+3—2+2 |
| 41358 | ♀ | 17 | 179 | 88+ | ÷ | 7—7 | 9—9 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 41359 | ♀ | 17 | 179 | 87c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 41360 | ♂ | 17 | 174 | 86+ | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 41361 | ♂ | 17 | 176 | 86c | ÷ | 8—8 | 7—7 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 43530 | ♀ | 17 | 181 | 90c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45402 | ♂ | 17 | 173 | 93c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45403 | ♀ | 17 | 181 | 72+ | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 1+2—2+2 |
| 45404 | ♂ | 17 | 193 | 97c | ÷ | 7—8 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45405 | ♂ | 17 | 172 | 92c | ÷ | 7—8 | 8—8 | 2—2 | 2—3 | 1—1 | 2+2—2+2 |
| 45406 | ♂ | 17 | 170 | 97c | ÷ | 8—7 | 8—9 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45407 | ♀ | 17 | 180 | 88c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45408 | ♂ | 17 | 176 | 84c | ÷ | 7—8 | 8—9 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45409 | ♀ | 17 | 179 | 87c | ÷ | 7—7 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45410 | ♂ | 17 | 168 | 98c | ÷ | 7—8 | 8—8 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |

### 21. **Coluber tæniatus tæniatus** (Hallowell)

Two specimens from Boise, Ada County, August 29, 1916, have scale counts as follows:

| Number | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Temporals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 41362 | ♀ | 15 | 202 | 126c | ÷ | 8—8 | 9—9 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 41363 | ♀ | 15 | 206 | 114c | ÷ | 8—8 | 9—9 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |

### 22. **Pituophis catenifer stejnegeri** Van Denburgh?

Two gopher-snakes (Nos. 45129, 45130) taken at Boise, Ada County, June 25 and 29, 1918, have already been recorded. (Proc. Cal. Acad. Sci., Ser. 4, Vol. X, 1920, p. 23).

### 23. **Rhinocheilus lecontei** Baird & Girard

So far as we know this snake has never been recorded as occurring in Idaho. We have secured no specimens there. The species is added to the list because of a specimen in the Julius Hurter collection, now in the National Museum. This specimen was sent to us, for examination, by Mr. Hurter, who stated that it had been caught in Elmore County, Idaho, October 15, 1910. It is a female with scales in 25 rows; gastrosteges 201; urosteges 43, the second to the twenty-fourth not divided; anal single; supralabials 8-8, the seventh largest, the fourth and fifth reaching eye; infralabials 8-8, the fifth largest; preoculars 1-1; postoculars 2-2; loreal 1-1; temporals 1+3+4—2+3+4; anterior and posterior genials nearly equal; red blotches 29 on body and seven on tail.

This species is as yet unknown from Nevada, Oregon, and Utah.

### 25. **Thamnophis sirtalis concinnus** (Hallowell)

Our collections include ten specimens of this garter-snake. These are one (No. 45428) taken at Boise, Ada County, July 17, 1918, and nine (Nos. 45770-45778) from McCall, Boise County, August 6-11, 1918. They have the following scale-counts:

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45428 | ♀ | 19—19—17 | 164 | 37+ | 1 | 8—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45770 | ♀ | 19—19—17 | 159 | 74c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45771 | ♂ | 19—19—17 | 164 | 93c | 1 | 7—7 | 9—9 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45772 | ♀ | 19—19—17 | 159 | 82c | 1 | 7—7 | 9—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45773 | ♂ | 19—19—17 | 162 | 85c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45774 | ♂ | 19—19—17 | 159 | 89c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45775 | ♀ | 19—19—17 | 157 | 73c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45776 | ♂ | 19—19—17 | 168 | 89c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45777 | ♀ | 19—19—17 | 159 | 66+ | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45778 | ♀ | 19—19—17 | 156 | 82c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |

### 26. **Thamnophis ordinoides vagrans** (Baird & Girard)

This garter-snake is common in Idaho, whence we have received fifty-two specimens. Many of these have been recorded in our paper on the garter-snakes of western North America (Proc. Cal. Acad. Sci., Ser. 4, Vol. VIII, No. 6, 1918, pp. 241-244).

Since the publication of that paper, thirty-nine specimens have been received as follows: Six (Nos. 45411-45416) collected at Boise, Ada County, June 6 to September 16, 1918; eight (Nos. 45757-45764) from McCall, Boise County, August 10-11, 1918; three (Nos. 45765-45767) from Little Payette Lake, August 11, 1918; two (Nos. 45768, 45769) from North Fork of Lake Fork Creek, Boise County, August 7, 1914; ten (Nos. 45864-45873) from Warm Springs Creek three miles west of Ketchum, Blaine County, August 29-30, 1919; and ten (Nos. 47732-47741) from Bear Lake, Bear Lake County, July 17-22, 1920. The scale-counts of these specimens are given below.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45411 | ♀ | 21—21—17 | 167 | 83c | 1 | 8—8 | 10—10 | 1—1 | 2—2 | 1—1 | 1+2—1+2 |
| 45412 | ♀ | 21—21—17 | 165 | 78c | 1 | 8—8 | 11—11 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45413 | ♀ | 21—21—17 | 169 | 86c | 1 | 8—8 | 10—10 | 1—1 | 4—3 | 1—1 | 1+2—1+2 |
| 45414 | ♀ | 21—21—17 | 168 | 81c | 1 | 8—8 | 10—11 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45415 | ♀ | 21—21—17 | 174 | 41+ | 1 | 8—8 | 10—10 | 2—2 | 3—3 | 1—1 | 1+2—1+2 |
| 45416 | ♂ | 21—21—17 | 174 | 91c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45757 | ♀ | 21—21—17 | 165 | 71c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+3 |
| 45758 | ♀ | 21—21—17 | 166 | 75c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45759 | ♂ | 21—21—17 | 171 | 89c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45760 | ♂ | 21—21—17 | 168 | 89c | 1 | 8—8 | 10—10 | 2—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45761 | ♂ | 21—21—17 | 171 | 87c | 1 | 8—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45762 | ♂ | 21—21—17 | 170 | 74+ | 1 | 7—6 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45763 | ♀ | 21—21—17 | 163 | 76c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45764 | ♀ | 21—21—17 | 168 | 80c | 1 | 8—8 | 10—10 | 1—1 | 4—4 | 1—1 | 1+2—1+2 |
| 45765 | ♂ | 21—21—17 | 169 | 60+ | 1 | 8—8 | 10—10 | 2—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45766 | ♀ | 21—21—17 | 160 | 76c | 1 | 8—8 | 10—10 | 1—1 | 4—4 | 1—1 | 1+2—1+2 |
| 45767 | ♀ | 21—21—17 | 168 | 74+ | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45768 | ♀ | 21—21—17 | 164 | 77+ | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45769 | ♀ | 21—21—17 | 166 | 77c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45864 | ♂ | 21—21—17 | 165 | 85c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45865 | ♂ | 21—21—17 | 172 | 90c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45866 | ♂ | 21—21—17 | 169 | 80c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45867 | ♂ | 21—21—17 | 169 | 80c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45868 | ♂ | 21—21—17 | 166 | 83c | 1 | 8—8 | 10—10 | 2—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45869 | ♀ | 21—21—17 | 166 | 78c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45870 | ♂ | 21—21—17 | 167 | 65+ | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45871 | ♀ | 21—21—17 | 167 | 82c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45872 | ♂ | 21—21—17 | 168 | 88c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45873 | ♂ | 21—21—17 | 167 | 88c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47732 | ♀ | 21—21—17 | 166 | 80c | 1 | 8—8 | 9—10 | 1—1 | 3—2 | 1—1 | 1+2—1+2 |
| 47733 | ♀ | 21—21—17 | 167 | 73c | 1 | 8—8 | 9—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47734 | ♀ | 21—21—17 | 173 | 83c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47735 | ♂ | 21—21—17 | 175 | 86c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47736 | ♀ | 21—21—17 | 172 | 79c | 1 | 7—7 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47737 | ♀ | 21—21—17 | 174 | 79c | 1 | 8—8 | 10—10 | 1—1 | 4—3 | 1—1 | 1+2—1+2 |
| 47738 | ♀ | 21—21—17 | 171 | 78c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47739 | ♀ | 21—21—17 | 172 | 80c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47740 | ♂ | 21—21—17 | 173 | 85c | 1 | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 47741 | ♀ | 21—21—17 | 170 | 79c | 1 | 8—8 | 10—10 | 1—1 | 4—4 | 1—1 | 1+3—1+2 |

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IV

# A LIST OF THE AMPHIBIANS AND REPTILES OF THE PENINSULA OF LOWER CALIFORNIA, WITH NOTES ON THE SPECIES IN THE COLLECTION OF THE ACADEMY

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This paper is primarily based upon a collection gathered by Mr. Slevin, in the Cape Region of Lower California, Mexico, in the months of June to September, 1919. Mr. Slevin also made a small collection at Ensenada, in 1905, while a member of the Academy's expedition to the Galapagos Islands. These specimens, and also a few secured by Dr. Gustav Eisen in June, 1899, at San Xavier, are included in this report. The specimens are all in the collection of the Academy, with the exception of those collected by Dr. Eisen, which were destroyed in the great fire of April, 1906.

The herpetology of Lower California was reviewed in several papers published in these Proceedings in 1895 and 1896. Since that time, through the study by Mocquard[1] of a collection

[1] Mocquard, Nouv. Arch. Mus. Hist. Nat. Paris., Ser. 4, Vol. I, 1899, pp. 297-343, pls. 11-13.

made by M. Diguet, and the publication by Meek[2] of a list of those secured by Edmund Heller, a number of species have been added to those known from the peninsula. It therefore seems worth while to publish a new list including all that are known to occur on the peninsula. The island reptiles are not included here. They have been recorded in another paper[3] published by us, and in one by Miss Mary C. Dickerson[4].

In the following list a star preceding the number indicates that no Lower Californian specimens of that species are at present in the collection of the Academy. The letters N., C., and S., following the names, indicate in a general way the portions of the peninsula inhabited by each species; N. meaning northern and including the San Diegan and Desert areas; C. the central portion of the peninsula; and S. the southern or Cape Region. A few species are included in the list without numbers but enclosed in brackets. These have not yet actually been collected in Lower California, but have been taken in California so close to the line as to make it practically certain that they occur in the Mexican territory.

## LIST OF THE AMPHIBIANS AND REPTILES OF LOWER CALIFORNIA, MEXICO

*1. Batrachoseps attenuatus. N. S.
*2. Plethodon croceater. N. S?
[Aneides lugubris lugubris]. N.
3. Scaphiopus couchii. S.
4. Bufo boreas halophilus. N.
5. Bufo punctatus. S.
6. Hyla regilla. N. S.
7. Hyla arenicola. N.
*8. Rana draytonii. N.
9. Phyllodactylus tuberculosus. C. S.
10. Phyllodactylus unctus. S.
*11. Coleonyx variegatus. N. C.
12. Ctenosaura hemilopha. S.
13. Dipsosaurus dorsalis dorsalis. N. C.

[2] Meek, Field Columbian Mus., Zool. Series, Vol. VII, No. 1, 1906, pp. 3-19, pls. I-III.
[3] Van Denburgh & Slevin, Proc. Cal. Acad. Sci., Ser. 4, Vol. IV, 1914, pp. 129-152.
[4] Dickerson, Bull. Amer. Mus. Nat. Hist., Vol. XLI, 1919, pp. 461-477.
*Species which the Academy has not yet received from Lower California.

14. Dipsosaurus dorsalis lucasensis. S.
*15. Sauromalus ater. N. C.
*16. Crotaphytus collaris baileyi. N.
*17. Crotaphytus wislizenii. N. S.
18. Uma notata. N.
19. Callisaurus crinitus. C.
20. Callisaurus draconoides. S.
*21. Callisaurus ventralis ventralis. N. C.
*22. Holbrookia species? C.
23. Uta thalassina. S.
24. Uta repens. C.
*25. Uta mearnsi. N. C.
[Uta ornata]. N.
26. Uta graciosa. N. C.
27. Uta nigricauda. S.
*28. Uta microscutata. N. C.
29. Uta stansburiana elegans. N. C. S.
*30. Uta stansburiana hesperis. N.
*31. Sceloporus graciosus vandenburgianus. N.
32. Sceloporus occidentalis biseriatus. N.
*33. Sceloporus magister. N.
34. Sceloporus rufidorsum. N.
35. Sceloporus zosteromus. S.
*36. Sceloporus orcutti. N. C.
37. Sceloporus licki. S.
38. Phrynosoma coronatum. S. C.
39. Phrynosoma blainvillii blainvillii. N.
*40. Phrynosoma solare. C.
*41. Phrynosoma platyrhinos. N.
[Phrynosoma m'callii]. N.
42. Gerrhonotus multicarinatus. S.
*43. Gerrhonotus scincicauda webbii. N.
*44. Anniella pulchra. N.
*45. Xantusia vigilis. N.
46. Xantusia gilberti. S.
47. Cnemidophorus maximus. S.
[Cnemidophorus tessellatus tessellatus]. N.
*48. Cnemidophorus tessellatus stejnegeri. N.

*Species which the Academy has not from Lower California.

*49. Cnemidophorus rubidus. C.
50. Verticaria hyperythra hyperythra. S.
51. Verticaria hyperythra beldingi. N. C.
*52. Plestiodon skiltonianus. N. S.
*53. Plestiodon lagunensis. S.
*54. Euchirotes biporus. S.
*55. Siagonodon humilis. S. C.
*56. Lichanura roseofusca. N.
*57. Lichanura trivirgata. S.
58. Coluber flagellum piceus. N. C. S.
*59. Coluber lateralis. N. C.
*60. Coluber aurigulus. S.
61. Salvadora hexalepis. N. C. S.
62. Phyllorhynchus decurtatus. N. S.
63. Elaphe rosaliæ. C. S.
64. Arizona elegans. N.
65. Pituophis catenifer annectens. N.
[Pituophis catenifer deserticola]. N.
66. Pituophis vertebralis. C. S.
*67. Lampropeltis getulus boylii. N.
68. Lampropeltis getulus conjuncta. S.
*69. Lampropeltis getulus yumensis. N.
[Lampropeltis californiæ]. N.
70. Lampropeltis nitida. S.
*71. Rhinocheilus lecontei. N.
72. Hypsiglena ochrorhynchus ochrorhynchus. C. S.
73. Natrix valida. S.
*74. Thamnophis ordinoides vagrans. N.
*75. Thamnophis ordinoides hammondii. N. C.
*76. Sonora episcopa. N.
[Sonora occipitalis]. N.
77. Chilomeniscus cinctus. C. S.
*78. Chilomeniscus stramineus. S.
*79. Tantilla planiceps. C. S.
[Tantilla eiseni]. N.
80. Trimorphodon lyrophanes. C. S.
81. Crotalus lucasensis. S.
82. Crotalus exsul. N. C.

*Species which the Academy has not from Lower California.

*83. Crotalus oreganus. N.
84. Crotalus enyo. C. S.
85. Crotalus mitchellii. N. C. S.
*86. Crotalus cerastes. N.
[Clemmys marmorata]. N.
87. Pseudemys nebulosa. C. S.
*88. Chelonia agassizii. S.
*89. Eretmochelys squamosa. S.
*90. Caretta olivacea. S.

### 3. **Scaphiopus couchii** Baird

On the way from La Paz, at sea level, to San Pedro, at an altitude of six hundred feet, the country passed through was the floor of the desert, covered with a heavy growth of cactus, mesquite, and various desert plants. Large numbers of this spadefoot toad were collected on July 3 while traversing this region. This proved just the proper time to secure any number of specimens, for thunder storms, accompanied by heavy rains, at a temperature of seventy-five or eighty degrees, were of daily occurrence. Immediately after the rains, the pools of water left in the road would be swarming with toads. A pool fifteen or twenty feet in length, and six feet or so wide, would contain as many as a hundred or more. This was the height of the breeding season, as nearly all the specimens observed were copulating. They made a loud croaking noise and would dive on one's approach, appearing again a few feet off, the male still clinging to its mate. This was the only time this species was observed, although several nights were spent in this locality collecting with a light.

### 4. **Bufo boreas halophilus** (Baird & Girard)

A single young toad (No. 8579), captured at Ensenada in July, 1905, affords the first definite record of this species in the peninsula.

### 5. **Bufo punctatus** Baird & Girard

This species, although supposed to be more abundant in the Cape Region than *Scaphiopus couchii,* was not found in such

*Species which the Academy has not from Lower California.

numbers. It was collected in only three localities: at an elevation of 1400 feet in the foothills of the Sierra Laguna Mountains, at San Antonio 803 feet above sea level, and at San Pedro. While collecting with a light early in the evening forty-six specimens were taken around the public square in the little village of San Antonio. They were heard calling late into the evening. A specimen captured was observed to make a shrill whistling noise of four or five seconds duration with about the same interval, the throat swelling considerably while it was doing so. The stomach of a specimen picked up dead contained the wing covers of several species of small beetles.

At Ensenada, in July, 1905, a number of young specimens (Nos. 8562-8569, 8576-8578, 8580-8589, 8645-8672) were secured.

### 6. **Hyla regilla** Baird & Girard

During the visit to the Cape Region, only one locality was found where this little tree-toad might be expected to occur. This was in the Sierra Laguna opposite Todos Santos, at an elevation of 5400 feet. The only two specimens (Nos. 47255, 47256) taken were found in the wet grass alongside a stream of running water. During the night a few were heard calling, but a thorough search of the streams and much beating of grass resulted in no more specimens being found.

At Ensenada, eight typical specimens (Nos. 8570-8573, 8590-8593) were collected in July, 1905.

### 7. **Hyla arenicolor** Cope

On February 27, 1908, Mr. R. H. Beck collected twenty specimens (Nos. 13424-13443) of this tree-toad at Ensenada. These seem to furnish the first definite record of this species in Lower California. Mr. Beck did not secure any specimens of *Hyla regilla*, which was the only species found by the Academy's collectors at Ensenada in July, 1905.

### 9. **Phyllodactylus tuberculosus** Wiegmann

A single gecko of this species (No. 3829) was found by Dr. Eisen at San Xavier.

Mr. Slevin collected one (No. 46843) at San Bartolo, in the Cape Region. It was found under a flake of granite pulled off of a large boulder in the canyon bottom. This harmless little lizard is much feared by the natives. They consider its bite to be deadly, and believe that picking one up will cause the skin to fall off the hand. The natives say that this gecko is not common. Their name for it is *Salamanquesa.*

### 10. **Phyllodactylus unctus** (Cope)

Two specimens of this species were collected: one (No. 46844) at Agua Caliente under the bark of an old stump, and the other (No. 46842) at Miraflores under the bark of the Guamuchil, (*Pithecolobium dulce*). The natives do not distinguish this from the larger *P. tuberculosus,* but on account of its small size call it *Salamanquesa chiquita.* Like other lizards of this genus it lives under the bark of trees and in the thatched roofs of houses.

### 12. **Ctenosaura hemilopha** Cope

This is the largest lizard of the Cape Region and was collected in the following localities: Vicinity of La Paz, San Pedro, Triunfo, San Antonio, San Bartolo, Buena Vista, Santiago, Agua Caliente, San José del Cabo and Todos Santos. It is fairly abundant where found, and inhabits the large granite boulders in company with *Uta thalassina.* Where boulders are not plentiful these iguanas resort to the trees. At San Bartolo they were seen only among the granite boulders, which abound in that vicinity, but at San Pedro and Agua Caliente they were found in the trees. None was observed on the ground. They seem to live strictly on vegetable matter, and the stomachs of all the specimens collected contained the leaves of one of the common trees. On breaking off the hollow limb of a tree, at San Pedro, a *Ctenosaura* was found so tightly wedged within that it could be secured only by cutting it out with a small hand axe. They have the same habit as our Chuckwalla (*Sauromalus ater*) of getting into crevices and holding tight by puffing up the body. Large specimens are very rare, as the natives kill them for food whenever they find one of desirable size. They are somewhat vicious when captured, and when held by the tail will always keep the mouth open ready to seize whatever comes within reach.

The coloration in life of No. 46408, was as follows: The back and sides are grayish, mottled with black. Three transverse black bands cross the shoulders. The upper surfaces of the fore limbs are black, spotted with gray; of the hind limbs, gray mottled with black. The gular region is black, bordered with gray. The ventral surface between the fore limbs is black. The belly is grayish.

The femoral pores in fifty specimens vary from four to seven; being 4 six times, 5 thirty-nine times, 6 forty-four times, and 7 eleven times.

### 13. **Dipsosaurus dorsalis dorsalis** (Baird & Girard)

Three specimens collected at San Xavier probably belonged to this subspecies. These were Nos. 3781, 3824 and 3844.

### 14. **Dipsosaurus dorsalis lucasensis** Van Denburgh

This lizard, abundant throughout the low brushy country in the Cape Region, was collected at the following localities: La Paz, San Pedro, Triunfo, San Bartolo, Buena Vista, Santiago, Agua Caliente, Miraflores, San José del Cabo, Cabo San Lucas and Todos Santos. The local name is *Cachora*. This species was not noted above 1020 feet and was particularly abundant close to the coast. Among the sand dunes back of the beach at San José del Cabo any number of specimens could be collected. Their principal enemy seemed to be the red racer, and two or three specimens of this snake when captured were found to contain the remains of a *Dipsosaurus*, and one red racer had a full grown lizard of this species in its stomach.

The femoral pores in fifty specimens vary from sixteen to twenty-one; being 16 twice, 17 eighteen times, 18 thirty-six times, 19 twenty-six times, 20 twelve times, and 21 six times.

### 18. **Uma notata** Baird

A single specimen (No. 39687) collected south of Laguna Salada about eighty miles south from Mexicali, April 5, 1915, was presented to us by Mr. R. C. Murphy.

### 19. **Callisaurus crinitus** Cope

One specimen (No. 47731), presented by Miss Mary C. Dickerson of the American Museum of Natural History, was collected at San Bartholeme Bay, Lower California, March 14, 1911.

### 20. **Callisaurus draconoides** Blainville

This lizard, called by the natives *Cachora de arena,* is a fairly common species, especially near the sea coast where most of our specimens were collected. Here it was found in the sandy areas back of the beaches. In the interior it frequented the hot sandy bottoms of the canyons and adjacent arroyos. It was collected at the following localities: Todos Santos, Cabo San Lucas, San José del Cabo, Miraflores, Agua Caliente, Buena Vista, San Bartolo, San Antonio, Triunfo, San Pedro and La Paz.

The femoral pores in fifty specimens vary from twelve to twenty; being 12 once, 13 four times, 14 nine times, 15 twenty-one times, 16 twenty-four times, 17 twenty-two times, 18 twelve times, 19 five times, and 20 once.

### 21. **Callisaurus ventralis ventralis** (Hallowell)

One specimen (No. 3815) was taken by Dr. Eisen at San Xavier, in June, 1899.

### 23. **Uta thalassina** Cope

This large lizard, the most beautiful species of the Cape Region, was collected at Triunfo, San Bartolo, Agua Caliente, and in the Sierra Laguna Mountains. One was seen at Cabo San Lucas where the type was secured by Xantus. As a rule, these lizards are fairly abundant where found. They frequent the cracks and crevices in and between huge granite boulders piled up in the canyon bottoms and the small adjacent arroyos. They resemble *Uta mearnsi* in their habits, crawling along the surface of the boulders and keeping always close to a crack or crevice into which they disappear on one's close approach. Being rather shy, they will not permit one to come closer than ten or twenty feet. On several occasions they were seen to jump from boulder to boulder a distance of four feet by actual measurement. They were found to range up to 5400 feet in the Sierra Laguna but at this elevation they were rare, and only three were seen in a small isolated pile of granite in a mountain meadow. The two specimens collected there did not show the brilliant coloring of those secured at lower levels.

Specimen No. 46505 showed the following colors in life: Top of head greenish blue; between the shoulders six spots of sky blue; anterior three transverse dorsal bars jet black, each black bar bordered posteriorly by one of orange; three less intensely black bars cross posterior half of body; tail with fifteen dark green bands spotted with black and narrowly bordered with light green; limbs light green or grayish, with bars of black; lower surfaces grayish, with exception of throat, chest and belly back to a point midway between the limbs, which are a rich orange; light blue spots on throat.

The femoral pores in fifty specimens vary from fourteen to twenty-one; being 14 twice, 15 four times, 16 sixteen times, 17 nineteen times, 18 thirty-one times, 19 twenty times, 20 seven times, and twenty-one once.

### 24. **Uta repens** Van Denburgh

One specimen (No. 3785) was taken by Dr. Eisen at San Xavier.

### 26. **Uta graciosa** (Hallowell)

Mr. R. C. Murphy very kindly presented a specimen (No. 39688) of this species collected by himself south of Laguna Salada, about eighty-five miles south from Mexicali, April 7, 1915.

### 27. **Uta nigricauda** Cope

This little tree lizard is one of the common species throughout the Cape Region where the natives call it *Bejore depiora.* It was collected at Todos Santos, Cabo San Lucas, San José del Cabo, Miraflores, Agua Caliente, Santiago, San Antonio, Triunfo, La Paz, San Pedro, and in the foothills of the Sierra Laguna Mountains. These lizards frequented rock piles, stone fences and the granite boulders in the canyon bottoms, but more commonly were found on Mesquite and other trees growing at the lower levels. They seldom were seen upon the ground. On several occasions they were observed eating ants which they had captured crawling up the tree trunks.

A specimen (C. A. S. No. 46536) was colored in life as follows: Throat patch lemon; belly indigo blue, lightly spotted on sides with very light blue; back dark gray to brown with transverse bars of black, divided along the dorsal line by rows of small grayish scales.

The femoral pores in fifty specimens vary from nine to fourteen; being 9 eleven times, 10 thirty-nine times, 11 thirty-seven times, 12 nine times, 13 three times, and 14 once.

### 28. **Uta microscutata** Van Denburgh

This very small-scaled Uta evidently is abundant about San Xavier, for Dr. Eisen collected fifty-three specimens of it there, in June, 1899. (Nos. 3782-3784, 3786-3790, 3792, 3794-3801, 3803, 3805, 3806, 3808-3814, 3816-3821, 3823, 3825-3828, 3830-3839, 3841-3843, 3845-3847).

### 29. **Uta stansburiana elegans** (Yarrow)

Five specimens (Nos. 3793, 3802, 3804, 3807, 3822) were collected by Dr. Eisen at San Xavier.

This lizard, which generally is common in desert areas, was not found so in the Cape Region, and strange to say, was taken only at the sea-coast. None was seen in any of the interior country. All the specimens taken were found in brushy areas back of the beaches. It was collected at the following localities: La Paz, Buena Vista, San José del Cabo, and Todos Santos.

The femoral pores in seventy-two thighs of specimens from the Cape Region vary from twelve to seventeen; being 12 four times, 13 sixteen times, 14 twenty-four times, 15 twenty-one times, 16 five times, and 17 twice.

This lizard was found also at Ensenada, where Nos. 8541, 8555-8560, 8603-8616, and 8642-8644, were secured.

### 32. **Sceloporus occidentalis biseriatus** (Hallowell)

This lizard is abundant at Ensenada, where numerous specimens were secured. (Nos. 8538, 8542, 8543, 8574, 8601, 8602, 8625, 8626).

### 34. **Sceloporus rufidorsum** Yarrow

Twenty specimens (Nos. 8533-8537, 8539-8540, 8561, 8594-8600, 8622, 8627-8631) from Ensenada agree perfectly in coloration with others from Cerros Island. When this large series is compared with a large series of *S. zosteromus* from the Cape Region it is found that they represent different species. No difference in squamation appears, but the femoral pores average fewer (16.56) than in *S. zosteromus* (18.46) and more than in *S. magister* (12.61). In *S. rufidorsum* mid-dorsal and dorsolateral longitudinal light stripes are present, and the parallel dark lines which mark the lateral scales in adult males of *S. zosteromus* are lacking. The coloration of *S. magister* is quite different and much less ornate.

### 35. **Sceloporus zosteromus** Cope

This was a fairly common lizard throughout the lower levels in the Cape Region, where it was collected at the following localities: Todos Santos, Cabo San Lucas, San José del Cabo, Miraflores, Agua Caliente, Buena Vista, San Antonio, San Pedro, and La Paz. It inhabited the brush fences around the settlements and the heavy patches of brush in the cactus belts, and was found to be extremely shy. The natives claim that this lizard is dangerous, and say that its bite is fatal to dogs. This seems to be a wide spread belief as all who saw it in the collection made the same remark. Their name for it is *Bejore*. None captured was as large as its near relatives, *S. magister* and *S. rufidorsum*. From the specimens taken in the Cape Region it appears that *S. zosteromus* is a much smaller species.

The males at this season (June to July) were brilliantly colored. A specimen in life showed the following coloring: Throat patch metallic blue; white stripe two or three scales wide down center of belly bordered by one of indigo blue, the blue one bordered by one of light green about two scales wide; sides grayish, turning to brown on the back; top of thighs and base of tail straw-colored.

The dorsal scales between the interparietal and back of thighs in forty-three specimens examined vary from twenty-six to thirty-two; being 26 once, 27 eight times, 28 five times, 29 fourteen times, 30 eight times, 31 six times, and 32 once.

Average 29. The femoral pores in forty-four specimens examined vary from sixteen to twenty-two; being 16 five times, 17 twenty-six times, 18 seventeen times, 19 seventeen times, 20 ten times, 21 twelve times, and twenty-two once; the average in eighty-eight thighs being 18.46.

### 36. **Sceloporus orcutti** Stejneger

Two specimens (Nos. 3791, 3840) secured at San Xavier are of interest as confirming our belief that Mocquard's *S. digueti* is based upon this species.

### 37. **Sceloporus licki** Van Denburgh

This, the smaller of the two Scelopori found in the Cape Region, was collected at San Antonio, Todos Santos, Guamuchil Rancho, Cabo San Lucas, San José del Cabo, Miraflores, Agua Caliente, San Bartolo, Triunfo, and La Paz. The species was found to range from sea-level to 1172 feet at Miraflores. It generally is found among the rocks in small arroyos and seldom is seen upon the ground. Being extremely shy, it will not allow one to approach nearer than fifteen or twenty feet, when it makes a hasty retreat to some nearby crevice or rock-pile. The males at this time of year (July) were brilliantly marked, and the sun shining on the metallic purple and green scales would at once attract the attention even of a casual observer.

The female shows none of the brilliant coloring of the male, and at first glance looks not unlike its northern congener, *S. occidentalis.* A male (C. A. S. No. 46808) was colored in life as follows: A band of metallic purple six scales wide extends from shoulder to base of tail; lateral scales bronze, bordered with black; scales on belly green bordered with black; throat black mottled with green; under surfaces of thighs green, and of tail, gray; a large black patch in front of each fore limb.

In the specimens collected the femoral pores vary from 13 to 18; being 13 four times, 14 seven times, 15 twenty times, 16 twenty-six times, 17 sixteen times, and 18 five times. The average in seventy-eight thighs is 15.95.

### 38. **Phrynosoma coronatum** (Blainville)

This lizard was not found to be particularly abundant and was collected in only a few localities: Todos Santos, Pescadero, San José del Cabo, Miraflores, Agua Caliente, Triunfo, and San Pedro. Eleven specimens in all were taken. One of these (C. A. S. No. 46832) was secured at Triunfo in the sandy bottom of a small arroyo as it was standing near the mouth of an ants' nest. The native name is *Chameleon*.

The femoral pores in eleven specimens vary from fifteen to twenty-three; being 15 three times, 16 three times, 17 six times, 18 four times, 19 four times, and 23 twice.

### 39. **Phrynosoma blainvillii blainvillii** (Gray)

Four specimens (Nos. 4694-4697) were collected at Ensenada, April 30 and May 1, 1903.

### 42. **Gerrhonotus multicarinatus** (Blainville)

Owing to the difficulty of reaching the higher altitudes in the mountain ranges of the Cape Region, only six specimens of this lizard were collected. These were found at an elevation of 5400 feet in the Sierra Laguna. One was found under a dead Yucca stalk, three under fallen pine trees, and two were running about the grass in a mountain meadow. They probably are not rare, but the cool weather and daily thunder showers at this time of year (the middle of August) kept them under cover.

### 47. **Cnemidophorus maximus** Cope

This lizard was collected at La Paz, San Pedro, Triunfo, San Antonio, San Bartolo, Buena Vista, Agua Caliente, Miraflores, San José del Cabo, Cabo San Lucas, Todos Santos, and Guamuchil Rancho about twenty-five miles north of Cabo San Lucas. It was one of the common lizards of the lower levels, but was not seen at a greater elevation than at Guamuchil Rancho, 1800 feet. Its movements were extremely swift and on several occasions individuals were seen to lift the front legs clear of the ground and hold the body at a slight angle while running. Not always relying on brush for shelter, they often run across large open spaces, depending on their speed to escape an enemy. A specimen was found in the stomach of a captured red racer, *Coluber flagellum piceus.* A *Cnemidophorus maximus* was seen under a pile of brush holding a *Verticaria* in its mouth. When captured this *Cnemidophorus* was found to have crushed the skull of its victim in its powerful jaws. The local name of this species is *Largartija.*

In eighty-seven specimens examined the femoral pores vary from eighteen to twenty-eight; being 18 once, 19 twice, 20 fifteen times, 21 thirty-one times, 22 forty-five times, 23 thirty-one times, 24 thirty-seven times, 25 eight times, 26 three times, and 28 once.

### 50. **Verticaria hyperythra hyperythra** (Cope)

This species was found to be the most abundant lizard of the Cape Region, where it was collected at La Paz, Todos Santos, Cabo San Lucas, San José del Cabo, Agua Caliente, Buena Vista, San Bartolo, San Antonio, Triunfo, San Pedro, Guamuchil Rancho, twenty-five miles north of the Cape, and in the foothills of the Sierra Laguna opposite Todos Santos. It ranged from sea-level to 1400 feet, and was found abundant throughout the lower levels among fallen cacti and the numerous brush heaps. The native name is *Waco.* This little lizard keeps well under cover, seldom coming into the open, and moves along with a short jerky motion a few inches at a time, until becoming alarmed when it makes off at top speed for the dense undergrowth. A pair were found mating at San Pedro the first week in July.

One hundred and sixty-eight specimens were examined to show a character used to separate this subspecies from the northern form *V. h. beldingi,* viz., the separation of the supraoculars from the medial head plates. The following table is given to show the distinction between the two subspecies. It will be seen that in the series from the Cape Region the separation and partial separation occurs more often at the third supraocular, while in *V. h. beldingi* it usually is at the second.

The femoral pores in fifty specimens vary from thirteen to twenty; being 13 three times, 14 ten times, 15 nineteen times, 16 thirty-one times, 17 twenty-one times, 18 thirteen times, 19 twice, and twenty once.

| | Number of Specimens of | |
|---|---|---|
| | *hyperythra* | *beldingi* |
| Second supraocular separated from median head scales | 16 | 16 |
| Second supraocular only partly separated from median head scales | 41 | 10 |
| Third supraocular separated from median head scales | 44 | 0 |
| Third supraocular only partly separated from median head scales | 67 | 2 |
| Total number examined | 168 | 28 |

## 51. **Verticaria hyperythra beldingi** (Stejneger)

The specimens of this subspecies recorded in the preceding table include twenty-four from Ensenada, two collected by Messrs. Stowell and Lunt at San Telmo, northern Lower California, and two from Poway Corners, San Diego County, California.

## 58. **Coluber flagellum piceus** (Cope)

This snake, called by the natives *Culebra chirrionera,* was found from sea-level at La Paz to an altitude of 722 feet at Miraflores. Brush fences around the numerous little ranch houses furnished excellent hiding places for this racer. Several of the specimens taken were found in these fences, where they lay stretched out at full length awaiting their prey. Lizards, to escape their natural enemies, the hawks, sought refuge here, and seldom would a snake have to wait long before securing a meal. This species, with the exception of the water snake, was the most abundant serpent met. It was not found above the floor of the desert and generally was confined to the more brushy portions of this area. Its food consisted of the numerous lizards found in the cactus belt. One specimen (No. 45966) had a full grown *Dipsosaurus* in its stomach. Another (No. 45962) had eaten a *Cnemidophorus,* and still another (No. 45970) a mouse. A fourth (No. 45972) had the tail of a *Dipsosaurus* in its stomach. A fifth (No. 45980) was taken in a brush pile just after it had caught a *Verticaria.* The tail of the lizard was protruding from the snake's mouth. A specimen (No. 45979) taken at San José del Cabo was six feet in length. The specimens varied in color, being gray, salmon, brown, or black. A cactus spine over an inch long was pulled out of a specimen taken at Miraflores.

The specimens whose scale-counts are given in the following table were all taken in the Cape Region except No. 8623, which was collected at Ensenada.

Specimens were secured at La Paz (Nos. 45960, 45965-45967) San Pedro (45961, 45968, 45969), Triunfo (45962, 45963, 45970, 45971), San Bartolo (45964, 45972), Agua Caliente (45973-45975), Miraflores (45976), San José del Cabo (45977-45979), and Todos Santos (45980).

The black specimens are Nos. 8623 from Ensenada, 45960 from La Paz, 45961 from San Pedro, 45962 and 45963 from Triunfo, and 45964 from San Bartolo.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8623 | ♂ | 17 | 191 | 105c | ÷ | 8—8 | 10—9 | 2—2 | 2—2 | 1—1 | 3—4 |
| 45960 | ♀ | 17 | 200 | 115c | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 1+1+2—2+2+2 |
| 45961 | ♀ | 17 | 195 | 104c | ÷ | 8—8 | 10—10 | 2—2 | 1—1 | 1—1 | 2+2+2—2+2+2 |
| 45962 | ♀ | 17 | 203 | 108c | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2+2—2+2+2 |
| 45963 | ♀ | 17 | 208 | 85+ | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 1+2+2—1+1+2 |
| 45964 | ♂ | 17 | 202 | 99+ | ÷ | ?—8 | 10—10 | ?—2 | 2—2 | 1—1 | 2+1+2—2+1+2 |
| 45965 | ♂ | 17 | 201 | 106+ | ÷ | 9—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45966 | ♀ | 17 | 197 | 118c | ÷ | 8—8 | 10—10 | 2—2 | 1—1 | 1—1 | 1+1—1+1 |
| 45967 | ♀ | 17 | 200 | 107+ | ÷ | 9—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+1—2+1 |
| 45968 | ♂ | 17 | 203 | 47+ | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+1—2+2 |
| 45969 | ♂ | 17 | 198 | 109+ | ÷ | 8—8 | 10—11 | 2—2 | 2—2 | 1—1 | 2+2—2+1 |
| 45970 | ♂ | 17 | 203 | 119c | ÷ | 8—8 | 9—10 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45971 | ♂ | 17 | 201 | 118c | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2—1+2 |
| 45972 | ♂ | 17 | 204 | 50+ | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+1—2+2 |
| 45973 | ♂ | 17 | 207 | 115+ | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2—2+3 |
| 45974 | ♂ | 17 | 202 | 107c | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2—2+1 |
| 45975 | ♀ | 17 | 198 | 78+ | ÷ | 9—8 | 10—10 | 2—2 | 2—2 | 1—1 | 1+2—2+2 |
| 45976 | ♂ | 17 | 206 | 94+ | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45977 | ♀ | 17 | 203 | 124c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 1—1 | 2+1—2+1 |
| 45978 | ♂ | 17 | 207 | 126c | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+1—2+1 |
| 45979 | ♂ | 17 | 213 | 118+ | ÷ | 8—8 | 11—11 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |
| 45980 | ♀ | 17 | 202 | 112c | ÷ | 8—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+2—2+2 |

### 61. **Salvadora hexalepis** (Cope)

This species was next in abundance to *Natrix* and *Coluber.* It inhabited the same kind of country as *Coluber* and was found from sea level at La Paz to over 900 feet at Triunfo. Of the ten specimens taken none gave an opportunity to discover their food. They were active throughout the day, being found out during the heat of the day as well as during the cooler hours. One specimen (No. 45954) was taken just about noon time in a brush thicket. Both the light and dark phases were found. Fallen cactus trees and brush thickets were good places to find this species. The natives call it *Culebra sorda.*

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45949 | ♀ | 17 | 199 | 96c | ÷ | 9—9 | 10—10 | 1—1 | 2—2 | 1—1 | 2+3—2+3 |
| 45950 | ♀ | 17 | 201 | 96c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45951 | ♀ | 17 | 193 | 92c | ÷ | 9—8 | 10—10 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45952 | ♂ | 17 | 199 | 86c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45953 | ♂ | 17 | 200 | 91c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45954 | ♂ | 17 | 194 | 92+ | ÷ | 9—9 | 10—11 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45955 | ♀ | 19 | 197 | 89c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45956 | ♂ | 17 | 190 | 98c | ÷ | 9—9 | 11—11 | 2—2 | 2—2 | 1—1 | 2+3—2+3 |
| 45957 | ♂ | 17 | 203 | 91c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 2—? | 2+3—2+3 |
| 45958 | ♂ | 17 | 200 | 96c | ÷ | 9—9 | 10—10 | 2—2 | 2—2 | 2—2 | 2+3—2+3 |
| 45959 | ♀ | 17 | 197 | 84c | ÷ | .... | ...... | .... | .... | .... | 2+3—2+3 |

These specimens were collected, Nos. 45949 and 45950, at San José del Cabo, 45951 and 45952 at San Pedro, 45953 at Buena Vista, 45954 at Santiago, 45955 and 45956 at Miraflores, 45957 at Todos Santos, 45958 at La Paz, and 45959 at Cabo San Lucas.

### 62. **Phyllorhynchus decurtatus** (Cope)

One specimen was collected by a Mexican boy in the outskirts of La Paz. It was found late in the afternoon crawling among a pile of rocks. Señor Rubio, a resident of La Paz from whom the specimen was secured, said he had never seen one like it although he had collected around La Paz for many months.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45983 | ? | 19 | 161 | 35c | 1 | 6—6 | 9—9 | 2—2 | 3—3 | 1—1 | 2+3—2+3 |

### 63. **Elaphe rosaliæ** (Mocquard)

The second known specimen of this species was collected at San Bartolo, in the arroyo close to the famous spring. It was found stretched at full length on the sand close to a grove of banana trees. At first glance, this snake might be taken for a red racer with absence of the dark markings on the head. The natives, although they have no name for this snake, probably on account of the rarity of the species, distinguish it from the racer because of the slowness of its movements. A Mexican boy, upon being questioned, said that he had seen others like it and that this snake did not run fast like the racer, but in its movements was more like the gopher snake, a specimen of which was shown him to see if he could distinguish it.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45982 | ♀ | 34 | 286 | 84c | ÷ | 11—10 | 12—13 | 2—2 | 3—3 | 1—1 | 3—4 |

### 64. **Arizona elegans** Kennicott

A male of this species (No. 8624) was found at Ensenada. Its scales are in 27 rows, gastrosteges 213, urosteges 51c, anal 1, supralabials 8-8, infralabials 12-12, preoculars 1-1, postoculars 2-2, loreals 1-1, and temporals 2+5–2+4.

### 65. **Pituophis catenifer annectens** (Baird & Girard)

One specimen (No. 8575) was captured near Ensenada. It is a male, and has scales in 31 rows, gastrosteges 229, urosteges 76c, anal single, supralabials 8-9, infralabials 13-14, preocular 2-2, postoculars 4-3, loreal 1-1, temporals 3-4.

### 66. **Pituophis vertebralis** (Blainville)

All the specimens of this species taken were found in the vicinity of towns or small rancherias. According to the natives this species is fairly abundant. One specimen (No. 45874), taken at a small ranch about three miles from San Pedro, had the remains of a small mammal in its stomach. The species is well known to the natives, who call it *Coralillo*.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals | Blotches on Body | Blotches on Tail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45874 | ♂ | 31 | 239 | 64c | 1 | 9—10 | 12—12 | 2—2 | 3—3 | 1—1 | 3—4 | 45 | 12 |
| 45875 | ♀ | 35 | 248 | 61c | 1 | 9—10 | 16—14 | 2—2 | 3—3 | 1—1 | 4—4 | 48 | 11 |
| 45876 | ♀ | 33 | 248 | 54+ | 1 | 10—9 | 13—14 | 2—2 | 3—3 | 1—1 | 4—4 | 43 | 10+ |
| 45877 | ♀ | 35 | 257 | 63c | 1 | 10—8 | 13—14 | 2—? | ?—3 | 1—1 | ?—? | 44 | 11 |
| 45878 | ♂ | 33 | 245 | 63c | 1 | 9—9 | 12—12 | 2—2 | 3—3 | 1—1 | 4—4 | 39 | 11 |

These specimens were collected at San Pedro (No. 45874), San Antonio (45875), San Bartolo (45876-45877), and Agua Caliente (45878).

### 68. Lampropeltis getulus conjuncta (Cope)

The only two specimens collected were brought in by small boys who found them in a sugar cane field in the outskirts of San José del Cabo.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45946 | ♀ | 23 | 236 | 46c | 1 | 7—7 | 10—10 | 1—1 | 2—2 | 1—1 | 2+3—2+3 |
| 45947 | ♀ | 23 | 230 | 46c | 1 | 7—7 | 10—10 | 1—1 | 2—2 | 1—1 | 2+3—2+3 |

### 70. Lampropeltis nitida Van Denburgh

The third known specimen (No. 3779) was collected by F. Billa at San José del Cabo, in April, 1896.

### 72. Hypsiglena ochrorynchus ochrorhynchus (Cope)

The one specimen of this snake collected was taken in the Sierra Laguna at an elevation of 5400 feet. It was found under an old pine log in one of the mountain meadows. The log had sunk several inches in the ground and the snake was tightly coiled in a small cavity beneath it.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Tem-porals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45889 | ♀ | 21 | 184 | 41c | 1 | 8—8 | 10—10 | 1—1 | 2—2 | 1—1 | 1+2—1+2 |

### 73. Natrix valida (Kennicott)

This serpent, although collected in only four localities, was the most abundant species found. Most of the specimens were collected in a stream flowing from the base of Mount San Rafael near Agua Caliente. Individuals were abundant in the quiet waters along the sides of the stream, where they were feeding on pollywogs, probably of *Bufo punctatus,* which swarmed in every pool. Only one specimen was found at any distance from the water, and this one only a hundred yards or so. This snake was collected at Agua Caliente, Miraflores, Santiago and San José del Cabo.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Temporals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45890 | ♀ | 19-19-17-17 | 144 | 56+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45891 | ♀ | 19-19-17-17 | 142 | 74c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45892 | ♀ | 19-19-17-17 | 146 | 71c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2 |
| 45893 | ♂ | 19-19-17-17 | 143 | 77c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45894 | ♂ | 19-19-17-17 | 144 | 76c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45895 | ♂ | 19-19-17-17 | 146 | 79c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45896 | ♂ | 19-19-17-17 | 142 | 76+ | ÷ | 8—9 | 10—10 | 2—2 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45897 | ♀ | 19-19-17-17 | 143 | 71c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45898 | ♀ | 19-19-17-17 | 143 | 70c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45899 | ♂ | 19-19-17-17 | 146 | 80c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+3 |
| 45900 | ♂ | 19-19-17-17 | 145 | 78c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45901 | ♂ | 19-19-17-17 | 144 | 25+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45902 | ♂ | 19-19-17-17 | 143 | 78c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45903 | ♀ | 19-19-17-17 | 142 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45904 | ♀ | 19-19-17-17 | 142 | 73c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45905 | ♀ | 19-19-17-17 | 144 | 83c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45906 | ♂ | 19-19-17-17 | 147 | 77c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+3—1+3 |
| 45907 | ♀ | 19-19-17-17 | 142 | 82c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45908 | ♂ | 19-19-17-17 | 143 | 80c | ÷ | 8—8 | 10—10 | 2—2 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45909 | ♀ | 19-19-17-17 | 140 | 74c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+3 |
| 45910 | ♀ | 19-19-17-17 | 143 | 71c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45911 | ♀ | 19-19-17-17 | 143 | 74c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45912 | ♂ | 19-19-17-17 | 144 | 20+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45913 | ♂ | 19-19-17-17 | 144 | 41+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45914 | ♀ | 19-19-17-17 | 144 | 65c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+1+3 |
| 45915 | ♀ | 19-19-17-17 | 146 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+3 |
| 45916 | ♀ | 19-19-17-17 | 144 | 75c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45917 | ♀ | 19-19-17-17 | 144 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+3 |
| 45918 | ♀ | 19-19-17 17 | 144 | 69c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+3 |
| 45919 | ♀ | 19-19-17-17 | 140 | 78c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45920 | ♀ | 19-19-17-17 | 142 | 69c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45921 | ♀ | 19-19-17-17 | 142 | 37+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45922 | ♀ | 19-19-17-17 | 142 | 68c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45923 | ♀ | 19-19-17-17 | 142 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45924 | ♂ | 19-19-17-17 | 147 | 78c | ÷ | 8—8 | 10—10 | 2—2 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45925 | ♂ | 19-19-17-17 | 146 | 78c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45926 | ♀ | 19-19-17-17 | 144 | 71c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45927 | ♀ | 19-19-17-17 | 142 | 28+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45928 | ♀ | 19-19-17-17 | 141 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45929 | ♂ | 19-19-17-17 | 146 | 81c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+3—1+2+3 |
| 45930 | ♂ | 19-19-17-17 | 146 | 80c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+3—1+2 |
| 45931 | ♀ | 19-19-17-17 | 144 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45932 | ♀ | 19-19-17-17 | 145 | 75c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+3 |
| 45933 | ♂ | 19-19 17-17 | 145 | 80c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+3 |
| 45934 | ♀ | 19-19-17-17 | 147 | 73c | ÷ | 8—8 | 10—10 | 1—2 | 2—3 | 1—1 | 1+2+2—1+2+2 |
| 45935 | ♀ | 19-19-17-17 | 143 | 74c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+3 |
| 45936 | ♂ | 19-19-17-17 | 144 | 71+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45937 | ♂ | 19-19-17-17 | 143 | 77c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45938 | ♂ | 19-19-17-17 | 145 | 77c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45939 | ♂ | 19-19-17-17 | 145 | 80c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |
| 45940 | ♀ | 19-19-17-17 | 144 | 72c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2—1+2 |
| 45941 | ♂ | 19-19-17-17 | 144 | 76+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+3 |
| 45942 | ♀ | 19-19-17-17 | 141 | 71c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+3—1+2 |
| 45943 | ♀ | 19-19-17-17 | 146 | 54+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+3—1+2 |
| 45944 | ♀ | 19-19-17-17 | 143 | 76c | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+3—1+2+2 |
| 45945 | ♀ | 19-19-17-17 | 147 | 60+ | ÷ | 8—8 | 10—10 | 1—1 | 3—3 | 1—1 | 1+2+2—1+2+2 |

### 77. **Chilomeniscus cinctus** Cope

The only specimen of this species taken by Mr. Slevin was found under a pile of debris close to a house in a street of Todos Santos. The species is known to the natives, who say it is rare and that they do not see many.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Temporals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45981 | ♀ | 13 | 120 | 26c | ÷ | 7—7 | 9—9 | 1—1 | 2—2 | 0—0 | 1+1—1+1 |

### 80. **Trimorphodon lyrophanes** Cope

One specimen of this snake was collected at San José del Cabo. It was found in the thatched roof of a house late in the afternoon as it was crawling over the rafters. The food of this snake consists, at least in part, of small mammals, as this specimen had in its stomach the remains of a mouse or some small mammal with long hair.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal | Temporals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45948 | ♂ | 23 | 231 | 74c | ÷ | 9—9 | 11—11 | 3—3 | 3—3 | 2—2 | 3+4—3+4 |

### 81. **Crotalus lucasensis** Van Denburgh

Although supposed to be the most common rattlesnake of the Cape Region, only a single specimen was collected. This was found in the vicinity of Agua Caliente, just at dusk, crossing a road. The stomach of this specimen contained the remains of a small mammal.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal |
|---|---|---|---|---|---|---|---|---|---|---|
| 45888 | ♂ | 27 | 186 | 26c | 1 | 17—16 | 19—19 | 2—2 | 3—3 | 2—2 |

### 82. **Crotalus exsul** Garman

Our collections include four specimens of this rattlesnake. Three of these were collected by Mr. R. H. Beck near Ensenada, February 27, 1908. The fourth (No. 42047) was brought back by the "Albatross" from Turtle Bay, Lower California. The scale-counts are given below.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal |
|---|---|---|---|---|---|---|---|---|---|---|
| 13416 | ♂ | 29 | 193 | 25c | 1 | 17—18 | 19—18 | 2—2 | 3—3 | 1—1 |
| 13417 | ♀ | 31 | 197 | 22c | 1 | 16—17 | 17—18 | 2—2 | 3—3 | 1—1 |
| 13418 | ♂ | 29 | 193 | 28c | 1 | 16—17 | 17—19 | 2—2 | 3—3 | 2—2 |
| 42047 | ♀ | 29 | 193 | 20c | 1 | 16—? | 18—? | 2—2 | 3—3 | 1—1 |

### 84. **Crotalus enyo** Cope

This species was the most abundant of the rattlesnakes encountered. Like the gopher-snakes they were mostly confined to the vicinity of habitations. As in other places, rattlesnakes were found in the early morning or evening. One specimen (No. 45884) was found early in the morning coiled up under a pile of brush. Another (No. 45886) was found coming out of a rock wall within a few feet of a house. Their food consisted of small mammals, as far as discovered from specimens collected. The natives call all rattlesnakes by the name *Vivora*. Specimens were collected at Miraflores (45879), San Antonio (45880), Todos Santos (45881), San Bartolo (45882), San Pedro (45883, 45884), San José del Cabo (45885), and in the Sierra Laguna (45886).

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal |
|---|---|---|---|---|---|---|---|---|---|---|
| 45879 | juv. | 27 | 170 | 23c | 1 | 14—15 | ?—? | 2—2 | 3—3 | 1—1 |
| 45880 | ♂ | 25 | 160 | 23c | 1 | ...... | ...... | .... | .... | .... |
| 45881 | ♂ | 25 | 163 | 25c | 1 | 13—13 | 14—14 | 2—2 | 3—3 | 1—1 |
| 45882 | ♂ | 25 | 166 | 25c | 1 | ?—13 | ?—13 | ?—2 | ?—3 | ?—1 |
| 45883 | ♀ | 25 | 169 | 18c | 1 | 15—13 | 13—13 | 2—2 | 3—3 | 1—1 |
| 45884 | ♀ | 25 | 169 | 19c | 1 | 13—13 | 13—13 | 2—2 | 3—3 | 1—1 |
| 45885 | ♂ | 25 | ... | 22c | 1 | ?—14 | ?—14 | ?—2 | ?—3 | ... |
| 45886 | ♂ | 25 | 166 | 26c | 1 | 14—14 | 15—15 | 2—2 | 3—3 | 1—1 |

### 85. **Crotalus mitchellii** Cope

The only snake of this species collected was found at Agua Caliente. It was brought in by a Mexican boy who caught it in a small field that was being dug up for planting corn. Mr. Ferris saw a rattlesnake which he thought was this species on Mount San Rafael, when about half way up the mountain.

| No. | Sex | Scale Rows | Gastro-steges | Uro-steges | Anal | Supra-labials | Infra-labials | Pre-oculars | Post-oculars | Loreal |
|---|---|---|---|---|---|---|---|---|---|---|
| 45887 | ♂ | 25 | 177 | 23c | 1 | 16—16 | 17—16 | 2—2 | 3—3 | 1—1 |

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V

# NOTES ON THE BIRDS AND MAMMALS OF SISKIYOU COUNTY, CALIFORNIA

BY

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The fact that but little has been written concerning the birds of Siskiyou County, California, at least for the breeding season, led to a decision to make that county the center of the field work of the Department of Ornithology for the spring of 1920.

The field party consisted of F. C. Holman, F. G. Gilchrist, and the writer, and remained in the field from May 10 to June 16.

While it might have been better to have reached this field somewhat earlier than May 10 for the purpose of noting migrants on their way to regions further north, this date was about right for the arrivals of those that breed in the region visited. Many of these latter were just coming in and we had the satisfaction of seeing them settling down and pairing off.

Arriving at Weed on the afternoon of May 11, the party passed the rest of the day in getting located and prospecting about for promising spots to work over. This town is a great lumbering center, and practically all the neighboring forests have been destroyed, the destruction being completed in many places by forest fires which have evidently often swept over great areas, destroying all young forest growth in their paths. The timbered country for the most part being extremely rocky and covered by lava and other volcanic ejecta, with none too plenteous a rainfall, the growth of a new forest is a slow process. Even the ceanothus brush has difficulty in many places in getting started, and the major part of the deforested area is a sad and disheartening sight.

In much of this there is but little bird life. The waters from the melting snows on Mt. Shasta sink through the porous rock and springs are scarce. Fortunately, some of these waters are checked by impervious strata and, collecting beneath the surface, produce some good live streams, which are utilized to water the meadows that have been formed in low spots, where Wilson's Snipe and the Nevada Red-winged Blackbird take advantage of the moisture and the long green grasses in which to hide their nests.

We were fortunate in finding a small valley about half a mile southeast of Weed, apparently coming straight down from Mt. Shasta, that had been spared by fire and still had some fair-sized forest trees in it, opening out into a meadow with a small stream running through.

Here we found birds quite plentiful. The weather was cold and windy, but the birds were commencing to breed. While the fox sparrows, in this case the Yosemite Fox Sparrow, are not found nesting below 4500 or 5000 feet even as far north as Plumas County (California), here they were numerous in a patch of heavy brush at not over 3600 feet altitude, in company with the Green-tailed Towhee. The fox sparrow breeding on Mt. Shasta has been previously recorded as the Thick-billed Fox Sparrow. C. H. Townsend, in his "Field Notes on the Mammals, Birds and Reptiles of Northern California" (Proc. U. S. Nat. Mus., X, 1887, p. 220), states that the Thick-billed Sparrow was "Common about Mount Shasta in summer, where it frequented the chaparral tracts and the bushes scattered through the pine country." C. Hart Merriam, in North American Fauna No. 16, 1899, p. 126, also mentions this form as found on Shasta.

Several specimens were taken by us near Weed and a number were evidently nesting or preparing to nest in some very thick brush near by, the cheery song of the males being a pleasant feature of the morning chorus. There is every reason to believe that the form we found breeding at the base of the mountain, the Yosemite Fox Sparrow, separated and described in 1918, is the one occupying the whole mountain, and is the same form that inhabits the higher altitudes along the Sierra in Plumas County and the Tahoe region, although it was originally recorded from the latter region also as the Thick-billed Fox Sparrow (*Passerella iliaca megarhyncha*).

Weed is situated at the westerly base of Mt. Shasta, a beautiful view of which, seemingly of an even slope from the brush-covered bottom to its glistening summit of snow and ice, is obtained—a view ever changing in character and ever new. The town itself is bordered by a meadow on the eastern side and more or less hemmed in by partly forested hills in other directions, with a small stream, tributary to Little Shasta River, which flows through Shasta Valley into the Klamath, running through it.

The character of the immediate vicinity is that of the Transition Zone. In addition to many of the more commonly known species found in this zone, we found here the Green-tailed Towhee and Yosemite Fox Sparrow, above mentioned; the Calliope Hummingbird, the Calaveras Warbler, and the Mountain Chickadee. Of these five species, three were breeding where we found them at not over 3500 feet elevation, while the Calliope Hummingbird and the Calaveras Warbler were nesting either here or not far away, to judge from their actions. Unfortunately, no females were secured to confirm this, but we later found these two species nesting at about the same elevation as Weed, and under practically similar conditions. ,

A Swainson's Thrush was taken here on May 14, but was probably a migrant, as it is recorded as a summer visitant in Modoc County, northeast of the Shasta region.

From the meadow in the evening came the call of Wilson's Snipe, and the Nevada Red-wing was there waiting for the meadow grass to grow high enough to make good nesting sites.

Merriam (*op. cit.*) makes no mention of the California Purple Finch in the Shasta region, while Townsend (*op. cit.*) says that it was observed on a few occasions only; he does not record it from northern California north of Shasta County. Miss Kellogg in "Mammals and Birds of Northern California" (University of California Publications in Zoology, Vol. 12, 1916), mentions it as having been taken only twice in the summer time by the Alexander expedition. On the other hand, we found it more or less common at nearly every station where we collected, at some places associated with Cassin's Finch.

The song sparrow of this region, so far as we could make out, is the Modoc Song Sparrow. This race appears to be a comparatively recent one, and not so well established as many others. This is shown in the wide variation of its markings, some specimens being practically without black centers to the dorsal feathers, while others have this black well developed. This species was common about Weed but did not appear to be especially numerous.

We found the Wright's Flycatcher quite common where the firs and yellow pines were of fair size and more scattered. They appeared to have just come into the region. No other Empidonax was recorded at Weed.

The Sacramento Towhee was fairly common in the vicinity of Weed, but the Northern Brown Towhee was extremely rare. While I was fairly sure of having caught a glimpse of one at Weed, the identification was not sufficiently positive to record it. However, as it is found only a few miles away and at but little lower elevation, the chances are that my guess was correct.

For some reason the Western Warbling Vireo seems to have been scarce during the visits of the Townsend and Merriam field parties, but we found it common enough this season, having met with it at each of our stations, except one in the heart of the coniferous forest. Miss Kellogg records it from three stations only.

While we found Audubon's Warbler, Black-throated Gray Warbler, Macgillivray's Warbler, and the Golden Pileolated Warbler more or less common in suitable places in this vicinity, we had no direct evidence of their nesting here, yet there was good reason to suppose that they would do so, or at least not far away.

The region immediately around Weed, at the altitude of 3000 to 3500 feet, has approximately the same forms of bird life as are found in Plumas County, California, or at other similar portions of the Western slope of the Sierra Nevada at 4000 to 5000 feet, except, perhaps, that the Hermit Warbler and the White-headed Woodpecker are not found breeding at the low level of Weed, though the latter comes down in the fall. The Long-tailed Jay was noted at Weed, but no specimen was secured. It seemed to be scarce and wary in this locality. In fact, it was noted at but one other station in this county, that is, at Yreka.

Miss Kellogg does not mention the Pygmy Nuthatch as noted at any station, and Townsend did not find it in the Shasta region, while Merriam speaks of it as having been noted at Edgewood and Sisson only, and then rather late in the season. As may be seen in the appended table, we found it everywhere except at Yreka, where there was no appropriate cover for it.

Dr. Will S. Tebbe of the Weed hospital, gave us information concerning likely places to visit, with the reasons therefor, as well as for advice and aid in regard to reaching them. I take this opportunity to thank him in the name of the California Academy of Sciences as well as in a personal way, for the assistance so kindly and enthusiastically given, and for introductions to others who also were of much assistance to us. Dr. Tebbe's knowledge of Siskiyou County is very extended, having been acquired by long residence and an active professional life in a thinly settled country as well as by numerous hunting and fishing expeditions, so that his suggestions concerning various localities that might prove of interest in our work were especially valuable. Following one of these suggestions, after a few days combing of Weed and its immediate neighborhood, we moved, on May 16, to Stewart's Springs, a well-known summer camping resort about eight miles southwest of Weed, Dr. Tebbe taking us there in his own car and Mr. Lloyd assisting with our impedimenta. This place is owned by Mr. and Mrs. E. C. Lloyd of Weed, who most kindly placed the cabin there, furnished with household utensils, at our disposal. This place is on Park's Creek, which here flows through a steep and rocky ravine at an elevation of about 4300 feet, and is in the forest proper where very little lumbering has been done. On the east side of the stream the forest is so thick overhead that there is but little shrub or small plant growth on the very rocky and poor soil of this part of the country, while on the west side the steep hill sides have more or less openings with some brush, mostly scattering, on them. Along the stream and in moist places the birch trees were just beginning to bud out. The forest at the springs is composed mostly of yellow pine, Douglas fir, and incense cedar, but sugar pine growth commences a short distance higher up. Around the camp-ground birds were extremely scarce, especially during the first day or two of our stay. The first bird that attracted attention was a Sierra Creeper, carrying material to a nest which was a few yards away from the cabin door, and situated behind a piece of loose bark on an incense cedar, about four feet from the ground.

The birds at this station were the general run of Sierran species from like altitudes, and, being enumerated in the table at the end of this paper, need not be listed here. Certain of our observations, however, may prove of interest.

One of the main objects of the field work in Siskiyou County was the investigation of the local fox sparrow (Passerella) situation, and one of the objects in making Stewart's Springs an observation station was that of visiting the ranges above in search of appropriate brush for this genus and to ascertain if it were breeding there. With this idea in view Messrs. Holman and Gilchrist were sent upon this errand on May 17. On that day they did not reach any great elevation, but returned with quite a list of birds noted, yet no fox sparrows, as they had not met with the sort of brush this genus inhabits in the nesting season. Mr. Gilchrist continued the search alone next day. He started early and reached a point close to the rapidly retreating snow line, securing one fox sparrow and hearing two or three more in a clump of dwarfed yew trees. The specimen taken is one of the small-billed, brown-backed races which I have identified as the Sooty Fox Sparrow. While this capture raised our hopes of finding something worth while in this line, surprising as it was to find one of the more northern forms here at so late a date (May 18), such hopes were misplaced. Further examination of that locality and of others near it resulted in absolute failure to discover fox sparrows of any form whatever, and the conclusion was reluctantly reached that those above noted were but late migrants on their way north. One specimen of Clark's Nutcracker was taken high up on the range.

We had been told of orioles which were good singers that were to be found there, but, as we surmised, the "orioles" proved to be Western Tanagers, which seemed to have but recently arrived. Their curious rolling chirp was heard constantly as they were apparently looking for good nesting sites. A few of these gave us the benefit of their rather attractive song, but singing was not general on the part of this species.

One of the interesting features of our stay here was the passing through to higher altitudes of the Townsend Solitaire. This flight, if it might be called such, commenced a day or two after our arrival and for the rest of the week there was hardly a moment when there were not a pair or two of these birds in sight from the cabin door, flying leisurely from tree to tree, alighting on the ground as they often did, or best of all with the male(?) perched on some dead twig and pouring out his love song—indeed a beautiful one, not loud but particularly soft, liquid, and melodious. In the solitudes of the forest it is especially pleasant to hear.

We found here the Hammond's Flycatcher quite common though not numerous. Several pair might be seen in a morning's walk, but they appeared to be much scarcer than the indications of insect life seemed to warrant. One pair was building a nest about a quarter of a mile above our camp, but unfortunately it was not finished before the end of our stay.

One Wright's Flycatcher was taken near this camp, but in a more open locality than that occupied by the Hammond's. As the Transition Zone merged quite rapidly into the Canadian at Stewart's Springs, on account of the steepness of the mountain sides, some of the birds recorded from this station might be from either zone. Our camp was in Transition, but sugar pine and other indications of the Canadian were not far away.

Our station on Park's Creek was probably within ten miles of the station of Misses Alexander and Kellogg at the head of Bear Creek, August 5-17, 1911, but on the northerly side of the range, i. e., on the Shasta Valley side, while their camp was on the southerly or Scott Valley side.

At Stewart's Springs we found quite a number of rodents, but did not succeed in securing as many species as we had hoped. Around the cabin were the Western Bushy-tailed Wood Rat, *Neotoma cinereus occidentalis,* apparently living in friendly community with the Sierra Golden-mantled Ground Squirrel, *Callospermophilus chrysodeirus chrysodeirus,* as we caught these two animals in the same spots, on one occasion at the mouth of a hole among the rocks, and on another in a trap kept set under the edge of a bath-house by the stream. Gambel's White-footed Mouse, *Peromyscus maniculatus gambeli* was the more numerous of the two species of the genus Peromyscus found here, the other being Gilbert's White-footed Mouse, *Peromyscus truei gilberti.* The Klamath Chipmunk, *Eutamias amœnus amœnus,* and Allen's Chipmunk, *Eutamias senex,* were both well represented here. The Sierra Chickaree, *Sciurus douglasi albolimbatus* was occasionally met with.

Just below the cabin was a dark, damp spot on the bank of the stream, that was full of holes among tree roots and appeared to be an ideal place for shrews, but persistent trapping there brought no results and no shrews were obtained anywhere.

As the owners of these springs wished to put the place in order for summer occupation, we returned to Weed, on May 23, to repack and make a new start.

We had been given to understand that we would find accommodation at "Big Springs" (Mayten), but upon reaching that place on Monday, May 24, we found this to be an error, and having no camping outfit with us we made a circuit around Shasta Valley to look for a hospitable location.

The object in going to this locality was to examine the lava and juniper country in the vicinity, which is here covered also with sage brush, on the one side and the meadows around the Big Springs laguna on the other, as this seemed to be an inviting combination for the Upper Sonoran Zone.

Its appearance, however, probably belies it, for the Alexander Expedition in 1911 remained there only two days, apparently not deeming the prospect sufficiently alluring for further effort. The road from Weed to Big Springs passes alongside or through the lava, sage and juniper for some miles, and, as we motored slowly along, especial watch was kept for any birds that might possibly be peculiar to such an association, but the few species we noted were the same as those in the adjacent pine regions.

The season was an intensely dry one and the prospects poor. As we traveled through the very open country, mostly pasture lands, stony surfaced hillsides, or alkali bottoms, we were surprised at the total absence of such birds as one would expect to find in such situations. Although we passed through apparently ideal places for horned larks (Otocoris), none was seen. An occasional Arkansas Kingbird and a Western Meadowlark were practically all the birds we saw.

In our circuit around this part of Shasta Valley, we failed to find any place that looked promising and we finally went to the small town of Gazelle where several field parties have done some collecting, but it looked too uninviting in such a dry season to be worth trying, there being little except open and more or less alkali land in its immediate vicinity. We finally went to Edgewood, a small town five miles northwest of Weed, at an altitude of 2900 feet. This place is on the edge of Upper Sonoran, changing quickly into Transition toward the southeast as the country rapidly rises.

Edgewood is surrounded by meadows irrigated from the snow-fed streams of Shasta, and here, as in the meadows about Weed, the Nevada Red-wing was just preparing to nest, several females being noticed carrying nesting material, while Wilson's Snipe was also taking advantage of such a favorable spot.

The birds about Edgewood were mostly the ordinary species found in Transition in this part of California, but it was here that we came across the only specimen that we noted of the California Cuckoo, which all three of us saw one evening fly across the railroad track in the town, of the Northern Brown Towhee, which I saw near the village one evening but did not secure, and of the San Joaquin Wren, which Gilchrist found nesting in a small, dead stump not far from the railroad track, and which, like many of the birds found near the railroad here and at Weed, was woefully smudged with oil soot. Shasta River runs through the valley just below Edgewood and in the willows on its banks we found Traill's Flycatcher. A Western

Flycatcher, seen here, was the only one of this species noted by us in Siskiyou County. The most interesting discovery at Edgewood was the presence of a small flock, or perhaps several small bands, of Cedar Waxwings in the town. These were first seen on May 25, feeding on the seeds or buds of some maple trees in a little grove in the middle of the village. We noticed some birds of this species every day we were there but saw no evidence of nesting. On May 26 a flock of 18 individuals was seen on the edge of the village, flying north, but whether there was only one flock in the locality moving about or whether succeeding flocks rested and fed there during migration, we did not succeed in determining. Most certainly some roosted there over night, as we saw them settling down in the trees toward dusk.

The meadows were searched for signs of Microtus, but none was found and our traps attracted neither this genus nor mice. Traps set along fences and in the fields brought no returns whatever. Gophers, however, were numerous in one handy corner, and several Red Bluff(?) Pocket Gophers, *Thomomys leucodon navus* (?), were taken here.

As there was not enough of interest at Edgewood to detain us long, we moved, on May 28, to Bray, a sawmill village in the lava country, about 20 miles northeast of Mt. Shasta, with an elevation of 4650 feet. Not finding accommodation in the town, we camped on the edge of an irrigated meadow, about a mile away in the valley of Butte Creek. For a long distance around Bray the standing timber of any value has been destroyed, and, except for a few large pines in the town, trees of any size are scarce. Even small timber is much scattered on account of the poorness of the rocky soil. Here a low, thin sage brush is a predominant characteristic of the lava country, the bushes for the most part too stunted and scraggly to afford much shelter for birds. Very little bird life could be found in this sage brush, but occasional spots among the remnants of timber or in the willows, aspens, and cottonwoods along the stream harbored a fair number for such a region. At Bray we discovered the Mountain Bluebird for the first and only time on this trip, nesting in old dead tree stubs. The usual Sierran forms for corresponding altitudes were for the most part present, or apparently were coming in during our week's stay. Among the late comers were the Brewer's Sparrow and Gray Flycatcher, the former in the sage brush and the latter in the willows along the stream.

Gilchrist came across an Osprey's nest on top of a tall pine stub, with the old birds in attendance, the secret of their presence here being the number of fish in Lake Orr, a small body of water a short distance west of Bray, and easily available to them.

Some ducks and other waterfowl breed about this lake and the Yellow-headed Blackbird nests here abundantly. The sage brush near the lake is higher than the major part of it elsewhere in the neighborhood and here was the only place where we found the Western Vesper Sparrow. Holman ascended Mt. Orr, close by and probably about a thousand feet higher than the town, and there found the Yosemite Fox Sparrow breeding, the identification being from specimens he brought in, this extending slightly the known range of this species.

A female Cedar Waxwing was seen on June 2, calling from the top of a small willow. This was taken and showed no sign of breeding. On June 3, Gilchrist came across a couple of California Evening Grosbeaks, one of which was secured. This proved to be a female with the ovary just commencing to swell, the largest ovum being about 1.4 mm. in diameter.

Here also, on June 2, we heard our first Pacific Nighthawks for the region, as they carried on their courting antics high above our heads. None came low, contrary to some of my previous experiences, when they had descended close enough for us to secure specimens. The Gairdner's Woodpeckers here seemed to have rather more left of their tails than some we had been taking. One of these taken at Weed had nearly half of the tail feathers worn away, leaving a sort of double crescent effect, the shaft of the main rectrices being only 32 mm. long, as measured from the end of the pygostyle, instead of something over 50 mm. I have placed this woodpecker from the Shasta Valley region with *gairdneri,* but it leans very strongly toward *turati,* being anything but typical. Near the lake Mr. Holman noted a Magpie, the only one seen, but failed, after a long chase, to secure it. The Poor-will was in evidence here, its soft call being audible at almost any time from dusk to daylight, but none was seen.

At Bray we were in a well populated colony of the Oregon Ground Squirrel (*Citellus oregonus*). Until we had taken several in traps they were numerous all around our cabin, but soon became very wary. In this region they are called "Picket Pins" or "Bulldogs," the former name arising from their habit of sitting by their holes, or on rocks or stumps, in an extremely erect position and at a distance strongly resembling wooden stakes. After our traps had taken two or three adults on the edge of the meadow, a warning seemed to have been circulated through the colony, for no trap was touched thereafter except by an occasional young one, in spite of change of bait and of smoking the traps to kill the scent of former casualties. This ground squirrel is so numerous in this part of the state as to be a great pest. Occurring here also in association with these animals was the Golden Mantled Ground Squirrel (*Callospermophilus chrysodeirus chrysodeirus*), which greatly resembles a large and handsomely marked chipmunk. The Klamath Chipmunk (*Eutamias amœnus amœnus*) was also found here. Mice, however, were very scarce and but few were obtained. Those taken were of two species, each of which appeared to be of intermediate form and neither of which has as yet been definitely determined. No shrews or meadow mice were taken, although the meadow seemed a fine place for them. Probably the irrigation had something to do with their absence, even though the ground was never absolutely covered with water.

After a week at Bray the party moved to Yreka, the county seat of Siskiyou County, which we reached on the afternoon of June 5. This town is at an altitude of 2620 feet and is in the Upper Sonoran Zone.

As this locality did not look very encouraging, we remained only one day to collect a few Dusky-Horned Larks, and then, on June 7, we moved to a place known as "Forest House Mountain," so called on account of being just west of an old-time tavern and resort called "The Forest House," on the road to Scott Valley. Our camp was at a woodchopper's cabin a few yards off the main road, known as "Robber's Rock Camp," on account of a series of stage robberies having taken place from a large rock just above it. The altitude here is nearly 4000 feet.

The cabin was beside what was usually a large spring, ordinarily making swampy ground of the hillside, but which was sadly reduced in size in this dry year. Through the day, from time to time, some birds came here to obtain water, yet the total number was comparatively small, and the species the usual Sierran forms, as may be gathered from the appended table of records. The records for this station cover a good deal of the vicinity as far as altitude is concerned, for the change from Upper Sonoran to Transition took place only a short distance below our camp, and the Transition ran up rapidly above us so as almost to develop into the Canadian stage of zonal association, the elevation just above our camp reaching over 5000 feet.

Bird life was extremely scarce over much of this higher territory and search along the higher range brought but little reward. This may have been partly due to lack of water, yet many well watered areas in Siskiyou County often made but little better showing. Our camp here was on the edge of a small opening in the pine forest which extended over the range. A quarter of a mile above us was a gap through which passed the road to Fort Jones, in Scott Valley, while below the forest merged into more or less brushy or chapparal country, with some sage interspersed.

We had come here in the hope of finding fox sparrows, but were disappointed in this. While the brush in places was of the right sort to suit fox sparrows, it was everywhere too low and scattering, not affording the heavy cover which these birds prefer, except at too low an altitude for this genus.

Just above our cabin one morning I had the pleasure of finding a brood of young Mountain Quail. The little fellows swarmed about my feet when I happened to be standing still for a few moments. The mother remained immovable not over six feet from me, her confidence assured by a partial screen of scraggly brush. She gathered her brood about her by uttering a succession of almost (to me) imperceptible, but very musical little clucks, to which the youngsters paid instant and obedient attention. Much as specimens were needed, it was far too fascinating a scene for me to disturb. Miss Kellogg records this subspecies from Bear Creek, in the Mt. Eddy region not many miles to the southeast, her identification being supported by Dr. Joseph Grinnell, who states, however, that the form taken there is an intermediate one, hence it is reasonable to suppose that those we saw or heard in this region should be placed in this category. Unfortunately we had no other opportunity to obtain specimens.

This was the only station at which we noted the California Pygmy Owl. A couple were heard by all three of the party on the morning of June 9, but the sounds appeared to come from a long distance, apparently across the cañon, and no specimen was secured. Here also we heard the Poor-will, but did not succeed in calling one within range of vision.

In a well-watered ravine we found the Sierra Hermit Thrush to be quite numerous and several individuals were secured. When "squeaked" to, these thrushes would come almost within arm's reach of a person, their curiosity to discover the source of the strange sounds being so easily aroused, according to Holman and Gilchrist who had the good fortune to find this favored spot.

The Dusky-footed Wood Rat (*Neotoma fuscipes fuscipes*) was very common here, its nests being widely distributed over the hillside where the cabin stood, and numerous crevices of rocks also served it for abiding places, these being usually marked by the presence of a few dead twigs strewn near the entrance or sticking out of the holes as if this species could not get away from the idea of *stick* construction for its habitations.

Mice (Peromyscus) were fairly numerous here, but we did not find the Kangaroo Rats we had been hoping to find from the accounts given by natives, although there is no doubt as to their presence in some localities within a few miles, as people told us of having seen them jumping across roads in front of their automobiles when traveling by night. Upon our first arrival at Forest House Mountain we found chipmunks very scarce, only one or two being seen, but on June 10 we discovered quantities of the Klamath Chipmunk just below our cabin from the level of the camp to some distance down hill, they being mostly near the little rivulet that flowed from our spring. Whether they had suddenly appeared, as it seemed, or whether, for some reason, we merely had not come across them before, I do not know, but they certainly were plentiful for the next two or three days. The weather had been cloudy and threatening on the day of our coming and perhaps it was the later sunshine that brought them out of their holes, but the situation had all the appearance of a sudden immigration. Porcupines, probably the Yellow-haired (*Erethizon epixanthum epixanthum*), were quite common in this neighborhood, and it was no rare sight to see the head of one sticking out of some concrete culvert along the road. As a place of shelter during the daytime at least, these culverts seem to have a special attraction for this animal. For certain reasons no attempt was made on this expedition to secure animals larger than a squirrel, so we did not take advantage of such opportunities as offered for its capture.

From the top of Forest House Mountain the view across Scott Valley to the Salmon Mountains was most enticing, and on June 12 we accepted the offer of a truck freighter to take us over to that range, as he claimed to know just the place where we could get nearly everything we wanted. We found, however, that the road we had intended to follow was in such condition that we could not get as far into the range as we wished, and had to content ourselves with making camp in a deserted building at the "Old Pinery Mine," some four miles southwest of Greenview and at an elevation of only about 3300 feet. We were in the Transition Zone here, on the edge of a national forest of Douglas fir and yellow pine with many oak trees in places. Unfortunately the weather turned against us, and became dark and drizzly. In the immediate vicinity of the old placer mine only common birds were found, the one exception being what I believed to be a Northern Spotted Owl, which was perched on a dead sapling in the wash of the old mine. It was about 100 yards away when seen, but unfortunately there was little cover about, and it was impossible to avoid making a good deal of noise scrambling over the loose stones and coarse gravel in the bed of the old wash. The bird was wary and uneasy, so that a long chase ended in failure to get any nearer, and it finally took to the woods nearby. It was too large for a Saw-whet and I can think of nothing that would fit the case except a Spotted Owl. With the idea of fox sparrows still dominant, Holman and Gilchrist made a long tour into the higher altitudes in search of birds of this genus, but found none.

We had been actually in or on the borders of the forest region over a month before we saw or heard the Northern Pileolated Woodpecker. On the last day of our stay at this camp, June 15, one was seen and heard at rather close range.

With the exception of the Douglas Ground Squirrel (*Citellus douglasi*), rodents were very scarce at this last station, although old signs were plentiful, especially in the house in which we camped. We had visions of wood rats playing tag over our prostrate forms as we slept on luxurious beds of pine needles upon the floors of the deserted rooms; but, while a mouse or two had the temerity to use some of us for runways, the rats seemed to have vacated the premises in our favor—not only as regards the interior of the house but beneath it as well. Traps were set at favorable looking openings and rat holes around the outside of, and underneath, the house, but not one was touched, although we caught rats in the bushes not fifty yards away.

There were several colonies of the Dusky-footed Wood Rat (*Neotoma fuscipes fuscipes*) in the brush surrounding the clearing occupied by the house, but further away fresh nests were not numerous. This subspecies varies a good deal with locality and climate, and in this place is much lighter in color than specimens from near the type locality, with feet practically white. A few of Allen's Chipmunk (*Eutamias senex*), were found here.

Singularly enough, gophers were very scarce wherever we went, fortunately for the farmers. Near this last camp was a field of perhaps twenty acres, with green crops, including potatoes, growing therein, and surrounded by dry, rocky soil, yet careful search failed to reveal the presence of any gopher sign whatever. Bray and Edgewood were the only stations at which we found signs in any quantity and even there this was restricted to small areas. The alfalfa fields in Shasta Valley at a lower elevation were not, however, examined critically by us, our only view of them being from the train windows, from which no particular damage to the crop was noticed.

While a comparison of the number of species noted by different field parties is usually of interest to the student of the geographic distribution of birds, such comparison loses value when the dates of observation are not similar. Although the records given in the reports of the Merriam and the Alexander expeditions to this region or its vicinity do not quite correspond to those given in this paper, many of those of the first two being either of an earlier or later date than the Academy expedition, for the benefit of future observers it seems worth while to call attention to the differences in these recorded lists.

The Merriam report includes 136 species of birds against our 109. This expedition covered a greater variation of territory than did ours, with larger range of elevation, and remained in the field from the middle of July until the beginning of October. This list includes a number of water birds and raptores that we did not find, as well as some birds of higher altitudes than those we visited. Among those not mentioned by Merriam are the following: Band-tailed Pigeon, American Osprey, Northern Spotted Owl, Nuttall's Woodpecker, Ash-throated Flycatcher, Traill's Flycatcher, Gray Flycatcher, California Purple Finch, Western Vesper Sparrow, Brewer's Sparrow, Cedar Waxwing, Black-throated Gray Warbler, Pallid Wren-tit, Russet-backed Thrush, and the Olive-backed Thrush, a total of 17 species.

Without further information it is useless to comment on these differences further than to say that some of them are due to differences in actual localities visited, even where these were not far separated from each other, and others may be due to difference in date of observations, which may account for the failure of the Merriam party to find the Russet-backed Thrush which we found widely distributed, although the first date of observation of the Merriam expedition, July 15, seems very early for all the individuals of this species to have departed for the south, especially as the Alexander party found it at Grizzly Creek in the Salmon Mountains as late as July 23.

Comparing ours with the Alexander expedition list of 95 species of birds, the same causes for differences can be assumed. The following is our list of species not therein noted: Mallard, California Great Blue Heron, Anthony's Green Heron, Wilson's Snipe, Band-tailed Pigeon, Turkey Vulture, Marsh Hawk, Western Red-tailed Hawk, American Osprey, Northern Spotted Owl, California Pygmy Owl, California Cuckoo, Nuttall's Woodpecker, Poor-will, Pacific Nighthawk, Anna's Hummingbird, Arkansas Kingbird, Ash-throated Flycatcher, Gray Flycatcher, Dusky Horned Lark, Western Crow, Western Vesper Sparrow, Brewer's Sparrow, Sooty Fox Sparrow, Western Martin, Cliff Swallow, Barn Swallow, Tree Swallow, Macgillivray's Warbler, Pygmy Nuthatch, and Sierra Hermit Thrush.

A notable fact in this is that no species of swallow is included in the Alexander expedition, whereas we found at least three. Nor did the Sierra Hermit Thrush appear to be breeding in the territory covered by that party, although one would suppose it to be rather widespread in this region, especially so, as in all probability some of the records of the "Dwarf Hermit Thrush" mentioned as noted in several localities by the Merriam parties were of this form.

While the Academy's expedition was principally interested in the bird life of the region visited, and succeeded in adding a number of species to the recorded list of Siskiyou County birds, and in adding in other ways to the comparatively meager knowledge of its avifauna, at the same time special efforts were made to obtain specimens of the rodents at each station. In this the results were disappointing, and, while part of our lack of success may have been due to want of experience on the part of the assistant members, there appeared to be a great thinning out, by some agency, of these small mammals. Probably the three successive dry seasons, with attendant scarcity of accustomed food supply, had something to do with this diminution in numbers.

The expedition was brought to a close June 16.

## BIRDS RECORDED IN SISKIYOU COUNTY, CALIFORNIA

California Academy of Sciences Expedition, May 10 to June 15, 1920

| * = noted<br>t = taken<br>n = nesting, or signs of nesting noted | Weed, 3450 ft. elevation | Stewart's Springs, Park Creek, W. of Edgewood, 4300 ft. | Edgewood, 2935 ft. | Bray, 4650 ft. | Yreka, 2620 ft. | Forest House Mt., 8 miles W. of Yreka, 4000 ft. | Kidder Creek, Salmon Mts., S. W. of Greenview, 3300 ft. |
|---|---|---|---|---|---|---|---|
| Mallard (*Anas platyrhynchos*) | | | | * n | | | |
| Californis Great Blue Heron (*Ardea h. hyperonca*) | | | | * | | | |
| Anthony's Green Heron (*Butorides v. anthonyi*) | | | * | | | | |
| Wilson's Snipe (*Gallinago delicata*) | *tn | | * n | *tn | | | |
| Spotted Sandpiper (*Actitis macularia*) | *tn | | | *tn | | | |
| Killdeer (*Oxyechus v. vociferus*) | * n | | | * n | * n | | |
| Mountain Quail (*Oreortyx p. plumifera*) | * n | * n | | | | * n | * n |
| Valley Quail (*Lophortyx c. vallicola*) | * n | | | | * n | * n | * n |
| Sooty (?) Grouse (*Dendragapus o. fuliginosus?*) | | | | | | | * n |
| Band-tailed Pigeon (*Columba f. fasciata*) | | | * | | | | |
| Western Mourning Dove (*Zenaidura m. marginella*) | * n | * | * n | * n | * n | * n | * n |
| Turkey Vulture (*Cathartes a. septentrionalis*) | * | * | | * | | * | |
| Marsh Hawk (*Circus hudsonius*) | * | | | * | | | |
| Western Red-tailed Hawk (*Buteo b. calurus*) | | * | | * | | | |
| American Sparrow Hawk (*Falco s. sparverius*) | * n | | * n | *tn | | | |
| American Osprey (*Pandion h. carolinensis*) | | | | * n | | | |
| Northern Spotted Owl (*Strix o. caurina*) | | | | | | | * |
| California Pygmy Owl (*Glaucidium g. californicum*) | | | | | | * n | |
| California Cuckoo (*Coccyzus a. occidentalis*) | | | * | | | | |
| Modoc Woodpecker (*Dryobates v. orius*) | *tn | | * n | *tn | | | |
| Gairdner's Woodpecker (*Dryobates p. gairdneri +turati*) | *tn | | *tn | *tn | | * n | |
| Nuttall's Woodpecker (*Dryobates nuttalli*) | * n | | | | | | |
| Northern White-headed Woodpecker (*Xenopicus a. albolarvatus*) | | *tn | | | | *tn | * n |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sierra Red-breasted Sapsucker (*Sphyrapicus v. daggetti*) | | *tn | *tn | *tn | | *tn | * n |
| Northern Pileated Woodpecker (*Phlæotomus p. albieticola*) | | | | | | | * n |
| Lewis's Woodpecker (*Asyndesmus lewisi*) | *tn | | * n | *tn | | | |
| Red-shafted Flicker (*Colaptes c. collaris*) | *tn | * n | * n | *tn | | * n | * n |
| Poor-will (*Phalænoptilus n. nuttalli*) | | | | * n | | * n | |
| Pacific Nighthawk (*Chordeiles v. hesperis*) | | | | * n | * n | | * n |
| Anna's Hummingbird (*Calypte anna*) | | | *t | | | | |
| Calliope Hummingbird (*Stellula calliope*) | *t | * n | | *tn | | *tn | *tn |
| Western Kingbird (*Tyrannus verticalis*) | | | * n | * n | * n | | |
| Ash-throated Flycatcher (*Myiarchus c. cinerascens*) | | | * n | | | | |
| Olive-sided Flycatcher (*Nuttallornis borealis*) | *t | * n | | | | | * n |
| Western Wood Pewee (*Myiochanes r. richardsoni*) | | * n | *tn | *tn | | * n | * n |
| Western Flycatcher (*Empidonax d. difficilis*) | | | * | | | | |
| Traill's Flycatcher (*Empidonax t. traillii*) | | | *t | *tn | | | |
| Hammond's Flycatcher (*Empidonax hammondi*) | | *tn | | | | | |
| Wright's Flycatcher (*Empidnoax wrighti*) | *t | *t | | | | *t | |
| Gray's Flycatcher (*Empidonax griseus*) | | | | *tn | | | |
| Dusky Horned Lark (*Otocoris a. merrilli*) | | | | | *tn | | |
| Blue-fronted Jay (*Cyanocitta s. frontalis*) | * n | *tn | * n | *tn | | *tn | *tn |
| Long-tailed Jay (*Aphelocoma c. immanis*) | * n | | | | * n | | |
| Western Crow (*Corvus b. hesperis*) | | | * | * | | | |
| Clarke's Nutcracker (*Nucifraga columbiana*) | | *t | | | | | |
| Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) | | | | *tn | | | |
| Nevada Red-winged Blackbird (*Agelaius ph. nevadensis*) | *tn | | *tn | *tn | | | |
| Western Meadowlark (*Sturnella neglecta*) | * n | | * n | * n | * n | | |
| Bullock's Oriole (*Icterus bullocki*) | | | *tn | | * n | | |
| Brewer's Blackbird (*Euphagus cyanocephalus*) | *tn | | * n | *tn | * n | | |
| California Evening Grosbeak (*Hesperiphona v. californica*) | | | | *t | | | |
| California Purple Finch (*Carpodacus p. californicus*) | *tn | | * n | * n | * n | *tn | * n |
| Cassin's Purple Finch (*Carpodacus cassini*) | | *tn | | *tn | | *tn | * n |
| California Linnet (*Carpodacus m. frontalis*) | * n | | *tn | * n | | * n | |
| Willow Goldfinch (*Astragalinus t. salicamans*) | | | *tn | | * n | | |
| Green-backed Goldfinch (*Astragalinus p. hesperophilus*) | *tn | | | | * n | | |
| Pine Siskin (*Spinus p. pinus*) | * n | | | * n | | | |
| English Sparrow (*Passer domesticus*) | * n | | * n | | * n | | |
| Western Vesper Sparrow (*Poœcetes g. confinis*) | | | | *tn | | | |

| * = noted<br>t = taken<br>n = nesting, or signs of nesting noted | Weed, 3450 ft. elevation | Stewart's Springs, Park Creek, W. of Edgewood, 4300 ft. | Edgewood, 2935 ft. | Bray, 4650 ft. | Yreka, 2620 ft. | Forest House Mt., 8 miles W. of Yreka, 4000 ft. | Kidder Creek, Salmon Mts., S. W. of Greenview, 3300 ft. |
|---|---|---|---|---|---|---|---|
| Western Lark Sparrow (*Chondestes g. strigatus*) | | | * n | | * n | | |
| Western Chipping Sparrow (*Spizella p. arizonæ*) | *tn | | * n | *tn | * n | * n | * n |
| Brewer's Sparrow (*Spizella breweri*) | | | | *tn | | | |
| Sierra Junco (*Junco o. thurberi*) | *tn | *tn | | * n | | *tn | *tn |
| Modoc Song Sparrow (*Melospiza m. fisherella*) | *tn | | *tn | *tn | | | |
| Yosemite Fox Sparrow (*Passerella i. mariposæ*) | *tn | | | *tn | | | |
| Sooty Fox Sparrow (*Passerella i. fuliginosa*) | | *t | | | | | |
| Sacramento Towhee (*Pipilo m. falcinellus*) | *tn | | *tn | | * n | *tn | * n |
| Northern Brown Towhee (*Pipilo c. carolæ*) | | | * | | | | |
| Green-tailed Towhee (*Oberholseria chlorura*) | *tn | | | *tn | | | * n |
| Pacific Black-headed Grosbeak (*Zamelodia m. capitalis*) | *tn | | * n | | * n | * n | |
| Lazuli Bunting (*Passerina amœna*) | *tn | | * n | * n | * n | | |
| Western Tanager (*Piranga ludoviciana*) | * n | *tn | *tn | *tn | * n | * n | * n |
| Western Martin (*Progne s. hesperia*) | * n | | | * n | | | |
| Cliff Swallow (*Petrochelidon l. lunifrons*) | | | * n | | * n | | |
| Barn Swallow (*Hirundo erythrogaster*) | | | * n | * n | * n | | |
| Tree Swallow (*Irodoprocne bicolor*) | * n | | * n | *tn | | | |
| Cedar Waxwing (*Bombycilla cedrorum*) | | | * | *t | | | |
| Western Warbling Vireo (*Vireosylva g. swainsoni*) | *tn | | *tn | * n | * n | * n | * n |
| Cassin's Vireo (*Lanivireo s. cassini*) | *tn | *tn | * n | *tn | * n | *tn | * n |
| Calaveras Warbler (*Vermivora r. gutturalis*) | *tn | *tn | | | | *tn | *tn |
| California Yellow Warbler (*Dendroica æ. brewsteri*) | *tn | | *tn | * n | * n | * n | |
| Audubon's Warbler (*Dendroica a. auduboni*) | *t | *tn | | *tn | | *tn | |
| Black-throated Gray Warbler (*Dendroica nigrescens*) | *t | | * n | *tn | | *tn | * n |
| Hermit Warbler (*Dendroica occidentalis*) | | *tn | | | | *tn | * n |
| Macgillivray's Warbler (*Oporornis tolmiei*) | *t | | *tn | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Western Yellowthroat (*Geothlypis t. occidentalis*) | | | *tn | | | | |
| Long-tailed Chat (*Icteria v. longicauda*) | * | | *tn | | * n | | |
| Golden Pileolated Warbler (*Wilsonia p. chryseola*) | *t | *tn | * n | | | | |
| American Dipper (*Cinclus m. unicolor*) | | * n | | | | | * n |
| Rock Wren (*Salpinctes o. obsoletus*) | | | | *tn | | | |
| San Joaquin Wren (*Thryomanes b. drymœcus*) | | | *tn | | * n | | |
| Western House Wren (*Troglodytes a. parkmani*) | *tn | * n | *tn | *tn | | *tn | * n |
| Sierra Creeper (*Certhia f. zelotes*) | | *tn | | *tn | | * n | * n |
| Slender-billed Nuthatch (*Sitta c. aculeata*) | | | | *tn | | * n | |
| Red-breasted Nuthatch (*Sitta canadensis*) | | *tn | | | | *tn | *tn |
| Pygmy Nuthatch (*Sitta p. pygmæa*) | *tn | *tn | * n | *tn | | * n | * n |
| Mountain Chickadee (*Penthestes g. gambeli*) | * n | *tn | | *tn | | * n | * n |
| Pallid Wren-tit (*Chamæa f. henshawi*) | | | | | * n | * n | |
| Coast Bush-tit (*Psaltriparus m. mimimus*) | *tn | | | | *tn | | |
| Western Golden-crowned Kinglet (*Regulus s. olivaceus*) | | *tn | | | | | |
| Ruby-crowned Kinglet (*Regulus c. calendula*) | | *tn | | * n | | * n | |
| Townsend Solitaire (*Myadestes townsendi*) | | *tn | | | | | *tn |
| Russet-backed Thrush (*Hylocichla u. ustulata*) | *tn | | *tn | *tn | | | * n |
| Olive-backed Thrush (*Hylocichla u. swainsoni*) | * | | | | | | |
| Dwarf Hermit Thrush (*Hylocichla g. nana*) | | *t | | | | | |
| Sierra Hermit Thrush (*Hylocichla g. sequoiensis*) | | | | | | *tn | |
| Western Robin (*Planesticus m. propinquus*) | *tn | *tn | * n | * n | * n | * n | * n |
| Western Bluebird (*Sialia m. occidentalis*) | * n | *tn | * n | *tn | | *tn | |
| Mountain Bluebird (*Sialia currucoides*) | | | | *tn | | | |

Note.—The Stewart's Springs list includes some species taken a short distance above, in the Canadian Zone.

The Yosemite Fox Sparrow recorded from Bray was taken on Mt. Orr, at several hundred feet higher elevation.

The list from Yreka is by no means complete as the species herein listed were noted only in passing through, no collecting having been done there.

Total number of species listed herein, 109.

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VI

# Preliminary Diagnoses of New Species of Reptiles from Islands in the Gulf of California, Mexico

BY

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AND

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*Assistant Curator, Department of Herpetology*

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VI

# PRELIMINARY DIAGNOSES OF NEW SPECIES OF REPTILES FROM ISLANDS IN THE GULF OF CALIFORNIA, MEXICO

BY

JOHN VAN DENBURGH
*Curator of the Department of Herpetology*

AND

JOSEPH R. SLEVIN
*Assistant Curator of the Department of Herpetology*

The following brief characterizations of new species of lizards and snakes are based upon specimens secured by an expedition sent by the California Academy of Sciences to the Gulf of California. Paratypes of all the lizards are at hand, but the snakes are known only from single specimens. The results of the expedition will be published in detail later, but it seems desirable to print these diagnoses of new species without delay.

**Crotaphytus insularis,** new species

*Diagnosis.*—Similar to *C. collaris baileyi* but with head narrower and snout much more elongate; black collar a single band.

*Type.*—California Academy of Sciences No. 49151; adult, collected by Joseph R. Slevin on the east coast of Angel de la

Guardia Island seven miles north of Pond Island, Gulf of California, Mexico, May 3, 1921.

**Cnemidophorus bacatus,** new species.

*Diagnosis.*—Structurally similar to *C. tessellatus,* but coloration very distinct. Upper surfaces brown or dark gray, shading to blackish on the hind limbs, with small, discrete, more or less equidistant, sometimes black-edged whitish spots or ocelli on the sides and back of body, hind limbs and base of tail. All lower surfaces black. No longitudinal markings at any age. Femoral pores 16 to 20.

*Type.*—California Academy of Sciences No. 49152; collected by Joseph R. Slevin on San Pedro Nolasco Island, Gulf of California, Mexico, April 17, 1921.

**Cnemidophorus canus,** new species.

*Diagnosis.*—Similar to *C. martyris* but much paler and with black suffusion restricted to the central subcaudal scale rows and the distal part of the tail. Upper surfaces light gray or brown with very indistinct fine dark gray reticulations on the body and hind limbs. No longitudinal markings. Lower surfaces of head, body and limbs bluish gray, often with a few minute black dots on the throat and a little black about the edges of the large plates on the chest, belly and limbs. Femoral pores 16 to 20.

*Type.*—California Academy of Sciences No. 49153; collected by Joseph R. Slevin on Sal Si Puedes Island, Gulf of California, Mexico, May 9, 1921.

**Cnemidophorus dickersonae,** new species.

*Diagnosis.*—A member of the *C. tessellatus* group somewhat intermediate in coloration between *C. t. stejnegeri* and *C. melanostethus,* having the yellowish brown dorsal ground color of the former and black gular and thoracic suffusion of the latter.

Dorsal longitudinal markings less evident than in either, and sides dark brown or black with whitish spots or transverse bars. It thus resembles *C. estebanensis,* but the pattern is quite different.

*Type.*—California Academy of Sciences No. 49154; collected by Joseph R. Slevin, on Isla Partida, near Angel de la Guardia Island, Gulf of California, Mexico, April 22, 1921.

**Verticaria picta,** new species.

*Diagnosis.*—Similar in size and form to *Verticaria hyperythra,* but with no dorsal longitudinal stripes. Lateral light stripes absent or very faintly indicated except on side of head. Back unicolor, ashy or brownish gray. Lower surfaces bluish white or blue. Adults with a brick-red lateral longitudinal band, absent in young. Young with light blue tails.

*Type.*—California Academy of Sciences No. 49155; collected by Joseph R. Slevin on Monserrate Island, Gulf of California, Mexico, May 25, 1921.

**Chilomeniscus punctatissimus,** new species.

*Diagnosis.*—Similar to *Chilomeniscus cinctus,* but with each scale of the white cross-bands marked with a dark brown central spot. Scale rows 13. Gastrosteges 121. Urosteges 23c. Black bars on body 32; on tail 7.

*Type.*—California Academy of Sciences No. 49156; young female, collected by Joseph C. Chamberlin, on Isla Partida, Espiritu Santo Island, Gulf of California, Mexico, May 31, 1921.

**Coluber barbouri,** new species.

*Diagnosis.*—Similar to *Coluber lateralis* but without dark markings on lips, chin and throat; lateral line pure white; labials, chin, throat and anterior gastrosteges white, more or less suffused with coral pink; rest of lower surfaces yellowish white. Slight enlargements of the white lateral line at intervals of from four to seven scales on the anterior half of the body are slightly suggestive of the color pattern of *C. aurigulus.* Scale rows 17. Gastrosteges 193. Urosteges 130+.

*Type.*—California Academy of Sciences No. 49157; adult female, collected by Joseph R. Slevin on Isla Partida, Espiritu Santo Island, Gulf of California, Mexico, May 30, 1921.

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VII

# NEW CALIFORNIAN SPIDERS

BY

NATHAN BANKS

The following new species of spiders are from a collection sent by the California Academy of Sciences to Mr. Emerton and myself for identification. Most of the material was taken by Mrs. E. P. (Helen) Van Duzee during the past few years and forms a part of the collections of the California Academy of Sciences where the holotypes are deposited. Paratypes are in the Museum of Comparative Zoology at Cambridge, Mass.

## 1. **Psilochorus apicalis,** new species

Very similar in general to *P. californiæ*. It differs in that in the male the tooth on the mandible in front is near the lower end and reaches to the tip of the mandible and is barely raised above the surface. In color it is pale yellowish, the cephalothorax with a median dark stripe, forked in front; the tips of the femora show very faintly a dark apical band; the abdomen is gray; of the same size as *P. californiæ*.

Figure 1.—Side view of manible.

*Holotype*, male, No. 737, Mus. Calif. Acad. Sci.; John I. Carlson collector.

*Type locality*, Sierra Madre, Los Angeles Co., Calif.

2. **Lathys hirsutipes,** new species

Cephalothorax yellowish brown, paler behind; mandibles reddish brown, in male rather long and but little divergent, with a few teeth on the inner edge and on front with small granules at bases of the hairs; sternum yellow brown; legs yellowish, unmarked. Abdomen gray, more or less plainly marked with small blackish streaks and patches. Posterior eyes subequal, and at about equal distances apart, the quadrangle of M. E. as long as wide behind. The cephalothorax with few, not especially long, hairs; longer ones on the abdomen, and the legs with especially long hairs and numerous short hairs; those on the tibiæ often three times the diameter of the joints. Length, male, 4 mm.

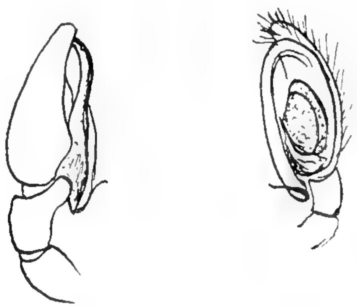

Figure 2.—*Male palpi.*

*Holotype,* male, No. 738, Mus. Calif. Acad. Sci.; Helen Van Duzee collector, May 27, 1918.

*Type locality,* Sacramento, Calif.

3. **Gayenna aperta,** new species

Cephalothorax yellow brown, dark marks on each side forming broken stripes; abdomen gray, with dark spots and streaks above; the venter with only a few dark marks; legs yellowish brown or paler, with dark dots at bases of some of the spines and bristles. Structure as usual; tibiæ I and II with three pairs of spines beneath, basal, median and apical; metatarsi I and II with long subapical spines and very short preapical ones. The vulva shows a spear-shaped opening in the middle, and a dark rim, widely curved each side, and nearly meeting behind where they bend back to the margin. Length, female, 6.8 mm.

A female from Olympia, Washington (Kincaid), M. C. Z., and some not quite mature from Cazadero and San Francisco, California (Helen Van Duzee).

Figure 3.—*Vulva*

*Holotype*, female, No. 739, Mus. Calif. Acad. Sci.; Helen Van Duzee collector, April 13, 1918.

*Type locality*, Cazadero, California.

4. **Agroeca hesperia,** new species

Similar to *A. ornata* in most respects. The cephalothorax and abdomen with the usual marks, two dark stripes on the venter; sternum of male with faint dark marks on the sides; legs yellowish to yellow brown, femora showing faint dark bands. The vulva shows a median pear-shaped outline, each side behind being darker, but the narrowed part not nearly as long as in *A. ornata*, nor widened behind. The male palpus has a long, stout process on the outer tip of the tibia, and a long curved style at tip of palpal organ. Length, male, 8.5 mm.; female, 11 to 12 mm.

Specimens from Sacramento, Mount St. Helena, and Santa Barbara, Calif.

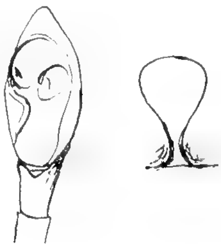

Figure 4.—*Male palpus, and vulva*

*Holotype*, male, No. 740, Mus. Calif. Acad. Sci.; Helen Van Duzee collector, May 27, 1918.

*Type locality*, Sacramento, Calif.

5. **Dendryphantes helenæ,** new species

Cephalothorax red-brown with short white hairs; mandibles not prominent, with a line of white hair in front; abdomen red-brown above with a white band around; venter gray; legs pale, not distinctly banded. The female has the cephalothorax rather paler, with more gray hair; abdomen dark gray above, pale on the sides, in the middle of the front part with a broad pale spot or a double elongate spot, in appearance similar to *D. æneolus*. Venter with two or three dark stripes. The palpus of the male is similar to that of *D. arizonensis* (and *glacialis*) but the palpal organ is more slender, the tube stouter and broad at tip (not pointed as in *arizonensis*), and the bifid process of the tibia has the outer part plainly longer than the inner (in *arizonensis* they are equal). The vulva shows two large openings much as in *D. glacialis* but they are less than their diameter apart, and behind is the usual median notch. Length, 6 mm.

Figure 5.—*Male palpus, and vulva.*

*Holotype*, male, No. 741, Mus. Calif. Acad. Sci.; Helen Van Duzee collector, April 7, 1918.

*Type locality*, San Francisco, Calif.

6. **Pellenes peckhami,** new species

Male:—Cephalic area and dorsum of abdomen clothed with appressed tawny or golden hair; other longer, erect, black hairs; on basal part of abdomen there is more or less trace of a median white line; sides of abdomen white-haired; sides of the cephalothorax with short white hair, and a faint line of white just below dorsal eyes; a row of long black hairs over front eye-row; clypeus and mandibles tawny, with very short white hair; legs paler, tibiæ rather darker, leg III unmodified; leg I reddish brown, metatarsi and tarsi paler, a long fringe below on outer part of femur, patella and tibia, and above on femur, patella and tibia; largely black below, largely pale above, but the basal section of tibia black; the inner side of tibia is black and densely clothed with black hair; tarsus of the palpus reddish, with short, white hair, the palpal organ very broad, much as in *P. elegans*. Length, 5 mm. Differs from *elegans* in absence of white median stripe on abdomen, and the denser, more variegated fringe to leg I.

Specimens from San Francisco and Los Baños, California (E. P. Van Duzee).

*Holotype*, male, No. 742, Mus. Calif. Acad. Sci.; E. P. Van Duzee collector, May 23, 1921.

*Type locality*, Los Baños, Calif.

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VIII

# UNDESCRIBED TIPULIDÆ (DIPTERA) FROM WESTERN NORTH AMERICA, PART II

BY

CHARLES P. ALEXANDER, Urbana, Illinois

The first part under this title appeared in 1920 (Proc. Cal. Acad. Sci., ser. 4, vol. X, no. 5, pp. 35-46). The few additional species that were included in the 1920 collections of crane-flies are discussed at this time. The types of all the species are contained in the collection of the California Academy of Sciences. I am indebted as heretofore to the collector, Mr. E. P. Van Duzee.

Subfamily Limnobiinæ
Tribe Eriopterini
Genus *Rhabdomastix* Skuse
Subgenus *Sacandaga* Alexander

## 1. **Rhabdomastix (Sacandaga) californiensis,** new species

Antennæ black; head dark, yellowish gray pruinose; pronotum light yellow with a narrow dark brown median line; mesonotum yellowish gray, the præscutum with four narrow dark brown stripes; pleura grayish plumbeous, variegated and striped with yellowish; halteres pale; wings grayish subhyaline; stigma pale brown; vein *Sc* long; $R_2$ moderately long, from one-third to nearly one-half $R_{2+3}$; abdomen dark brown, the segments indistinctly and narrowly ringed with paler.

Male.—Length, 4.6 mm.; wing, 5.6 mm.

Rostrum and palpi dark brown. Antennæ black, the first scapal segment grayish pruinose; flagellar segments oval, the more distal ones long-cylindrical. Head dark brown, heavily light gray pruinose.

Pronotum conspicuous light yellow with a narrow dark brown median line. Mesonotal præscutum yellowish-gray with four narrow and rather indistinct dark brown stripes, the intermediate pair longest, only narrowly separated from one another; pseudosutural foveæ conspicuous, black; scutum and postnotum light gray pruinose; scutellum brown, grayish pruinose, the caudal margin broadly yellowish. Pleura grayish plumbeous, variegated with yellowish; a conspicuous yellowish longitudinal stripe crossing the dorsal margin of the sternum, above the legs, passing ventrad in front of the posterior coxæ. Halteres pale. Legs with the coxæ obscure yellow, the outer faces slightly infuscated; trochanters pale; remainder of the legs pale brown, the tarsi dark brown. Wings grayish subhyaline; stigma oval, pale brown; veins dark brown. Venation: $Sc$ ending from two-thirds to three-fourths the length of the long sector, $Sc_2$ far from the tip of $Sc_1$, the latter alone being a little longer than the basal deflection of $Cu_1$; $R_{2+3}$ comparatively short, from two to two and one-half times $R_2$ alone; $r$ lacking; basal deflection of $Cu_1$ at about one-fourth the length of cell *1st* $M_2$; vein *2nd A* but slightly sinuous.

Abdomen dark brown, the caudal margins of the segments narrowly and indistinctly ringed with paler.

In its venation, *Rhabdomastix californiensis* agrees more closely with the type of the subgenus, *R. flava* (Alex.) than it does with *R. monticola* (Alex.) of British Columbia. *Gonomyia galactoptera* Bergr. of Alaska is a member of this genus and subgenus.

*Holotype*, male, No. 743, Mus. Calif. Acad. Sci.; E. P. Van Duzee collector, May 22, 1920.

*Type locality*, Pleyto, Monterey County, Calif.

Tribe Hexatomini

The writer has explained in another paper (The Crane-flies of New York, Part 2, Biology and Phylogeny. Cornell Univ. Agr. Expt. Sta., Memoir 38, p. 835, 1921) the necessity for uniting the former tribes Limnophilini and Hexatomini.

Genus *Limnophila* Macquart

2. **Limnophila pteropœcila,** new species

General coloration, shiny dark brownish-black; halteres pale;

femora brownish yellow, tipped with dark brown; wings pale yellowish, conspicuously variegated with brown on the cross-veins and deflections of veins; cell *1st* $M_2$ long and narrow, $m$ being one-half longer than the basal deflection of $Cu_1$.

Female.—Length about 8.8 mm.; wing, 9.3 mm.

Rostrum and palpi brownish-black. Antennæ dark brownish-black throughout, the first scapal segment elongate-cylindrical. Head shiny dark brown, sparsely pruinose, strongly narrowed posteriorly, the eyes protuberent.

Thorax shiny dark brown, very sparsely grayish yellow pruinose, without stripes. Pleura dark brown, sparsely pruinose. Halteres pale throughout. Legs with the coxæ and trochanters obscure yellow; femora brownish yellow, tipped with dark brown; tibiæ light brown, tipped with dark brown; tarsi dark brown. Wings with a strong yellowish tinge; cells $C$ and $Sc$ more saturated; a conspicuous brown pattern, arranged as follows: A brown spot at the origin of $Rs$; a conspicuous seam along the cord, extending from the tip of $Sc$ to the fork of $M$; $Cu$ and the deflection of $Cu_1$ seamed with brown; outer end of cell *1st* $M_2$ similar; a brown spot at $r$ and a smaller one at the fork of $M_{1+2}$; veins dark brown, paler in the saturated areas. Venation: $Sc$ long, $Sc_1$ ending about opposite the fork of $R_{2+3}$, $Sc_2$ at the extreme tip of $Sc_1$, a little longer than $r$-$m$; $Rs$ rather long, almost straight, arcuated at origin; $R_{2+3}$ rather short, from one to two times as long as $r$-$m$; $r$ at the tip of $R_1$ and on $R_2$ beyond midlength; inner ends of cells $R_3$ and $R_5$ in alignment; cell *1st* $M_2$ very long and narrow, its inner end conspicuously arcuated; $m$ very long and slightly arcuated, about one-half longer than the basal deflection of $Cu_1$ and nearly three times the outer deflection of $M_3$; cell *1st* $M_2$ much longer than vein $M_3$ beyond it and longer than the petiole of cell $M_1$; cell $M_1$ shorter than its petiole; basal deflection of $Cu_1$ about its own length beyond the fork of $M$; distal section of $Cu_1$, beyond cell *1st* $M_2$, about equal to $m$.

Abdomen dark brownish black, the pleural membranes paler. Ovipositor with the valves horn-colored, the dorsal shield shiny black; tergal valves of the ovipositor strongly compressed.

It is possible that *Limnophila pteropœcila* is more correctly referable to *Dactylolabis* but this is uncertain. The fly differs strikingly from all other known species in the Nearctic fauna.

*Holotype*, female, No. 744, Mus. Calif. Acad. Sci.; E. P. Van

Duzee collector, July 1, 1920.

*Type locality*, Forks, Clallam Co., Washington.

Subfamily Tipulinæ

Tribe Tipulini

Genus *Tipula* Linnæus

3. **Tipula optiva,** new species

Antennæ of male elongated; head and thorax gray, the præscutum with three brown stripes; femora yellow, the tips dark brown; wings grayish yellow; abdomen yellow, the tergites with a conspicuous black median stripe; segments eight and nine, black; male hypopygium with a conspicuous, pale, shovel-shaped median lobe on the caudal margin of the eighth sternite.

Male.—Length, 14.5 mm.; wing, 14 mm.; antenna about 8 mm.

Frontal prolongation of head brownish-yellow; palpi dark brown, passing into black at tip. Antennæ of male elongated, if bent backward, extending about to base of fourth abdominal segment; scapal segments yellow; first flagellar segment yellowish-brown; remainder of flagellum black; flagellar segments elongate, constricted at midlength, the apical node longer than the basal enlargement. Head dull gray; two buffy spots on the occipital region.

Mesonotum buffy gray, the præscutum with three dark brown stripes, the median stripe narrowly bisected behind; scutum gray, the centers of the lobes darker; scutellum light brown; postnotum light gray. Pleura light gray pruinose, the dorso-pleural membrane more buffy. Halteres pale brown, the knobs dark brown. Legs with the coxæ gray; trochanters yellow; femora yellow, the tips conspicuously dark brown; tibiæ dark brown, passing into black at the tips; tarsi black. Wings with a strong grayish yellow tinge; wing-base and cells *C* and *Sc* more yellowish; stigma oval, brown; veins dark brown. Venation: *Rs* gently arcuated, shorter than $R_3$; cell *1st* $M_2$ elongated; *m* parallel with the basal deflection of $M_{1+2}$; petiole of cell $M_1$ about equal to *m; m-cu* punctiform, a short distance beyond the fork of *M*.

Abdominal tergites yellow, segments two to seven with a narrow but conspicuous black dorso-median stripe that is narrowly interrupted at the posterior margin of the segments; tergites eight and nine black; an indistinct brown sublateral line;

sternites yellow, the eighth segment black with the conspicuous median lobe light yellow; ninth sternite brownish black. Male hypopygium with the posterior margin of the ninth tergite produced into a flattened ledge with a very broad and shallow V-shaped notch, the margins rugulose, sparsely setiferous, the lateral angles short and subacute. Ninth pleurite small but complete; outer pleural appendage very long and narrow, broadest just beyond the base, tapering gradually to the blunt apex. Ninth sternite very broadly membranous beneath; dorso-caudal angle produced proximad and slightly dorsad into cylindrical reddish lobes that are clothed with reddish setæ. Eighth sternite with a conspicuous shovel-shaped median lobe that is broadest at the base, narrowed to the apex, the narrow caudal end weakly emarginate.

Superficially, *Tipula optiva* bears a considerable resemblance to *T. taughannock* Alexander (Eastern North America). The structure of the hypopygium, however, indicates that it is, in all probability, a member of the *arctica* group, allied to *T. subarctica* Alexander, *T. pribilofensis* Alexander, and other species.

*Holotype*, male, No. 745, Mus. Calif. Acad. Sci.; E. P. Van Duzee collector, July 9, 1920.

*Type locality*, Northbend, King County, Washington.

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IX

# DESCRIPTION OF A NEW SPECIES OF PERO FROM CALIFORNIA

BY

W. S. WRIGHT, San Diego, California

**Pero vanduzeeata,** new species

Alar expanse 46 mm. (measurement made from center of thorax to apex of each wing and added).

Head black with tinges of brown; thorax mouse-colored; abdomen gray with black cross-stripes dorsally at the joints; palpi concolorous with the head; antennæ brown, slightly lighter in color than the head.

Above: Primaries rather sordid-white ground-color; basal area to first line black, preceded by a fine white hair line perpendicular to costa, or nearly so, at one-third from base, which after reaching the cell, curves rather broadly to median vein whence it runs in a straight course to inner margin at the middle; whole line subcrenulate, with a rather sharp outward bend between vein I and inner margin. Median area black, with little of the ground-color apparent, a little wider on costa than distance from base to first line, rather suddenly narrowing below the cell to half the costal width. Second line black, rather broadly sinuate with fine white hair-line beyond. Terminal space somewhat lighter than basal area, broken into two rather indefinite bands, the outer darker and having a rounded inner edge commencing just below the apex and sweeping to anal angle; a dark patch of same color on inner margin between anal angle and second line. Discal dot white, linear, transverse, and slightly angled in the center. Secondaries sordid white, heavily sprinkled with black. Discal dot black, faintly apparent.

Cross-line dark, with white hair line outwardly, strongly sinuous from just within the anal angle in a generally straight course to a little less than one-third in from apex.

Beneath: Primaries smoky with scattered black atoms along the costa and on the disk; white discal dot conspicuous. Secondaries: as above, but a little lighter; discal dot more conspicuous, cross-line less so.

This species is quite remarkable for the almost absolute absence of brown color. In only one of the three specimens before me is there any indication of other color than black and white, except as stated. Paratype No. a, shows slight tinges of rufous in the outer area of the primaries both above and below. In this specimen the median area expands a little on the inner margin. Paratype No. b, has more the appearance of *behrensarius* Grossbeck.

The species is closely related to *behrensarius* Grossbeck, and may prove to be a form or race of that species. Its greater expanse and general lack of brown color seem to set it apart and make it worth a name.

It is through the courtesy of Mr. E. P. Van Duzee that I am privileged to describe this species, and a sense of gratitude prompts me to dedicate this new species to him.

*Holotype*, male, No. 746, Mus. Calif. Acad. Sci.; E. P. Van Duzee collector, July 9, 1919.

*Paratypes*, male, a, Mus. Calif. Acad. Sci., collected at Huntington Lake, Calif., July 20, 1919, by E. P. Van Duzee, and male, b, collection of W. S. Wright, collected at Mt. Lowe, Calif., July 11, 1918, by E. Piazza.

*Type locality*, Huntington Lake, Calif.

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X

# CHARACTERS OF SOME NEW SPECIES OF NORTH AMERICAN HEMIPTEROUS INSECTS, WITH ONE NEW GENUS

BY

EDWARD P. VAN DUZEE
*Curator, Department of Entomology*

## 1. Brochymena hoppingi, new species

Allied to *affinis* and with the same winged form of male genital segment, but with shorter head and shorter second antennal segment; nearly black with the pronotal margins roundedly crenulate. Length, male 12; female, 14 mm.

Male: Head slightly longer than broad across the eyes; cheeks overlapping tylus, sometimes almost contiguous at apex; subapical angle obtuse or rounded; second antennal segment two-thirds length of third. Sides of pronotum with about five rounded teeth on anterior lobe, the humeral lobe rounded anteriorly as in *affinis* but scarcely crenulate, humeral angle less prominent; surface deeply puntured and sculptured, the callosities more prominent than in *affinis*. Scutellum a little shorter, scarcely raised at base, median line subcarinate, surface more deeply pitted than in *affinis*. Elytra closely and quite evenly punctured with a few smooth calloused points. Rostrum passing middle of third ventral segment; venter nearly smooth with small, scattering obsolete punctures, sulcus shallow but obvious. Genital segment greatly extended either side as in *affinis*, their apices distinctly surpassing line of sixth abdominal segment, hind margin heavily bearded.

Color, mostly black, the testaceous interspaces less conspicuous, lateral crenulations of pronotum rufous; membrane with but few pale vermiculate marks; femora with pale subapical mark and median annulus more or less distinct; antennal incisures very narrowly rufous; connexivum with small marginal spots and the incisures rufous, the median line of the venter narrowly rufous.

Female: Larger with pale markings a little more conspicuous, especially near apex of scutellum and on venter.

Described from five male and five female examples taken by Mr. Ralph Hopping from beneath bark of a dead conifer in Vallecito, Co., Colorado, April 18, 1919. This species is quite distinct by its almost uniform dull black color. It differs from all our other species except *affinis* by the great lateral extension of the male genital segment.

It affords me pleasure to dedicate this interesting form to my friend, Mr. Ralph Hopping, in recognition of the valuable services he has rendered to entomology by his researches in forest insects.

*Holotype,* male, No. 749, and *allotype,* female, No. 750 Mus. Calif. Acad. Sci. A *paratype,* male, has been deposited in the Canadian National collection at Ottawa, at the request of Mr. Hopping. Other *paratypes* are in the Academy's collection.

*Type locality,* Vallecito County, Colorado.

### 2. **Trichopepla pleyto,** new species

Allied to *californica* but with broader pronotum and finer, concolorous punctures. Length 6 mm.

Head as in *californica,* with the cheeks more narrowed at apex and the whole surface more finely evenly punctured. Pronotum broader and flatter than in its ally, its width 2⅓ times its greatest length (two times in *californica*), surface closely, finely punctured, omitting an irregular, incomplete, transverse vitta between the humeri, the callosities smooth; sides broadly expanded, flattened or slightly reflexed anteriorly, more oblique than in *californica* and slightly more arcuate; scutellum and elytra closely punctate. Antennæ, segment II a fourth longer than III and subequal to IV, V longest, II to IV becoming consecutively thicker. Rostrum attaining base of hind coxæ; segment II equal to III and IV together; osteolar canal long, flat and obtuse at apex. Male genital segment deeply excavated, its lateral angles truncate; this sinus in *californica* more shallow and trisinuate. Whole surface clothed with scattering long pale hairs.

Color, pale testaceous slightly varied with fulvous-brown, most conspicuous being a cloud on disk of corium, a short vitta either side on pronotum, a longer one within the lateral margins, a faint cloud either side on base of scutellum including a pale point, an indefinite vitta either side the pale median line of head and a narrow one within the margins of the cheeks. Usually there is a piceous cloud behind the calli and another on the anterior angle of pronotum. Beneath slightly clouded, but without distinct ventral vitta; tibiæ and tarsi a little darker; antennæ beyond middle of segment II blackish; membrane hyaline, showing the brown surface of the tergum; connexivum indistinctly alternated.

Described from two males taken at Pleyto, Monterey Co., California, May 21, 1920, one male from Bradley, Monterey Co., May 17, 1920, and four from Bryson, Monterey Co., May 19, 1920. The finer, almost concolorous puncturation and broader flattened form give this insect much the aspect of a Carpocoris, but it has the longer osteolar canal of Trichopepla. Stål says this genus has the canal short and abrupt but this is true only when compared with such genera as Thyanta. He fails to compare his genus with Carpocoris with which it is closely allied.

*Holotype,* male, No. 751, and *allotype,* female, No. 752, Mus. Calif. Acad. Sci. *Paratypes* also are in the Academy's collection.

*Type locality,* Pleyto, Monterey Co., Calif.

### 3. **Tollius quadratus,** new species

Allied to *setosus* but with the antennæ more slender, the hairs clothing the body longer, the colors darker and more uniform, and the male claspers very differently formed. Length 9 mm.

Head obviously shorter and less produced before the eyes than in *setosus.* Antennæ more slender throughout with the first segment less incrassate than in the allied form and the fourth segment proportionately longer. Long hairs on the face arranged in three longitudinal bands as in the two allied species. Pronotum shorter than in *setosus,* its basal width one-fifth greater than the median length. Rostrum more slender, the basal segment nearly attaining base of gula (distinctly shorter in *setosus*), its apex reaching to the intermediate coxæ. Male claspers nearly quadrate, perhaps a little longer than broad, their inner margin converging somewhat apically and right-angled at apex, and armed with an almost terete projection at their outer angle which is nearly as long as the apical width of the clasper and a little oblique.

Color, grayish-brown, sparsely mottled with fuscous; vertex, neck and callosities infuscated; median line and sides of the face and two divergent vittæ on the neck dull castaneous; scutellum blackish with the basal angles and apex pale; membrane faintly mottled; beneath and legs dark castaneous varied with paler; tibiæ and tarsi, except at apex, pale; antennæ pale with first and fourth segments piceous beneath. Whole body evenly clothed with long stiff black hairs and minute pale pubescence.

Described from one male taken by R. Mead at Monmouth, Fresno Co., California, late in August, 1915, and kindly sent to me for study by Dr. H. M. Parshley. The very characteristic male claspers with the shorter head and more slender antennæ makes the recognition of the male of this species a simple matter.

*Holotype,* male, No. 753, Mus. Calif. Acad. Sci.

*Type locality,* Monmouth, Fresno Co., Calif.

### 4. **Ischnodemus macer**, new species

Allied to *præcultus,* a little longer with shorter rostrum and black sericeous venter; black, basal three segments of antennæ, rostrum and legs fulvo-testaceous; elytra short, fuscous with pale costa and membrane. Length 4-6 mm.

Antennæ but little shorter than median line of head and pronotum together; segment I little longer than wide, attaining apex of tylus; II as long as anterior width of pronotum; III a little shorter than II, fusiform. Rostrum arched in all specimens before me but apparently reaching nearly to anterior coxæ; segment IV not longer than II; anterior femora more expanded than in *falicus,* its inner margin ciliate and armed at apical fourth with a short sharp tooth. Pronotum with a broad transverse minutely punctured area before the hind margin and an obvious sulcate median line on the anterior lobe. Elytra abbreviated, tip of corium attaining apex of first tergal segment; membrane ovate, reaching to middle of second segment, veins obscure.

Color, black, nearly opaque, clothed with minute sericeous scale-like pubescence and some longer gray hairs; hind margin of pronotum sometimes tinged with castaneous; antennæ, rostrum and legs fulvo-testaceous or at times almost castaneous; apical segment of antennæ black; elytra fuscous with costa pale yellowish and membrane white; connexival margins faintly castaneous.

Described from one male and two female examples taken by Mr. A. Koebele at Nogales, Arizona, September, 1906. In my own collection is one male taken by the late Prof. F. H. Snow on the Santa Rita Mountains, Arizona, which differs only in having the hind margin of the pronotum castaneous. This specimen was listed by me as *præcultus* Dist. ?, in 1909 (Can. Ent., xli, p. 375) but it undoubtedly is distinct and specifically identical with those described above.

*Holotype,* male, No. 754, and *allotype,* female, No. 755, Mus. Calif. Acad. Sci. *Paratype* in Koebele collection.

*Type locality,* Nogales, Arizona.

### 5. **Plinthisus martini**, new species

Minute, piceous or black, moderately polished; hind margin of pronotum castaneous; antennæ at base, rostrum and legs, honey-yellow; brachypterous elytra truncate, with the corium and clavus connate, the latter confused punctate. Length scant 2 mm.

Head two-thirds as wide across the eyes as basal width of pronotum; eyes small, contiguous to pronotum; rostrum slender, attaining hind margin of metasternum; segment I attaining base of head, II and III subequal, each longer than I. Antennæ slender; segment I scarcely surpassing apex of head, III and IV subequal, fusiform, and with the apex of II sparsely pilose. Pronotum about a fifth broader than long, moderately convex, minutely punctate near the hind margin; sides about parallel, very obsoletely sinuated posteriorly, carinate with a concentric groove beneath; anterior angles rounded. Elytra in type material brachypterous, truncate at apex, clavus and corium connate, their surface minutely confused punctate. Abdomen polished, minutely punctate; suture between third and fourth ventral segments straight and attaining margin of connexivum in female, slightly bent and becoming nearly obsolete on connexivum in male. Pleuræ polished, impunctate; osteolar canal slender, curved backward along hind margin of a broad opaque area. Anterior femora much dilated, unarmed, anterior tibiæ strongly curved and expanded at apex with the basal segment of its tarsus as long as the apical two together.

Color, head, pronotum and elytra piceous or almost black, the hind margin of pronotum slightly castaneous; abdomen brown, segment I and base of II paler; rostrum and legs honey-yellow.

Described from five males and three females taken at Redwood Canyon, Contra Costa Co., Calif., February 11, 1920, from nests of wood rats, by Mr. J. O. Martin, to whom this species is gratefully dedicated. In addition, two male paratypes were taken by Mr. Martin from Berkeley hills, August 28, 1919. This tiny species is interesting in showing a difference between the sexes in the course of the suture between the third and fourth ventral segments. I am unable to detect the posterior opaque spot on fourth segment but probably it is distant from anterior if present at all.

*Holotype,* male, No. 756, and *allotype,* female, No. 757, Mus. Calif. Acad. Sci.; *paratypes* also in the Academy's collection.

*Type locality,* Redwood Canyon, Contra Costa Co., Calif.

### 6. **Eremocoris semicinctus,** new species

Aspect of *obscurus* but larger and rougher punctate with long-setose hind tibiæ and concolorous base of elytra bordered only with pale in male, anterior femora with large teeth. Length 9 mm.

Male: Head a little longer than broad across the eyes; bucculæ not attaining base of antennæ, segment I of antennæ passing clypeus by two-thirds its length; II a third longer than I; III two-thirds of II; IV two-thirds of III; rostrum attaining base of hind coxæ, segment I slightly passing base of head, II fully equal to III and IV together; mesosternal groove deep, the angular elevated sides forming a roughened tubercle; osteolar canal long, a little less than right-angled. Pronotum large, parallel, its length and width subequal; constriction shallow, at basal fifth; anterior lobe long, unusually convex, obscurely punctate, posterior flat, coarsely punctured; collum linear, delimited by a row of punctures; explanate margins straight, narrow except across the constriction; hind margin broadly excavated. Scutellum broader than in *obscurus*: elytral punctures smaller than is usual; membrane complete. Anterior femora strongly incrassate, subsulcate beneath, the anterior edge armed with two large teeth, the apical the larger, and about three small ones either side the apical; anterior tibiæ much curved, armed with three teeth on the expanded apex, followed basally by about six small ones; hind tibiæ armed with numerous long erect stiff pale hairs.

Color, piceous black, becoming paler or more castaneous on antennæ, rostrum and legs, and slightly so on elytra, incisures of first antennal segment and base of second and third segments; tibiæ and tarsi honey-yellow; margin of pronotum for a space at middle and narrow costa to beyond tip of scutellum whitish; extreme tip of scutellum and spot on membrane at apex of corium pale.

Female: Brachypterous, darker, more roughly punctured, especially on anterior lobe of pronotum.

Described from one male taken by Dr. E. C. Van Dyke, July 24, 1910, at Paradise Valley, Kings River Canyon, Fresno Co., Calif., at an elevation of 7,000 feet, one female taken by Dr. Van Dyke on Cypress Ridge, near Fairfax, Marin Co., Calif., May 29, 1920, and another female taken by the writer at Fairfax, May 11, 1919. This is a much larger species than, and very different looking from, the eastern *ferus*, our only other species having the hind tibiæ setose in both sexes.

*Holotype*, male, No. 758, and *allotype*, No. 759, Mus. Calif. Acad. Sci.; a *paratype* also in the Academy collection.

*Type locality*, Paradise Valley, King's River Canyon, Fresno Co., Calif.

### 7. **Eremocoris dimidiatus**, new species

Allied to *ferus* but larger and more parallel in form; elytra castaneous-brown with base abruptly pale. Length 7mm.

Head shorter than in *ferus*, minutely punctured either side beyond eyes; segment II of antennæ nearly twice as long as I; III three-fourths of II, IV a little shorter than III; rostrum reaching middle of metasternum, segment I just passing base of head, II shorter than III and IV together. Pronotum about as long as its humeral width; sides parallel with anterior angles rounded; constriction near basal fourth; anterior lobe polished, impunctate, strongly convex; collum narrow, linear, strongly differentiated by a line of punctures; posterior lobe flat, coarsely punctured; expanded sides rather broad. Scutellum long, depressed, remotely punctured and transversely wrinkled. Clavus with usual four rows of punctures, the second broken and connate with third at base; membrane reaching tip of abdomen in type; Carinate posterior margin of prosternum forming an angle or obtuse carina across base of median tooth which is much bent inward between anterior coxæ; mesosternal sulcus deep, the tuberculate sides rough; osteolar canal broad and angled, the apex shorter than in allied species. Anterior femora shallowly sulcate beneath, the anterior edge with one large tooth and about five small ones either side, the basal larger; hind tibiæ with irregular long hairs along its inner face, the outer surface nearly smooth.

Color, black, dull on the scutellum but more or less polished elsewhere; tip of tylus, basal segment of antennæ, rostrum and legs honey-yellow; segments II to IV of antennæ and anterior femora darker or piceous; collum and posterior lobe of pronotum castaneous, the latter with humeral angles and two oblique discal rays blackish; expanded pronotal margins whitish edged with fuscous; elytra testaceous to tip of scutellum, then abruptly fuscous-brown veined with castaneous; membrane brown with base and veins pale, both outer and inner angles with a large oval white spot; hind margin of metapleuræ, acetabulæ and genital segment castaneous.

Described from one male taken by me at Sunset, Colorado, July 19, 1903, at an elevation of 8,000 feet. This species has a longer, more pointed and flatter scutellum than *obscurus* and the hind tibiæ are ciliate within but bare in *obscurus* where also the pale basal portion of the elytra is shorter and does not include the clavus as it does in *dimidatus*. *E. ferus* has the anterior lobe of the pronotum flatter and opaque, the hind tibiæ entirely ciliate and the scutellum shorter.

*Holotype,* male, in collection of the author.

*Type locality,* Sunset, Colorado.

### 8. **Eremocoris opacus,** new species

Shorter, broader and more opaque than in any of our other species. Length 6 mm.

Head a fourth broader across the eyes than long, shagreened but scarcely punctate, opaque at base, somewhat polished and clothed with appressed golden pubescence anterior to middle line of eyes. Basal segment of antennæ surpassing clypeus by a little more than half its length, segment II one-half longer than I; III and IV subequal, a little shorter than II. Pronotum almost a third wider than long, regularly narrowed anteriorly much as in *ferus,* moderately constricted at basal third, anterior lobe flattened as in *ferus,* nearly impunctate, dull black; collum narrow and distinct; expanded margins a little broader than in *obscurus,* armed by a single row of distant long hairs; posterior lobe coarsely punctured, hind edge less deeply excavated. Elytra more opaque than in *obscurus,* the expanded costa only a little polished; membrane complete, attaining apex of abdomen; scutellum a fourth broader than long; anterior femora of male about as in *obscurus,* armed with two strong teeth, the apical the larger, and about three small ones either side the apical large tooth; anterior tibiæ much curved and expanded at apex where there are two larger teeth and about four smaller ones placed basally from these; rostrum attaining middle of hind coxæ; segment I passing base of head, II subequal to III and IV together; mesosternal sulcus shallow, its sides scarcely tumid; osteolar canal right-angled; male genital segment feebly bi-tuberculate with a broad shallow apical sulcus.

Color, dull black becoming piceous or castaneous and polished on the antennæ, legs, rostrum and venter, paler on the rostrum, tibiæ and tarsi, darker on the anterior femora and venter; collum, posterior lobe of pronotum, clavus and corium behind tip of scutellum castaneous somewhat varied with obscure brown; expanded lateral margins of pronotum to the tumid humeri and base of costa and corium creamy white; membrane fuscous with a large oval white spot at apex of corium and the base and nervures paler; surface clothed with sparse, short appressed golden pubescence.

Described from one male taken by me at Keen Camp in the San Jacinto Mountains, at 4,800 feet, June 8, 1917, and one male taken by Dr. Charles von Geldern at Cisco, Calif., in July, 1911. The broad form, short scutellum and opaque surface will distinguish this among our species with smooth hind tibiæ.

*Holotype,* male, No. 760, Mus. Calif. Acad. Sci.; a *paratype,* male (von Geldern specimen) also in Academy's collection.

*Type locality,* Keen Camp, San Jacinto Mountains, Calif., at 4,800 feet.

9. **Megalocerœa koebelei,** new species

Paler than *debilis,* with antennæ and legs more hairy and the clypeus less prominent; pale testaceous with slender rosaceous line behind the eye attaining hind margin of pronotum, and a similar one inferiorly on the sides of pectus and venter. Length 6½ to 7 mm. to tip of venter.

Head as wide across the eyes as long from the basal constriction; a little narrowed behind the eyes so the latter do not quite touch the anterior angle of pronotum; vertex smooth, convex, slightly tumid above base of clypeus; median sulcus obsolete beyond the middle; clypeus very prominent and convex with deep sutures. Antennæ inserted close to anterior angle of eye; segment I as long as pronotum, cylindrical, becoming a little thinner on apical fourth; II nearly three times length of I and considerably thinner; III and IV successively thinner, III two-thirds length of II, IV one-half of III, I pale pilose, the hairs equal to thickness of III, II to IV subequal. Rostrum reaching on to second ventral segment, segment I attaining base of anterior coxæ. Pronotum two-thirds as long as wide, coarsely punctate; sides with a short obtuse carina behind collum, posteriorly ecarinate; callosities forming a narrow transverse ruga either side; median line obscurely carinate. Scutellum rugose-punctate, smooth at apex; basal lobe narrowly exposed, smooth. Elytra surpassing the abdomen, coarsely punctate, becoming smooth toward the costa. Male genital segment subacutely triangular; sinistral clasper slender, curved upward and acute at apex, the dextral short, blunt.

Color, yellowish luteous, a little deeper on head and scutellum; a longitudinal vitta behind the eye, fading out toward hind margin of pronotum, and another inferiorly nearly attaining apex of abdomen rosaceous or dark sanguineous, basal angles, depressed margins, and sometimes the median line of scutellum, sanguineous; antennæ rufous or rufo-piceous; tip of tibiæ and the tarsi blackish; eyes black; tergum with a sanguineous lateral vitta.

Described from one male and two female examples taken by Mr. A. Koebele at Nogales, Arizona, in September, 1906. This species should perhaps not be considered as congeneric with *gracilis* as the latter has the head longer and more depressed and the margins of the pronotum laminate, but in these respects *debilis* is nearly intermediate and is apparently more typical of the genus.

Named for Mr. A. Koebele who collected the specimens on which the description is based.

*Holotype,* male, No. 761, and *allotype,* female, No. 762, Mus. Calif. Acad. Sci.; a *paratype* in collection of Mr. Koebele.

*Type locality,* Nogales, Arizona.

### 10. Lygidea solivaga, new species

Smaller and paler than *rubecula;* color and aspect of a small Platylygus; fulvo-testaceous, in male marked with piceous on head and pronotum and tinged with rufous on elytra. Length 5½ to 6 mm.

Male: Head vertical, produced below the eye for a space equal to three-fourths length of eye; vertex much swollen, more prominent than in *rubecula,* polished, its base depressed and slenderly carinate; clypeus prominent, convex; rostrum somewhat surpassing hind coxæ. Pronotum shaped as in *rubecula,* the sides straight and ecarinate; surface more closely and finely punctate, Callosities prominent; scutellum minutely transversely rugose; vertex, pronotum and scutellum with a median smooth line indicated. Antennæ long, slender; segment I as long as head viewed from above; II 3½ times as long as I and nearly as thick, a little more slender at base; III and IV slender, together two-thirds length of II. IV nearly one-half of III. Elytra closely, minutely punctate. Sinistral male clasper small, but little wider at base, almost terete; dextral larger than sinistral, its superior angle somewhat produced and acute. Upper surface clothed with short, appressed pale hairs, more apparent on elytra.

Color, above fulvo-testaceous, paler on pronotum anteriorly and scutellum; head more fulvous with an oval piceous cloud either side anteriorly between the eyes; pronotum becoming fuscous toward sides and base, callosities polished black, collum and slender hind edge whitish, median line pale; scutellum with a brown cloud either side the pale median line, becoming piceous on basal lobe; elytra obscurely mottled with dull rufous, the apex of cuneus rufous; membrane faintly fuliginous with indications of a paler area at apex and smaller one either side; antennæ fuscous, segment I and immediate base of II and III pale; beneath piceous, polished, prosternum, margin of the pleuræ, osteolar region, coxæ and disk of venter yellowish; legs irrorate with rufous or brown, the base of femora pale.

Female: Fulvo-testaceous, almost uniform, base of pronotum more or less infuscated; antennæ slightly darker toward apex.

Described from four males and three females taken on pines on the summit of Mt. Eddy, Siskiyou Co., Calif., July 28, 1918.

*Holotype,* male, No. 763, and *allotype,* female, No. 764, Mus. Calif. Acad. Sci.; *paratypes* also in Academy's collection.

*Type locality,* summit of Mount Eddy, Siskiyou County, Calif.

### 11. **Neoborus illitus,** new species

Aspect of *amœnus scutellaris* but still darker; black, shaded and varied with fulvous and brown. Length 5½ mm.

Head vertical, produced below the eye for a space equal to length of eye; eyes unusually narrow, but little wider above; vertex with a large polished paler spot either side; depressed base and a spot against either eye, punctate; base strongly carinate; disk with faint arcs and a median sulcus; clypeus smooth, polished, its base poorly distinguished; cheeks tumid; pronotum broader anteriorly and more convex than in *amœnus,* shaped more as in Lygus; coarsely punctate, polished; callosities oblong, highly polished, sides carinate; scutellum with a few transverse dragged punctures; elytra closely punctate; rostrum attaining base of intermediate coxæ. Antennæ rather short; segment I a little shorter than distance between eyes; II slightly longer than width of head including eyes; III and IV together two-thirds length of II; IV two-fifths of III. Anterior angle of propleura below eye produced in a narrow rounded lobe above base of anterior coxæ. Sinistral clasper shaped as in *amœnus,* strongly curved with a dorsal tooth at base.

Color, piceous black; collum and tumid inner cheeks polished whitish; vertex with a large fulvous spot either side; anterior submargin of pronotum, three rays on disk, and the slender hind edge yellowish; scutellum yellow, basal lobe black; elytra with a pale ray along median vein; base of cuneus broadly pale; membrane fuscous with whitish spot at apex of cuneus indicating a transverse band; prosternum, coxæ and disk of venter pale yellowish; antennæ fulvo-testaceous, infuscated on inner surface of segment I and base of II; legs pale with middle of femora and base of tibiæ fuscous. Pale colors more extended in female.

Described from two males and nine females taken on ash trees at Fairfax, Marin Co., Calif., May 25, 1919. In form of pronotum allied to Lygus but the genital and most other characters indicate relationship with Neoborus. It shows much variation in extent of pale colors.

*Holotype,* male, No. 765, and *allotype,* female, No. 766, Mus. Calif. Acad. Sci.; *paratypes* also in Academy's collection.

*Type locality,* Fairfax, Marin Co., Calif.

### 12. **Neoborus pacificus,** new species

Allied to *canadensis;* uniformly whitish testaceous, with a black point on either pronotal callosity. Length 5 mm.

Male: Head vertical, produced below the eye for a space nearly equal to length of eye; clypeus strongly incurved below; cheeks tumid; vertex coarsely punctured with a spot against the inner angle of either eye and a concentric mark either side of middle line of vertex, anteriorly smooth; basal carina very slender; pronotum regularly, coarsely punctured, more convex than in *canadensis;* callosities small, transverse; sides ecarinate; collum and slender hind edge calloused and whitish; scutellum sparsely punctate, the edges smooth; elytra closely uniformly punctured; rostrum attaining posterior coxæ. Antennæ short; segment I a little longer than width of vertex between eyes; II about three times length of I; III nearly as long as I; IV a little shorter. Sinistral clasper shaped as in allied species but with the incurved apex longer and more slender and the basal tooth more prominent.

Color, uniformly testaceous, a little tinged with yellow, the punctures on head and pronotum more fulvous, the pale areas on vertex, collum, hind margin of pronotum and sides of scutellum whitish; callosities with round black dot at proximal end; antennæ slightly infuscated beyond the basal segment; tip of tarsi and a point on intermediate and posterior knees black; beneath tinged with fulvous with coxæ and disk of venter whitish; membrane faintly enfumed with pale lines along veins and spot on exterior margin, the apex of areole with short brown line.

Female: Similar to male, without brown line at apex of areole.

Described from one male and two female examples taken at Corvallis, Oregon, July 31, 1900.

*Holotype,* male, No. 767, and *allotype,* female, No. 768, Mus. Calif. Acad. Sci.

*Type locality,* Corvallis, Oregon.

### 13. **Neoborus viscicolus,** new species

Allied to *pacificus,* but more tinged with fulvous and more uniformly punctured, without the smooth areas on the vertex found in that species. Length 3½ to 4½ mm.

Front and clypeus convex, more prominent than in *pacificus,* with deep impression at base of clypeus; vertex closely punctate with four flattish areas forming an arc anteriorly; front closely punctate with four smoother areas either side; cheeks as in *canadensis,* less prominent than in *pacificus.* Pronotum unusually convex, coarsely closely punctate, more finely about callosities, the latter prominent and distant but without indication of a longitudinal smooth line; scutellum tumidly convex and with the elytra coarsely and closely punctate; antennæ as in *pacificus,* but with segment II more slender; rostrum reaching hind margin of metasternum.

Color, a clearer and more fulvo-testaceous than in *canadensis,* almost uniform, a little paler beneath and somewhat darker on the head; proximal end of callosities in one example with a piceous point as in *canadensis*; membrane faintly, almost uniformly fuliginous.

Described from two female specimens taken by me from mistletoe, *Phoradendron villosum,* growing on oaks at Sisson, California, July 24 and 26, 1918. The more convex form and different puncturation of head will distinguish this species from both *canadensis* and *pacificus.*

The paratype is larger and tinged with green on the abdomen and may be somewhat immature.

*Holotype,* female, No. 769, Mus. Calif. Acad. Sci.; the *paratype* also in Academy's collection.

*Type locality,* Sisson, Siskiyou County, Calif.

### 14. **Dichrooscytus vittatus,** new species

Allied to *irroratus,* but with a fuscous vitta across apex of corium, an oblique mark on inner angle of clavus, longer elytra and different male genitalia. Length 5 mm.

Head nearly vertical, more convex than in *suspectus,* about as in *irroratus* but with the vertex much broader; basal width of vertex subequal to length of pronotum in female, a little less in male, basal carina very feeble, the surface before it scarcely depressed; eyes much smaller than in *irroratus;* antennæ long, reaching to apex of cuneus; segment II four times length of I, subequal to the corium; III twice as long as IV, these together three-fourths of II; rostrum attaining apex of hind coxæ. Pronotum twice wider than long, nearly smooth, callosities small, distant; costal margin of elytra a little arcuate posteriorly, clothed with rather long prostrate pubescence; cuneus a little longer than its basal width. Sinistral male clasper broad for this genus, the two branches of nearly equal width, the ventral attaining apex of genital segment, broad and rounded at apex; dextral clasper short, rounded, with a minute hook at its dorsal angle.

Color, yellowish or greenish, more or less marked with sanguineous on the vertex, anterior lobe of pronotum, middle of scutellum and disk of corium; apex of corium with a rather broad transverse fuscous vitta, becoming sanguineous toward the costa; at inner angle of clavus a fuscous cloud which may be extended basally or even wanting; cuneus conspicuously pale, sulphur-yellow, sanguineous at tip; membrane hyaline, slightly infuscated at apex with a darker spot at tip of cuneus and in apex of each areole. Beneath, with the antennæ, rostrum and legs including coxæ, paler or whitish; pleuræ and sides of venter washed with sanguineous; tip of rostrum and of tarsi black; tergum sanguineous or blackish; tibial spines short, brown.

Described from two male and seven female examples taken by me at Huntington Lake, Fresno Co., Calif., July 27, 1919, at an elevation of 8,000 feet, one female from Colestin, Oregon, July 31, 1918, four females from Cayton, Shasta Co., Calif., July 14, 1918, and one pair taken at Fallen Leaf Lake, Eldorado Co., Calif., July 30, 1915. This is the species listed by me as *irroratus* in my report on the Hemiptera of Lake Tahoe, but that species differs in wanting the fuscous markings on the elytra, in its narrower vertex and in the much longer and more pointed male clasper. I possess one specimen of what seems to be the true *rufipennis* Fallén, taken by me at Ward, Colorado, July 18, 1893, at an elevation of 9,500 feet, so that species should again be placed in our fauna. This specimen from Ward is a male and has the uniform coloration, fuscous vestiture, narrower vertex with weak basal carina and the smaller size of *rufipennis*.

*Holotype,* male, No. 770, and *allotype,* female, No. 771, Mus. Calif. Acad. Sci.; *paratypes* in the Academy's collection and in that of the author.

*Type locality,* Huntington Lake, Fresno County, Calif.

### 15. **Coquillettia uhleri,** new species

Aspect of *insignis,* longer and more slender, pale portions of elytra pale yellow, membrane almost entirely fuscous. Length 7 mm.

Head about as in *insignis,* produced beyond eye for a space about equal to greatest length of eye and to length of first antennal segment, subequal to width of vertex between eyes. Pronotum as in *insignis,* a little more than one-half as long as its basal width; scutellum almost equilateral; elytra nearly parallel, scarcely widened at apex of corium, distinctly so in *insignis*; tip of abdomen scarcely surpassing apex of corium; second antennal segment equal to sutural margin of clavus; III subequal to II, IV twice length of I; rostrum attaining apex of mesosternum.

Color, rufo-brunneus, clearer red on scutellum, anterior portion of pronotum and legs, tip of tibiæ and tarsi infuscated; elytra pale canary-yellow, the clavus, broad apex of corium, and extreme tip of cuneus, olive-brown; membrane uniformly infuscated with margin next cuneus narrowly white; antennæ and legs clothed with minute fuscous hairs; cheeks, coxæ and pleural sutures a clearer red.

Described from one male taken by Mr. Fordyce Grinnell at Pasadena, Calif., May 29, 1909. In this species the apical fuscous band of the corium is a little shorter than the width of the corium at that point with its basal margin oblique, nearly parallel with the apical margin of the corium and quite broadly connecting with the fuscous of the clavus. This is the "variety" mentioned by Dr. Uhler in his description of *insignis*.

*Holotype,* in collection of the author.

*Type locality,* Pasadena, California.

*Sericophanes noctuans* Knight, I have taken at Soboba Springs in the San Jacinto Mountains, California, and at Cayton, Shasta Co., Calif. Mr. Knight was certainly right in placing this genus near Pilophorus. Another genus wrongly placed in the Halodapini in my catalogue is Dacerla which undoubtedly should go in Division Myrmecoraria near Mimoceps.

### 16. **Coquillettia foxi,** new species

Allied to *insignis,* but smaller, more slender and very distinct by the white elytra marked by a black band on apex of corium. Length scant 6 mm.

Head more porrect than in *insignis,* the gula and margin of bucculæ in nearly the same plane, quite strongly angled in allied species; segment I of antennæ scarcely longer than width of eye viewed from the side, less than width of vertex between eyes; II a little more than length of claval suture; length of pronotum about half its basal width; elytra distinctly but not strongly widened at apex of corium; tip of abdomen reaching nearly to apex of cuneus; rostrum attaining intermediate coxæ.

Color, pale rufo-fulvous becoming clearer red on scutellum and beneath, the abdomen in the holotype piceous; antennæ infuscated with segment I and base of II paler; elytra white tinged with yellow on clavus, costal margin and middle of cuneus; apex of corium with a broad band of deep black which is one-half longer than width of corium at that point and is cut almost square across anteriorly at the apex of the clavus; cuneus white shading to pale yellow next the black apex; membrane infuscated on its apical half; tibiæ and tarsi more or less infuscated, the posterior more strongly so; rostrum piceous on apical half; abdomen piceous, reddish at base with a pale band separating these portions.

Described from one male taken by Mr. C. L. Fox at Olancha, Inyo Co., Calif., June 5, 1917, and one male taken by Mr. J. O. Martin on the Mohave Desert, California, June 9, 1918.

I take pleasure in dedicating this distinct and pretty species to Mr. C. L. Fox in recognition of his valuable services in enlarging our knowledge of the insect fauna of California.

*Holotype,* male, No. 772, Mus. Calif. Acad. Sci.; a *paratype* also in the Academy's collection.

*Type locality,* Olancha, Inyo County, Calif.

The four species known to me may be separated by the following key:

Apex of corium and the clavus similarly colored. 1
Apex of corium deep black, clavus white. *foxi*, new species.
1. Apex of corium and clavus dark red, narrowly edged with black, base of corium silvery white. *mimetica* Osb.
Apex of corium and clavus olive brown. 2
2. Pale portions of corium and cuneus yellowish, elytra scarcely widened apically, apical band of corium oblique anteriorly. *uhleri*, new species
Pale portions of corium and cuneus white, elytra distinctly widened apically, apical band of corium nearly transverse anteriorly. *insignis* Uhler.

*Coquillettia balli* Parshley is still unknown to me but probably is allied to *amœnus* Uhler, a species I have never been able to recognize.

### 17. **Lopidea taurina,** new species

Aspect of *heidemanni,* but with a thicker head; bright sanguineous, darker along middle of elytra and on scutellum. Length 6 mm.

Surface moderately polished, sparsely clothed with very minute fuscous hairs; elytra scarcely wider apically; front unusually convex; base of vertex normally depressed. Antennæ long; segment I equal to width of vertex; II one-half longer than width of pronotum. Sides of pronotum feebly sinuated, the carinate edge extended entirely around the humeri to basal angle of scutellum; cuneus surpassing abdomen by more than half its length. Sinistral male clasper slender, the incurved apex forked; dextral clasper subterete for a distance of twice its width, then broadly bifurcate, the branches lying at a right angle with the stem and parallel with the apex of the genital segment, terete, acute at apex, and together forming three-fourths of a circle; dorsal spine of the pygofer abruptly incurved and very acute.

Color, bright sanguineous, becoming darker on head which has the usual black marks; callosities, antennæ, rostrum and legs black, pronotum posteriorly, scutellum and disk of the elytra more or less piceous or almost black; beneath largely infuscated or black, the propleura bright sanguineous; membrane black .

Described from five males and six females taken by me at Colestin, Jackson Co., Oregon, August 1, 1918. In this very distinct species the dextral male clasper has much the shape found in *robiniæ* but the stem is slender and the two curved horns are subequal.

*Holotype,* male, No. 773, and *allotype,* female No. 774, Mus. Calif. Acad. Sci.; *paratypes* also in Academy's collection.

*Type locality,* Colestin, Jackson County, Oregon.

### 18. **Lopidea bifurca,** new species

Allied to *marginata;* yellowish brown, becoming clearer on the costal margin and cuneus. Length 5½ mm.

Surface a little polished, clothed with scattering minute white deciduous hairs; base of vertex flattened with an angular impression each side near the basal carina; sides of pronotum more sinuated with the humeral angles more prominent than in *marginata;* apical lobe of scutellum scarcely impressed at base; costa feebly arcuated. Sinistral male clasper broad, subtriangular, its abruptly incurved apex notched above and incised, with the ventral member blunt, the dorsal acute; dextral clasper very broad, slightly wider at apex, abruptly bent inward beyond the middle, the broad thin apex incised, having an acute tooth above and a squarish lobe below with its oblique apex recurved and minutely crenulate. In *marginata* the dextral clasper is longer and narrower, nearly parallel, with its apex oblique and entire or nearly so.

Color, pale fuscous-brown becoming yellowish along the costa and on anterior and lateral margins of pronotum; cuneus clear testaceous-yellow; membrane smoky, darker at base; head tinged with fulvous, base of vertex, a broad arcuate vitta either side on front and clypeus, black; antennæ black, rather slender, with basal segment much thicker; callosities black; legs pale brownish touched with fuscous on the femora, tip of tibiæ and tarsi; beneath varied with pale fuscous and brown, becoming whitish on the pleuræ and coxæ; rostrum varied with black.

Described from 40 examples taken by me from a whitish weed growing along the railroad tracks at Colestin, Jackson Co., Oregon, August 1, 1918. This species has an immature look but this material is fully pigmented. Its dull colors match well the flower heads on which it lives.

*Holotype,* male, No. 775, and *allotype,* female, No. 776, Mus. Calif. Acad. Sci; *paratypes* in Academy's collection

*Type locality,* Colestin, Jackson County, Oregon.

### 19. **Lopidea puella,** new species

Smaller than *marginata;* smoky brown, the costa narrowly and the cuneus entirely whitish. Length 4½ mm.

Surface moderately polished, clothed with short black hairs and a few white scale-like hairs; front strongly convex, base of vertex feebly impressed; antennæ short, segment I half as long as width of vertex; segment II shorter than width of pronotum at base, angular impression between the collosities very deep; sides of pronotum feebly arcuated, the carinate edge carried around the rounded humeri to basal angles of scutellum; elytral costa scarcely arcuated. Sinistral male clasper broad, subovate; dextral subtriangular at base, its dorsal angle armed with an acute erect spine, apical member bent at right angles across the aperture of the segment, elongate triangular, obtuse. longitudinally furrowed.

Color, testaceous or smoky brown; callosities, antennæ and head black, the latter with the orbital margins and cheeks yellowish, sides and anterior margin of pronotum paler; narrow costal margins and cuneus whitish, the latter tinged with pink and edged with fuscous; membrane smoky black; legs blackish; lower surface blackish varied with reddish, the propleura whitish; gula and sternum black.

Described from three males taken by me at Bryson, Monterey Co., Calif., May 18, 1920. This is the smallest western species of Lopidea known to me and is quite distinct by its brown color with pale costal line and cuneus and the very distinct male genital characters.

*Holotype,* male, No. 777, Mus. Calif. Acad. Sci.; *paratypes* in collection of the Academy.

*Type locality,* Bryson, Monterey County, Calif.

### 20. **Lopidea discreta,** new species

A large dark red species allied to *nigridea,* but with the red coloring of *heidemanni;* male claspers much as in *nigridea.* Length 6½ mm.

Surface moderately polished, sparsely clothed with oblique stiff black hairs as long as the thickness of the fourth antennal segment; segment II of antennæ a fifth longer than basal width of pronotum; sides of pronotum rectilinear. Sinistral male clasper small, linear, abruptly incurved at apex; dextral shaped much as in *nigridea* but broader and more sinuated ventrally with the vertical apical margin rectilinear, its lower (ventral) angle armed with two continguous teeth as long as their combined width; sinus at base of long apical spur with a short but distinct tooth.

Color, sanguineous; basal margin of pronotum, scutellum, clavus and corium as far as ulnar nervure much darker or even black; callosities, base of vertex, a double vitta on front, clypeus, sutures of cheeks, antennæ, rostrum, legs, pectus and venter in part black, the propleura bright red; membrane deep fuscous.

Described from 24 specimens representing both sexes, taken at Huntington Lake, Fresno Co., Calif., during the last week of July, at an elevation of 7,000 feet. They occurred in numbers on elderberry bushes, on a blue-flowered lupine, and on a species of Vicia. It might be best to consider this a race or variety of *nigridea,* but it seems to me its characters on the whole are of specific value.

*Holotype,* male, No. 778, and *allotype,* female, No. 779, Mus. Calif. Acad. Sci.; *paratypes* in Academy's collection.

*Type locality,* Huntington Lake, Fresno County, Calif.

### 21. Lopidea nigridea hirta, new subspecies

Broader than *nigridea*, darker in color and more opaque and hairy with the antennæ thicker. Length 4½ mm.

Surface opaque, dull, clothed with short, stiff, black hairs and a few minute white scale-like hairs intermixed; costa quite distinctly arcuated; sides of pronotum moderately sinuated; segment II of antennæ about equal to basal width of pronotum; base of vertex feebly impressed. Dextral male clasper longer and slenderer than in *nigridea*, its apical margin minutely but quite evenly crenulate, not at all produced and lacinate at its ventral angle.

Color, dark brownish sanguineous, becoming clearer red on the pronotum and costal margin of corium, the cuneus still lighter sanguineous; head marked as in typical form but less distinctly; callosities black.

Described from 29 examples representing both sexes, taken by me on San Miguel Island, Santa Barbara Co., Calif., May 20, 1919. The dark, opaque and hairy surface will best distinguish this subspecies.

*Holotype*, male, No. 780, and *allotype*, female, No. 781, Mus. Calif. Acad. Sci.; *paratypes* in collection of Academy.

*Type locality*, San Miguel Island, Santa Barbara County, Calif.

Under the name *nigridea* Uhler, I have placed a species commonly found on bushes in San Diego County and elsewhere in California, during May and June, which agrees exactly with Uhler's description except that segment II of the antennæ is as long as from the tip of scutellum to front of eyes, thus assuming a clerical error in the original description. In this species the dextral male clasper is broad, convex and strongly arched across the aperature of the genital segment, with its apex obliquely produced in a long acute spur which attains the dorsal line of the segment and is minutely serrated exteriorly; interior to the base of this spur is a shorter spine or tooth, sometimes minute.

### 22. Ceratocapsus apicatus, new species

Closely allied to *fasciatus* Uhl., but with thicker antennæ, a pale band across apex of corium as well as one at apex of scutellum, a unicolorous membrane and darker legs. Length 4½ to 5 mm.

Male: Head slightly more porrect and vertex more convex than in *fasciatus*; antennæ stouter throughout; segment II as long as III and IV together. Scutellum proportionately narrower than in *fasciatus*. Rostrum attaining apex of intermediate coxæ; segment I attaining base of head. Apex of genital segment strongly subacutely produced, a little surpassing the valve; sinistral notch deep, abrupt, dextral shallow, sinuate; sinistral clasper small, forming a lobe at fundus of sinistral notch, dextral inconspicuous; plates long, produced for more than twice their basal width, rounded at apex. In *fasciatus* the ventral genital segment is short, truncate, not nearly attaining apex of valve; sinistral notch scarcely indicated, sinistral clasper long, acute at apex and curved to conform with apical margin of valve; dextral clasper ligulate, more than twice longer than wide, the plates short and subtriangular in form, with their apex rounded.

Color, castaneous-brown becoming paler on the head, pronotum and propleura and fuscous on antennæ beyond basal segment: elytra fuscous with a broad pale transverse band at apex of scutellum and a narrower one across apex of corium, leaving the intermediate fuscous band a little wider than basal pale band; cuneus and abdomen polished piceous black; membrane deep fuscous with black veins, faintly marked with a paler spot at apex of cuneus; in *fasciatus* there is a conspicuous pale band against apical margin of cuneus. Legs castaneous.

Female: Broader behind, as in *fasciatus,* the color paler anteriorly, sometimes with the corium almost entirely pale. In both sexes the upper surface is closely minutely punctured and clothed with short appressed pale hairs.

Described from 58 examples representing both sexes, taken from pine trees at Berkeley, Calif., September 29 and October 14, 1919, by Mr. J. O. Martin, and two females taken by me, one at Hoberg's Retreat, Lake Co., Calif., August 2, 1916, the other at Cayton, Shasta Co., Calif, July 15. 1918. This species could easily be confused with *fasciatus* but the thicker and darker antennæ, dark legs, black cuneus, darker membrane, narrower fuscous band on base of elytra, additional pale band at apex of corium and especially the very distinct male genital characters will distinguish the present species.

*Holotype,* male, No. 782, and *allotype,* female, No. 783, Mus. Calif. Acad. Sci.; and *paratypes,* all presented to the Academy by Mr. Martin.

*Type locality,* Berkeley, Calif.

### 23. **Orthotylus dodgei,** new species

Closely allied to *pacificus* Van D., separable by the blacker membrane and very different male genitalia; black, sides and abbreviated median vitta of pronotum, margins of elytra, and legs, yellowish. Length 6 mm.

Male: Head as in *pacificus,* the vertex flattened before the prominent basal carina; clypeus very prominent; segment II of antennæ rather longer than from tip of scutellum to apex of head, three times length of I. Pronotum as in *pacificus,* one-half wider than long; sides straight, carinate; surface transversely rugose behind the prominent callosities. Apex of abdomen attaining middle of cuneus. Surface clothed with rather long scattering pale hairs. Sinistral male clasper long, straight, somewhat clavate; dextral equally long, parallel sided, flat, wider than hind tibiæ, somewhat incurved and sinuated with its apex abruptly bent upward in the same plane and truncate.

Color, black; a line next eye from antennæ to base of vertex, interrupted a little before the base, a short line on anterior edge of pronotum, a broader vitta on basal lobe of pronotum and a similar one on each humeral margin, costal margin of corium, cuneus, rostrum and legs yellowish; knees with a dusky spot; apex of tarsi black; genital pieces partly pale. Female paler, with the antennæ mostly pale.

Described from two male and six female examples taken by me at Santa Cruz, Calif., June 3, 1919. This species could scarcely be distinguished from *pacificus* but for the very distinct male genitalia. *Orthotylus pacificus,* described from Victoria, B. C., I took at Northbend, Wash., July 9, 1920.

I am dedicating the present species to my friend Mr. E. A. Dodge of Santa Cruz, in recognition of his efficient work in the cause of entomology and of his courteous assistance to students of insects whose paths of effort are fortunate enough to meet his.

*Holotype,* male, No. 784, and *allotype,* female, No. 785, Mus. Calif. Acad. Sci.; *paratypes* also in the Academy's collection.

*Type locality,* Santa Cruz, Calif.

### 24. Orthotylus marginatus Uhler

A more careful study of my material in this species and *dorsalis,* in connection with additional specimens, has made it necessary to correct my former assignment of the males of these species. In his description of *Cyrtorrhinus marginatus,* Dr. Uhler has confused two species, a black form, margined with pale but wanting the pale median vitta on the pronotum and scutellum, and the species described below as *serus* in which this vitta is present and which Dr. Uhler mentions as a variation of *marginatus.* In my monograph of 1916, I placed this as a variation of *dorsalis,* and by some mishap, transferred the figure and description of the male claspers in these two species. The dextral clasper of *marginatus,* given as *dorsalis* (fig. 15), has its basal lobe too pointed. Better cuts of the claspers of these and related species will be published later. The true *Orthotylus marginatus* I have from Quinze Lake, Quebec, August 15, 1907, and Hamburg, N. Y., June 14, 1902. Like *dorsalis,* it is a willow feeder.

### 25. Orthotylus serus, new species

Closely related to *marginatus* Uhler, differing in having a pale median vitta from front of pronotum to tip of scutellum, the inner limit of the pale costal vitta straight, and in the form of the male claspers. Length 6 mm.

Vertex distinctly flattened before the obtuse basal carina, this flattening in *marginatus* very feeble; clypeus little prominent with feeble impression at its base; eyes, viewed from the side, reaching well toward the gula, in *marginatus* distinctly smaller. Pronotum as in *marginatus,* its length three-fifths its basal width; the callosities connected by an elevated area anteriorly which is scarcely apparent in *marginatus*; the posterior lobe nearly smooth, distinctly shagreened in *marginatus.* Rostrum attaining the hind coxæ, in *marginatus* not surpassing the intermediate. Dextral male clasper forming two squarish denticulate lobes, the ventral produced for about twice its width, with a truncate apex, its upper angle subacutely prominent; basal lobe squarish, broader than long and oblique at apex; sinistral clasper triangularly enlarged at tip with its apex obliquely truncate and its upper angle subacute; no basal appendage discernable.

Color, black and yellowish testaceous; above black, lateral and posterior margins of the vertex, broad median vitta from front edge of pronotum to tip of scutellum, and broad costal vitta on the elytra pale, the latter with a straight inner margin and enclosing toward its apex an obscure smoky cloud; cuneus fulvo-testaceous with a large fuscous cloud against its inner margin; membrane deep smoky with dark nervures and a pale spot at apex of cuneus, sometimes much reduced. Whole upper surface clothed with long pale decumbent hairs. Beneath black with a broad pale vitta, extended along the sternum to tip of venter in female; genital pieces largely pale; legs dusky testaceous with the tarsi embrowned; rostrum pale, black at tip; antennæ black.

Described from three male and ten female examples taken by me as follows: Hamburg, N. Y., July 1, 1911; Gowanda, N. Y., August 2, 1907; Colden, N. Y., July 7, 1901; Salamanca, N. Y., July 24, 1911. It lives on thorn bushes (Cratægus, species).

*Holotype,* male, and *allotype,* female, in collection of the author; *paratypes* in his collection and in that of the California Academy of Sciences.

*Type locality,* Hamburg, N. Y.

### Genus Strophopoda, new genus

Aspect of a small Plagiognathus, but with an obtuse facial angle; allied to Chlamydatus with a narrower head and a distinct suture at base of tylus.

Head nearly vertical, with the eyes two-thirds basal width of pronotum, distinctly wider than median length of pronotum; vertex swollen, separated from base of clypeus by a distinct incised line; facial angle a right angle; eyes vertical, oval; gula short; rostrum passing intermediate coxæ, segment I reaching to base of head. Antennæ inserted near apical angle of eye; segment I attaining apex of clypeus; II as long as width of head with eyes, linear, a little thickened in male; III and IV together equal to II, III a third longer than IV. Pronotum transverse, its length one-half its basal width and equal to its apical width, sides straight or nearly so. Elytra long, almost parallel in male, the costa a little arcuated in female; tip of cuneus attaining apex of abdomen. Posterior femora much thickened; third segment of hind tarsi not longer than II, the suture very obscure. Surface smooth, polished, thickly clothed with short pale deciduous hairs.

Type of genus, *Strophopoda aprica,* new species. This genus was included in my keys to the genera of the Miridæ, 1916, but not before validated by description of a species.

### 26. **Strophopoda aprica,** new species

Black, polished, short pale-pubescent; antennæ and legs in part whitish, tip of cuneus and a connecting spot on membrane white. Length 2½ mm.

Characters as given for the genus; surface impunctate but minutely shagreened; male genital segment narrow, conical; sinistral clasper incurved and acute as in *Chlamydatus suavis,* the dextral broad, curved, truncate at apex.

Color, deep black, polished; base of vertex with a pale median dot; antennæ pale yellowish in female, somewhat infuscated in male; segment I black, white at apex; II and III narrowly fuscous at base, more apparent in female; edge of bucculæ narrowly white; segment II of rostrum fuscous brown; apex of cuneus and a line on its basal fracture white; membrane with a white spot at tip of cuneus; femora black, tipped with white; tibiæ white, with spines and large dots at their bases black; tarsi brown.

Described from numerous examples of both sexes taken at various places in San Diego Co., Calif., from sea level to 3500 feet in the Cuyamaca Mountains, from April to October.

*Holotype,* male, and *allotype,* female, in collection of the author; *paratypes* in his collection and that of the California Academy of Sciences.

*Type locality,* San Diego County, Calif.

### 27. **Chlamydatus monilipes,** new species

Allied to *suavis* Reut., but with the antennæ mostly pale and the tibiæ dotted. Length 2½ mm.

Head with eyes about as wide as base of pronotum; vertex distinctly more convex than in *suavis*, with a nearly obsolete median sulcus; surface more dull and clothed with a shorter pubescence than in its ally. Male claspers formed as in *suavis*, the sinistral shorter and thicker.

Color, deep black, moderately polished; membrane uniformly infuscated; antennæ pale yellowish white becoming dusky on segments III and IV, basal two-thirds of I and narrow base of II black; femora black, tipped with white; tibiæ white strongly dotted with black at base of the black spines; tarsi whitish, the apical segment and claws blackish.

Described from seven males and three females taken by me at Alpine, San Diego Co., Calif., April 22, 1913. More recently Mr. Ralph Hopping has sent me a series of 15 taken by him at Mohave, Calif., May 3, 1919. Easily recognized by the pale antennæ and white legs with black femora and tibial dots. In this and the allied species the second antennal segment is thicker in the male.

*Holotype*, male, from Alpine, and *allotype*, female, in collection of author; *paratypes* in his collection and that of the California Academy of Sciences.

*Type locality*, Alpine, San Diego County Calif.

### 28. **Merragata slossoni**, new species

Narrower and paler than *hebroides* White, with the antennæ and legs more slender and less hirsute, apex of scutellum bifid. Length 1¾ mm.

Head more tumid on base of vertex than in *hebroides*, elevated above line of the ocelli by more than twice the diameter of the ocelli, the contour more convex when viewed from the side; above with a shallow median sulcus; antennæ nearly twice length of head as seen from above, segments I and II equal, I almost attaining apex of head, III shorter, IV fusiform, considerably longer and thicker than II but notably thinner than in *hebroides;* rostrum passing hind coxæ, segment I attaining anterior line of eye, II the anterior line of front coxæ, and III the middle of the mesosternum. Pronotum hardly twice wider than long, deeply constricted between the lobes, the median sulcus deep and passing anterior one-half of posterior lobe; collar distinct, distinguished behind by a line of deep punctures, a similar line following the posterior submargin, otherwise impunctate. Scutellum with a distinct median carina basally, its apex obtusely bifid.

Color, pale castaneous becoming almost black on scutellum, vertex and meso- and meta-pleuræ, the middle of vertex broadly, and a large lobate spot covering much of the posterior lobe of pronotum, paler or fulvo-testaceous. Elytra pale at base, infuscated toward apex, claval area entirely and an interstitial line on the corium white; membrane pale fuscous with four white spots, one basal, one elongated, at apex, and one either side at apex of corium; antennæ and legs pale yellowish testaceous, the apical segment of the former darker; apex of tarsi infuscated, the claws pale; rostrum pale becoming blackish at apex; pronotum sparsely clothed with soft pale hairs; thickened portion of corium and vertex with soft white pubescence, the depressions on pronotum and the pectus pruinose.

Described from one male taken at Biscayne Bay, Florida, by Mrs. Annie Trumbull Slosson, to whom I take pleasure in dedicating the species. The collection of the California Academy of Sciences contains four specimens of a species that agrees in every particular with Champion's description of *hebroides* White, taken on the hills back of Oakland, Calif., September 27, 1908. *M. foveata* Drake, is very close to *hebroides* but the white marks on the membrane are narrower, the general color is darker and the sulcus on the vertex has an obvious median longitudinal ridge. *M. brunnea* Drake is paler with the membrane almost uniformly whitish.

*Holotype,* male, in collection of the author.

*Type locality,* Biscayne Bay, Florida.

### 29. **Neæthus fragosus,** new species

Related to *grossus;* longer with the front distinctly longer than broad and the costa much less arcuated toward the base; elytra subopaque as in *grossus,* the veins more or less infuscated. Length, male 5, female 6 mm.

Vertex transverse, oblong, on the median line a little more than one-half the length of the pronotum, its anterior margin very obscurely angled; front oblong, slightly wider at apex, its greatest length a fifth more than the width; clypeus with an obtuse median keel. Pronotum strongly produced anteriorly, much more so than in *vitripennis.* Elytra longer and narrower, than in *grossus,* in female 3½ by 5 mm., in *grossus* these measurements are 2½ by 3½ mm., opaque or slightly translucent, not at all transparent as in *vitripennis*; wings nearly as long as the elytra. Genital plates of male longer and more narrowed at the obtusely angled apex than in *grossus.*

Color, yellowish or greenish testaceous, in male usually becoming brownish on vertex and face, with a paler area on apex of front; veins of elytra sometimes distinctly infuscated, especially in the male.

Described from six males and five females taken by me on the summit of Mt. Wilson near the observatory, October 18, 1917. This species is longer and narrower than *grossus,* with the females distinctly larger and paler than the males. In none of these types is there suggestion of the maculation found in typical *grossus.*

*Holotype,* male, No. 786, and *allotype,* female, No. 787, Mus. Calif. Acad. Sci.; *paratypes* also in the Academy's collection.

*Type locality,* summit of Mount Wilson, Pasadena, Calif.

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XI

# OUR NORTH AMERICAN SPECIES OF STRONGYLOCORIS (HEMIPTERA)

BY

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### 1. Strongylocoris stygicus Say

There can, I think, be no question as to the identity of Say's species. In this, as in the allied forms, the antennæ of the female are pale, with the base of segment I and extreme base and apex of II, black, and III and IV dusky. I have taken this species at Montreal, Canada, Portland, Me., Wellesley, Mass., and Buffalo, N. Y., and have received it from Quinze Lake, Quebec, and Washington, D. C.

### 2. Strongylocoris atratus Uhler

Closely allied to *stygicus,* but distinguishable by the shorter second segment of the female antennæ and the form of the male clasper. The apex of the dextral clasper shows considerable variation in the length of the "comb teeth" but all conditions seem to occur connecting the extremes, indicating intraspecific variation only. This species averages larger than *stygicus.* I have it from Ottawa, Ont., Montreal, Canada, Bretton Woods, N. H., Yaphank, N. Y., Ft. Collins, Colo., Cloudcroft, N. Mex., and San Diego, Calif., and in the collection of the California Academy of Sciences are specimens from several localities in California south of Sacramento. An examination of Uhler's types shows that they were males and that the tibiæ were brown rather than black. The females of this species have the antennæ and legs marked with pale as in *stygicus,* although here the hind tibiæ are frequently brown as in the males.

### 3. Strongylocoris robustus Uhler

In this species the size and form are about as in corresponding sexes of *stygicus,* but the polished convex face will at once distinguish it. Here the dextral male clasper has the median angle obtuse, not forming a tooth, and the upper apical tooth of the fan-shaped apex greatly developed, the balance of the fan-shaped apex being represented by about two small teeth situated about midway between the median angle and the apex. My specimens are from Denver and Boulder, Colo., and in the collection of the California Academy of Sciences are specimens from Colestin, Oregon, McCloud, Siskiyou Co., and El Cajon and San Diego, in San Diego Co., California.

### 4. Strongylocoris croceipes Uhler

This species is very distinct by its hairy upper surface and orange colored legs. I have seen it only from San Diego Co., California, and American Fork, Utah.

Front flattened, minutely rugulose-punctate. 1
Front convex, polished. 2

1. Segment II of female antennæ a fifth longer than width of head across the eyes; dextral male clasper with median angle produced in a long tooth, thus forming a semicircle with the incurved angle of the fan-shaped apex. *stygicus* Say.
   Segment II of female antennæ not longer than width of head across the eyes; dextral male clasper with median angle obtuse or produced in a short tooth thus forming a shorter arc with the fan-shaped apex; the latter quadrifid, usually forming four acute teeth, the dorsal much the longer. *atratus* Uhler.

2. Legs entirely orange; surface clothed with sparse long white suberect hair; base of vertex strongly carinate. *croceipes* Uhler.
   Femora, at least, black; surface nude, without long pale pubescence; base of vertex slenderly carinate. *robustus* Uhler

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XII

# CHARACTERS OF EIGHT NEW SPECIES OF NORTH AMERICAN ANTHOCORIDÆ OR FLOWER BUGS

BY

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## 1. Xylocoris umbrinus, new species

Allied to *cursitans* Fallén, but proportionately broader as in *discalis* Van D.; deep polished black, antennæ rostrum, corium and tibiæ brown or piceous. Length 3 mm.

Head a little shorter and broader than in *sordidus,* about as long as wide including the eyes, polished. Antennal seg. I scarcely attaining apex of head; III and IV equal, each but little shorter than II. Rostrum long, apparently nearly attaining intermediate coxæ. Pronotum as in *discalis,* highly polished, the lobes scarcely distinguished, the posterior minutely aciculate, not transversely impressed; sides straight, rounded to anterior angles, obtusely carinate, this carina reaching to middle of collum. Scutellum nearly flat, highly polished, feebly rugose posteriorly. Elytra uniformly polished, behind the fracture narrower than abdomen; costa feebly arcuate behind the middle of corium, surface with scattering minute pale hairs. Ostiolar canal shorter than in *discalis* and the *sordidus* group of species, bent toward, but not quite attaining, the anterior margin of the metapleura, the angle rounded, apex subacute. Hind tibiæ pale-pubescent, without longer soft hairs.

Color, deep shining black, basal two antennal segments and femora piceous-black; apical two segments of antennæ, rostrum and tibiæ pale piceous or brownish; elytra piceous-brown, clavus, or at least its inner margin, and the cuneus darker; membrane hyaline-white.

Described from one male taken by me at Bryson, Monterey Co., Calif., April 23, 1917, and one female taken from under the bark of an old fir log near Cayton, Shasta Co., Calif., July 14, 1918.

*Holotype,* male, No. 788, and *allotype,* female, No. 789, Mus. Calif. Acad. Sci.

*Type locality,* Bryson, Monterey Co., Calif.

*Xylocoris californicus* Reut., I have taken at Cayton, Shasta Co., Calif., and at Bryson, Monterey Co., Calif. It may be distinguished by the broad lunate and striate area anterior to the ostiolar canal and whitish elytra with the inner and commissural margins of the clavus, apex of the embolium and the cuneus, except its inner angle, piceous. *X. flaccidus* and *discalis* have the ostiolar canal long and curved, with its acute apex at the basal margin of the metapleura, and pertain to the section of the genus with *sordidus* Reut., while *umbrinus* has this canal shorter and more obtuse at apex, thus allying it with *cursitans* Fall.

### 2. **Anthocoris tristis,** new species

Allied to *dentipes* Champ., but larger, with the elytra, except the clavus, polished; antennæ, legs and base of elytra, deep piceous. Length 4½ mm.

Head shorter, scarcely longer than median line of pronotum; surface minutely shagreened. Antennæ short, stout, scarcely longer than basal width of pronotum; seg, I reaching apex of head; II as long as width across the eyes; III and IV equal, together distinctly longer than II. Pronotum broad, strongly impressed across the disk; sides feebly sinuated, slenderly carinate as far as the collum, the latter broad; posterior lobe minutely rugose, the region of the callosities nearly smooth; scutellum smooth. Elytra rather narrow, polished, the clavus only opaque; membrane much exceeding the abdomen; outer vein indistinct, the others obsolete or nearly so. Rostrum hardly attaining the anterior coxæ; seg. I scarcely longer than broad; III but little longer than the width of the collum. Ostiolar canal short, broad, its hind margin broadly curved, the anterior slightly curved anteriorly. Beneath polished, the prosternum opaque and strongly rugose; ventral segments punctate becoming smooth along the hind margins; anterior femora with a small tubercle at apical third.

Color, deep black, the antennæ, rostrum, legs and elytra to apex of corium more or less piceous with the embolium paler; upper surface sparsely clothed with soft white pubescence; basal third of membrane obscurely whitish.

Described from one female taken in Yosemite Valley, California, in June, 1916, by Mr. Walter M. Giffard. The larger size, polished corium and embolium and the shorter third segment of the antennæ will most readily distinguish this form from *dentipes* Champ.

*Holotype,* female, No. 790, Mus. Calif. Acad. Sci.

*Type locality,* Yosemite Valley, Calif.

### 3. **Anthocoris dimidiatus,** new species

Allied to *nigripes;* polished black, second antennal segment, except its apex, and legs, castaneous; elytra yellowish testaceous as far as apex of clavus; basal half of membrane white; corium entirely opaque or subopaque. Length 3 mm.

Head as long as pronotum and basal lobe of scutellum combined, its length before the ocelli a little greater than width across the eyes; sides parallel to a point nearly one-half distance from front of eye to apex, then suddenly constricted and again somewhat expanded at tip; this character, common to all allied species, is more pronounced here. Antennæ slender, as long as head, pronotum and scutellum as far as the transverse depression; basal segment not attaining apex of head; II as long as head; III and IV subequal, fusiform, a little thinner than II. Rostrum reaching to middle of mesosternum; seg. I attaining anterior line of eye; II touching anterior coxæ. Prosternum deeply impressed across the middle; sides sinuated, the carinate edges not encroaching upon the collum; surface minutely rastrate punctate, the prominent callosities nearly smooth. Posterior lobe of scutellum minutely rastrate. Elytra subopaque over their whole surface, the thickened apical margin of the cuneus only polished; membranal veins moderately and about equally prominent, the inner pair scarcely approaching at base, the outer a little arcuate. Venter very minutely rastrate with base of segments polished.
Color, deep black; femora, apex of second antennal segment and the third and fourth piceous brown; basal two thirds of second antennal segment and tibiæ honey-yellow. Elytra yellowish white as far as tip of clavus, becoming black beyond that point, with a pale mark on the thickened apex of the embolium; basal half of membrane milky white, the apical blackish; surface clothed with a few soft pale hairs.

Described from one female taken by me on the Felch Ranch, near Cayton, Calif., July 15, 1918. The long antennæ would seem to ally this species with *sylvestris,* but the opaque elytra and distinct membranal veins indicate closer relationship with *nigripes,* and will serve to distinguish it from *whitei* which it slightly resembles. With the type were taken two immature females, one winged but teneral, the other a nymph with the abdomen broad oval and the elytra short, attaining middle of third tergal segment, black with the scutellar margin of clavus castaneous, base of corium and embolium and narrow membrane white.

*Holotype,* female, No. 791, Mus. Calif. Acad. Sci.

*Type locality,* Felch Ranch, near Cayton, Shasta Co., Calif.

### 4. **Lyctocoris doris,** new species

Allied to *campestris* and belonging to that section of the genus; more elongated and darker in color; piceous-black with the antennæ, rostrum and legs testaceous. Length 4 mm., width 1⅓ mm.

Head longer than in *campestris,* longer than median length of pronotum and equal to its width across eyes; vertex with a few coarse punctures anteriorly, smooth about the ocelli. Segment I of antennæ not quite attaining apex of head; II as long as head; III and IV subequal, each two-thirds of second. Pronotum rugose as in *campestris,* the sides a little more sharply carinate and subsinuate posteriorly, the surface depressed across disk behind middle. Elytra narrower than in *campestris,* parallel, opaque, closely punctured; membrane long and narrow, considerably exceeding abdomen; outer veins distinct, others obsolete or practically so. Rostrum attaining middle of hind coxæ; seg. I reaching almost to base of head. Orifices and canal as in *campestris,* the metastethal carina sharp and a little curved; mesostethus with a minute tubercle at base of intermediate coxæ. Anterior femora considerably thickened, fusiform, about twice thickness of intermediate.

Color, a deep opaque piceous-black, becoming a little paler on costal base, behind ocelli and along either side of tylus; antennæ, rostrum and legs honey-yellow or pale piceous.

Described from one pair taken in the cool foggy coastal belt of California, at Lagunitas, Marin Co., April 9, 1911, by Dr. E. C. Van Dyke.

*Holotype,* male, No. 792, *allotype,* female, No. 793, Mus. Calif. Acad. Sci.

*Type locality,* Lagunitas, Marin Co., Calif.

### 5. **Tetraphleps latipennis,** new species

Allied to *aterrima;* black, pronotum, the callosities excepted, and the elytra castaneous brown. Length 4½ mm., width 2 mm.

Head as long as median length of pronotum; vertex broad and convex between the ocelli. Antennæ a little shorter than head and pronotum along median line; seg. I scarcely attaining apex of head; II as long as from tip of head to ocelli; III and IV together rather longer than II, IV slightly exceeding III. Rostrum attaining anterior coxæ; seg. II a little surpassing base of head. Prosternum transversely wrinkled, connate with the collum, obtusely angled between anterior coxæ, its edge obscurely carinate; mesosternum slightly carinate-produced between anterior coxæ, sulcate posteriorly, smooth with sides aciculate almost to anterior margin. Ostiolar canal straight, its margins distinctly elevated to an acute apex. Pronotum broad, sides well arcuated and slenderly carinate; collum broad and well defined, entirely free from lateral carinæ; region of callosities smooth, distinctly elevated; collum and posterior lobe closely punctate. Scutellum roughened but scarcely punctate, the usual median depression distinct. Elytra broad, costa rather strongly expanded at base, nearly straight; surface uniformly but moderately polished, closely punctate; membrane exceeding abdomen by about a fourth its length, the veins distinct, the outer abruptly curved and more prominent, surface with irregular transverse wrinkles which become longitudinal at apex. Surface clothed with soft whitish pubescence, longer on pronotum and elytra, nearly or quite wanting on base of head, pleural pieces and base of ventral segments; head with six stiff bristles.

Color, piceous black; pronotum, excepting the region of the callosities, and the elytra castaneous brown; membrane smoky, a large basal spot emphasized at apex of cuneus and the borders of the veins nearly to their apex, pale.

Described from 36 examples taken by me from *Pinus albicaulis* at an altitude of 9,100 feet on top of Mt. Eddy, Siskiyou Co., Calif., July 28, 1918. No males or immature individuals were seen. The Academy also possesses a series taken by me at Huntington Lake, Fresno Co., Calif., in July, 1919, at an altitude of 7,500 feet, three taken by Mr. C. L. Fox at Dry Lake Lookout Station near Walker, Siskiyou Co., Calif., June 1, 1920, at 7,000 ft. elevation, and one taken by me at the Biological Station near Nanaimo, Vancouver Island, June 28, 1920, all females. This species seems to be quite typical of the genus Tetraphleps, and occurs only on pine so far as my experience goes. I would distinguish this genus primarily by the punctate elytra and form of the ostiolar canal. The membranal veins seem always to be prominent.

*Holotype,* female, No. 794, Mus. Calif. Acad. Sci.

*Type locality,* top of Mt. Eddy (altitude 9,100 ft.), Siskiyou Co., Calif.

### 6. **Tetraphleps furvus,** new species

Closely allied to *latipennis,* a little narrower and more polished with the elytra of a paler and more testaceous brown. Length 4 mm., width 1½ mm.

Head narrower and flatter between the ocelli than in *latipennis,* the apex slightly notched either side the tylus. Antennæ longer and more slender; seg. I slightly surpassing the head; II as long as the entire head; III fully equal to IV in length and somewhat thinner. Rostrum slightly surpassing anterior coxæ; prosternum more flattened with margins more prominent than in *latipennis;* mesosternum less strongly aciculate on sides, ostiolar canal as in allied species. Pronotum more transverse, sides nearly rectilinear, a little rounded at anterior angles, slenderly carinate; region of callosities scarcely elevated; surface closely, obscurely punctate. Elytra parallel, costa subsinuate, veins less distinct and the punctures more distant and obscure than in *latipennis;* membrane longer, exceeding abdomen by about half its length, outer veins less abruptly curved, the inner less prominent; surface with obscure transverse wrinkles which become longitudinal at apex. Whole surface of body clothed with a pale pubescence, more highly polished than in *latipennis.*

Color, piceous black; pronotum and elytra testaceous-brown, the anterior disk of pronotum darker and embolium paler; membrane brown with a transverse row of pale marks at apex of cuneus.

Described from four males taken by me on a small (cedar?) tree at Ward, Colorado, July 1, 1903, at an altitude of 9,300 feet. With these were numerous young, so apparently the males were reaching maturity before the females and may perish much earlier which would account for the scarcity of males in all species of this genus as represented in collections.

*Holotype,* male, in collection of the author, *paratypes* in his collection and in that of the California Academy of Sciences.

*Type locality,* Ward, Colo.

My notes on the Provancher collection indicate that the type of *Tetraphleps canadensis* Provancher, was in poor condition, leading me to place it in genus Lyctocoris but a study of these allied species now convinces me that it might have been rightly placed after all. It should not be difficult to procure additional specimens from pines about Cap Rouge, Quebec, which would soon settle the matter.

### 7. **Tetraphleps lepidus,** new species

Smaller and narrower than *latipennis* with more slender antennæ, seg. II being broadly pale in middle, the pronotum entirely black and ostiolar canal distinctly curved apically. Length 3½ mm.

Female: Head as long as half the posterior width of pronotum, rounded at apex, the clypeus slightly exceeding the cheeks, base of vertex polished. Seg. I of antennæ distinctly shorter than apex of head; II equal to median length of pronotum, scarcely thicker at apex; III linear, one-half length of II; IV fusiform, equal to III. Pronotum closely, finely punctured, callosities polished; carinate sides a little expanded anteriorly but scarcely reflexed, straight, attaining middle of collum. Elytra slightly widened to apex of corium; membrane exceeding the cuneus by two-thirds its own width, subhyaline and somewhat opaque and brownish at base and apex, leaving a broad hyaline band at apex of cuneus. Rostrum attaining posterior coxæ; seg. I passing anterior angle of eye. Ostiolar canal distinctly curved anteriorly at apex. Whole upper surface moderately polished, closely minutely punctate except for the smooth areas on vertex and callosities, clothed with soft appressed pale hairs with apparently four longer stiff hairs on head.

Color, deep piceous or black; seg. II of antennæ, except base and apex, elytra, apex of femora and the tibiæ rufo-testaceous; sometimes base of first antennal segment, gula, and coxæ more rufo-piceous and the subcostal portions of the elytra may be infuscated.

Male: Darker in color with the second antennal segment thicker and black or nearly so, and the elytra piceous with a pale median dot on apical margin of corium, the membrane entirely fuscous.

Described from five males and 24 females taken by me on lodge pole pine at Huntington Lake, Fresno Co., Calif., July 24, 1919, at an altitude of 7,400 feet, all in the Academy's collections.

*Holotype,* male, No. 795, *allotype,* female, No. 796, Mus. Calif. Acad. Sci.

*Type locality,* Huntington Lake, Fresno Co., Calif.

Our five North American species of this genus may be roughly distinguished by the following key. *Xylocoris uniformis* Parshley is unknown to me in nature and the characters are taken from the description.

Rostrum short, not attaining anterior coxæ; size large (4½ mm.); pronotum castaneous with black callosities. Calif. *latipennis,* new species.
Rostrum at least attaining anterior coxæ; length 4 mm. or less 1

1. Ostiolar canal distinctly anteriorly curved at apex; rostrum attaining posterior coxæ. Calif. *lepidus,* new species.
   Ostiolar canal straight 2

2. Rostrum scarcely surpassing anterior coxæ; membrane surpassing cuneus by three-fourths its width. Colorado *furvus,* new species
   Rostrum attaining middle of mesosternum or longer 3

3. Black with the elytra castaneous-brown varied with darker; membrane with a pale spot either side, another at base and pale along the veins. Eastern States, Canada. *americana* Parsh.
   Light brown, almost uniform; pale markings on membrane mostly obsolete. New Hampshire. *uniformis* Parsh.

## 8. **Melanocoris nigricornis,** new species

Allied to *obovatus* Champ., but with the antennæ longer and entirely black; piceous-black; elytra castaneous-brown. Length 4 mm., width 1½ mm.

Head as long as median line of pronotum; apex broadly truncate, almost clavate; vertex broadly convex, the ocelli prominent, red. Antennæ about as long as median line of head and pronotum combined; segment I nearly attaining apex of head; II about three times length of I; III thinner and hardly longer than IV, these two together as long as II. Rostrum not passing anterior coxæ. Pronotum broad and unusually flattened; collum not distinguished; sides nearly straight, broadly expanded and rounded toward anterior angles; surface minutely transversely rugose, impressed across the middle. Elytra opaque, not visibly punctate; membrane passing abdomen by nearly one-half its length, very obscurely wrinkled, the veins about equally prominent, the inner pair approximate at base and the outer sinuated as in Tetraphleps. Ostiolar canal straight and prominent at apex, about as in Tetraphleps. Whole surface opaque; superiorly clothed with fine pale pubescence which shows an inclination to serial arrangement about the clavus. Legs and antennæ minutely pubescent.

Color, dull piceous-black becoming obscure castaneous on the legs; elytra dull castaneous-brown, paler on the embolium and outer margin of cuneus; membrane slightly enfumed with an indistinct paler spot within the apex of the cuneus.

Described from three females, one taken by Mr. Walter M. Giffard at Summit, Placer Co., Calif., August 24, 1916, at an elevation of 7,000 feet; another taken by me on pine trees on Mt. Tahquitz above Keen Camp, Riverside Co., Calif., June 9, 1917, at an elevation of 7,000 feet; the third taken by Mr. Ralph Hopping on Jeffrey pine at Monmouth, Mono Co., Calif., May 9, 1919. The Summit specimen is the insect recorded by me as *M. obovatus* Champ., in Proc. Calif. Acad. Sciences, Ser. 4, VII, p. 262, 1917.

*Holotype,* female, No. 797, Mus. Calif. Acad. Sci.

*Type locality,* Summit, Placer Co., Calif.

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XIII

# A STUDY OF NORTH AMERICAN GRASS-BUGS OF THE GENUS IRBISIA

BY

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Four species of Irbisia have heretofore been reported from North America: *sericans* Stål, from Alaska; *brachycerus* Uhler, from Colorado; *solani* Heidemann, from California; and *mollipes* Van Duzee, from California. Six new forms are now added, making ten known species, for the separation of which a key is appended.

## 1. **Irbisia castanipes,** new species

Surface dull black, less polished than in most of our species; vestiture pale, rather long, appressed; legs uniformly castaneous; dextral male clasper long. Length 6 mm.

Head oblique, its length beyond eye one-third greater than greatest length of eye; vertex flattened; temporal areas conspicuous, shagreened; antennal segment II three times length of I, III and IV equal. Pronotum transversely rugose or obscurely punctate, the callosities small, shagreened; scutellum minutely transversely wrinkled; elytral punctures obscure. Vestiture very minute and sparse, cinereus; sides of pronotum with a few longer erect pale hairs anteriorly. Rostrum reaching apex of intermediate coxæ; lower surface polished. Sinistral clasper of male rather narrow, broadly curved, the subacute apex straight; dextral clasper short, little exceeding ventral apex of genital segment.

Color, opaque bronze-black above and on sides of pronotum; beneath deep polished black; legs castaneous, the femora and tarsi usually darker; apex of coxæ and base of trochanters pale; anterior margin of intermediate and posterior coxal cavities and the orifices polished ivory white.

Described from two males and nine females taken by me on pine at Keen Camp, San Jacinto Mts., Calif., June 6-12, 1917, at an altitude of 5000 to 7000 feet. This species agrees with *sericans* Stål, in the opaque surface, but the latter has the vestiture much longer and conspicuously gray, the dextral male clasper much longer, head less produced beyond eye, knees and tibiæ mostly pale, and all coxal cavities white. Of *sericans* I have before me two males, one macropterous and one brachypterous, taken by Dr. E. C. Van Dyke in Unalaska, the former at Glacier River, July 2, 1907, the latter at Mokushin Bay, July 15, 1907, one pair from Vancouver Island taken by the late Geo. W. Taylor, and a series taken by Dr. G. Dallas Hanna on the Pribilof Islands, Alaska.

*Holotype,* male, No. 798, and *Allotype,* female, No. 799, Mus. Calif. Acad. Sci.

*Type locality,* Keen Camp, San Jacinto Mountains, Calif.

2. **Irbisia californica,** new species

Polished black; vestiture long, golden-gray, suberect; legs fulvous or fulvo-testaceous; membrane with pale mark at apex of cuneus; sinistral male clasper large, abruptly elbowed. Length about 7 mm.

Head oblique, produced beyond eye for a space one-half greater than length of eye; eye produced and much narrowed below; vertex flattened between antennæ; clypeus abruptly depressed at tip; temporal areas poorly distinguished; segment II of antennæ three times length of I; III and IV equal, together four times length of I. Pronotum rugosely punctured, the callosities large, shagreened; scutellum strongly wrinkled; elytra distinctly, closely punctured. Vestiture close long, golden-gray, erect on head and pronotum, somewhat appressed on the elytra; antennæ minutely gray-pubescent, this pubescence black on segment I and base of II, with a few longer bristles on base of I. Beneath mostly polished black, the venter with minute pale pubescence, the genital segment with a few long pale hairs; rostrum attaining middle of intermediate coxæ. Sinistral male clasper large, broad, abruptly elbowed at apex of genital segment, its apical portion longer than basal, triangularly expanded immediately before its truncated apex; dextral clasper long, thick and terete, nearly attaining apex of sinistral.

Color, black, polished; rostrum and legs fulvo-testaceous, femora more or less marked with brown, beneath usually with a row of brown dots; tibial spines and tarsi black; coxæ mostly, margins of coxal cavities and orifices, white; membrane fuscous with small pale mark at apex of cuneus.

Described from numerous examples of both sexes representing the following localities in California: Hills back of Oakland, April 12, 1908, April 30, 1911, and May 8, 1910; Lagunitas, Marin Co., April 24, 1910, and Muir Woods, Marin Co., May 17, 1908, Dr. E. C. Van Dyke; Mt. Diablo, April 29, 1917; Leona Heights, Oakland, May 5, 1918; Ross, Marin Co., March 31, 1918; San Mateo Co., May 19, 1918; Carmel, Monterey Co., March 23, 1918, and Bradley, Monterey Co., April 23, 1917, E. P. Van Duzee; Portola Valley, San Mateo Co., May 4, 1917; Santa Cruz Co., June 9, 1917; Dublin Canyon, Alameda Co., May 6, 1917, W. M. Giffard; Santa Clara, April 20, 1914, Leroy Childs; Alameda Co., May, 1915, M. C. Van Duzee; Piedmont, Alameda Co., April 22, 1917, J. C. Bradley; Oakland, April 3, 1905, and Pasadena, April 30, and July 25, 1909, Fordyce Grinnell.

This species is found from Los Angeles Co., north at least to Marin Co., and probably much farther. About the Bay region it is often excessively abundant on grass on open hillsides. I have formerly determined this species as *sericans* Stål, but a study of typical specimens of the latter from Alaska shows them to be very distinct. The Pasadena specimens are a little smaller than those from farther north.

*Holotype,* male, No. 800, and *allotype,* female, No. 801, Mus. Calif. Acad. Sci.; E. C. Van Dyke collector.

*Type locality,* hills back of Oakland, Calif.

Paratypes in Academy collection, also in that of the author.

### 3. **Irbisia mollipes** Van Duzee

(Proc. Calif. Acad. Sci., Ser. 4, VII, p. 264, 1917.)

Polished black; pronotal punctures distinct, scarcely showing traces of transverse rugæ; vestiture long, gray; legs fulvous; sinistral male clasper broadly curved. Length 5½ to 6 mm.

Head oblique; length beyond eye hardly more than greatest length of eye; eye well produced and narrowed below; vertex flattened between the antennæ; temporal areas scarcely distinguished. Segment II of antennæ three times length of I; III scarcely longer than IV, these together one-sixth longer than II. Pronotum deeply, distinctly punctured, showing scarcely a trace of the transverse rugæ; scutellum obscurely wrinkled: elytra closely, obscurely punctured. Vestiture long, dense, pale, erect on head and pronotum; rostrum attaining base of intermediate coxæ. Sinistral male clasper wide and convex at base, broadly curved, its acute apex short and straight; dextral short, but little surpassing the subacute ventral apex of the genital segment.

Color, polished black obscured by the heavy vestiture above; beneath polished black. Rostrum, apex of coxæ and legs fulvous; margin of coxal cavities and orifices yellowish white; rostrum and tibiæ infuscated at apex; membrane uniformly smoky or with a very faint pale mark at apex of the cuneus.

This species was founded as a variety of *californica,* then misidentified as *sericans.* It is readily distinguished from *californica* by the form of the male claspers and the red legs. Material is before me from the following localities in California in addition to those listed in the original description: Ross, Marin Co., March 31,1918; San Luis Obispo, April 24, 1919; Santa Cruz Island, May 17, 1919; Keen Camp, San Jacinto Mountains, June 8, 1917, Alpine, San Diego Co., March 11, 1914, E. P. Van Duzee; Pasadena, April 9 to May 1, 1909, Fordyce Grinnell; top of Las Vegas Range, N. M., June 28, 1902. The holotype was taken in Santa Cruz Co. by Mr. W. M. Giffard.

4. **Irbisia arcuata**, new species

Black, polished; vestiture white, short, appressed; face in profile regularly convex; legs fulvo-testaceous or castaneous on the femora, the tibiæ paler. Length 6 mm.

Head nearly vertical, produced beyond eye for a space nearly twice length of eye; eyes small, oval, little produced and narrowed below; vertex seen from side regularly arcuated from base to apex of clypeus; temporal areas scarcely elevated, a little shagreened posteriorly. Segment II of antennæ 2½ times length of I; III one-half longer than IV, these together one-fourth longer than II. Pronotum strongly, transversely, rugosely punctured; callosities moderately elevated, shagreened, not conspicuous; scutellum strongly transversely wrinkled; elytra closely, distinctly punctate. Vestiture not dense, short, white, appressed. Beneath polished, minutely shagreened, the venter with longer appressed white hairs. Sinistral male clasper rather wide, broadly curved, flattened and obtuse at apex; dextral clasper long, surpassing the genital segment by one-half its length and attaining apex of sinistral.

Color, deep polished black; rostrum and legs fulvo-testaceous; femora more or less rufous or castaneous; tibiæ paler, their spines black; tarsi black; prosternum anteriorly, apex of coxæ and margin of coxal cavities whitish.

Described from one pair taken by me at Sunset, Colo., July 19, 1907, at an elevation of 8000 feet, and one pair labelled "Colo." received in exchange from Prof. C. F. Baker. The latter have the apical half of segment I of the antennæ castaneous. One male taken by me at Sunset with the foregoing I believe to be the true *brachycerus* Uhler. It has the gray vestiture long and erect as described by Dr. Uhler, the vertex flattened between the antennæ, rostrum and legs piceous, becoming castaneous on the tibiæ, prosterum concolorous, coxal cavities and orifices broadly ivory-white and the dextral clasper short, scarcely surpassing ventral aspect of genital segment. Another male of this form was sent to me by Prof. Aldrich from Moscow, Idaho. In both these species the membrane is uniformly infuscated.

*Holotype,* male, No. 802, Mus. Calif. Acad. Sci.; *allotype* and paratypes in collection of the author.

*Type locality,* Sunset, Colo., at 8000 feet elevation.

### 5. Irbisia setosa, new species

Polished black, coarsely punctured and somewhat bronzed on the pronotum; vestiture of long erect fuscous hairs and minute white appressed ones; legs mostly black. Length 5-6 mm.

Head short, nearly vertical, produced beyond eyes for a space equal to length of eye; eyes large, ovate, narrowed below; vertex flattened between the antennæ; clypeus much incurved at apex; temporal areas prominent, shagreened. Segment II of antennæ three times length of I; III and IV equal, together a little longer than II. Pronotum coarsely, distinctly punctate, scarcely rugose; scutellum finely wrinkled; elytra roughened or obscurely punctate. Vestiture of erect stiff black hairs as long as thickness of femora, and very minute appressed white hairs. Beneath highly polished, black, with scattering pale hairs along middle to apex of genital segment. Sinistral male clasper broad and convex at base, curved and sickle-shaped, its acute apex scarcely exceeding the dextral clasper.

Color, deep black a little bronzed above, especially on pronotum; rostrum and legs dark castaneous or almost black on femora, the tibiæ paler, margins of coxal cavities scarcely touched with white; membrane uniformly infuscated.

Described from one pair taken by me at Cazadero, Sonoma Co., Calif., April 12-14, 1918; another pair taken by me at Bradley, Monterey Co., Calif., April 23, 1917; one male taken at Fairfax, Marin Co., Calif., May 7, 1919; and two males from the hills back of Oakland, Calif., taken May 12, 1908, by Dr. E. C. Van Dyke. This form may be distinguished by the long erect fuscous vestiture, which, however, is easily rubbed off, the short vertical head, black legs and male genital characters.

*Holotype,* male, No. 803, and *allotype,* female, No. 804, Mus. Calif. Acad. Sci.

*Type locality,* Cazadero, Sonoma Co., Calif.

### 6. **Irbisia sita,** new species

Polished black, head smooth; vestiture rather dense, long, gray; legs fulvous to castaneous; sinistral male clasper large, elbowed. Length 5-5 ½ mm.

Head nearly vertical; hardly longer below eye than length of eye; vertex slightly convex between antennæ, polished and impunctate; temporal areas scarcely distinguished; eyes long, much contracted below; clypeus strongly arcuate; second antennal segment 2½ times length of I; III and IV subequal, together a little longer than II. Pronotum deeply closely punctured, scarcely rugose, callosities scarcely elevated; scutellum feebly wrinkled: elytra obscurely punctate; rostrum attaining apex of intermediate coxæ. Beneath polished, clothed with conspicuous white hairs, a few on anterior coxæ, prosternum and disk of male venter and genital segment longer and suberect. Sinistral male clasper broad, abruptly elbowed as in *californica,* its broad flattened apex a little exceeded by the terete dextral clasper; vestiture long, soft, white, more erect on head and pronotum.

Color, deep polished black, bronzed on pronotum and scutellum and less so on elytra, not at all on head and beneath; rostrum and legs fulvous to castaneous, paler or more testaceous on tibiæ; extreme tip of tibiæ and tarsi black; prosternum, broad margins of coxal cavities, orifices and usually apex of coxæ white; tibial spines black; sutures of face sometimes pale.

Described from five male and five female examples taken by me in San Diego Co., Calif., in April and May, 1913-1914, one male and three females taken by me at Atascadero, Calif., April 23, 1919, and three males and one female taken by Fordyce Grinnell at Pasadena Calif., in April, 1909. This species, with *setosa* and *pæta,* constitutes a group of smaller forms more characteristic of the southern portion of the state. Of these, *pæta* may be distinguished by its small round eyes, *setosa* by the long stiff fuscous vestiture and black legs, and *sita* by its soft white vestiture and castaneous legs.

*Holotype,* male, No. 805, and *allotype,* female, No. 806, Mus. Calif. Acad. Sci.; *paratypes* in Academy's collection, also in that of the author.

*Type locality,* Foster, San Diego Co., Calif.

### 7. **Irbisia pæta,** new species

Polished black, coarsely punctate on pronotum; vestiture long, soft, white; eyes small, but little elongated; legs fulvous. Length 5 ½ mm.

Head moderately oblique, produced beyond eye for a space rather more than length of eye; vertex flattened between antennæ; clypeus strongly arcuate; temporal areas large, obscure, nearly smooth; antennæ short; segment II less than three times length of I; III and IV subequal, together nearly as long as I and II together. Pronotum coarsely punctate: scutellum obscurely rastrate but scarcely wrinkled. Vestiture long, white, nearly erect on head and pronotum. Beneath polished, with sparse, rather long white pubescence, longer on the male genital segment. Sinistral male clasper broadly curved, its apex exceeded by the long dextral clasper.

Color, deep polished black, a little bronzed on the pronotum; rostrum and legs fulvous, tibiæ becoming whitish testaceous as are the coxæ; orifices and narrow margin of coxal cavities white; membrane uniformly fuscous; apex of first antennal segment sometimes castaneous.

Described from three males taken by me in Balboa Park, San Diego, Calif., April 9, 1913. This species may be distinguished by the small, nearly round eyes, the fulvous legs and pale coxæ.

*Holotype,* male, No. 807, Mus. Calif. Acad. Sci.

*Type locality,* Balboa Park, San Diego, Calif.

A study of this genus with larger material at hand has enabled me to correct some former errors made by me. All the species in this genus have the head somewhat exserted with a black calloused area on the posterior face of the eye about which is a pale arc. As will be seen, many of our species, especially *solani* Heid., have the pronotum distinctly punctate, thus throwing them into Division Capsaria, according to my key of 1916, where they would run to Lygidea nearly, but their broader form, more hairy surface, black color and more exserted eyes, with the ocular callous mentioned above, will separate them. In the key of 1916, under Irbisia (page 207) the word "close," beginning the last line, should read "closer." The following key will distinguish our species:

Surface dull, opaque or nearly so ........ 1
Surface distinctly polished ........ 2

1. Posterior lobe of pronotum coarsely, transversely wrinkled, impunctate; head shorter; vestiture conspicuous, yellowish; legs black, apex of coxæ, trochanters and tibiæ in part pale, 1, *sericans* Stål
   Posterior lobe of pronotum finely, transversely wrinkled and obscurely punctate; head longer; upper surface sparsely clothed with very minute gray pubescence; legs castaneous, darker on the femora. 2. *castanipes,* new species.

2. Face, viewed from side, regularly arcuated from base of vertex to tip of clypeus, not flattened between antennæ; vestiture sparse, white; legs fulvo-testaceous, the femora invaded with black; length 6 mm. 6, *arcuata,* new species.

Face, viewed from side flattened between the antennæ. 3

3. Eyes small, nearly round; vestiture rather long, dense, white, membrane uniformly black; legs fulvous. 9, *pæta,* new species
Eyes larger, ovate, distinctly produced and narrowed ventrally. 4

4. Longer, 6 mm. or over. 5
Shorter, under 6 mm.; membrane uniformly infuscated. 7

5. Sinistral male genital clasper abruptly elbowed, the apical half vertical to the margin of the ventral segments. 6
Sinistral male genital clasper curved; sickle-shaped; vestiture rather dense and long, gray; membrane uniformly infuscated; legs blackish. 4, *brachycerus* Uhler.

6. Pronotum transversely rugose or rugosely punctate; vestiture golden-gray; legs soiled fulvo-testaceous, the femora, at least in part, apex of the tibiæ, and the tarsi black. 3, *californica,* new species.
Pronotum distinctly punctured; vestiture close, gray; legs fulvous. 5, *mollipes* Van Duzee.

7. Sinistral male genital clasper abruptly elbowed as in *californica;* vestiture dense, whitish; legs fulvous to castaneous; beneath with a percurrent white vitta either side. 8, *sita,* new species.
Sinistral male genital clasper curved, sickle-shaped. 8

8. Surface subopaque, vestiture long, brownish, especially on head and pronotum; sides of pronotum distinctly sinuated, its surface minutely punctate. 7, *setosa,* new species.
Surface polished; vestiture short, gray, appressed, the head and pronotum usually denuded; sides of pronotum rectilinear, its surface more coarsely punctate. 10, *solani* Heid.

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**XIV**

# INSECTS OF THE PRIBILOF ISLANDS, ALASKA

CONTENTS



## INTRODUCTION

BY

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The Pribilof Islands, or the Alaska Fur-seal Islands, as they are often called, are located near the center of Bering Sea. They are approximately 200 miles from land in three directions. Geologically, they are volcanic and very young. All evidence points to the conclusion that they have never been united to any of the near-by islands or continents. They appear to have been "Oceanic" from the time of their birth and this was not earlier than the Pliocene period. The fauna and flora of the islands must have arrived chiefly through agencies other than human because they were not inhabited at the time of their discovery in 1786. Insects might reach them by means of several carriers, such as drift ice, floating trees, river-bank sod floating on ice, air currents and birds. Little definite information is to be had on this subject and very few records of the prevailing ocean and air currents are available. Nevertheless the animals, other than the insects and the plants, are more closely related to those of Alaska than to those of Siberia; however, a mingling of elements from both regions is evident.

As the Pribilofs are the home of the Alaska fur-seals, they are of great commercial value to the United States, and the study of these mammals brings to them almost every season one or more men interested in some branch of biology. Usually they are able to devote some spare time to the collecting of specimens, and it is through their activities that the wild life of the Pribilofs has become better known than that of any similar area in northern North America.

Unfortunately, however, the region has never been thoroughly worked by a trained entomologist. Professor Trevor Kincaid landed there for a short time with the Harriman Alaska Expedition, and he was also attached to the Fur-Seal Commission in 1897. Mr. J. August Kusche landed on St. George Island for a few hours in 1913 and collected some insects which are supposed to have gone to the Carnegie Museum in Pittsburgh, Pa.

Incidental collecting has been done by various men as opportunity from other work permitted. The members of the Fur-Seal Commission of 1896-97 were the earlier contributors and as a result of their activities a paper was published on the insects of the islands in 1899[1]. Also some records were published in the results of the Harriman Expedition. Otherwise the insects are mentioned only incidentally and in widely scattered papers[2].

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1 Fur-seals and Fur-seal Islands of the North Pacific Ocean, pt. 3, pp. 547-554, 1899.)

2 The reader is referred to Bulletin XXXIV, Document No. 820, U. S. Bureau of Fisheries, 1915, for a partial bibliography of the Pribilof Islands and their life. Further information may be secured from the Annual Reports of the same Bureau under the Appendix entitled "Alaska Fisheries and Fur Industries."

In 1911, Dr. Barton W. Evermann, then Chief of the Alaska Fisheries Service, directed the intensive collecting of specimens in all branches of natural history, having in mind ultimately, a complete monograph of the group. Naturalists were appointed and as assistants they had the services of the resident school teachers. Thus, A. G. Whitney, on St. Paul, 1912-14, and the writer on St. George, 1913-14, made considerable collections of insects which were promptly transmitted to the Government. A report upon them, however, has not as yet appeared.

With the departure of Dr. Evermann from the Bureau of Fisheries, his policies were unfortunately changed and it was not until the summer of 1920 that insect collecting again engaged the attention of the writer. Some opportunity was then presented to obtain a fair series in most of the groups. It is this material which forms the basis of the following report. In addition to the material listed the collection contained several species of Diptera and Hymenoptera which are still undetermined.

In the report of 1899, 42 species were listed. The number reported herewith is 86. Together the two reports contain about 100 species. Those which have been listed or described in other places bring the total up to about 125 species exclusive of the Hymenoptera. Of this order Ashmead[3] lists from the Pribilofs 67 species, of which 52 were described as new to science.

Schwartz[4] estimated that the total number of insects which might be expected there would be about 400 species. If correct, it appears that the work is not as yet half done.

The 1899 report contains erroneous statements, quoted from Elliott[5], which need correction. On page 550 "a very few species of butterflies" are recorded. There are no butterflies on the Pribilofs. Likewise the record of "a single dragon fly" on page 552 should be ignored, because these insects are absent. Similar sweeping statements were made regarding several species of mollusks in his "Monograph."

The absence of mosquitoes and other insects injurious to man and animals is noteworthy. The Pribilof tundra is a paradise to one accustomed to similar territory in other northern regions.

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3 Proc. Wash. Acad. Sci., II, 1900.
4 Fur-seals and Fur-seal Islands, pt. 3, p. 547, 1899.
5 Report of the 10th Census, 1884, p. 12, Monograph of the Seal Islands.

# COLEOPTERA FROM THE PRIBILOF ISLANDS, ALASKA

BY

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The collection of Coleoptera, made by Dr. Hanna while stationed on the Pribilof Islands during the summer of 1920 contains 21 species, most of them represented by numerous specimens. It includes nearly all of those known to have been found there. In the present report, the lacking ones are mentioned in order to make the list as complete as possible. A short bibliography is also given.

The beetles of the Fur-seal Islands are better known than is any other portion of its insect fauna, many of the species having been known for a long time. The first one to be mentioned was *Carabus truncaticollis* Esch., which was captured by Dr. Eschscholtz while on his second voyage, the second Kotzebue Expedition, 1823-1826, and described in 1833 in his "Zoological Atlas." Eschscholtz does not seem to have visited the Pribilofs during his first voyage, 1815-1818, although he collected on Unalaska Island on that trip and not only described a number of the species captured, in his "Entomographien," published in 1822, but furnished Fisher von Waldheim with a number to be described by him in his "Entomographia imperü russici," published in 1820-1822. Other species named by Eschscholtz were not described by him because of his early death, but by others, such as Count Dejean and Baron von Mannerheim who, of course, are given credit for the same. Meanwhile, other Russians stationed at the Fur-seal Islands, as elsewhere in the Russian possessions in North America, collected specimens and sent them back, chiefly to the two great museums at Moscow and St. Petersburg. Here they were described by various workers, chiefly Ménétries at St. Petersburg and Count von Mannerheim at Moscow. The latter, in his classical "Beitrag zur Käfer-Fauna der Aleutischen Inseln, der Insel Sitkha and Neu-Californiens," published in 1843 in the "Bull. de la Soc. Imper. des Natural. de Moscou," and in his three supplements to the same, published respectively in 1846, 1852, and 1853, gave us the most complete work which has been published on the Coleoptera of Alaska and one which has served as the basis for all subsequent studies. Since the Pribilof Islands became a part of the United States, small collections of specimens have been made from time to time by various collectors stopping there or by those investigating the fur-seal herds. The two who have collected the most are Professor Trevor Kincaid, who, while working as a student under Dr. Jordan, in 1897, collected a fair series of the Coleoptera, part of which went to the National Museum and part remained behind in his own hands; and Mr. J. August Kusche who made a brief stop there in 1913; the bulk of his material went to the Carnegie Museum at Pittsburgh.

The Coleopterous fauna of the Pribilofs, as shown by the species studied, is distinctly arctic. Most of the species are found also on the Seward Peninsula and other parts of the adjacent mainland. A few are met with on the Aleutian Islands, chiefly the uplands of Unalaska Island; but many of the most characteristic species of the Aleutian Islands, those belonging to the Vancouveran fauna[6], as I have called it, and which are also to be found along the south side of the Alaska Peninsula and in southeastern Alaska generally, are not to be found on the Pribilof Islands. This would seem to indicate that they had at one time been connected to the mainland to the east or northeast, never with the Aleutian Islands, and had received their fauna from the former.

## CARABIDÆ

### 1. **Carabus truncaticollis** Esch.

Esch., Zoo. Atlas, V (1833), p. 22.

Mots., Bull. Mosc., IV (1845), p. 337, t. 5 f. 3.

Sahlb. J., Col. and Hemiptera of the Vega Exped. (1885), p. 12.

Many specimens. The series shows many color phases, varying from brilliant green through bronze to almost black. This is the largest and most conspicious beetle found on the islands. Eschscholtz in his original description states that he found this insect both at Kamchatka and on the Islands of St. George and St. Paul. It has since been taken by numerous collectors on the Seward Peninsula and upper Yukon and by the Vega Expedition

6 "The Distribution of Insects in Western North America," by Edwin C. Van Dyke, Anns. Ent. Soc. Amer., Vol. XII (March, 1919), pp. 1-12.

at various places in Arctic Siberia from Bering Strait to the Ural Mountains. It has also been recorded from the Sierra Nevada Mountains on the authority of Henry Edwards. This last record, however, I very much doubt.

### 2. **Nebria bifaria** Mann.

Mann., Bull. Mosc., XXVI (1853), p. 128.

*N. Carbonaria* Mann., Bull. Mosc., XXV (1852), p. 293.

Heyden, Cat. Col. Siberia, Berlin (1880-81), p. 13.

Six specimens of the typical form with red femora and dark knees, tibia, and tarsi, from St. Paul Island, the type locality. Typical specimens of the same species are also to be found at Teller and Nome, and on the Alaska Peninsula and all black phases with the same at the last locality as well as near the mouth of the Mackenzie. (See Report Canadian Arctic Exped., Vol. III, Insects (1919), p. 14E.) It has also been reported from Kamchatka and by Heyden from various places along the coast of northeastern Siberia. It has not been found on the Aleutian Islands. *Bifaria* is the only *Nebria* that I have seen in the various collections that have been made on the Pribilof Islands. The *Nebria reducta* Casey (Memoirs on Col., IX (1920), p. 150), described from St. Paul Island, I am inclined to believe is not only a dark or fully pigmented phase of *N. viridis* Horn, but may never have been actually taken on the islands. A good deal of the material taken in Alaska has, through carelessness, often been tagged with wrong locality labels by the collectors.

### 3. **Patrobus septentrionis** Dej.

Dejean, Spec., III (1828), p. 29.

*Fossifrons* Esch., Mén. de la Soc. Imp. de Natur. de Moscou, VI, p. 104, 9.

*Fossifrons* Esch., Mann., Bull. Mosc., XVI (1843), (Sep. p. 22).

A series of 28 specimens, three from St. Paul Island, the rest from St. George. These are all similar to the phase described as *fossifrons* Esch., from Unalaska, and found so abundantly there. The species is found on this continent extending from Alaska to Labrador, to the Lake Superior region, down the Rockies to

Colorado, through the Cascades and Sierra Nevada Mountains to Lake Tahoe, and along the lowlands of the West Coast as far south as middle Washington. In the old world, it extends from the Scandinavian Peninsula and Scotland eastward across northern Europe and Siberia to Bering Strait. It varies considerably, and as a result, a great number of varieties and so-called species have been erected at its expense. Very large series, however, from many localities, show that they all grade one into the other.

4. **Pterostichus hyperboreus** Mann.

Mann., Bull. Mosc., XXVI (1853), p. 127.

Ménétr., Käfer Russl., p. 54.

A large series, mostly from St. George Island, though with a few from St. Paul, and containing typical as well as atypical examples. The typical have the area within the hind angles of the pronotum convex and impunctate; in the atypical, the same area is more or less flattened and irregularly punctured. All degrees of variation are observable. The series shows that this species, like all of the others of the subgenus *Cryobius,* is exceedingly variable. The color ranges from a metallic green through violet and bronze to black, the last found generally in the older and more rubbed individuals. In its limited sense, this species is restricted to the Pribilof Islands, but it is, in reality, little more than a geographic race or subspecies of *P. ventricosus* Esch. of Unalaska; the same is true of the more widely distributed mainland form, *P. vindicatus* Mann.

5. **Pterostichus hudsonicus** Lec.

Le Conte, Proc. Acad. Nat. Sci. Phila. (1873), p. 315.

A good series with representatives from both St. George and St. Paul islands. This variable species is not found on the Aleutian Islands, but ranges, on the mainland, from the Seward Peninsula, Alaska, to Labrador, Mt. Washington, N. H., and Lake Superior.

6. **Pterostichus similis** Mén.

Ménétr., Käfer Russl., p. 55.

Mann., Bull. Mosc., XXV (1852), p. 296 (Sep. p. 9).

Var. *quadricollis* Mann., Bull. Mosc., XXVI (1853), p. 133.

Many specimens of the typical form as well as a number of the smaller and broader individuals which would be classed as var. *quadricollis* Mann., all from St. George Island, the type locality for both. This is the third species of the subgenus *Cryobius* from the Pribilofs. I have found it myself on the mountains of Unalaska Island and it has also been taken abundantly on the Seward Peninsula, and according to Sahlberg, at St. Lawrence Bay, Peninsula of Tschutski, Siberia.

7. **Amara brunnipennis** Dej.

Dej., Spec. (1831), V, p. 800.

Twenty specimens of this variable species with representatives from both St. George and St. Paul islands, and with the phases having light and dark elytra, in about equal numbers. This species is not found on the Aleutian Islands, but is common on the mainland and extends from the Seward Peninsula to Labrador, Mt. Washington, N. H., and the high Rocky Mountains of Colorado.

8. **Amara glacialis Mann.**

Mann., Bull Mosc., XXVI (1853), p. 135.

One specimen from St. Paul Island. This is an interesting addition to the Coleopterous fauna of the Pribilofs. It was described from the Kenai Peninsula, but has since been found at Cockburn Point and Bernard Harbor, Canadian Northwest Territory, Ungava, Hudson Bay, and Labrador, and is stated to be represented by a variety in Kamchatka.

9. **Amara remotestriata** Dej.

Dej., Spec. general des Col., III (1828), p. 473.

*Indistincta* Mann., Bull. Mosc., XXVI (1853), p. 45.

*Reducens* Mann., Bull. Mosc., XXVI (1853), p. 46.

Not found by Dr. Hanna but by Professor Kincaid on St. Paul Island, in July, 1897. This species is also found on Atka, Unalaska, and Akutan of the Aleutian Islands, on Kodiak, and the Alaska Peninsula, and extends across the continent and as far south on the Atlantic Coast as New Jersey, down the Rocky Mountains to New Mexico, and along the Pacific Coast as far as middle California.

## DYTISCIDÆ

### 10. **Agabus hypomelas** Mann.

Mann., Bull. Mosc., XVI (1843), p. 221 (Sep. p. 97).

Var. *irregularis* Mann., Bull. Mosc., XXVI (1853), p. 72.

Twelve specimens, including some from both St. George and St. Paul islands. It is found also on Unalaska Island, Alaska Peninsula, Kodiak Island, Kenai Peninsula, Sitka, and Vancouver Island. The specimens from the Pribilofs are slightly darker than those seen from Unalaska.

### 11. **Laccophilus decipiens** Lec.

Lec. Anns. Lyc. Nat. Hist. N. Y., V (1851), p. 205.

*Truncatus* Mann., Bull. Mosc., XXVI (1853), p. 68.

*Californicus* Mots., Bull. Mosc., XXXII (1859), II, p. 172.

This species is listed from St. George Island as well as the Kenai Peninsula, on the authority of Mannerheim, but it has not been found farther north than British Columbia in recent years. It is a common species in both Oregon and California. I would questionably admit of its being Alaskan until verified.

## SILPHIDÆ

### 12. **Lyrosoma opacum** Mann.

Mann., Bull. Mosc., XXVI (1853), p. 175.

Sahlb. J., Vega Exped. (1885), p. 66.

Numerous specimens from both St. George and St. Paul islands. It is a widely distributed species in Bering Sea, being found on Bogoslof, Atka, Unalaska, and Bering islands; it is also found on Afognak Island. It lives in the rotting kelp and is at times completely submerged by the tides.

## STAPHYLINIDÆ

### 13. **Atheta graminicola** Gravh.

Gravh., Mon. Col. Micropt. (1806), p. 76.

*Stonolota granulata* Mann., Bull. Mosc., XIX (1846), p. 508.

Three specimens. This small rove beetle is abundant on Unalaska and Atka islands, and is also to be found on the Alaska Peninsula, Kodiak, Queen Charlotte Islands, as well as in Arctic Europe and Asia.

### 14. **Quedius fulvicollis** Steph.

Steph., Ill. Brit. Ent., V (1832), p. 244.

*Hyperboreus* Er., Gen. (1839), p. 547.

Not found by Dr. Hanna, but secured previously by Professor Kincaid. It is found also on Unalaska Island, at Nome, and extends across the continent to Labrador and Newfoundland, to Maine, to Colorado, to Vancouver Island, and is found likewise throughout Europe and Arctic Asia.

### 15. **Tachinus apterus** Mäklin

Mäklin, Bull. Mosc., XXVI (1853), p. 113.

Six specimens from St. George Island. This species is supposed to be restricted to this island, but though considered distinct by Fauvel, is undoubtedly very closely related to others found at Unalaska and on the mainland.

### 16. **Arpedium beringensis** Van Dyke, new species

Apterous; nigro piceous, antennæ, palpi, margins of the prothorax and elytra, and feet refuescent. Head triangular, vertex bi-impressed, front slightly convex and shallowly obliquely impressed on each side anteriorly, the disc alutaceous and minutely sparsely punctate, the tempora very prominent, the head rather suddenly constricted behind. Antennæ extending almost to middle of elytra, joints 2, 3 and 4 of about equal length and breadth, slightly more than twice as long as broad, 4—10 gradually shorter and broader but never broader than long or transverse. Prothorax transverse, one-third broader than long, slightly narrowed posteriorly, moderately convex, broadly shallowly emarginate at apex, narrowly emarginate at middle of base, sides rounded, disc alutaceous and finely sparsely yet distinctly punctate and pilose, more markedly at sides, a fovea at sides in front of middle. Elytra at least a third longer than prothorax and one-half broader, with sides straight and diverging from humeri, the margin fine and reflexed, the apex of each elytron obliquely truncate outwards, the outer apical angles broadly rounded, the disc moderately coarsely punctured and minutely pilose. Abdomen broader than elytra, above minutely rather sparsely punctate and pilose, beneath more definitely but equally punctured. Length 4 mm., breadth 2 mm.

*Holotype* and three *paratypes* in my collection, collected on St. George Island, Pribilof Islands, Alaska, June 14 and August 5, 1897, by Professor Trevor Kincaid, and by him kindly presented to me. Two *paratypes* collected on St. George Island, July 1, 1920, by Dr. G. Dallas Hanna are in the collection of the California Academy of Sciences, as is also a series of eight specimens of the same from St. Paul Island, collected by Dr. Hanna. In Dr. F. E. Blaisdell's collection, there are also several more from the Pribilofs, collected July, 1911, as well as two from Nome, Alaska, collected June, 1899. In my collection there is one from Teller.

*Type locality,* St. George Island, Pribilof Group, Alaska.

This species, I have for some time considered as but a dark phase of the widely distributed *Arpedium brunnescens* Sahlb. Upon more careful comparison with that species, I find, however, that it differs not only in color but by being generally more robust, by having antennæ of a different type, the joints 8—10 in *brunnescens* being decidedly transverse, by having more prominent and angular tempora, and a more definite and abundant punctuation and pilosity, the abdomen being especially more punctate and pilose. So far as I know, *beringensis* is local to the Pribilof Islands and the neighboring Seward Peninsula on the mainland, while *brunnescens* is found on Unalaska Island, and extends to Banff, Alberta, and the Lake Superior region. It is also found throughout the arctic portions of Europe and Asia.

### 17. **Olophrum fuscum** Grav.

Grav., Mon. Col. Micropt. (1806), p. 211.

*Latum* Mäkl., Bull. Mosc., XXVI (1853), p. 194.

Eighteen specimens, some from St. George, others from St. Paul. It is also found on the Kenai Peninsula as well as in northern Siberia, Caucasia, and temperate and northern Europe.

### 18. **Micralymma dicksoni** Mäklin

Mäkin, Öfv. Finsk vet. Soc. Förh, (1877), p. 24.

Sahlberg, J., Vega Exped. (1885), p. 28.

One specimen collected by Dr. Hanna. I have also a series in my own collection given to me by Professor Kincaid, who captured them on St. George Island, as well as a series from northwest Siberia, not far from the type locality, which agree perfectly with the Pribilof specimens. The species has so far only been found along the coast of Siberia from the mouth of the Yenisei River east to Bering Strait and on the Pribilof Islands.

## BYRRHIDÆ

### 19. **Byrrhus fasciatus** Fabr.

Fabr., Ent. Syst., I (1792), p. 85, 4.

Not found by Dr. Hanna, though collected there by Professor Kincaid. It is found also on Unalaska Island and the Seward Peninsula, as well as throughout Europe and northern Siberia.

## ELATERIDÆ

### 20. **Cryptohypnus littoralis** Esch.

Esch., Thon Entom. Archiv, II (1829), I, p. 33.

Dej., Cat., 3rd Ed. (1833), p. 105.

Germ., Zeitsch. V (1844), p. 137, 3.

Mann., Bull. Mosc., XIX (1846), p. 510.

Not found by Dr. Hanna, but secured previously on the islands by Professor Kincaid. It is found also on the seacoast of Atka, Unalaska, and Kodiak islands, as well as on the Kenai Peninsula and at Kukak Bay (Kincaid, Harriman Exped.). It is also reported from Kamchatka.

21. **Hypnoidus musculus** Esch.

Esch., Entomographien (1822), p. 70.
Esch., Thon Entom. Archiv, II (1829), p. 33.
Mann., Bull. Mosc., XVI (1843), (Sep. p. 66).

One specimen. Taken in numbers previously by Professor Kincaid. Found also on Unalaska and Kodiak islands, the Kenai Peninsula, Wrangel Island, and Queen Charlotte Islands.

## CHRYSOMELIDÆ

22. **Chrysomela subsulcata** Mann.

Mann., Bull. Mosc., XXVI (1853), p. 247.

A large series, including specimens from both St. George and St. Paul islands, the latter the type locality. They show a great variation in color, ranging from brilliant green, through blue, bronze, to black; also in size and in sculpture, most of the specimens having the elytral intervals subcristate with the striæ deeply impressed while others show intermediate degrees of development to certain small specimens which have the intervals very flat and the striæ hardly indicated except by the punctures. The life history of this interesting willow-feeding species was described by Kincaid[7]. It was not found on the Aleutian Islands, even after a most careful search, but it has been reported from Popof Island (Harriman Exped. 1900), and Camden Bay and Collinson Point, Alaska, Arctic Coast (Canad. Arctic Exped., 1919). Related but distinct species are found on the opposite Siberian Coast.

## EURYSTETHIDÆ (ÆGIALITIDÆ)

23. **Eurystethus (Ægialities) californicus** Mots.

Mots., Bull. Mosc., XVIII (1845), p. 33.
*Debilis* Mann., Bull. Mosc., XXVI (1853), p. 180.
Seidlitz, Deutsch Ent., Zeit. (1916), p. 127.
Van Dyke, Entom. News, XXIX (Oct., 1918), p. 307.

Nineteen specimens, several of which have a much narrower and more cylindrical prothorax and generally narrower after-body, including the elytra, but otherwise not different. This insect, perhaps the most distinctive of the North Pacific, has

7 Harriman Alaska Expedition, Vol. VIII, Insects, Part I (1904), p. 199.

been found on all of the Commander Islands, the Aleutian Islands, Kenai Peninsula, Sitka, Queen Charlotte Islands, and Vancouver Island. It has not so far ever been captured on the coast of either Oregon or California, but it is replaced in the latter by other species of the same genus.

## CURCULIONIDÆ

### 24. **Lophalophus inquinatus** Mann.

Mann., Bull. Mosc., XXV (1852), p. 351 (Sep. p. 135).
Mann., Bull. Mosc., XXVI (1853), p. 244 (Sep. p. 231).

One specimen. Found also on Atka, Unalaska, Unga, Kodiak and Afognak islands, the Kenai Peninsula, and at Sitka.

### 25. **Lephyrus palustris** Scopoli

Scopoli, Entomologia Carniolica, etc. (1763), p. 33.

Not found by Dr. Hanna, though secured by Professor Kincaid on St. George Island. I have wing cases taken by myself on Unalaska Island; also specimens from Nome and Teller, Alaska. It has also been taken at Bernard Harbor, Northwest Territory (Can. Arctic Exped., 1919). These are the typical *palustris,* agreeing perfectly with the typical form from Europe. The subspecies *canadensis* Csy., which is found in the Hudsonian and Canadian faunal regions more to the south, of which I have specimens from Rampart, Tanana, and Dawson, is quite distinct, as is also the subspecies *geminatus* Say, the common form in the Eastern United States, and the subspecies *perforatus* Csy. of British Columbia and Washington. The true *palustris* is also found throughout Europe and Arctic Siberia.

### 26. **Trachodes ptinoides** Germ.

Germ., Insect. Spec. Novæ Halæ, XXIV (1824), p. 327.
Mann., Bull. Mosc., XVI (1843), p. 249 (Sep. p. 120).

Thirty-eight specimens from St. George Island. Found also on Atka, Unalaska and Akutan islands, at Yakutat, Wrangel, on the Queen Charlotte and Vancouver islands, and the mainland as far south as California. It breeds only in the driftwood found

# A NEW SPECIES OF THE DIPTEROUS FAMILY DOLICHOPODIDÆ FROM THE PRIBILOF ISLANDS, ALASKA

BY

M. C. VAN DUZEE

## **Hydrophorus fumipennis** Van Duzee, new species

Female: Length 4 mm. Face wide, shining coppery, its lower edge nearly straight, palpi brownish yellow. Front seal-brown. Antennæ black, rather short; third joint small, about as long as wide; arista about as long as the antenna. One pair of post-verticals; postorbitals about eight on each side, reaching but little more than one-third the eye height, black. Beard yellow, almost golden, not very abundant.

Thorax brown with about six or seven dorsocentrals in each row; acrostichals black, in a single row; pollen on upper half of the pleuræ brown, on lower half and on the coxæ whitish. Propleura with one black bristle above the fore coxa. Scutellum with two pair of bristles. Scutellum and abdomen coppery-bronze colored.

Fore coxæ, tibiæ and femora bronze; middle and hind coxæ and all tarsi blackish. The anterior surface of fore coxæ covered with minute white hairs, and with a row of 12 or more small black bristles of nearly equal length on the outer edge, these scarcely as long as thickness of tibia. Fore femora considerably thickened, appearing to have two rows of close-set, short spines on the whole length of its lower surface; fore tibiæ nearly straight, with a distinct angle at tip projecting a little towards the femora, and with short spines nearly the whole length of its inner surface, nearly as long as those on the femora. Fore tarsi as long as their femora; first joint as long as the two following joints taken together, last four joints of nearly equal length. Middle femora and tibia each about as long as the abdomen; middle tarsi scarcely more than half as long as their tibiæ, the first two joints shorter than those following, the second being the shorter, about half as long as third. Halteres altogether black. Calypters black with yellowish cilia.

Wings brown in front of fourth vein and along the fifth and cross veins, a small spot at base, a slender streak in the center of the marginal cell, and a spot at tip of the submarginal cell, which is gray; the center of the first posterior cell also a little grayish; third vein bending forward a little just before its tip as it often does in this genus.

*Holotype,* female, No. 821, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, July 20, 1920.

*Type locality,* St. Paul Island, Alaska.

This interesting form can be recognized by the row of 12 or more little black bristles of nearly equal length on the anterior edge of the outer side of the fore coxæ, the very short middle tarsi, especially the short first two joints, and the dark wings, together with the metallic face, black halteres and the black calypters with their pale cilia.

# DIPTERA FROM THE PRIBILOF ISLANDS, ALASKA

BY

F. R. COLE

*Stanford University*

A few Diptera have been recorded from the Pribilof Islands in past years, but heretofore no extensive collection has formed the basis of a report. Dr. G. Dallas Hanna and Mr. A. G. Whitney made a collection a few years ago and reports were prepared by Mr. J. R. Malloch and Dr. C. P. Alexander on the Diptera in general and the Tipulidæ, respectively. The following list is based solely upon the considerable series secured by Dr. Hanna in 1920. The Tipulidæ were determined by Dr. C. P. Alexander; the Anthomyiidæ, Chironomidæ and some of the Scatophagidæ by Mr. J. R. Malloch; and one species of Dolichopodidæ by Mr. M. C. Van Duzee. Their reports appear as sections of the present series.

Owing to the cold, foggy, summer climate of the Pribilof Islands, one would not expect to find many species of flies, especially as the islands are about 200 miles from the mainland; but there is a considerable number and some of them are said to occur in almost incredible abundance. The large number of decomposing carcasses of fur-seals and the kelp beds along the beaches attract many scavengers, such as certain of the Muscidæ, Scatophagidæ and Anthomyiidæ. This dampness of the climate also makes the preservation of dry specimens somewhat difficult.

## CHIRONOMIDÆ

The few species collected were examined by Mr. Malloch. All of the specimens were in rather poor condition for study.

## MYCETOPHILIDÆ

### 1. **Boletina obesula** Johanns.

One female, St. Paul Island, June 21. The type is a female, taken at the head of the Tsirku River, Alaska.

2. **Boletina** sp.

One male of an undescribed species, St. Paul Island, June 21. Too poorly preserved for description.

3. **Neosciara** sp.

Near *tridentata* Rubs. One female in rather poor condition, so that its identity is not certain, St. Paul Island, June 21.

## DOLICHOPODIDÆ

4. **Hydrophorus fumipennis** Van Duzee

For description see page 167 of preceding paper.

5. **Dolichopus rupestris** Halid.

St. Paul Island, August 10. Previously described from St. Paul Island and from Kukak Bay and Popof Island, Alaska.

## EMPIDÆ

6. **Empis** sp.

One male of a species probably undescribed, St. George Island, June 30. In poor condition.

7. **Rhamphomyia** sp.

One female of a species very close to *conservatica* Malloch, recently described from the Yukon and Northwest Territory. St. Paul Island, August 10.

## SYRPHIDÆ

8. **Pterallastes borealis** Cole, new species, figures 1, 1a

Female: Length 13.5 mm. Very near *P. perfidiosus* Hunter.

Antennæ black, arista brown and bare, third joint about as broad as long (fig. 1a). Middle of face and triangle in front of cheeks shining black (fig. 1), otherwise yellowish pollinose and pilose, with yellowish ground color under the pollen. Vertex black; frons yellowish pollinose, with erect black pile. Occiput yellowish gray with yellow pile and a few black hairs above eye margin. Proboscis black.

Mesonotum opaque black, with yellowish pollen on lateral margins and two faint yellow longitudinal stripes, widely separated and narrow; pile rather dark yellow. Narrow base of scutellum black, the rest translucent yellow, rather densely yellow pilose. Pleura semishining black, with black pile. Halteres small and yellowish, the stigmata below halteres with short, dense, fur-like, bright yellow pile.

First abdominal segment semishining black, second with broad yellow lateral margin, the yellow portion triangular in shape and reaching one-third distance across abdomen; third segment with small round yellow spot on anterior corners; remainder of abdomen black, the posterior portion of 2 to 5 shining, the basal portion opaque; a pair of linear, oblique, yellow pollinose marks on dorsum of third and fourth segments. Pile of abdomen largely yellow, black on posterior margins of third, fourth and fifth segments. Venter semishining black, with sparse whitish yellow pile. Legs black, extreme tips of femora and bases of tibiæ; pile of front femora and most of pile of middle and hind femora, black; some yellowish pile; hind tibia arcuate; hind femora noticeably thickened and with black bristles below, short and dense on outer third; short pile below on tarsi golden yellow. Wings hyaline and about as figured for *P. perfidiosus;* anterior cross-vein slightly beyond middle of cell 1st A.

Male: Length 11.5 mm. Very near the female in appearance. Eyes widely separated, frons almost twice as wide as ocellar tubercle; vertex noticeably convex, a depression between it and antennal protuberance. Abdomen lacks oblique yellowish pollinose marks on third and fourth segments. Hypopygium quite large, blackish, with short yellow pile.

*Holotype,* female, No. 808, and *allotype,* male, No. 809, Mus. Calif. Acad Sci.; collected by G. Dallas Hanna, August 20, 1920.

*Type locality,* St. Paul Island, Alaska.

### 9. **Syrphus contumax** O. S.

St. George Island, June 30. This species has a wide northern range.

## TACHINIDÆ

### 10. **Didyma pullata** v. d. Wulp.

St. Paul Island, July 21 and August 10. The type was described from the high mountains in Guerrero, Mexico. Coquillett determined a specimen from Farragut Bay, Alaska, as this species.

## MUSCIDÆ

### 11. **Cynomyia hirta** Hough.

St. Paul Island, July 12 and August 10; St. George Island, July 1. Originally described from St. Paul Island. Coquillett reported the species from Alaska as *mortisequa* Kirby. It is much less numerous than the species given below.

### 12. **Calliphora vomitaria** Linn.

St. Paul Island, August 10 and 16; St. George Island, July 1. Apparently very common.

## ANTHOMYIIDÆ

All of these flies, except the genus *Fucellia,* were sent to Mr. J. R. Malloch for examination and are considered separately (p. 178). Aldrich has worked up the genus *Fucellia* so that the species are easily determined.

### 13. **Fucellia antennata** Stein.

A common species on St. Paul Island, August 10 to 25.

### 14. **Fucellia fucorum** Fall.

The commonest species, taken in large numbers from June 21 to August 25.

### 15. **Fucellia ariciiformis** Holmgr.

A series taken on St. Paul Island, August 10.

### 16. **Fucellia pictipennis** Beck

Three specimens taken on St. Paul Island, June 21 and August 25.

## SCATOPHAGIDÆ

### 17. **Scatophaga crinita** Coq.

St. Paul Island, August 10; St. George Island, July 1, a large series. Described from Bering Island.

### 18. **Scatophaga islandica** Beck

St. Paul Island, June 21 and August 10. Described from Iceland and Labrador; reported from Alaska and Bering Island.

19. **Scatophaga dasythrix** Beck

St. Paul Island, June 20; St. George Island, June 30. Described from Bering Straits; reported from Bering Island, by Coquillett.

20. **Scatophaga furcata** Say

St. Paul Island, June 21 to August 10; St. George Island, June 30. Very common.

21. **Scatophaga rubicunda** Mall.

St. George Island, July 1. The description by Malloch is in press, the name having been given in a preliminary paper. Described from Northwest Territory and Pribilof Islands.

## HELOMYZIDÆ

22. **Leria crassipes** Loew.

St. Paul Island, July 4 and August 10. Described from Germany and reported by Aldrich from Ungava Bay, Hudson Bay Territory.

23. **Leria fraterna** Loew.

St. Paul Island, June 21; St. George Island, June 30. Originally described from Alaska.

24. **Leria** sp.

One female from St. Paul Island, June 10; near *iners* Meigen, of which only the male has been described.

## BORBORIDÆ

Two species were taken, one a *Copromyza,* the other a *Leptocera,* but the specimens are in poor condition for identification.

## PHYCODROMIDÆ

25. **Coelopa frigida** Fall.

St. George Island, July 19; St. Paul Island, July 4 and August 10. Very common.

### 26. **Coelopa parvula** Halid.

*(Nitidula* Zett.)

St. Paul Island, June 8 and 21. An European species, reported from Kodiak, Alaska, by Coquillett. Less common than *C. frigida.*

## SCIOMYZIDÆ

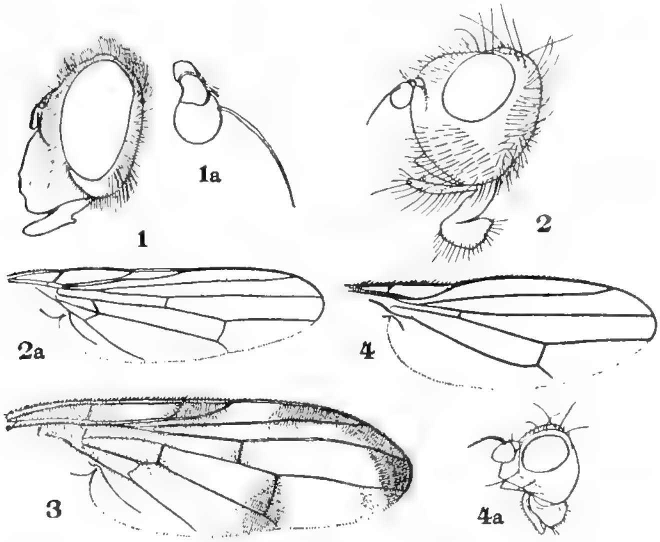
### 27. **Dryomyza hannai** Cole, new species

Male: Length 5 to 7 mm. Ground color of head largely yellowish, of rest of body largely black. First two joints of antennæ reddish; third blackish brown, arista black and very short pubescent, the joint itself longer than first two combined (fig. 2); first two joints black pilose, black bristles above on second. Face and cheeks yellow, with yellow pollen, the face retreating, the epistoma projecting. Palpi yellow, with black pile. Cheek slightly broader than eye, with black pile, longer near the oral margin, but no pile on the oral margin. Frons yellowish below and in the middle, the sides and vertex reddish brown; lower half of frons with short black pile; three fronto-orbital bristles; 2 large proclinate ocellars; post vertical bristles almost as long as ocellars. Occiput blackish in ground color, bare of pile in the middle, but with blackish pile on sides.

Thorax black, largely gray pollinose, mesonotum in median portion brownish; pile and bristles of mesonotum black; dorso-central bristles more or less distinct and about 9 in a row. Humeral and propleural bristles quite long. Pleura dense gray pollinose; sternopleura densely black pilose, all rest bare. Scutellum triangular, gray pollinose in middle, sides above brown; two long apical bristles and two bristles on side near base. Halteres yellow.

Abdomen blackish or blackish brown in ground color, gray pollinose, densely black pilose; pile of first segment short, on the rest of the abdomen, long. Genitalia of medium size, long black pilose. Legs near a honey-yellow, apical half or more of femora darkened; legs long black pilose, even to second joint of tarsi; spurs of mid-tibiæ strong and black, three quite long and four or more shorter ones; one large and one small spur on hind tibiæ. Wings gray hyaline, stigma and base of wing yellow; yellow color along radial veins; no clouding on cross-veins; first vein bare; cell 1stA scarcely longer than cell 2 M; $R_{4+5}$ ending in wing tip parallel with M; anal cross-vein reflexed, (fig. 2a).

Female: Length 5 mm. Very nearly like male, slightly paler in coloration and with very much shorter pile. Front and hind tibiæ with a distinct preapical bristle. Upper margin of




1, 1a. *Pterallastes borealis* Cole, new species.
2, 2a. *Dryomyza hannai* Cole, new species.
3. *Acidia uncinata* Coquillett.
4, 4a. *Parydra metallica* Cole, new species.

sternopleura with 4 bristles, quite distinct from the surrounding pile.

Several specimens were taken with the types, most of them males. The shape of the head is not exactly typical of *Dryomyza*, and there are some other characters which make its position in that genus a little doubtful.

This species is named for Dr. G. Dallas Hanna in recognition of his interest in the insect fauna of the Pribilof Islands.

*Holotype,* male, No. 810, and *allotype,* female, No. 811, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, August 20, 1920.

*Type locality,* St. Paul Island, Alaska.

## TRYPETIDÆ

### 28. **Acidia uncinata** Coq.

Several specimens of both sexes were taken on St. Paul Island, August 10 and 12. Coquillett described the species from a unique female, collected at Ft. Wrangel, Alaska. The male answers the description of the female quite closely.

Male: Length 4 mm. Antennæ light yellow, arista yellow at base, black beyond. Bristles of head black; short sparse pile of cheeks yellow.

Thorax shining reddish yellow, humeral callosities and stripe at base of wing pale yellow. Pleura and femora reddish yellow, tibiæ and tarsi paler. Abdomen shining reddish yellow, without black spots mentioned in description of female (also lacking in female specimens examined). Wing markings paler than in female, the mark at apex of cell 1st A not so large (see fig. 3).

*Allotype,* male, No. 812, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, August 10, 1920.

## PIOPHILIDÆ

### 29. **Piophila oriens** Mel.

St. Paul Island, August 10. Two specimens were taken. The species was described from New York and Massachusetts.

## EPHYDRIDÆ

### 30. **Scatella quadrisetosa** Beck

St. Paul Island, June 21 and August 10. A large series of specimens seem to answer the description of this form, which was originally taken in Norway.

### 31. **Parydra metallica** Cole, new species

Male: Length 3 mm. Largely metallic bluish black or bluish green. Antennæ black, third joint very large, the arista black, long pubescent to tip (fig. 4a). One large bristle on cheek near front corner of eye, a smaller one back of it and under eye. Lower half of face almost perpendicular, slanting from middle back to antennal base, blackish, metallic; cheeks thinly blackish brown pollinose; frons and vertex blackish with metallic olive green reflections; two large ocellar, two fronto-orbital, two vertical bristles; face just below antennæ with pollen yellowish in certain lights; cheeks fairly broad (fig. 4a).

Mesonotum metallic blackish green, with a faint suggestion of purple vittæ; bristles short, sparse and black; one pair of long prescutellar bristles; about 12 small dorsocentral bristles, about 12 acrostichal. Scutellum colored as thorax, dorsum flat, with four marginal bristles, no conical warts. Pleura blackish pollinose, the metallic color when apparent more coppery than mesonotum. Knob of halteres pale brown, the stem blackish.

Abdomen metallic greenish, with coppery reflections, semi-shining but finely tessellate; pile short and black. Femora metallic greenish black, rest of legs black, all of pile black. Wings dis-stinctly infuscated, more strongly at base and along anterior border, veins black, cross-veins not clouded; $R_{2+3}$ without appendiculate vein; $M_{2+3}$ not reaching margin of wing; $R_{4+5}$ and $M_1$ parallel. (Fig. 4.)

This species would run to *cognata* Loew. in Becker's table of species and to *breviceps* or *limpidipennis* in the table given by Jones (Univ. Cal., Tech. Bull., vol. I, p. 190). It differs quite distinctly from these species in several important characters.

*Holotype,* male, No 813, Mus. Calif, Acad. Sci.; collected by G. Dallas Hanna, June 28, 1920.

*Type locality,* St. George Island, Alaska.

# DIPTEROUS INSECTS OF THE FAMILY ANTHOMYIIDÆ FROM THE PRIBILOF ISLANDS, ALASKA

BY

J. R. MALLOCH
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The species given below are those contained in the collection made on the Pribilof Islands by Dr. G. Dallas Hanna in 1920.

## ANTHOMYIIDÆ

The number of species of this family in the collection is rather small, but contains some new ones. I notice all of them, because some have not previously been recorded from the Pribilof Islands.

### 1. **Mydæa rugia** Walker

One female, St. George Island, July 1, 1920. This is the first female of this species that I have seen, but I am positive of the identification. I have previously seen males from New England where it is not uncommon.

### 2. **Eriphia cinerea** Meigen

The genus, Eriphia, has not previously been recorded from this country. It is represented in the material before me by two males and one female which do not agree in every respect with the European example of the male which I have; but they probably belong to *cinerea* Meigen, which is the genotype and only species.

### **Eupogonomyia** Malloch, new genus

This genus differs from Pogonomyia in having the prealar bristle absent or minute; the hind tibia in male with fine setulose hairs instead of strong bristles on posterodorsal surface, and its apex produced on ventral side; fore tarsus short and stout, with two or more bristles at apex above on fourth segment; hind tarsus with two outstanding short bristles near base on ventral surface. The pteropleura is bare.

There are three species which I assign to this genus which may be separated as indicated below.

Genotype, *Eupogonomyia pribilofensis* Malloch, new species.

### Key to Males

a. Mid-femur with anteroventral surface bare except apically where there are a few setulose hairs; anterior surface at base with about four curved bristles. *borealis* Malloch.

aa. Anteroventral surface of mid-femur with some long slender bristles proximad or distad of middle. . . . . . b.

b. Mid-femur with some long fine curled bristles about one-fourth from apex on anteroventral surface, the posteroventral surface with a series of long hairs on entire length. *grœnlandica* Lundbeck.

bb. Mid-femur densely clothed on basal half of anteroventral and ventral surfaces with long bristly hairs, the posteroventral surface with bristly hairs except at base. *pribilofensis,* new species.

### 3. **Eupogonomyia pribilofensis** Malloch, new species

Male: Length 7 mm. Black, shining, thorax and abdomen with gray pruinescence. Abdomen with a black dorsocentral vitta which is dilated subtriangularly at the apex of each tergite. Wings hyaline, veins black to bases. Knobs of halteres black.

Eyes bare, separated at narrowest part of frons by a distance a little greater than width across posterior ocelli; orbits with fine hairs on entire length; parafacial at base of antennæ wider than third antennal segment and height of cheek, not narrowed below, the vibrissal angle produced much beyond a vertical line drawn from base of antennæ. Antennæ separated at base, third segment not longer than second; arista subnude, swollen on basal half; proboscis slender, not much elongated. Thorax with 4 pairs of postsutural dorsocentrals. Abdomen subcylindrical, with numerous long, slender bristles, those on fourth tergite apically and laterally rather conspicuous; sixth tergite distinct, with numerous setulose hairs; fifth sternite with a shallow rounded posterior emargination, and numerous fine lateral bristles at apex. Fore tibia with two or three median postero-ventral bristles; fore tarsus not longer than tibia, fourth segment with two short bristles at apex; mid-femur with dense bristly hairs on basal two-thirds of anteroventral and ventral surfaces, the postero-ventral surface with some fine bristles except apically; mid-tibia with 6 or more short posterodorsal and posteroventral bristles; hind femur with a series of anteroventral bristles; hind tibia straight, with a distinct production at apex ventrally, the anterodorsal and posterodorsal surfaces with a number of short bristles, the anteroventral surface with a few short setulæ. Costal thorn minute.

*Holotype,* No. 814, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 21, 1920.

*Type locality,* St. Paul Island, Alaska.

The species described as *Ophyra grœnlandica* by Ludbeck was afterwards removed to *Pogonomyia* by Stein, but belongs to this genus. *Pogonomyia segnis* Holmgren, may be the same as my *Pogonomyioides atrata,* in which case the species name *atrata* will be replaced by that of Holmgren.

4. **Melanochelia sanctipauli** Malloch, new species

Male: Length 5-6 mm. Black, subopaque, densely pale gray pruinescent. Thorax with three brown vittæ. Abdomen with basal tergite largely black, second and third each with a pair of large subtriangular black spots which are narrowly separated in middle, fourth with a less distinct subtriangular central spot. Legs black. Wings slightly infuscated basally, veins black. Calyptræ yellow. Halteres fuscous.

Eyes bare, separated by a little more than width across posterior ocelli; orbits very wide, almost obliterating interfrontalia at middle, with fine setulose hairs to anterior ocellus; parafacial at base of antennæ about as wide as third antennal segment; vibrissal angle produced much beyond a vertical line drawn from base of antennæ; arista with very short pubescence. Hairs on area in front of suture and between dorsocentral bristles erect, sparse, in four or more irregular series; postsutural dorsocentrals 4. Abdomen subcylindrical; fifth sternite with a deep V-shaped posterior incision. Legs with the fine hairs longer than usual; mid-femur with some bristles on basal half of posteroventral surface; mid-tibia with one or two anterodorsal and two or three posterodorsal bristles; hind femur with a series of anteroventral bristles; hind tibia with two or three anterodorsal and anteroventral bristles, and a few erect posterior setulose hairs. Veins 3 and 4 divergent apically. Lower calyptra much larger than upper.

Female: Differs from the male in having the frons over one-third of the head-width. Genitalia without thorns. Fore tibia with a weak median posterior bristle.

*Holotype,* male, No. 815, and *allotype,* female, No. 816, Mus. Calif. Acad. Sci.; also one male and three female *paratypes,* all collected by G. Dallas Hanna, July 12, 1920.

*Type locality,* St. Paul Island, Alaska.

This species will run down to *nobilis* Stein, in a key to the species of this genus which I have submitted for publication in the "Canadian Entomologist." It differs from that species in having the thorax distinctly vittate, the abdominal spots separated, and the vibrissal angle very distinctly produced.

5. **Melanochelia spinicosta** Malloch, new species

Female: Length 6-5 mm. Similar to the preceding species in color; the cross-veins of the wings distinctly but inconspicuously infuscated; halteres yellow.

Frons opaque, over one-third of the head-width; parafacial at base of antennæ wider than third antennal segment; face concave in profile, vibrissal angle almost in line with base of antennæ; cheek nearly twice as high as width of parafacial; arista with short pubescence. Thorax with three pairs of postsutural dorsocentrals. Abdomen with apical genital segment armed with about 12 short thorns. Hind femur with four or five bristles on apical half of anteroventral surface, posteroventral surface with a few fine bristles on basal half; hind tibia with bristles as in preceding species. Wing-veins 3 and 4 slightly convergent apically; costa with long bristles almost to apex of second vein, those at and near apex of first vein about three times as long as diameter of costal vein.

Distinguished from any species known to me by the spinose genitalia and the long bristles on costal vein.

*Holotype,* female, No. 817, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, August 10, 1920.

*Type locality,* St. Paul Island, Alaska.

6. **Melanochelia hirticauda** Malloch, new species

Male: Length 5-6 mm. Deep black, subopaque. Orbits, parafacials and cheeks white pruinescent. Thorax not vittate. Abdomen unmarked. Wings infuscated. Calyptræ grayish white. Knobs of halteres fuscous.

Eyes bare, separated at narrowest part of frons by a distance a little greater than width across posterior ocelli; orbits narrower than interfrontalia, setulose to anterior ocellus; parafacial at base of antennæ about as wide as third antennal segment, narrowed below; face concave in profile; vibrissal angle not protruded beyond line of base of antennæ; some short setulæ above vibrissæ; cheek over twice as high as widest part of parafacial; arista minutely pubescent. Presutural acrostichals long, two-rowed; postsutural dorso-centrals 4. Abdomen cylindrical, hypopygium of moderate size; fifth tergite linear, sixth with a number of long bristly hairs; fifth sternite with a moderately deep U-shaped incision. Hairs on legs rather long for this genus; hind femur with some long bristles on apical half of anteroventral surface, and some shorter bristles on basal half of posteroventral; hind tibia with two or three anterodorsal and anteroventral bristles and an outstanding setula at middle on posterior surface. Calyptræ small. Veins three and four slightly divergent apically; costal setulæ rather long.

Female: Differs in color from the male in having orbits parafacials and cheeks brownish pruinescent, the thorax densely brownish pruinescent and with three broad, subcontiguous fuscous vittæ. Legs as in male, but there are a number of short posterodorsal setulæ on hind tibiæ.

*Holotype,* male, No. 818, *allotype,* female, No. 819, Mus. Calif. Acad. Sci. These and one female paratype from the type locality, collected by G. Dallas Hanna, August 10, 1920. One male *paratype* from the type locality collected July 12, 1920.

*Type locality,* St. Paul Island, Alaska.

One male, in poor condition, was collected by Dr. Hanna on St. George Island, June 30, 1920.

### 7. Hydrophoria alaskensis Malloch

Of this recently described species, the types of which came from the Pribilof Islands, there are two specimens in the collection. St. Paul Island, June 21, 1920.

# DIPTEROUS INSECTS OF THE FAMILY TIPULIDÆ FROM THE PRIBILOF ISLANDS, ALASKA

BY

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The collection of Tipulidæ secured by Dr. G. Dallas Hanna on the Pribilof Islands, Alaska, in 1920, contains five species. One of these is a very remarkable insect which is believed to be a new species and is made the type of a new subgenus. The description of one other species has recently been published by the writer. The remaining three species were first discovered by Messrs. Hanna and Whitney on the Pribilof Islands in 1912 to 1914. Descriptions of these were drawn up for publication by the U. S. Biological Survey several years ago, but unfortunately, their appearance has been delayed. In order to save confusion for future bibliographers it does not seem to be advisable to give publicity to the three names prior to their appearance with descriptions.

### 1. **Tricyphona glacialis** Alexander

Can. Ent. vol. 49,1917

Two males, St. Paul Island, June 19, 1920.

### **Nesotipula** Alexander, new subgenus

Characters as in *Tipula*, s. s.; wings with but two branches of media attaining the margin; radial sector elongate; *m-cu* at or before the fork of *M*.

Type of the subgenus, *Tipula (Nesotipula) pribilovia,* new species.

### 2. **Tipula (Nesotipula) pribilovia** Alexander, new species

General coloration black; wings semiatrophied; *Rs* long; two branches of *M* reach the wing-margin; *m-cu* at or before the fork of *M*.

Female: Length 10 mm.; wing 5.4 mm.

Rostrum, palpi and antennæ black. Head black.

Pronotal scutellum obscure yellow. Mesonotum black. Pleura black, the dorso-pleural membrane obscure yellow. Halteres brown, the knobs darker. Legs black, short and stout; fore and hind tarsi shorter than their respective tibiæ. Wings semiatrophied, tinged with brown; stigma dark brown; veins dark brown. Venation: *Rs* elongate, about equal to $R_{1+2}$; deflection of $R_{4+5}$ obliterated or very short; but two branches issue from cell *1st* $M_2$; *m-cu* connecting with *M* at or before the fork.

Abdomen black, the caudal margins of the segments very narrowly ringed with yellow. Ovipositor with the tergal valves greatly exceeding the relatively short sternal valves.

*Holotype*, female, No. 820, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920. One female *paratype* was collected at the same time.

*Type locality*, St. George Island, Alaska.

*Tipula pribilovia* is a remarkably anomalous insect in many respects. Although the wings are semi-atrophied, distorting the venation to some extent, there is no doubt that only two branches of media attain the wing-margin. There are but three genera of Tipulinæ known in which this latter condition obtains and these are antipodal in their distribution. The discovery of the male sex of this fly will be of great interest. The elongate sector is a character of the genus *Tipula*, but the situation of *m-cu* at or before the fork of *M* is almost as decisively a character of *Nephrotoma*.

# HYMENOPTEROUS INSECTS OF THE FAMILY BREMIDÆ FROM THE PRIBILOF ISLANDS, ALASKA

BY

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## 1. Bremus (Bombus) kincaidii (Cockerell)

Among the insect material collected by Dr. G. Dallas Hanna on the Pribilof Islands in 1920 are two specimens of this interesting species of bumblebee. One of the specimens is a queen and the other a worker. The queen was collected August 24, 1920, and the worker August 25, 1920, both on St. Paul Island.

The species was first described from a series of queens, workers and males, by Cockerell in 1898. In 1913 Franklin redescribed the species from a queen and a male in the collection of the American Entomological Society and a worker in the collection of the United States National Museum. Ashmead, according to the synonymy of this species as given by Franklin, described the male as a *Psithyrus*.

Cockerell in describing the species believed it to be "endemic in the Pribilof Islands," saying "I cannot find any described from the mainland or any of the other islands which agrees with it." Franklin, in 1913, gives the habitat of this species as the Pribilof Islands. If *Psithyrus kodiakensis* Ashmead is a synonym of *B. kincaidii* (Cockerell), as Franklin considers it, *B. kincaidii* (Cockerell) is not endemic to the Pribilof Islands, for *P. kodiakensis* Ashmead was described from two males collected July 20 at Kodiak. Kodiak is situated on Kodiak Island and is very close to the mainland of Alaska in the vicinity of the Aleutian mountain range. Quite recently two papers giving records of Alaskan bumblebees have been published, one by Salden (1919) and another by Bequaert (1920). Neither of these two last-mentioned authors reports *B. kincaidii* (Cockerell) as occurring in the collections from Alaska at his disposal. All this indicates that either *B. kincaidii* (Cockerell) is endemic to the Pribilof Islands and that *Psithyrus kodiakensis* Ashmead is wrongly placed in the synonymy of the former species, or that *B. kincaidii* (Cockerell) is not restricted to the Pribilof Islands. If the latter alternative is correct, the species is to be expected on other outlying islands near the Alaskan mainland and even on the mainland proper.

The descriptions of this species by Cockerell and Franklin agree very well, except in regard to the statement of length of the malar space in the queen. Cockerell says "area between eyes and base of mandibles about as broad as long," whereas Franklin states "malar space about one-half longer than wide at apex." The queen before me agrees with Franklin's statement, which I believe is to be regarded as the correct interpretation of the comparative length of the malar space in the queen of this species. Otherwise the specimens before me agree perfectly with Cockerell's original description. That Cockerell and Franklin were dealing with different species is very improbable. The bumblebee fauna of the Pribilof Islands is necessarily extremely limited, and besides an instance of two bumblebees paralleling each other in color characters and in every other way excepting in the length of the malar space is a rarity, if it ever occurs. The discrepancy between the two descriptions may better be explained as due to a variable character. Cockerell says, "This *Bombus (B. kincaidii)* was the only bee to be found on the Pribilofs, notwithstanding that there is a tolerable extensive series of bright-flowered plants, as enumerated by Dr. Merriam in Proc. Biol. Soc. Wash. July 1892." The fact that Dr. Hanna took only the one species of bumblebee, further indicates that only one species of this genus occurs on the Pribilof Islands.[1]

The bumblebees collected by Trevor Kincaid on St. Paul Island in 1897 were all taken between August 1 and 25. Three of the queens and one worker were collected August 1. The capture of the queens on this date is suggestive of some of the characteristics of the biology of the northern Bremidæ. Either the queens in such northern latitudes never produce a worker offspring sufficient to relieve the old queens of the labor of foraging, as is usually the case in more temperate climes, or these August queens were those destined to hibernate through the

1 In this connection it might be well to record the fact that bumblebees are confined solely to St. Paul Island of the Pribilof Group. During seven summers spent up there I have never seen one elsewhere and the natives, who are quite familiar with the bees, are positive in their assertions that the facts are as stated. (G. Dallas Hanna.)

winter and continue the species the following spring and summer. The queen collected by Dr. Hanna on August 24 is in perfect condition and undoubtedly is a queen produced the same season in which she was collected. Queens which have developed or possess a colony can be recognized usually through the loss of a certain amount of pubescence and through the tattered wing margins. The early production of queens and males, colonies of small size and with a poor ratio of workers as compared with a colony of a more austral species are phenomena to be expected in the life-histories of our bumblebees inhabiting the far north.

*B. kincaidii* (Cockerell) may eventually prove to be a "color variant or subspecies of *strenuus* or *polaris*" as Franklin has suggested. Of the two, *B. stenuus* (Cress.) is perhaps the closer ally of *B. kincaidii* (Cockerell). *B. strenuus* (Cress.) seems to have a more western distribution than *B. polaris* (Curtis), the latter being one of the common species in Greenland where *B. strenuus* (Cress.) is unknown. *B. polaris* (Curtis), however, is reported also as far west as Alaska. Ashmead's record of *B. polaris* (Curtis) was regarded by Franklin in 1913 as questionable, but since then the species has again been reported from Alaska by both Lutz (1916) and Sladen (1919). At present the separation of *B. strenuus* (Cress.), *B. kincaidii* (Cockerell) and *B. polaris* (Curtis) is based almost entirely upon color characters, as no real distinct structural differences have been discovered. Such color characters are valuable, but subject to extreme variation as every student of the bumblebees knows, and future study may cause all three species discussed to be considered as constituting but one distinct species; this is particularly true of the two species *B. strenuus* (Cress.) and *B. kincaidii* (Cockerell).

# NEW SAW-FLIES FROM THE PRIBILOF ISLANDS, ALASKA

BY

ALEXANDER D. MACGILLIVRAY

The following six species of saw-flies were collected on St. George Island, Alaska in 1920 by Dr. G. Dallas Hanna. The material was received for identification from Mr. E. P. Van Duzee, Curator, Department of Entomology of the California Academy of Sciences, and the types of the new species have been deposited in that institution.

## 1. **Pontania sueta** MacGillivray, new species

Male: Head polished, dull, not punctulate; clypeus narrowly shallowly emarginate, emargination subangular at bottom, clypeal lobes very broad, rounded; antennal furrows broad and distinct, partially interrupted by a linear elevation at middle, linear on dorsal aspect; ocellar and interocellar furrows distinct, connecting with each other and the antennal furrows; postocellar area broader than long, convex, polished; frontal crest recognizable, only slightly elevated, not broken; pentagonal area distinct, bounding walls linear, not elevated; ocellar basin depressed, limited by walls of pentagonal area, depression greater adjacent to median ocellus; median, fovæ broad, shallow, ventral, margin angular; supraclypeal area elevated; antennæ with fourth segment one-third longer than third, fifth longer than third but shorter than fourth, segments roughened, setiferous; lobes of mesonotum polished, surface roughened with numerous shallow punctures; mesopleuræ polished, dull, setiferous; claws cleft, the inner ray nearly as long as the outer; wings hyaline, stigma and costa and veins very light brownish in color; body black, with the following parts rufous: clypeus, spot on vertical orbits, extending for one-half length of occipital orbits, narrow margin to pronotum, distal third of femora, tibiæ, tarsi, and caudal abdominal tergum and sternum. Length 4.5 mm.

*Holytpye,* male, No. 822, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920.

*Type locality,* St. George Island, Alaska.

## 2. **Pontania stipata** MacGillivray, new species

Male: Head polished, dull, not punctulate; clypeus truncate; labrum quadrangular, nearly as long as broad; antennal furrows broad and shallow, continuous, punctiform caudad of lateral ocelli, not interrupted; ocellar and interocellar furrows wanting; postocellar area not differentiated from the vertex on each side, caudal portion slightly elevated; frontal crest hardly elevated, not broken; median fovea shallow, oval, small, distinct; pentagonal area broadly convexly elevated, including ocellar basin, walls of pentagonal area wanting, lateral portions sloping into antennal furrows; ocellar basin with slight depression adjacent to median ocellus, surface of ocellar basin with slight depression adjacent to median ocellus, surface of ocellar basin and dorsal surface of frontal crest meeting at a different angle; supraclypeal area not prominent; antennæ with third and fourth segments subequal, the fifth slightly shorter, surface roughened and densely finely setiferous; mesonotum polished, surface of median and lateral lobes with dense shallow punctures; mesopleuræ dull, setiferous; claws cleft, inner ray hardly one-half as long as outer ray; wings hyaline, costa and stigma pale, veins brownish; body black with the following parts brownish: labrum, tips of femora, tibiæ, tarsi, and last abdominal tergum and sternum. Length 5 mm.

*Holotype*, male, No. 823, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920.

*Type locality*, St. George Island, Alaska.

### 3. **Pontania subatrata** MacGillivray, new species

Male: Head polished, dull, not punctulate; clypeus narrowly broadly emarginate, emargination rounded, clypeal lobes narrow and angular; labrum short, broader than long, rounded; antennal furrows traceable from the pretentorinæ to the occiput, very broad ventrad of lateral ocelli, narrower and deeper on dorsal aspect; ocellar and interocellar furrows wanting; postocellar area flat, not limited except by antennal furrows; frontal crest wanting, not elevated above surrounding surfaces; median fovea an obscure oval depression, longer than broad; pentagonal area not distinguishable, sides rounded off to the antennal furrows; ocellar basin flat to slightly convex, small puncture-like depression adjacent to the ventral margin of median ocellus; supraclypeal area not prominent; antennæ with fourth and fifth segments subequal, distinctly longer than third, segments roughened, finely setaceous; mesonotum, including lobes and mesoscutellum, polished, shining; claws cleft, inner ray short, about one-half the length of the outer; wings hyaline, the costa and stigma pale, the veins brownish; body black with the following parts brownish; the knees, tibiæ, and tarsi, all sometimes strongly infuscated and nearly black. Length 4 mm.

Female: Specimen of what is taken as the female of this species, in poor condition, has labrum, tegulæ, and extreme angles of pronotum pale, the pale markings of legs are lighter colored; saw-guides stout, dorsal margin straight, ventral and caudal margins continuously uniformly convex, forming a blunt point with the dorsal margin, setiferous. Length, 4 mm.

*Holotype*, male, No. 824, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920.

*Type locality*, St. George Island, Alaska.

### 4. **Pontania sublorata** MacGillivray, new species

Male: Head polished, dull, not punctulate; clypeus narrowly broadly emarginate, emargination rounded, clypeal lobes broad and rounded; labrum as broad as long, rounded; antennal furrows broadly interrupted, dorsal and ventral portions deep, distinct; ocellar and interocellar furrows wanting; postocellar area not elevated, not limited except by antennal furrows; frontal crest not prominent, not broken, hardly raised above surrounding surface; pentagonal outline distinguishable, not prominent; ocellar basin depressed, irregular; median fovea broad, shallow, oval depression, not prominent; supraclypeal area not prominent; antennæ with fourth segment very slightly longer than third and fifth, segments roughened and densely finely setiferous; mesonotum polished, the median lobe and the cephalic half of each lateral lobe finely punctured; mesoscutellum polished; mesopleuræ polished, dull; claws cleft, inner ray not one-half the length of outer; wings hyaline, veins pale, costa and veins brownish; body black with the following parts brownish: margin of clypeus, labrum, spot at corners of compound eyes, sometimes indistinct, distal ends of femora, tibiæ, and tarsi, metatibiæ more or less infuscated, and caudal tergum and sternum of abdomen.

*Holotype*, male, No. 825, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920.

*Type locality*, St. George Island, Alaska.

### 5. **Pachynematus venustus** MacGillivray, new species

Male: Head not punctured, dull, very sparsely roughened; clypeus polished, very broadly shallowly emarginate, clypeal lobes broad, angles rounded; labrum polished, rounded; antennal furrows broad deep depressions, traceable from the pretentorinæ to occiput, narrow and deep near ocelli, convergent from middle of length to occiput; ocellar furrow broad and shallow, connected with but elevated above the antennal furrows; interocellar furrow an inconspicuous broad puncture; ocellar areas not strongly minute tooth at middle; abdomen polished, setaceous; color black elevated, pentagonal area identifiable, side walls not elevated, rounded; ocellar basin broadly concave, with three slight elevations; frontal crest short, not extending beyond antennal furrows, not strongly elevated, almost wanting, not broken; median fovea broad shallow inconspicuous depression; antennæ with fourth segment longer than third, segments setiferous, roughened; mesonotum and mesopostscutellum polished, bare, cephalic two-thirds with shallow punctures; mesopleuron polished, sparsely setiferous; abdomen polished, sparsely setiferous with short setæ; wings prominent, hyaline, costa and stigma pale, veins brownish; claws with a minute erect tooth at middle; body black with distal third of femora, tibiæ entirely, and tarsi brownish. Length 6 mm.

Female: The female differs in having median fovea shallower, antennæ and ocellar furrows not so distinct; mesonotum and mesopostscutellum polished, not punctured; cerci extending to ends of saw-guides, stout and setiferous; saw-guides stout, dorsal margin straight, ventral and distal margins continuous, oblique, forming a point at distal end with dorsal margin; color black with the following parts brownish: clypeus, labrum, mandibles, tegulæ, pronotum very narrowly, median lobe of mesonotum except central black spot, mesopleuræ, inconspicuous in great part, distal ends of coxæ, trochanters, distal ends of femora, tibiæ, and tarsi. Length 7 mm.

*Holotype,* male, No. 826, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920.

*Type locality,* St. George Island, Alaska.

### 6. **Pachynematus vernus** MacGillivray, new species

Male: Head not punctured, but irregularly roughened or granular; clypeus polished, deeply and roundly and very narrowly emarginate, clypeal lobes sharply angularly pointed; labrum polished, rounded; antennal furrows broadly interrupted on middle of cephalic aspect, narrow and deep near pretentorinæ, broad and shallow near ocelli, then divergent to occiput; ocellar furrow wanting; ocellar area not elevated, sides flat, pentagonal area slightly elevated as a whole and outline identifiable; frontal crest wanting; median fovea a broad shallow depression, longer than broad, inconspicuous; antennæ with the fourth segment distinctly longer than the third, roughened, densely setaceous; median lobe of mesonotum polished, cephalic two-thirds with broad shallow punctures, lateral lobes and mesoscutellum not punctured or very sparsely; mesopleura polished, setaceous; wings large, prominent, stigma and costa pale, other veins brownish; claws with a very with the following parts brownish: distal ends of femora, tibiæ, tarsi, and caudal end of abdomen. Length 5.5 mm.

*Holotype*, male, No. 827, Mus. Calif. Acad. Sci.; collected by G. Dallas Hanna, June 30, 1920.

*Type locality*, St. George Island, Alaska.

# ORTHOPTERA, NEUROPTERA, HEMIPTERA AND LEPIDOPTERIA FROM THE PRIBILOF ISLANDS, ALASKA

BY

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Among the insects collected by Dr. G. Dallas Hanna on the Pribilof Islands in 1920 are several which belong to the orders mentioned above. The Lepidoptera are of special interest since no species of this order has heretofore been recorded from these islands. The Neuroptera listed below were determined by Mr. Nathan Banks and the Lepidoptera by Messrs Barnes and Lindsey.

## ORTHOPTERA

### 1. **Blattella germanica** (Linn.)

St. George Island, July 1. This insect has been introduced into the Pribilof Islands on at least two different occasions. The first time it was exterminated by freezing it out of the kitchen where it had become established.

## NEUROPTERA

### 2. **Anabolia simplex** Banks

St. Paul Island, August 10. Three examples.

### 3. **Chilostigma præterita** Walker

St. Paul Island, June 21, and August 10. Three individuals.

### 4. **Limnophilus kincaidi** Banks

St. Paul Island, August 10. Nineteen examples.

## HEMIPTERA

### 5. **Irbisia sericans** Stål

St. Paul Island, August 10 to 25. St. George Island, July 19.

## LEPIDOPTERA

### 6. **Hyphoraia subnebulosa** Dyar

Three males and one female were taken on St. George Island, June 30. With these were taken five larvæ apparently belonging to this species. Two of these are larger and perhaps half grown. They are heavily clothed with long soft hairs which increase in length posteriorly and are rather closely appressed. In one the hair is fulvous throughout; in the other, fulvous on the sides and glossy black dorsally. The smaller specimens are similarly colored but have shorter and more erect hair.

### 7. **Agrotiphila alaskæ** Grote

St. George Island, June 30. Two examples showing some variation in distinctness of markings and depth of coloring; one malformed, or perhaps teneral specimen has a more rufous tinge, paler beyond the t. p. line, with the ordinary spots pale and contrasting.

### 8. **Psychophora sabini** Curtis

Of this species there are 64 specimens taken on St. Paul island, June 29 to July 12, which are in condition suitable for preservation. This series shows a most remarkable variation in color and markings with no two specimens alike. From the more typical form they vary to an almost uniform fulvous-brown or become strongly banded. Among the latter the median area becomes almost black in one extreme and of a light gray in the other. This series would make a most interesting study in insect variation.

### 9. **Phlyctænia washingtonalis** Grote

Four smaller specimens were taken on St. George Island, June 30, and one larger one on St. Paul Island, July 12.

### 10. **Phlyctænia** sp.

One specimen of a clearly marked species was so determined by Barnes & Lindsey. It was taken on St. Paul Island, July 7.

### 11. **Argyroploce schulziana** Fabricius?

St. Paul Island, July 12, one example in poor condition. Barnes & Lindsey report this identification as very doubtful and add that this "specimen is very probably the *bentleyana* of Curtis (Ross Voyage) but not that of Donovan (Brit. Ins.). This name is supplanted in both the Dyar and Barnes & McDunnough catalogues by *schulziana*."

### 12. **Borkhausenia pseudospretella** Stainton

St. Paul Island, July 7, one example in fair condition.

In addition to the above species there is one micro in very poor condition, which Barnes & Lindsey think may be an Adelid.

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XV.

# AN ANNOTATED LIST OF THE DIPTERA (FLIES) OF OREGON

BY

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## INTRODUCTION.

In the preparation of this list we have endeavored to get a representative collection of diptera from the state of Oregon, but we have had little or no opportunity to collect in some of the faunal areas. Collectors in the state will at least have something to work from and we hope to see the list greatly increased in the near future. Cosmopolitan species have been listed without giving any particular data. Considering the great area of the state and the diversity of ecological conditions, our list seems quite small and it is intended only as a preliminary report. Aldrich's Catalogue lists only 89 species of diptera from Oregon, but we must add to this number about 40 species having a general distribution and at least six species mentioned as occurring all along the Pacific coast. Of Aldrich's 89 species, we have been unable to find 24; seven of these are species described by Loew, five are Bigot's species, and six are species described by Williston. One hundred and seventy-eight species in this list have been described since the publication of the Aldrich Catalogue, and several European species are included which were not known from North America at that time. The rediscovery of many old species has been more gratifying to us than the discovery of a number of undescribed ones.

Most of the collecting was done in the Hood River Valley, Forest Grove, the Mt. Jefferson region, and the section around Corvallis. Our collecting time has been short, as work on the list was commenced in the early summer of 1917, and most of the work had to be done in spare time. Naturally, we spent most of the limited time at our disposal in collecting specimens that were of especial interest to us; as a consequence, many of the families are not adequately represented. The diptera collection at the Oregon Agricultural College formed a nucleus on which to build; the earliest records are a little previous to 1900, and some specimens were collected in 1906 and 1907 by Mr. J. C. Bridwell. No extensive collections of Oregon diptera are known to us outside of those we have assembled.

Space does not permit of a detailed comparison of this list with others, such as the New Jersey and Florida lists written by C. W. Johnson, but such a comparison is interesting to the student of distribution. This preliminary paper lists 953 species from Oregon; Johnson gives 845 species for Florida and 1662 species for New Jersey. Certain families of the diptera are well represented in Oregon, although only one group, the Syrphidæ, has been collected extensively. In the Asilidæ only one species is common to Oregon and Florida and there is no species common to Oregon and New Jersey. Each region has a distinct dipterous fauna, with a sprinkling of widely distributed forms, some of which are boreal and some cosmopolitan.

## PHYSICAL FEATURES OF OREGON

The state of Oregon has an area of 95,607 square miles. In altitude, it ranges from sea level to over 10,000 feet on some of the mountain peaks. The annual rainfall ranges from 70 inches or more on the coast to nine inches in parts of the eastern plains region.

The Cascade Range has a great effect on the climate and faunal distribution; the Coast Range has less influence, being low and more or less broken; distinct in the north, it is merged into a complex mass in the south known as the Klamath Mountains, a joining of the Cascade, Sierra Nevada and Coast ranges. Toward the south, the general elevation west of the Cascades increases.

Forest Grove is about 28 miles west of Portland in a region of rolling hills which are heavily wooded to the north and south. There is a good deal of level farmland with occasional patches of woodland or swamp. The annual rainfall is about 45 inches, the wet season coming in the winter and spring. Corvallis is about 65 miles south of Forest Grove, in what is known as the Willamette valley region. Many of our records are from Mary's Peak, a mountain in the Coast Range of about 4,000 feet elevation, lying some 15 miles south of Corvallis.

The seacoast is largely a series of sand-beaches interrupted by rocky headlands, and is a region of rather heavy rainfall. The summers are cool, and a heavy growth of grass and ferns spreads over the sand ridges. Several miles north of Tillamook, these ridges inclose a number of lakes. The last geological movement of the coast region here was one of subsidence, the sea advancing over the land and drowning the rivers in the lower portion of their channels.

The Hood River Valley is a great sloping lava plain from the foot of Mt. Hood to the Columbia River; through this old plain the Hood River has cut a deep channel. Most of the land is very fertile and the uncleared sections are well forested. The section known as Dee is in the middle valley, much higher than the level of the Columbia. Parkdale is almost at the foot of Mt. Hood and has an elevation of about 3,000 feet. Over the eastern rim of hills lies the Mosier Valley, a different type of country. In these few miles the rainfall drops from 30 to about 12 inches, and crossing the next range of hills, we come to the Dalles, at the edge of a great, wind-swept, arid region.

The picturesque region around Mt. Jefferson has furnished many interesting records in the diptera. Mt. Jefferson rises rather abruptly from the rim of Lake Pamelia, which has an altitude of 3,800 feet, and towers majestically above the timber line to the zone of gnarled and twisted spruce and barren wastes. North of the mountain is Jefferson Park or Hanging Valley, set in the backbone of the Cascades at an elevation of 5,400 to 6,000 feet. In ages past, great glaciers moved down from the mountain and formed this park, splitting as they advanced and going both east and west; their remnants are still present on the sides of the peak. The park is a series of beautiful clear lakes, clumps of trees, and meadows. In the spring, the wild flowers carpet the mountain meadows and the insects, while not abundant, are mostly uncommon forms, so that the collecting there is fascinating.

Oregon east of the Cascades is largely a plateau, broken in the far east and south by mountain ranges and low rocky hills. There are many fertile valleys, but much of the region is arid. The elevation averages 4,000 feet. Scarcely any collecting has been done in the Blue Mountains country or in the southeast where there are many lakes and small streams.

## DISTRIBUTION

Collectors in the past have noted the fact that diptera from the western United States resemble those of Europe more closely than do the species in the eastern part of the country, there being many cases of specific identity. Osten Sacken discussed this resemblence at length in his "Western Diptera." The Trichoceræ are not so rare in California as Osten Sacken was led to think from his limited collecting, and in Oregon they are very abundant in the winter and early spring. The genus Villa (Anthrax) is not so well represented in Oregon as farther south, but the asilid genus Cyrtopogon is rich in species, many of the forms appearing to be limited to the Lower Boreal zone. The western syrphid genera Arctophila, Pocota and Pyritis are typically northwestern forms, and there are many species of Chilosia and Pipiza in this area. Two species of the cyrtid genus Eulonchus are not uncommon in parts of Oregon, but the two other known species in the genus are probably more southern in their range. The Blepharoceridæ are typically western diptera and are remarkably abundant in the Hood River valley of Oregon. The western fauna as a whole is limited to the line of *summer dryness* in its spread to the eastward, and this line seems more impassable than the Rocky Mountains. The summers are usually dry some distance west of the Cascades in Oregon.

The life zones of Oregon have not been worked out in detail like those of California, but the general divisions are known. Diptera are not so limited in their distribution as are the majority of plants and animals, but they are for the most part characteristic of certain areas and associations. Our material is much too meagre to work out their distribution and we shall not attempt any general conclusions on this point. The coastal strip is usually known as the Canadian or lower Boreal, except around the mouth of the Columbia River where the Transition comes in. Dr. E. C. Van Dyke has recently published a paper on the life zones of Oregon, Washington, and California, and certain of his terms are used in designating the different areas. The name Vancouveran corresponds very closely to the term Transition and is applied to nearly all of Oregon west of the Cascades; the fauna it contains is quite a distinct one. The Willamette valley is pure Vancouveran and Van Dyke believes that it has changed very little since the Tertiary period. A subdivision of this zone along the coast is termed the Pacific Maritime, and is found in western Washington and the northern coast region of California; it is a region of much moisture and many species in the coleoptera tend toward melanism there. There are some evidences of this tendency among the diptera from this region.

A modified branch of this Vancouveran starts in west central Oregon and runs south, including the mountains of southern Oregon and northern California; it follows along the western slope of the Cascades down into the California Sierra, possibly reaching into Lower California. In this Sierran fauna certain species seem to be broken up into rather weak races in the chaos of the Klamath Mountains. Above the Sierran we find the Canadian zone, which is not very extensive in Oregon. The great Upper Sonoran area of eastern Washington pushes down in a wedge to the center of Oregon, nearly connecting with the Upper Sonoran coming up through Nevada from Mexico; here we find the Great Basin fauna.

The Hudsonian zone is narrowed in Oregon and follows down the Cascades into the Sierra of California, ascending as it goes south, until in southern California it is limited to a few mountain peaks. The zones of eastern Oregon have not been carefully worked out, but there are a number of mountains extending up into the Canadian and Hudsonian zones. A great many records will be added to the diptera list when this region is worked over. Many of the typical Californian zone species are not found in Oregon as far as our collecting shows, but we have obtained some of these forms and more will be found in the southern part of the state. The Vancouveran and Pacific Maritime zones are rich in species of Mycetophilidæ, many of which are undescribed.

## ACKNOWLEDGMENTS

The general arrangement of this list was planned by both authors. Prof. Lovett has written up the Syrphidæ and we are indebted to Mr. Leroy Childs for much of the work on the Tabanidæ and for material collected at Hood River. The senior author is responsible for the work on the other families of diptera, except where material was turned over to specialists in some of the groups, and for the drawings illustrating most of the families represented.

Several dipterists have been of help to us in determining material in families in which they are specializing, and to the following we wish to express our thanks: Mr. J. R. Malloch, Dr. C. P. Alexander, Mr. M. C. Van Duzee, Dr. J. M. Aldrich, Prof. J. S. Hine, Dr. A. L. Melander, Mr. A. Spuler, Dr. E. P. Felt, Prof. R. C. Osburn, Mr. E. T. Cresson, Jr., and Mr. C. H. Curran. We are also indebted to the entomologists at the Oregon Agricultural College for specimens they have collected and to the following members of the staff of the Forest Grove Experiment Station, Bureau of Entomology, U. S. Department of Agriculture: Mr. M. C. Lane, Mr. L. P. Rockwood, Mr. J. B. Thompson, Mr. A. C. Burrill, Mr. C. W. Creel, and Mr. M. M. Reeher. Mr. E. P. Van Duzee has added several records from southern Oregon which were particularly valuable because we know so little of the diptera in that region.

## Family TIPULIDÆ

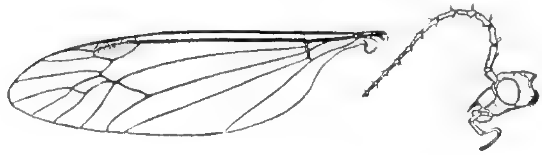


Fig. 1. *Nephrotoma erythrophrys* Will. Wing and head from side.

The craneflies are usually quite easily distinguished from the other diptera by the long legs and characteristic wing venation. They have a blunt snout and often very long palpi. One of the other distinguishing marks of the family is a V-shaped suture on the upper part of the thorax. A few species are wingless. The adults frequent meadows and edges of woods where there is a rank growth of vegetation and most are found near water. Many species come to lights.

The larvæ are aquatic or semi-aquatic and are usually root feeders and scavengers. The terrestrial larvæ are commonly known as "leather jackets" and may injure root crops.

Nearly all of the species listed below were determined by Dr. C. P. Alexander; these are marked C. P. A. det.

1. **Dicranomyia concinna** (Will.)

Hood River, VI-3 (Cole). C. P. A. det. Described as a Limnobia.

2. **Dicranomyia particeps** Doane

Hood River, X-26 (Cole). 1908, Ent. News, XIX, p. 7.

3. **Dicranomyia stigmata** Doane

Corvallis, IV-18. C. P. A. det.

4. **Geranomyia diversa** O. S.

Hood River, X-30 (Cole). C. P. A. det.

5. **Limnobia californica** O. S.

Forest Grove, IV-20 (Cole). C. P. A. det.

6. **Limnobia sciophila** O. S.

Corvallis, IV-20 and V-28; Mt. Angel (Epper). C. P. A. det. Very common at Forest Grove in September and October around thickly wooded sections. A disturbance of the underbrush in more or less moist sections will often start hundreds of them into flight.

7. **Dicranoptycha sobrina** O. S.

Forest Grove, VII-8 and 12 (Cole).

8. **Ormosia subcornuta** Alex.

Forest Grove, III-20 to 26 and Hillsboro, IV-1 (Cole). A good series of this small form was taken in a small swampy area. 1920, Pomona College Journ. Ent. and Zoology, XII, 88. The western representative of *O. meigenii* (O. S.)

9. **Ormosia stylifer** Alex.

Forest Grove, VI-3 (Cole). C. P. A. det. 1919, Insec. Insc. Mens. VII, p. 146. A species near *deviata* Dietz.

10. **Erioptera alicia** Alex.

Forest Grove, VI-3 (Cole). C. P. A. det. Two females collected. Previously known from the single type female from Calif. 1914, Proc. Acad. Nat. Sci. Phila., LXVI, p. 585.

11. **Erioptera oregonensis** Alex.

Tillamook, III-26 (A. C. Burrill). 1920, Pomona College Jour. Ent. and Zoology XII, 87.

12. **Molophilus comatus** Doane

Hood River, X-1 (Cole). C. P. A. det.

13. **Molophilus nitidus** Coq.

Hood River, VI-2 (Cole); Forest Grove, V-4 (Burrill).

14. **Helobia hybrida** (Meig.)

Corvallis, V-29; Hood River VI-8 (Cole). C. P. A. det.

15. **Cladura oregona** Alex.

Forest Grove, IX-30 (Cole). C. P. A. det. 1919, Insec. Insc. Mens., VII, p. 147.

16. **Crypteria americana** Alex.

Mt. Angel (Epper). 1917, Can. Ent., XLIX, p. 29.

17. **Phyllolabis latifolia** Alex.

Forest Grove, III-28 (Cole). 1920, Pomona College Journ. Ent. and Zoology, XII, p. 90.

18. **Limnophila cressoni** Alex.

Corvallis, IV-29 (Cole). C. P. A. det. 1917, Can. Ent., XLIX, p. 208.

19. **Eriocera sp.** near **eriophora** Will.

Grant Co., VII-1 (Chamberlin). One mutilated specimen. C. P. A. det.

20. **Tricyphona ampla** Doane

Corvallis, IX-25; Forest Grove, V-5, 20 and X-3 (Cole). C. P. A. det.

21. **Tricyphona aperta** Coq.

Hood River, VI-8 (Cole). det. with a doubt by Alexander.

22. **Tricyphona constans** Doane

Forest Grove, III-29 (Cole). C. P. A. det.

23. **Tricyphona sparsipunctata** Alex.

Corvallis, V-14 (Moulton); Hillsboro, IV-1 (Cole). 1920, Pomona College Journ. Ent. and Zoology, XII, p. 90.

24. **Polyangæus maculatus** Doane

Forest Grove, V-20 (Cole). One specimen.

25. **Ctenophora angustipennis** Loew

Common at Corvallis and vicinity in April and May, but taken as late as October 29. The tunnels of the larvæ in dead heartwood of prune trees allows the winter rains to soak in and Prof. Lovett has found the species to be of some economic importance for this reason.

26. **Nephrotoma californica** (Doane)

Corvallis, VI-2. 1908, Ent. News, XIX, p. 176.

27. **Nephrotoma erythrophrys** (Will.)

Joseph. C. P. A. det.

28. **Nephrotoma ferruginea** (Fabr.)

Hood River, VI-3 to 15 (Cole). The larvæ were collected around the bases of strawberry plants in large numbers in early May, at which date some had commenced to pupate. The damage to the plants could not be easily estimated as the strawberry-root weevil was at work in the same places. C. P. A. det.

29. **Nephrotoma macrophallus** (Dietz)

Forest Grove, VII-8 (Cole). C. P. A. det. 1918, Trans. Amer. Ent. Soc., XLIV, p. 114.

30. **Holorusia rubiginosa** Loew

Corvallis, VI-10; Oswego; Cascadia, VIII; Hood River, VI (Cole).

31. **Tipula æqualis** Doane

Forest Grove, VII-22 (Cole).

32. **Tipula albofascia** Doane

Corvallis, V-22-1898.

33. **Tipula angustipennis** Loew

Corvallis; Forest Grove, IV-20 to V-10 (Cole). C. P. A. det.

34. **Tipula armata** Doane

Corvallis; Forest Grove, V-17 (Cole). C. P. A. det.

35. **Tipula californica** Doane

Corvallis IX-25; Forest Grove V-20 (Cole). C. P. A. det. 1912, Annals Ent. Soc. Amer., V, p. 49.

36. **Tipula carinata** Doane

Corvallis, X-26 to XI-21.

37. **Tipula fallax** Loew

Corvallis, IV-18 to V-9.

38. **Tipula pubera** Loew

Corvallis, V-12 (Gentner). C. P. A. det.

39. **Tipula retusa** Doane

Forest Grove, VII-22 (Cole). C. P. A. det.

40. **Tipula apernax** O. S.

Corvallis, V-5 and IV-19 (Cole). C. P. A. det.

41. **Tipula streptocera** Doane

Corvallis, VI-13. C. P. A. det.

42. **Tipula tristis** Doane

Forest Grove, V-5 (Cole).

43. **Tipula unicincta** Doane

Corvallis, V-25. C. P. A. det.

44. **Tipula usitata** Doane

Corvallis, VI-2.

Family PTYCHOPTERIDÆ

These crane-flies are distinguished from the Tipulidæ by having the V-shaped suture poorly defined and by lacking the second anal vein. The larvæ are quite remarkable in structure, having an extensile, elongated breathing tube on the caudal end. The pupa has one of the thoracic horns greatly elongated and breathes through this while the body is covered with mud or water.

45. **Ptychoptera lenis** O. S.

Hood River, VI-5 (Cole). C. P. A. det.

46. **Bittacomorpha occidentalis** Aldr.

Hood River, VI-3 (Cole). This is undoubtedly the species recorded from Oregon by Osten Sacken in "Western Diptera" at *clavipes*.

47. **Bittacomorphella**[1] **sackenii** (Röder)

Hood River, VI-5 (Cole). C. P. A. det.

Family RHYPHIDÆ

Fig. 2. *Rhyphus alternatus* Say. Wing, and head from above.

This small family should be changed from the old position as it is now connected with the Tipulidæ through the Trichocerinæ. The flies of the genus Trichocera are quite different from the others of the family in general appearance and wing venation, but the early stages are so near the Rhyphinæ that they have recently been placed in their present position by Dr. Alexander.

48. **Rhyphus alternatus** Say.

Corvallis, V-25; Albany, V-2 and Forest Grove, IV-20 (Cole).

49. **Trichocera**[2] **colei** Alex.

Forest Grove, XI-11, III-20, 26, and Hillsboro, IV-1 (Cole). C. P. A. det. 1919, Can. Ent., LI, p. 162. Paratypes of this species were reared from turnips at Vancouver, Wash., Dec. 12, 1918 (Wm. Giles).

[1]Genus *Bittacomorphella* Alexander 1916, Proc. Acad. Nat. Sci. Phila., LXVIII, p. 545.

[2]The species of this genus in North America will have to be compared with the European forms before they can be made out with any certainty. Many of the species seem to be holarctic and it is probable that some of our names are synonyms. Some of the species collected in Oregon could not be determined owing to this condition in the taxonomy of the group.

50. **Trichocera trichoptera** O. S.

Forest Grove in Dec., Jan. and Feb. (Cole). C. P. A. det.

Family DIXIDÆ

Small slender flies, all belonging to the genus Dixa. There are eight species listed from North America. The adults resemble mosquitoes but are not pilose and do not bite; they are found in moist localities where there is abundant vegetation. The larvæ are aquatic and resemble mosquito larvæ.

51. **Dixa centralis** Loew

Hood River, X-1 (Cole).

Family PSYCHODIDÆ

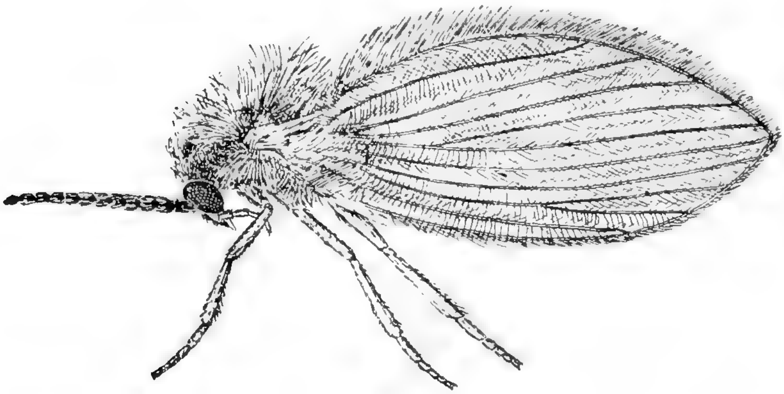


Fig. 3. *Psychoda cinerea* Banks.

The moth-flies are attracted to lights in great numbers. Some are found on tree trunks and many in damp, shady places, often on the undersides of leaves or on the surface of some stagnant pond. They are also found on windows and in outhouses in the winter and spring.

Many of the species have aquatic larvæ, Maurina (Pericoma) preferring swift streams and being provided with ventral suckers on the abdomen. Some larvæ occur in cow-dung and in decaying vegetable matter. The larvæ have spiracles and tracheal gills.

52. **Psychoda cinerea** Banks

Common at Hood River and Forest Grove in late December and January. On rainy days many could be found under old sheds or in protected places on the bark of trees; females were observed about excrement.

53. **Psychoda schizura** Kincaid

Hood River, VII-9 (Cole).

54. **Psychoda sigma** Kincaid

Forest Grove, III-28 and VI-3 (Cole). On the latter date collected at light.

55. **Pericoma sitchana** Kincaid

Hood River, VI-19 (Cole).

Family CHIRONOMIDÆ

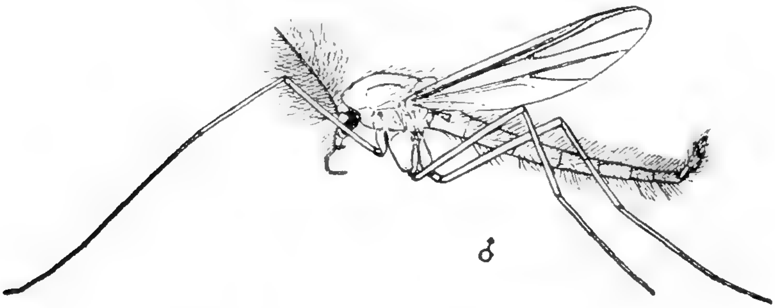



Fig. 4. *Chironomus colei* Malloch.

This family, the midges, now includes two subfamilies, the Tanypinæ and Chironominæ. They might be called "sunset-flies," often appearing in swarms at that time. Many are seen in the air in the autumn, dancing in the sunshine, usually near some body of water. They can be collected at lights in large numbers. The adults resemble mosquitoes superficially, but have poorly developed mouth parts and the costa is not continued all the way around the wing. The males, as in the Culicidæ, have feathery antennæ. Midges usually alight with the fore legs in the air and mosquitoes as a rule raise the hind legs.

Almost all the species are aquatic in the early stages, the larvæ feeding on decaying vegetable substances and tiny aquatic organisms. A few are terrestrial, one lives in sap and one species mines the leaves of water plants. Many species furnish food for trout.

56. **Chironomus colei** Mall.

Forest Grove, VI-3 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 255.

57. **Chironomus plumosus** (Linn.)

Corvallis (Churchill).

58. **Chironomus riparius** Meig.

Forest Grove, III-10, 20 and VI-3 (Cole); Hillsboro, IV-1 (Cole).

59. **Chironomus viridis** Macq.

Forest Grove, V-17 (Cole).

60. **Tanytarsus**[3] **dissimilis** Johann.

Forest Grove, VI-2 (Cole). At light. 1905, N. Y. State Museum, Bull. 86, p. 292.

61. **Tanytarsus fatigans** Johann.

Forest Grove, III-28 (Cole). 1905, N. Y. State Museum, Bull. 86, p. 292.

62. **Tanytarsus obediens** Johann.

Forest Grove, IV-5 (Cole). 1905, N. Y. State Museum, Bull. 86, p. 286.

63. **Tanytarsus politus** Mall.

Forest Grove, III-20 and VI-3 (Cole); Forest Grove, V-4 (Burrill). 1915, Bull. Ill. St. Lab. Nat. Hist. X, p. 493.

64. **Metriocnemis flavifrons** Johann.

Forest Grove, III-26 to IV-14 (Cole). 1905, N. Y. State Museum, Bull. 86, p. 301.

[3]A number of species were collected at Forest Grove which could not be determined with certainty; some of them are probably undescribed.

65. **Cricotopus slossonæ** Mall.

Forest Grove, VI-3 (Cole). At light. 1915, Bul. Ill. St. Lab. Nat. Hist. X, p. 506.

66. **Cricotopus trifasciatus** Panz.

Forest Grove, VI-3 (Cole). At light.

67. **Camptocladius byssinus** Schrank

Very common at Forest Grove in early spring, often seen in swarms in sunny afternoons; III-3 to IV-5 (Cole).

68. **Orthocladius**[4] **obumbratus** Johann.

Forest Grove, III-28 and VI-3 (Cole); Hillsboro, IV-1 (Cole). 1905, N. Y. State Museum, Bull. 86, p. 281.

69. **Orthocladius nivoriundus** Fitch

Forest Grove, III-28 and Hillsboro, IV-1 (Cole).

70. **Orthocladius sordidellus** Zett.

Forest Grove, VI-3 (Cole). At light.

71. **Diamesa chorea** Lundb.

Forest Grove, VI-3 (Cole). At light.

72. **Paraclunio alaskensis** (Coq.)

Several specimens of this curious chironomid were taken at Seaside Beach by L. G. Gentner, VIII-15-1914. Aldrich lists the species from Newport in his Catalogue.

73. **Tanypus dyari** Coq.

Forest Grove. III-4 (Cole).

74. **Tanypus flavifrons** Johann.

Forest Grove, V-14 (Cole); Hillsboro IV-1 (Cole). 1905, N. Y. State Museum Bull. 86, p. 150.

75. **Tanypus monilis** (Linn.)

Forest Grove, III-26 to VI-3 (Cole).

[4]Species of this genus were common in the spring and early summer at Forest Grove and several of those collected are apparently undescribed.

## Family CERATOPOGONIDÆ

We follow Malloch in making this group a family separate from the Chironomidæ. Here belong the "punkies" or "no-see-ums" which are wicked biters and are so small that an ordinary net will not keep them out. The thorax is large, but does not project over the head as in the true Chironomidæ. The species of Culicoides are especially bloodthirsty; some of the other genera are said to attack insects, attaching themselves to the body and wings.

The larvæ of most are aquatic or semi-aquatic, often being found in decaying wood that is submerged.

76. **Culicoides biguttatus** (Coq.)

Forest Grove, VI-3 (Cole). Taken at light. Malloch det.

77. **Culicoides sanguisugus** (Coq.)

Forest Grove, VI-3 (Cole). Taken at light. Malloch det.

78. **Forcipomyia cilipes** (Coq.)

Forest Grove, VI-3 (Cole). Malloch det. Taken at light.

79. **Serromyia femorata** (Meig.)

Forest Grove, V-5 (Cole). Malloch det.

80. **Hartomyia**[5] **mallochi** Cole, new species

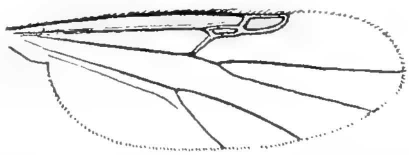


Fig. 5. *Hartomyia mallochi* Cole, n. sp. Wing of holotype.

Female: Length 1.5 mm. Head and its appendages black, the antennæ brownish black with pale pile. Mesonotum, scutellum and postnotum black subshining, the bristles black. Scutellum with a bristle on each side near the base and two

[5]This genus was erected by Malloch in 1915, Bull. Ill. State Lab. Nat. Hist. X, Art. VI, p. 339.

apical bristles. Pleura black, mostly shining. Halteres blackish near the base, the knob whitish.

Abdomen dull black, nearly devoid of pile on the basal half, the apical half with longer sparse brown pile. Legs entirely brownish black, the tarsal claws large and equal. Basal joint of hind tarsus a little less than twice as long as second joint; joints of the tarsi with pile longer than their diameters. Tip of hind tibia with several short bristles. Wings whitish hyaline, the anterior veins heavy and brownish yellow, the other veins very thin; petiole of the media about the length of the cross vein (see fig. 5); cubitus forks distinctly proximad of the cross vein.

*Holotype,* female, No. 828, Mus. Calif. Acad. Sci.; F. R. Cole collector, March 28, 1919.

*Type locality,* Forest Grove, Oregon.

The species would run to couplet 6 in Malloch's table of species, but differs from *antennalis* in size, color of halteres, and in lacking spines on the last tarsal joint. It is larger than *arctica* with large tarsal claws. The species is named for Mr. J. R. Malloch, the author of the genus, whose fine paper on the Chironomidæ of Illinois has been very useful in working up this family.

## Family CULICIDÆ

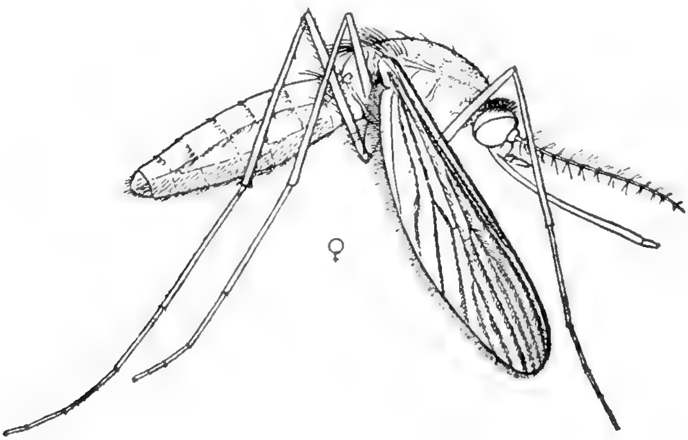



Fig. 6. *Culex pipiens* Linnæus.

The mosquitoes have the wings clothed with scales and there is no discal cell; the ocelli are lacking. Not all species bite and only a few come into houses. They are found at all altitudes and in all lands, myriads occurring in the Arctic. Birds and dragon-flies prey on the adults, and the larvæ serve as food for fishes and dragon-fly nymphs.

The larvæ are aquatic, some requiring little water for their development. They differ in habits, some feeding on decaying vegetable material and others preying on small organisms.

81. **Anopheles occidentalis** D. & K.

Corvallis; Klamath Falls (Dyar and Caudell). 1906, Proc. Biol. Soc. Wash., XIX, p. 159.

82. **Anopheles punctipennis** (Say)

Corvallis; Forest Grove, II and III (Cole); Portland, VI-30 (Dyar and Caudell).

83. **Anopheles pseudopunctipennis** Theob.

Corvallis, IX-6; Forest Grove, II-17 to XII-7 (Cole).

84. **Theobaldia annulata** (Schrank)

Reported from Calif. to B. C. in Aldrich's Catalogue.

85. **Culiseta consobrina** (Desv.)

Warm Springs.

86. **Culiseta incidens** (Thoms.)

Corvallis (Theobald); Klamath Falls (Dyar and Caudell).

87. **Culiseta inornata** (Will.)

Klamath Falls (Dyar). Reported from Cal. to B. C.

88. **Culiseta sylvestris** (Theob.)

Fish Lake.

89. **Culiseta stigmatosoma** (Dyar)

Klamath Falls (Dyar). 1907, Proc. U. S. Nat. Mus. XXXII, p. 123.

90. **Culex pipiens** Linn.

Forest Grove, III-26 (Cole).

91. **Aedes curriei** (Coq.)

Burns; Klamath Falls VII-27 (Dyar and Caudell); Corvallis.

92. **Aedes hexadontus** Dyar?

Corvallis. Dr. Dyar in making the determination of this and the following species stated that males were necessary for a certain determination of the species. 1916, Ins. Insc. Menstr., IV, p. 83.

93. **Aedes palustris** Dyar

Corvallis. 1916, Ins. Insc. Menstr., IV, p. 89.

94. **Aedes varipalpus** (Coq.)

Ashford (Dyar and Caudell); Portland (Currie).

## Family MYCETOPHILIDÆ

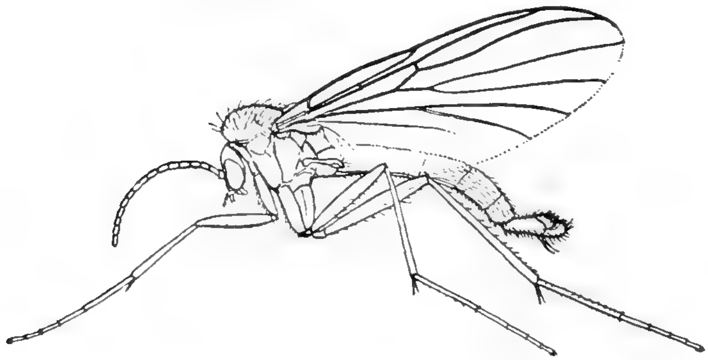


Fig. 7. *Boletina atra* Cole, n. sp. Drawing of holotype.

In the fungus-gnats the abdomen ends in a forceps-like process in the males, and in a pointed ovipositor in the females. The thorax is usually highly arched. Malloch has recently divided this group into five families but in this paper only the Sciara group is considered as a separate family.

The adults are found in situations conducive to fungus growth, damp, dark places, and can often be swept from grass in shady places. Some are found on tree trunks; and windows in old deserted houses are good places to collect in certain seasons. Western Oregon is undoubtedly rich in forms of this group and the list given below could be greatly increased by one interested in the family. In addition to the species we have listed there are some which could not be identified with certainty, owing to the lack of material or to the imperfect condition of the specimens. One species each of Leia, Brachypeza, Rhymosia, Odontopoda and Mycomya were taken and six species of Mycetophila, which could not be identified.

95. **Bolitophila hybrida** (Meig.)

Forest Grove, III-28 (Cole); Tillamook, III-26 (Burrill).

96. **Symmerus annulatus** (Meig.)

Several specimens, taken at Corvallis, IX-10 (Cole), are probably this species, which has been recorded from New Jersey and New Hampshire. The wing venation is the same as that given in Williston's Manual on page 134 (Plestiana), but the wing is more pointed.

97. **Diadocidia borealis** Coq.

Forest Grove, II-10, III-14 and V-2 (Cole). In one female the tip of the first radial vein is distinctly proximad of the end of the anterior branch of the cubitus.

98. **Apemon[6] maudæ** (Coq.)

Corvallis, V-3 to V-30.

99. **Apemon pectoralis** (Coq.)

Corvallis, VI-4.

100. **Platyura nigra** Cole

Forest Grove, V-20 (Cole). 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 222.

101. **Macrocera formosa** Loew

Hood River, V-2 (Cole).

[6] 1909, Genera Insectorum, Mycetophilidæ, p. 20.

102. **Tetragoneura pimpla** Coq.

Forest Grove, II-17 (Cole).

103. **Tetragoneura quintana** Cole, new species

Male: Length, 3.5 mm. General body color black. Head black, the palpi and other mouth parts blackish brown. Antennæ blackish, the third joint twice as long as wide, the succeeding joints decreasing in length to the last joint, which is half again as long as the penultimate.

Mesonotum, scutellum, pleura and postnotum black, with a brownish tinge, made lighter by the gray pollen. Bristles of thorax yellowish. Halteres brownish yellow, the knobs darker.

Abdomen dull blackish brown with sparse yellowish pile. Hypopygium blackish brown, the lower forceps rather large, the tip excavated, with a yellow thorn below. Hind legs blackish brown, including the coxæ; middle legs with the femora yellowish brown; fore legs with the coxæ, femora and base of tibæ more or less yellowish. Wings grayish hyaline, the costa and radial veins heavy and dark brown, the other veins thinner and paler; subcosta ends in $R_1$ nearer the base of the radial sector than the humeral cross-vein. Cell $R_1$ very small, usually forming a small triangle; anterior branch of cubitus detached at base but reaching proximad of base of R-M cross vein.

Female: Much like the male, the femora paler. Genitalia yellowish. The basal two joints of the antennæ yellowish and angles of pronotum yellow.

*Holotype,* male, No. 829, and *allotype,* female, No. 830, Mus. Calif. Acad. Sci.; F. R. Cole, collector, March 27, 1919.

*Type locality,* Forest Grove, Oregon.

This is the fifth species in the genus Tetragoneura one of which is a fossil species. The one described above is in the group with *bicolor* and *pimpla,* where the subcosta ends in $R_1$ but differs in color from both of these, in the shape of the cell $R_1$, and in the forking of the cubitus, the anterior branch not being detached in the related species.

104. **Sciophila hirta** Meig.

Forest Grove, III-15 (Cole). One female was taken and the description given by Johannsen fits it exactly. The length is 5 mm and the length of the wing 5 mm. It is a European species reported from Greenland.

105. **Dziedzickia**[7] **immaculata** Cole

Forest Grove, V-2 (Cole). 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 222.

106. **Dziedzickia oregona** Cole

Forest Grove, II-10 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 223.

107. **Mycomya mendax** Johann.

Forest Grove, II-10 and V-2 (Cole). 1910, Maine Agr. Exp. Sta., Bull. 180, p. 182.

108. **Neuratelia**[8] **coxalis** (Coq.)

Forest Grove, III-28 (Cole). Several specimens collected. 1905, Jl. N. Y. Ent. Soc., XIII, p. 68 (Anaclinia).

109. **Boletina atra** Cole, new species

Male: Head, thorax, and abdomen black. Antennæ and mouth parts black. First two antennal joints about as broad as long, the last joint longer than any of the preceding eight. Mesonotum, pleura and scutellum thinly gray pollinose; the median dorsal stripe on mesonotum semishining, wedge-shaped and divided by a longitudinal row of short yellow bristles; on either side of the median vitta is a faintly defined oval spot destitute of pollen; bristles of the thorax yellow. Halteres yellow.

Abdomen, including the genitalia, opaque black; pile of the genitalia black, the rest of the abdominal pile yellowish. Lateral claspers of the genitalia with two small curved apical spines and a larger yellow pre-apical spine. Fore coxæ more or less yellow, the two hind pair black. Femora and tibiæ yellowish, the trochanters and tips of the hind femora brown; tarsi blackish brown; tibial spurs brown. Wings

[7] 1909, Genera Insectorum, Mycetophilidæ, p. 44.

[8] 1856, Dipterologiæ Italicæ, Prodromus I, p. 195.

nearly hyaline, the apical half grayish; costal and radial veins heavy and black, the other veins lighter; Sc ends in C slightly beyond base of Rs; Cu forks slightly distad of the base of the R-M cross vein; costa prolonged beyond tip of Rs nearly half way to $M_1$ (see fig. 7).

Female: Very nearly the same as the male in color and structure. The last antennal joint proportionately shorter than in the male. Genitalia brown.

*Holotype*, male, No. 831, and *allotype*, female, No. 832, Mus. Calif. Acad. Sci.; F. R. Cole, collector, March 14, 1919.

*Type locality*, Forest Grove, Oregon.

The writer collected three female paratypes at Forst Grove and Hillsboro, Oregon, a little later in the year. The species is very near *sobria* Johannsen. A single male of a closely related species was collected at about the same time and near the same place; this form is clearly separable only by characters of the male genitalia.

110. **Boletina inops** Coq.

One pair taken at Forest Grove, I-10 (Lane); same locality, X-11 (Cole).

111. **Leia winthemi** Lehmann

Forest Grove, IX-14 (Cole).

112. **Phthinia curta** Johann.

Forest Grove, II-20 and XII-17 (Cole). 1911, Fungus Gnats of N. A., part III, p. 291.

113. **Cœlosia flavicauda** Winnertz

Hood River, X-11 (Cole).

114. **Cœlosia pygophora** Coq.

Forest Grove, III-21 (Cole). One specimen taken. 1904, Proc. Ent. Soc. Wash., VI, p. 170.

115. **Rhymosia sp. A.**, Johann.

Forest Grove, V-17 (Cole). 1911, Fungus Gnats of N. A., part III, p. 310.

116. **Telmaphilus tenebrosa** (Coq.)

A single male, taken at Forest Grove, III-21 (Cole), in most respects answers the description of the female given by Coquillett. It differs in having all of the coxæ blackish, the femora and tibiæ brown, the tarsi blackish brown. Wings as figured by Johannsen.

117. **Exechia**[9] **cincinnati** Johann.

Forest Grove, V-5 and XI-15 (Cole). 1912, Fungus Gnats of N. A., part IV, p. 69.

118. **Exechia obediens** Johann.

A very common species in winter and early spring at Forest Grove. 1912, Fungus Gnats of N. A., part IV, p. 73.

119. **Exechia umbratica** (Aldr.)

Corvallis, XI-15.

120. **Dynatosoma nigrina** Johann.

Forest Grove, III-6 (Cole). One female collected. 1912, Fungus Gnats of N. A., part IV, p. 75.

121. **Mycothera fenestrata** (Coq.)

Forest Grove, II-10 to XII-13 (Cole). One of the commonest mycetophilids in this locality.

122. **Mycetophila falcata** Johann.

Forest Grove, V-2 (Cole). 1912, Fungus Gnats of N. A., part IV, p. 93.

123. **Mycetophila fatua** Johann.

Forest Grove, II-25 (Cole). op. cit. p. 102.

124. **Mycetophila lassata** Johann.

Forest Grove, III-6 (Cole). op. cit., p. 101.

125. **Mycetophila lenta** Johann.

Tillamook, III-26 (Burrill). op. cit., p. 102.

[9]The species of this genus are very difficult to separate, the male genitalia offering the best characters for classification. There are at least five undetermined species in material collected at Forest Grove from April to December.

126. **Mycetophila monochæta** Loew

Forest Grove, IV-5 (Cole); Corvallis, I-14 (Gentner).

127. **Mycetophila mutica** Loew

Forest Grove, III-6 (Cole). Large series taken.

128. **Mycetophila mutica var. A,** Johann.

Forest Grove, III-14 (Cole). 1912, Fungus Gnats of N. A., part IV, p. 93.

129. **Mycetophila perita** Johann.

Forest Grove, V-14 (Cole). op. cit., p. 90.

130. **Mycetophila punctata** Meig.

Forest Grove, V-14 (Cole); Tillamook. III-26 (Burrill). This is one of the commonest and most widely distributed species. The Oregon specimens are darker than eastern specimens in my collection.

131. **Mycetophila scalaris** Loew

Hood River, X-2 (Cole).

## Family SCIARIDÆ

These small flies are separated from the Mycetophilidæ by several dipterists and are easily recognized by the venation and much shorter coxæ.

The larvæ are scavengers but some do damage to mushrooms. Many species breed in leaf mold.

132. **Sciara**[10] **scita** Johann.

Newport (Aldrich), type locality. 1912, Fungus Gnats of N. A., part IV, p. 135.

133. **Neosciara**[11] **munda** (Johann.)

Forest Grove, III-26 and IV-5 (Cole). 1912, Fungus Gnats of N. A., part IV, p. 127.

[10]Several species of this genus were taken which cannot be identified with certainty without male specimens; some are probably undescribed.

[11]1918, Ann. Ent. Soc. Amer. XI, p. 320.

134. **Eugnoriste occidentalis** Coq.

Albany, VI-17 (Creel). This species has a long proboscis and feeds on flowers.

Family CECIDOMYIIDÆ

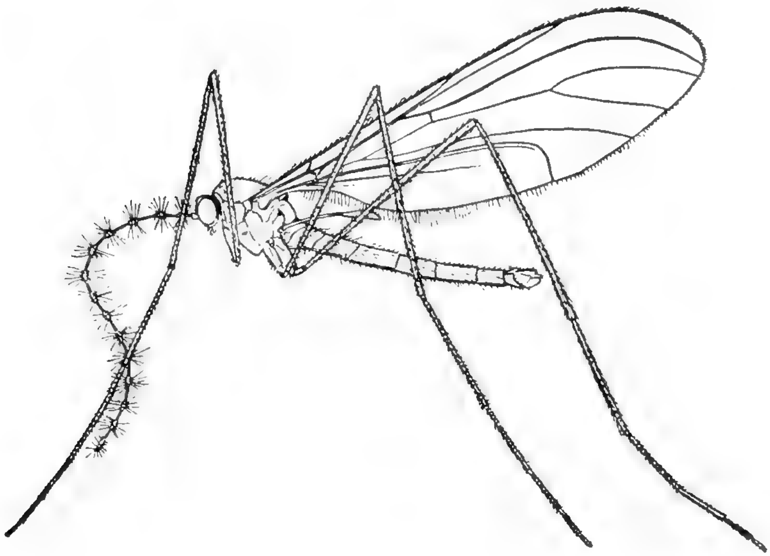


Fig. 8. *Hormosomyia oregonensis* Felt. Drawing of homo-topotype.

In the little gall-midges the antennæ are many jointed and often with whorls of hairs. There are usually three longitudinal veins and the costa continues around the wing.

The family is an immense one and the larval habits vary somewhat. A great majority of the species cause abnormal growths on plants and some are recognized by their galls alone.

Scarcely any material was taken in this family, most of that sent to Dr. E. P. Felt being probably undescribed. More specimens will be required before the identification of the species of Lestremia, Prionellus, Rhabdophaga and Lasioptera can be made with certainty. A female of a species of Lasioptera taken near Forest Grove has 36 antennal segments, more than have been recorded from any other American species according to Dr. Felt.

135. **Mayetiola destructor** (Say)

This famous wheat pest, known as the Hessian Fly, is found west of the Cascades in Oregon and often does considerable damage.

136. **Aphidoletes meridionalis** Felt

Specimens taken at Forest Grove and Corvallis (Rockwood and Lovett). 1908, N. Y. State Mus., Bull. 124, p. 397.

137. **Prionellus boulderensis** Felt

Recorded from Oregon by Felt.

138. **Dasyneura leguminicola** (Lintn.)

The clover seed midge, common throughout western Oregon and an important pest in many clover growing sections.

139. **Hormosomyia**[12] **oregonensis** Felt

Forest Grove, X-10 (Cole). Described as a new genus and species in the Porricondylariæ in the article referred to above. It is one of the non-gall-making species. Two males were taken of this species.

140. **Colpodia colei** Felt

Forest Grove, VI-2 (Cole). This species is described by Dr. Felt as related to *C. americana*. 1919, Ent. News, XXX, p. 223.

[12] 1919, Ent. News, XXX, p. 220.

## FAMILY BIBIONIDÆ

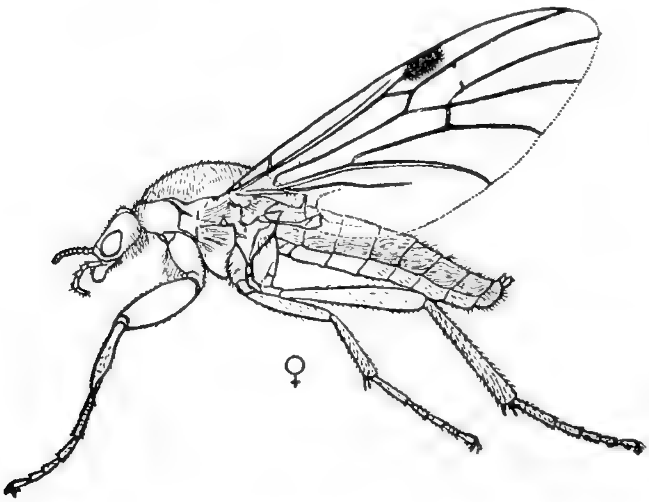



Fig. 9. *Bibio nervosus* Loew

The males and females of these ungainly little "March flies" often differ considerably, the females having grotesque little heads. They emerge in April and May and often on bright sunshiny days they will appear in swarms, sailing about in an aimless sort of way.

The larvæ have a false segment behind the head which is well developed and has spiny processes. They are scavengers, feeding on decaying vegetable matter or excrement. A few feed on grass roots.

### 141. **Bibio hirtus** Loew

This species is usually less common that the following and emerges a week or more later. It has been reported as injurious to turnips in one section of the state.

### 142. **Bibio nervosus** Loew

Very common in spring and early summer.

### 143. **Bibio variabilis** Loew

Reported from Oregon by Coquillett.

144. **Dilophus serotinus** Loew

Odell, X-14 (H. F. Wilson).

145. **Dilophus tibialis** Loew

Hood River, VI-8 (Cole).

Family SCATOPSIDÆ

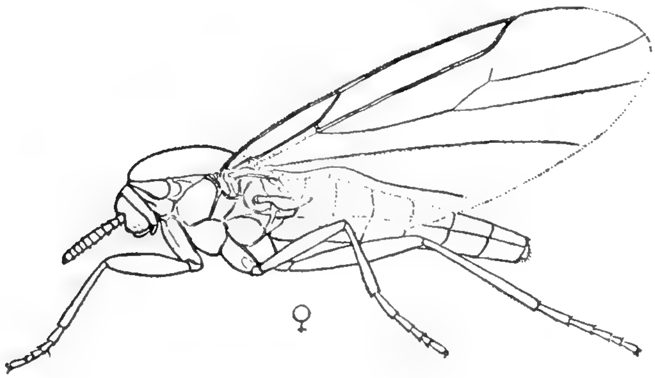


Fig. 10. *Scatopse notata* Linn.

These very small black flies were formerly included in the Bibionidæ but now are generally given family rank. The costa and two veins next to it are thickened, the other veins being very weak. The larvæ of all the known species are recorded as breeding in excrement. Several species have been bred from sewers.

146. **Scatopse notata** Linn.

Corvallis, XI-30 (Bridwell); Crystal Lake VI-8.

147. **Rhegmoclema**[13] **atrata** (Say)

Hood River, X-3 (Cole); Corvallis.

148. **Reichertella**[14] **collaris** Mel.

Corvallis, IX-10 (Cole), 1916 Wash. Exp. Sta., Bull, 130, p. 10.

[13] 1912, Zool. Anzeiger, XL, p. 276.

[14] 1912, Zool. Anzeiger, XL, p. 268.

## Family SIMULIIDÆ

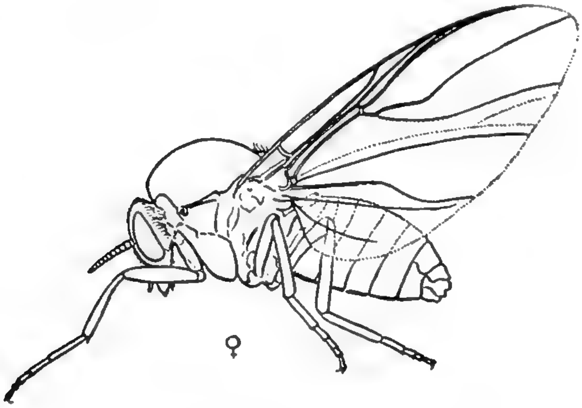



Fig. 11. *Prosimulium fulvum* (Coq.)

These tiny flies are easily recognized and are variously known as black-flies, buffalo gnats and sand-flies. The females "bite", as many are willing to testify, and are sometimes very troublesome to stock and man. The larvæ live in running water, often in swift currents, and feed on small animals and algæ. Peculiar fans on the head create a current toward the mouth. They are anchored to rocks by a sucking disc near the tail and by a silken line, and breathe by means of a peculiar organ near the tip of the body; the larvæ move like geometrid larvæ.

### 149. **Prosimulium fulvum** (Coq.)

Pamelia Lake, Mt. Jefferson, elevation 3,000 feet. (Bridwell). Malloch det.

### 150. **Prosimulium hirtipes** (Fries.)

Sand Mountain, VI-20; Dee, VI-17 (Cole); Forest Grove, IV-20 (Cole); Mt. Jefferson, VII-15 (Bridwell). Malloch det.

### 151. **Simulium bivittatum** Mall.

Hood River (Cole). Very common in July in the willow flats along the Columbia River. They make their appearance about sundown and late bathers then are glad to put on their clothes and go home. 1914, U. S. Bur. Ent., Tech. Series, No. 26, p. 31.

152. **Simulium vittatum** Zett.

Narrows, VII-1. Malloch det.

Family BLEPHAROCERIDÆ

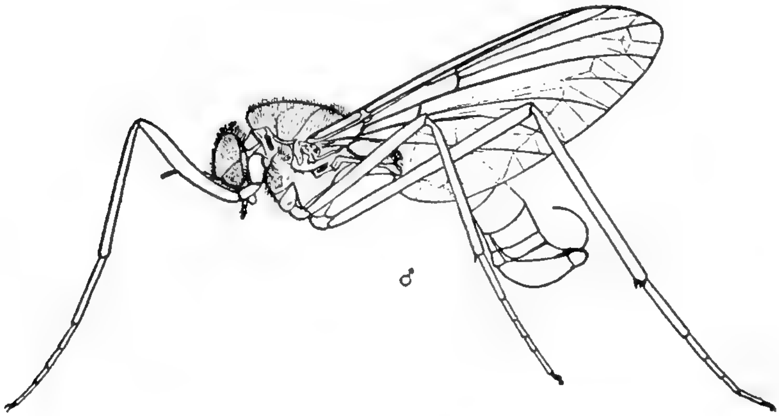



Fig. 12. *Bibiocephala grandis* O. S.

These flies could be mistaken for Tipulidæ at first glance. The venation is quite characteristic and there are creases in the membrane which give the impression of a secondary venation. The females are predaceous. The larvæ live in swift streams, attaching themselves to rocks by means of ventral suckers. They feed on minute aquatic organisms. Many of the flies are swept away in the swift current as they emerge from the pupal cases, being unable to get their wings unfolded in time. This may account for the few species in existence.

These flies are not uncommon along some of the swift streams of Oregon and one species of Blepharocera taken in the Hood River valley, as well as a small species of Bibiocephala occasionally collected, will be described later by Mr. Leroy Childs. These two undescribed species were not found in any such numbers as were the two forms listed below.

153. **Bibiocephala grandis** O. S.

Common at Hood River along the stream of that name. The first specimens were collected about the middle of May and were seen in large numbers up to the early part of June. They fly clumsily, like some of the tipulids, and will dash headlong into anything that happens to be in their way.

154. **Bibiocephala comstocki** Kell.

This species emerged later than *grandis* and was more abundant; its season was much longer and it was more active. In resting on the leaves of plants it would usually fly to the under side of the leaf and hang by its feet. In the swift water of the upper Hood River these flies could be seen flying and hovering close to the surface of the stream; they seemed to prefer shady places and were often flying after sundown.

## Family STRATIOMYIDÆ

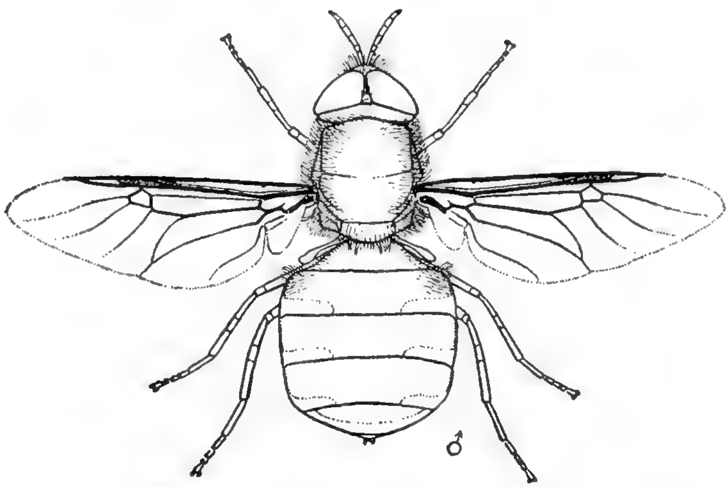



Fig. 13. *Odontomyia hoodiana* Bigot

The so-called "soldier-flies" have a strikingly characteristic wing venation; when at rest the wings are laid flat and overlapping on the abdomen. The abdomen is usually broad and flattened. The adults are flower flies, the smaller species being quite active and the larger ones usually slow.

155. **Beris annulifera** Bigot

Hood River, VI-8, 20 (Cole). The larvæ of the Berinæ are terrestrial and have been bred from moss.

156. **Scoliopelta luteipes** Will.

Multnomah Falls, IX-30 (Cole), two females taken in grass around a small spring. Williston had two males from Mt. Washington, N. H., which were 7 mm. in length. These specimens are about 9.5 mm.; the antennæ are more than two-thirds as long as the distance from their base to the ocelli, and there are a few other slight discrepencies, but these may be sexual differences.

157. **Sargus pallipes** Bigot

Hood River, VI-21 (Cole). This species like others of the genus, is found on the leaves of plants, usually in the sunlight.

158. **Sargus picticornis** Bigot

Hood River, V-15 (Cole).

159. **Sargus tricolor** Loew

Corvallis, V-12 and VII-7.

160. **Sargus viridis** Say

Very common at Hood River and Forest Grove during early summer.

161. **Stratiomyia atra** Cole

Empire, Coos Co., VII-27. 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 223.

162. **Stratiomyia barbata** Loew

Hood River, VI-21 (Cole).

163. **Stratiomyia discalis** Loew

Hood River, VI-6 to VI-21 (Cole).

164. **Stratiomyia laticeps** Loew

Reported from Oregon by C. W. Johnson.

165. **Stratiomyia maculosa** Loew

Common at Hood River, V-19 to VII-7 (Cole).

166. **Stratiomyia melanostoma** Loew

Reported from Oregon by C. W. Johnson.

167. **Odontomyia arcuata** Loew

Umatilla, VII-14 (H. F. Wilson).

168. **Odontomyia cincta** Oliv.

Blitzen River, VII-6; Ashland, VI-21 (Chamberlin).

169. **Odontomyia hoodiana** Bigot

Described from Mt. Hood. Quite common in the lower Hood River Valley during the month of June. Collected on marshy ground sloping toward the river.

170. **Odontomyia pilosa** Day

Described from California; Bigot described it five years later, as *pyrrhostoma,* from Mt. Hood.

171. **Euparyphus apicalis** Coq.

Hood River, IX-4 (Cole).

172. **Clitellaria lata** Loew

Corvallis, V-8 to VI-2; Mary's Peak and Kiger's Island.

## Family TABANIDÆ

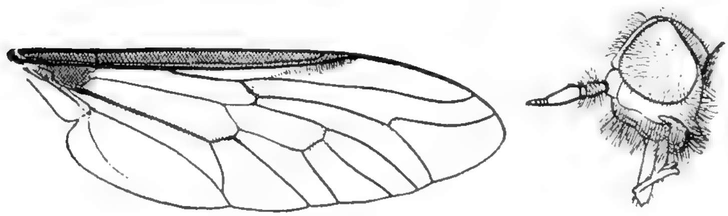


Fig. 14. *Tabanus procyon* O. S.

These flies are commonly known as "horse-flies", "gad-flies", "deer-flies", "green-heads", etc. They have short, broad heads and the eyes are often colored. The mouth parts are a series of sharp lancets (four in the male, six in the female), enclosed in a lip-like organ. They are remarkable fliers and are fond of warm weather and sunshine. The males do not bite; feed on plant nectar or honeydew secreted by plant lice or scale insects.

The larvæ are found in rotting logs, under stones in ditches, or in mud along streams or other bodies of water. They are predacious and feed on various little animals.

173. **Pangonia dives** Will.

Hood River, VII-26 (Childs).

174. **Pangonia fera** Will.

Described from Mt. Hood. Horse Lake, VII-25; Mt. Jefferson, VII-27 (Bridwell).

175. **Chrysops coloradensis** Bigot

Rickreall, VII-23 (Allen). Hine det.

176. **Chrysops discalis** Will.

Warm Springs, VII-7.

177. **Chrysops excitans** Walk.

Mt. Jefferson, VII-12 (Bridwell); Horse Mt. Flats, VII-30. Cole det.

178. **Chrysops lupus** Whitney

Pamelia Lake, VII-27 (Bridwell); Corvallis, IX-26; Grant Co., VII-14.

179. **Chrysops noctifer** O. S.

Parkdale, VI-18 and Dee, VI-17 (Cole); Mt. Jefferson, VII-12 (Bridwell); Whitman Nat. Forest, VII-14 (Chamberlin).

180. **Chrysops pachycera** Will.

Buck Mt., VII-19. Cole det.

181. **Chrysops proclivis** O. S.

Common at Parkdale, VI-18 (Cole and Childs). Cole det.

182. **Chrysops surdus** O. S.

Mt. Jefferson, VII-16 (Bridwell); Pamelia Lake, VII-19 (Bridwell).

183. **Tabanus ægrotus** O. S.

Williston reports this species from Oregon. Corvallis; Mackenzie Ridge, VIII-27; Lava Lake, VII-25 (Lovett). Cole det.

184. **Tabanus captonis** Marten

Hood River, VIII-1 (Childs); Corvallis, V-12; Grant Co., VII-13; Whitman Nat. Forest, VII-14 (Chamberlin); Subalpine regions on Mt. Jefferson, VII-20; Mary's Peak, VII-18 (Gentner); Horse Lake, VII-25 (Bridwell). Hine det.

185. **Tabanus centron** Marten

Whitman Nat. Forest, VII-14 (Chamberlin). Cole det.

186. **Tabanus epistatus** O. S.

Hood River, VII-22 (Childs); Whitman Nat. Forest, VII-14 (Chamberlin); Grant Co., VII-8. Cole det.

187. **Tabanus insuetus** O. S.

Blitzen River, VII-6; large series from Whitman Nat. Forest, VII-11 (Chamberlin); Burns, VII-29. Cole det.

188. **Tabanus intensivus** Towns.

Horse Lake, VII-30 (Bridwell). Cole det.

189. **Tabanus laticeps** Hine

Whitman Nat. Forest, VII-12 (Chamberlin); Big Lake, VII-20 (Bridwell). Cole det.

190. **Tabanus leucophorus** Bigot

Described from Mt. Hood.

191. **Tabanus lineola** Fabr.

Hood River, VII-17 (Childs) and VI-25 (Cole).

192. **Tabanus opacus** Coq.

Whitman Nat. Forest, VII-18 (Chamberlin).

193. **Tabanus osburni** Hine

Large series from Whitman Nat. Forest, June and July (Chamberlin); Corvallis. Hine det.

194. **Tabanus phænops** O. S.

Corvallis, V-30; Whitman Nat. Forest, VII-14 (Chamberlin).

195. **Tabanus procyon** O. S.

Corvallis, V-29; Dee, VI-17 (Cole). This species is apparently rare in the northwest. Osten Sacken in his description in "Western Diptera" does not mention the long, black pile on the under and outer side of the femora, and the long, rather sparse, black pile on the tibiæ. The third antennal joint has scarcely any basal projection. Cole det.

196. **Tabanus punctifer** O. S.

Crooked River, VII-23; Mt. Jefferson, VIII-14 (Lovett); Corvallis, VII-22.

197. **Tabanus rhombicus** O. S.

Horse Lake, VII-25 (Bridwell). Hine det.

198. **Tabanus sequax** Will.

Hood River, VII-1 (Childs); Mt. Jefferson, VII-6 (Bridwell) and VIII-14 (Lovett); Mary's Peak, VII-14 (Lovett). Hine det.

199. **Tabanus sonomensis** O. S.

Whitman Nat. Forest, VII-14 (Chamberlin); Wilson River, VIII-6 (Reeher).

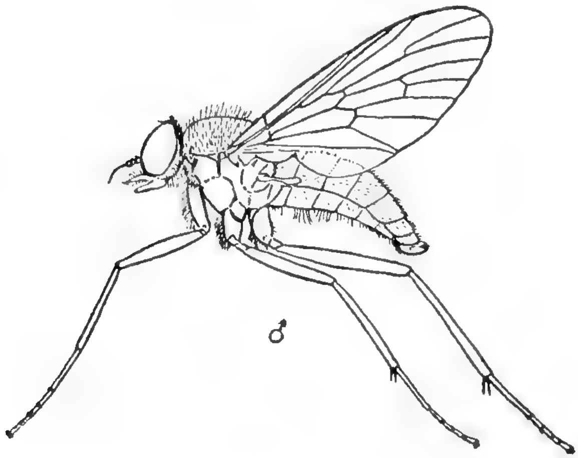
200. **Tabanus zonalis** Kirby

Three Sisters, VII-20 (Bridwell); Corvallis, V-20. Cole det.

201. **Silvius gigantulus** (Loew)

Corvallis, IV-15; Subalpine regions on Mt. Jefferson, VII-20 (Bridwell); Whitman Nat. Forest, VII-11 (Chamberlin); Sumpter, VII-5 (Wilson).

## Family RHAGIONIDÆ (LEPTIDÆ)



♂

Fig. 15. *Rhagio dimidiata* (Loew)

In these flies the thorax is rounded and the abdomen usually pointed. The mouth parts are prolonged into a beak projecting downward and backward. Some of the species are predaceous but they are as a rule rather sluggish and are often found on flowers. They can be collected in dense woods on the tall grass and ferns and around swampy land. Some of them rest on the trunks of trees, usually head downward. The females of Symphoromyia attack man. Some forms are called "snipe flies." The name Leptidæ has long been applied to the family but as Rhagio Fabr. has priority over Leptis Fabr. the family name must change accordingly.

202. **Arthroceras pollinosum** Will.

Forest Grove, VII-8 (Cole). A single female of this rare species was taken in a densely wooded section. It was flying about close to the ground over small weeds and grass and was mistaken at the time for a species of *Chrysopila.*

203. **Dialysis aldrichi** Will.

Hood River, VI-12 (Cole); Wallowa, VI-8 (Creel).

204. **Triptotrichia discolor** Loew

Forest Grove, VI-2 (Cole); Corvallis, V-15 (Lovett); Mary's Peak.

205. **Triptotrichia lauta** Loew

Corvallis, V and VI; Rock Creek, VII-14 (Lovett).

206. **Rhagio albibarbis** (Bigot)

Hood River, VI-2 and Forest Grove, V-17 (Cole).

207. **Rhagio costata** (Loew)

Corvallis, VII-17; Forest Grove, VI-18 (Reeher); Corvallis and Newport in May.

208. **Rhagio dimidiata** (Loew)

Dewey, V-29; Corvallis, V-28 and V-7 (Lovett); Forest Grove, V-2 (Cole).

209. **Rhagio hoodiana** (Bigot)

Described from Mt. Hood.

210. **Rhagio incisa** (Loew)

Hood River, V-16 and 21 (Cole)

211. **Rhagio maculifera** (Bigot)

Forest Grove, VI-5 (Cole).

212. **Rhagio pruinosa** (Bigot)

Described from Mt. Hood.

213. **Chrysopila**[15] **testaceipes** Bigot

Hood River, VI-2 to VI-24 (Cole). Aldrich det.

214. **Chrysopila tomentosa** Bigot

Hood River, VI-2 to VII-5 (Cole). Aldrich det.

[15]One species in this genus, fairly common at Hood River, is apparently undescribed.

215. **Symphoromyia atripes** Bigot

Joseph.

216. **Symphoromyia inquisitor** Aldr.

Corvallis, V-29. 1915, Proc. U. S. Nat. Mus., XLIX, p. 127.

217. **Symphoromyia kincaidi** Aldr.

Mt. Jefferson, VII-15 (Bridwell). 1915, Proc. U. S. Nat. Mus., XLIX, p. 129.

218. **Symphoromyia latipalpis** Bigot

Described from Mt. Hood as *fulvipes*.

219. **Symphoromyia pachyceras** Will.

Described from Mt. Hood as *trivittata*. Corvallis, V-30; Forest Grove, V-2 (Cole).

220. **Symphoromyia plagens** Will.

Described from Mt. Hood. Corvallis, VI-14; five males at Parkdale, VI-18 and one female, in the act of biting, at Hood River, VII-17 (Cole).

221. **Hilarimorpha obscura** Bigot

Two specimens taken at Hood River, VI-2 (Cole).

Family XYLOPHAGIDÆ

This family has been included under the Rhagionidæ by many dipterists. The imagines are found in the woods, and frequent flowers. The larvæ live in earth or under the bark on trees and are predaceous; they are quite distinct from the larvæ of the Rhagionidæ.

222. **Xylophagus decorus** Will.

Corvallis, V-17; Mary's Peak, V-16 (Gentner).

223. **Xylophagus gracilis** Will.

Reported from Oregon by Williston.

224. **Xylomyia parens** (Will.)

Toledo; Corvallis, VII-18 (A. B. Black).

## Family CYRTIDÆ

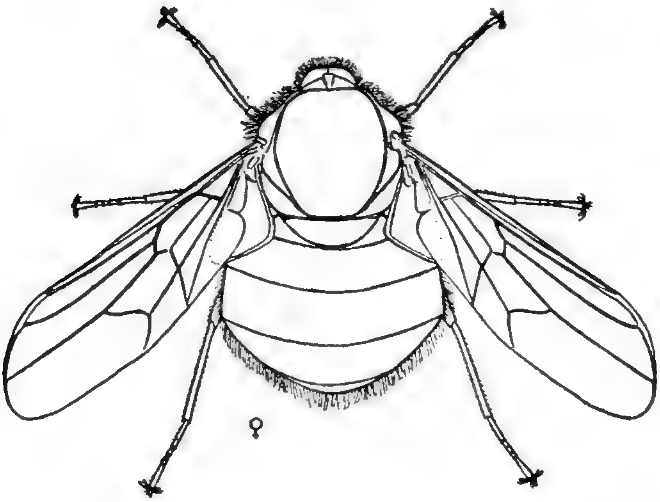


Fig. 16. *Pterodontia misella* O. S.

These curious little flies are usually very rare. The thorax and abdomen are large and inflated in appearance, and the head, which is composed almost entirely of the compound eyes, is quite small. All the species in North America have three pulvilli and enormous squamæ. Great variations occur within the family, especially in the wing venation and structure of the mouth parts. The larvæ are parasitic in the bodies or egg cases of spiders as far as known and apparently this parasitic mode of life has modified the structure of the flies.

### 225. **Pterodontia misella** O. S.

Described from Oregon. One specimen from Forest Grove, VI-5-1918 (M. C. Lane); a single female from Mary's Peak, V-15 (Moznette).

### 226. **Eulonchus sapphirinus** O. S.

A large series taken at Parkdale, VII-12 (Cole and Childs); Forest Grove, VI-3 and 5 (Cole); Mt. Jefferson, VIII-15 (Bridwell); Corvallis, V-20; Mary's Peak, VI-6 (Lovett); Buck Mt., VII-10.

227. **Eulonchus tristis** Loew

Several specimens taken at Parkdale, VI-18 (Cole and Childs); Alsea, Benton Co., VIII-6 (Bridwell); Lava Lake, VII-25 (Lovett); Mt. Jefferson, V-12 (Bridwell).

228. **Acrocera melanderi** Cole

Corvallis, VIII-18 (F. H. Lathrop). 1919, Trans. Amer. Ent. Soc., XLV, p. 55. The type was taken in Gallatin Co., Mont., elev. 6,400 feet, 1918.

229. **Oncodes melampus** Loew

Shedd, V-30; Hood River, VI-8 (Childs).

## Family NEMESTRINIDÆ

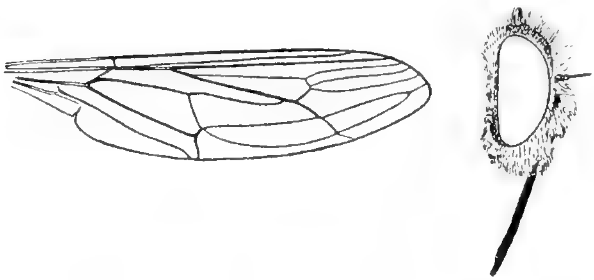


Fig. 17. *Rhynchocephalus sackeni* Will.

These are sometimes known as the Tangle-vein flies, because of the complex wing venation. The antennæ are small and the proboscis rather elongate; the female has a long ovipositor. The adults are flower frequenting and quite rare.

The early stages are not well known. The larvæ of one species are parasitic on a beetle.

230. **Rhynchocephalus sackeni** Will.

Forest Grove, VII-31 (Reeher) and VIII-12 (Lane); Mary's Peak; Corvallis, VII-19; Lewisburg, VII-5 (Black); Union Co., VII-18 (Black).

## Family SCENOPINIDÆ

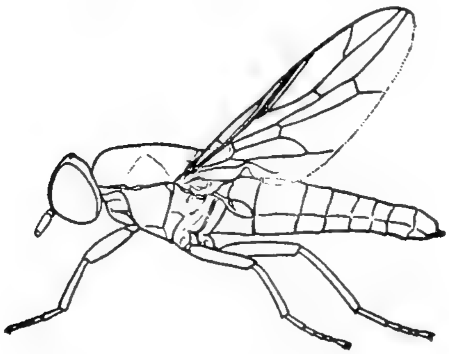


Fig. 18. *Scenopinus fenestralis* Linnæus

The name "window flies" is often applied to the members of this family because they are frequently found in houses on the windows. The adults are small, slender, and rather flattened; the wing membrane is smooth and there are two veins from the discal cell.

The larvæ are closely allied to those of the Therevidæ and are predaceous. The larvæ of *Scenopinus fenestralis* are found in rotten wood and fungi, and under carpets in houses, where they feed on the larvæ of the "moths".

231. **Scenopinus fenestralis** (Linn.)

Forest Grove, VIII-20 (Cole).

## Family MYDAIDÆ

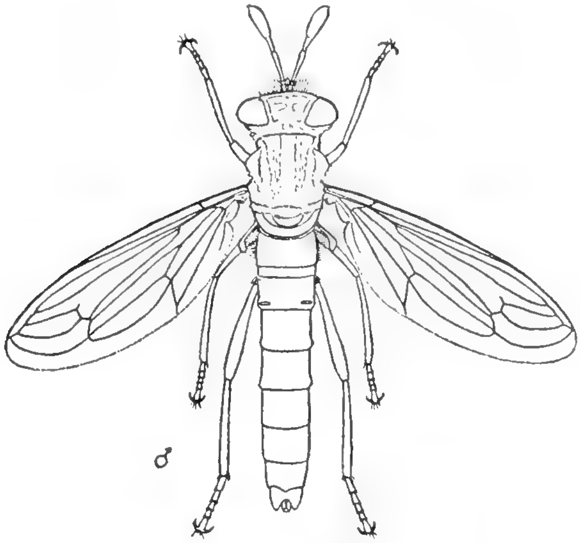



Fig. 19. *Leptomydas pantherinus* Gerst.

These flies resemble the Asilidæ in form. They are supposed to be predaceous but do not have mouth parts which would bear this out.

232. **Leptomydas pantherinus** Gerst.

Medford, VII; Hood River, VII-25 (Cole). Twelve males and one female taken at Hood River in one day. One male is an allotype in the collection of the California Academy of Sciences. The males were observed flying along the Mt. Hood Railway over sandy ground in the heat of the day. 1919, Proc. Cal. Acad. Sci., Ser. 4, col. IX, p. 228.

## Family THEREVIDÆ

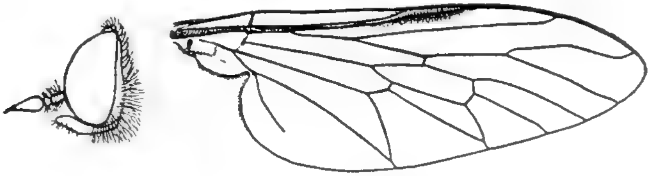


Fig. 20. *Psilocephala munda* Loew

Comstock called these "stiletto-flies" on account of their general form. The adults resemble robber flies but are not as strongly built and the eyes do not protrude above the vertex; the abdomen of most species is slender and the wings of all the known American species have five posterior cells. They have been recorded as preying on other diptera, but must capture very small species as their mouth parts would not permit them to kill the prey selected by their more robust relatives, the robber flies. The larvæ are long and slender, with segments 1 to 6 so constructed that they appear to have twenty segments. They live in mold, rotten wood, and in the ground, and prey on other insects or their larvæ. The metamorphoses are not well known.

233. **Psilocephala aldrichii** Coq.

Burns, Mt. Jefferson, VIII-14 (Lovett); Hood River, VI-20 and Forest Grove, VII-12 (Cole).

234. **Psilocephala costalis** Loew

Hood River, VII-3 (Cole). A large number were taken on the foliage of strawberry plants.

235. **Psilocephala munda** Loew

Multnomah Falls, IX-30 (Cole).

236. **Psilocephala notata** Wied.

Hood River, VI-4 to VI-20 and Forest Grove, VII-12 (Cole).

237. **Thereva fucata** Loew

Crook Co., VII-14 (Lovett); McDermitt, Malheur Co., VIII-20 (J. R. Bunch).

238. **Thereva hirticeps** Loew

Horse Lake, VII-25 (Lovett).

239. **Thereva johnsoni** Coq.

Hood River, VII-5 (Cole); Forest Grove, V-20, bred from rotting debris in stump. (Rockwood).

240. **Thereva vialis** O. S.

Quite common in Hood River in June and early July;

collected mostly on sandy stretches along the Hood River on bright sunny days (Cole).

241. **Dialineura crassicornis** (Will.)

Common at Hood River, V-10 to VI-26 (Cole). The habits are like those of *Thereva vialis*. Williston described the species in the genus *Thereva*.

242. **Metaphragma planiceps** (Loew)

Burns, V-19 (B. G. Thompson).

Family BOMBYLIIDÆ

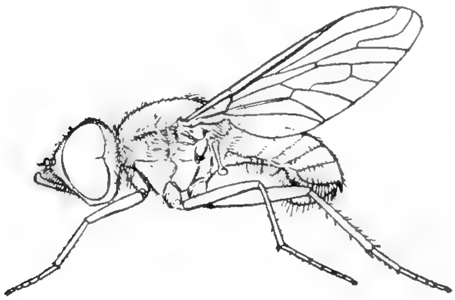


Fig. 21. *Epacmus nitidus* Cole, n. sp. Drawing of holotype.

The "bee-flies" are usually more or less covered with fur-like hair and look less like bees than some other flies; one group is furnished with a long proboscis. During the spring and summer they are often seen hovering in the air. They are flower feeders and creatures of the sunshine. Their flight is very quick, but consists of short dashes, and they are often seen resting on the ground or on low plants in the sun.

The larvæ are parasitic, predaceous, or inquilinous. Some are decidedly beneficial, being parasitic on injurious species.

243. **Spogostylum anale** (Say)

Forest Grove, IX-15 (Thompson and Cole). A few females were taken along Gale's Creek; the males, with numbers of other insects, were flying around some small pine trees in the afternoon sunshine.

244. **Spogostylum argentatum** Cole

Hood River, VI-20 to VII-5 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 227. This species was collected around old burned pine logs, like many others of the genus.

245. **Spogostylum œdipus** (Fabr.)

Parkdale, Dee and Hood River in June (Cole).

246. **Spogostylum pauper** (Loew)

Parkdale and Hood River in June (Cole).

247. **Spogostylum stellans** (Loew)

Parkdale and Dee in June (Cole and Childs).

248. **Spogostylum varium** (Fabr.)

Mosier and Parkdale, VI (Cole); Hood River, VI-16 to VII-16 (Cole).

249. **Exoprosopa capusina** (Fabr.)

Hood River, VII-9 to VII 25 (Cole).

250. **Exoprosopa doris** O. S.

Hood River, VII-28 (Cole).

251. **Exoprosopa eremita** O. S.

Pendleton, VII-17 (Thomson).

252. **Dipalta serpentina** O. S.

Hood River, VII-28 to IX-20 (Cole).

253. **Villa**[16] **alternata** (Say)

This rather variable species is common in Oregon in July, but the typical form was not collected.

254. **Villa atrata** (Coq.)

Hood River, VII-25 (Cole). These big flies appear to be on the wing most of the time, flying around in large circles close to the ground.

[16]There is some difference of opinion as to the acceptance of this name for the old genus Anthrax as currently understood.

255. **Villa autumnalis** (Cole)

Colestin, VIII-1 (E. P. Van Duzee). This species, together with *fuliginosa* and *willistonii,* belongs to the subgenus *Pœcilanthrax.* 1917, Jl. N. Y. Ent. Soc., XXV, p. 71.

256. **Villa edititia** (Say)

Sherwood, VII-12.

257. **Villa eumenes** (O. S.)

Corvallis, V-20 and VI-3; Hood River, VI-12 (Cole).

258. **Villa fuliginosa** (Loew)

Hermiston, IX-18 (Rockwood).

259. **Villa fulviana** (Say)

Colestin, VII-31 and VIII-1 (E. P. Van Duzee); Corvallis, IX-10 (Cole).

260. **Villa inops** (Coq.)

Hood River, VI-7 and VII-10 (Cole).

261. **Villa lateralis** (Say)

Colestin, VII-1 (E. P. Van Duzee); Corvallis, Hood River, Forest Grove and the Dalles. Common in the summer.

262. **Villa macula** (Cole)

Hermiston, IX-18 (Reeher); The Dalles, VII (Moznette). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 226.

263. **Villa miscella** (Coq.)

Hood River, VII-10 (Cole). One specimen.

264. **Villa morio** (Linn.)

Hood River, VI and Parkdale, VII-2 (Cole). This common species has been bred from bees of the genera Anthophora, Megachile and Andrena.

265. **Villa sinuosa** (Wied.)

Hood River, VII-9 to X-1 (Cole); Colestin, VII-31 and Ashland, VIII-2 (E. P. Van Duzee).

266. **Villa vana** (Coq.)

Hood River, VII-25 (Cole); The Dalles; Lakeview (Thompson).

267. **Villa willistoni** (Coq.)

Crook Co., VIII-14 (Lovett).

268. **Lepidanthrax inauratus** (Coq.)

Hood River, VI-3 to VII-9 (Cole). Not uncommon.

269. **Pantarbes pusio** O. S.

Burns, VI-1 (Thompson).

270. **Bombylius aurifer pendens** Cole

Hood River, VI-2 to VI-20 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 226.

271. **Bombylius metopium** O. S.

Corvallis, IV-29; Hood River, V-8 to VI-3 (Cole). Osten Sacken described only the male in his "Western Diptera." The description will apply to the female in most respects. In the female there is a tuft of silvery tomentum-like pile on each side of the frons, between the antennæ and the eye margin, which is very noticeable. Frons with short yellow pile and some long, black pile; pile of occiput whitish.

272. **Bombylius albicapillus** Loew

Large series taken at Hood River in early summer (Cole); Corvallis, V-15 to VI-3; Burns, V (Thompson). There is a great variation in the color of the pile and in the intensity of the wing markings. In some females the pile is almost entirely reddish, in others sordid, whitish. The amount of black pile on the abdomen varies. The silvery pile on the occiput of the male is noticeable at some distance in life. These flies were parasitic in the nests of a species of Halictus at Hood River.

273. **Bombylius lancifer** O. S.

Corvallis, VI-9; Whitman Nat. Forest; Buck Mt., VII-9; Hood River, VII-20 and Parkdale, VI-18 (Cole).

274. **Bombylius major** Linn.

Common at Hood River and Corvallis and probably in many other parts of Oregon. Corvallis, III-4 to IV-24. Latest date at Hood River, V-28 (Cole).

275. **Bombylius silvus** Cole

Parkdale, VI-8 (Cole). 1919, Proc. Cal. Acad. Sci. Ser., 4, IX, p. 225.

276. **Heterostylum robustum** O. S.

Lewisburg, VII-5 (Black).

277. **Anastœchus barbatus** O. S.

Hermiston, IX-18 (Rockwood). This form has in the past been made a synonym of *nitidulus* Fabr., the European species, but Cresson has recently compared European specimens with ours and believes it best to keep Osten Sacken's name. 1919, Proc. Acad. Nat. Sci. Phila., LXXI, p. 179.

278. **Systœchus oreas** O. S.

Common at Hood River and Forest Grove in June and July.

279. **Ploas amabilis** O. S.

Burns, V-19 (Thompson). A single specimen. This species undoubtedly occurs in eastern Oregon in large numbers as it is common in parts of arid, eastern Washington.

280. **Ploas atratula** Loew

Common at Hood River, V-10 to VI-22 (Cole).

281. **Ploas fenestrata** O. S.

Hood River, V-8 to VI-22 (Cole); Burns, V (Thompson).

282. **Ploas melanocerata** (Bigot)

Hood River, VI-2 to VI-26 and Mosier, VI-14 (Cole and Childs).

283. **Ploas nigripennis** Loew

Several specimens from Hood River, V-5 to VI-24 (Cole); Mary's Peak, V-16 (Lovett); Corvallis, V-4; Pamelia Lake, VII-19.

284. **Lordotus apicula** Coq.

Burns, VI-19 (Thompson).

285. **Lordotus gibbus** Loew

Lakeview, VIII-24 (Thompson); Freewater, IX-28; Hermiston, IX-18 (Rockwood).

286. **Acreotrichus americanus** Coq.

Hood River, V-10 (Cole).

287. **Eclimus celer** Cole

Parkdale, VI-18 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 224.

288. **Eclimus lotus** Will.

Quite common at Hood River, VI-5 to X-1 (Cole). Females were collected around old burned logs and lumber piles. Like many other bombylids they will alight in a certain place in the sunlight, and, if frightened, will keep returning to the same spot.

Apparently *auratus* Will. is the same as this species. Williston described both species on the same page (Kansas Univ. Quarterly, vol. 2, No. 2), but *lotus* has at least paragraph priority. The type of *lotus* was a male specimen from California; *auratus* was described from two females from the state of Washington, and might easily be thought another species. The female is much brighter colored than the male, unrubbed specimens being almost entirely covered with golden tomentum on the dorsum of the thorax and abdomen. There is considerable variation in size in the species.

289. **Eclimus luctifer** (O. S.)

Parkdale, VI-18 (Cole); Hood River, VII-5 and Forest Grove, VII-8 (Cole); Joseph; Cascadia, VII-21. Several specimens of what we take to be this species were collected at Hood River; some are quite small. The wings are infuscated and the anal angle much reduced. The male has traces of golden tomentum above, and perfect specimens of females are nearly covered above with these scales as in *E. lotus*. This species is usually much smaller than *lotus*, but is very near it.

290. **Eclimus magnus** (O. S.)

Forest Grove, VI-3 to VI-18 (Cole and Lane); Joseph. Allotype described, 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 225.

291. **Eclimus marginatus** (O. S.)

Hood River, VI-2 to VI-24 (Cole).

292. **Eclimus muricatus** (O. S.)

Hood River, VI-12 (Cole); Dee and Parkdale in June (Cole and Childs); Grant Co. This big black species was collected on old burned logs.

293. **Eclimus sodalis** Will.

Mosier, VI-14 and Dee, VI-17 (Cole). Three female specimens agree very well with the description of this species. One specimen from Mt. Jefferson, VIII-1 (Lovett), has the pile of the occiput whitish and not yellowish; halteres with a blackish knob; pile of thorax, pleura and pectus white. The base of the third antennal joint is rather broad.

294. **Epacmus sp.**

Mosier, VI-14 (Cole). A single female of an undescribed species was taken on the same day with the new species described below. It is a very distinct species, but until the male is collected it will not be described.

295. **Epacmus nitidus** Cole, new species

Male: Length 6 mm. Black, with yellow tomentum and pile. The occiput and cheeks dull grayish black with some yellowish and white tomentum and short yellow pile above that barely reaches the cheeks. Proboscis black and projecting beyond the oral margin about the length of the labellæ; palpi yellow with short yellow hairs. Frontal triangle and face pruinose, with short yellow pile except at apex of the triangle, the pile of the oral margin longer. Antennæ black, the styliform portion of the third joint about as long as the thick basal portion. Eyes separated by less than width of front ocellus.

Thorax shining black with yellow and white tomentum and faint indications of three white vittæ. Pile and bristles yellowish. Scutellum rounded, shining black, and bare except for a basal line of orange-yellow scales; the scales just in front of the scutellum obscuring the ground color. Pleura and coxæ densely gray pollinose with some yellowish and white pile. Femora black except the yellowish tip; the tibiæ reddish yellow; first three joints of tarsi yellowish, the last two brown. Wings hyaline; subcostal cell yellow, the costal and first vein yellowish brown, the rest blackish. Halteres yellow. Abdomen shining black with yellowish and white scales, denser at the bases of the segments. Pile at sides of first segment erect, whitish, bristle-like, the rest of the pile sparse and whitish. Venter densely covered with white tomentum and white pile. Most of genitalia black, more or less yellow below.

Female: Much like the male. Proboscis projecting almost half its length beyond the oral margin. The upper half of frons shining black with a few short black hairs; lower half pruinose and yellow pilose, the shining black reaching down a little on the sides (see fig. 21). Last abdominal segment laterally compressed, with a fringe of short golden pile.

*Holotype,* male, No. 833, and *allotype,* female, No. 834, Mus. Calif. Acad. Sci.; F. R. Cole, collector, June 14, 1917. These types are on the same pin and were taken in coitu.

*Type locality,* Mosier, Oregon.

This species is near *E. pallidus* Cresson, but has a long antennal style; most of the wing veins are blackish, the scutellum not emarginated and no brown tomentum on abdomen. In *E. modestus* the lower part of the face is polished.

296. **Aphœbantus borealis** Cole, new species

Male: Length 6 mm. Black, shining in ground color. Head black, the proboscis black and not projecting beyond the oral margin; palpi yellow. Occiput pruinose above with short yellow pile and yellowish scales. Antennæ black, the styliform portion of third joint about as long as the thickened basal portion.

Thorax shining black with white and yellow tomentum and yellow pile. Scutellum with yellowish tomentum at base and tip, the rest bare and shining black; bristles of thorax and scutellum reddish. Pleura gray pollinose with some whitish scales near the center; whitish pile above front coxæ, yellowish along dorso-pleural suture.

Abdomen black, thickly covered with brownish yellow tomentum above, white on first segment and posterior margin of second. Long, erect, whitish pile at sides of first segment. Venter with whitish scales not obscuring ground color. Genitalia rather large, about one-third as long as the rest of the abdomen, black, yellowish on the sides. Pile above on genitalia sparse and rather long, shorter below. Legs white and yellow tomentose, hind femora with several short bristles but no long hairs below. Femora black except tip, the tibiæ and tarsi reddish. Halteres yellow. Wings hyaline, the apical two-thirds of subcostal cell yellowish.

*Holotype,* male, No. 835, Mus. Calif. Acad. Sci.; F. R. Cole, collector, June 25, 1917.

*Type locality,* Hood River, Oregon.

Of this species a single specimen was taken; it runs to couplet 20 in Coquillett's table of species (Trans. Amer. Ent. Soc., XXI, p. 105), and there the characters do not apply as the hypopygium is not "small and not more than half as long as the abdomen."

297. **Aphœbantus peodes** O. S.

Hood River, VI-3 (Cole). Described from Mexico.

298. **Geron senilis** (Fabr.)

Hood River, VII-25 (Cole).

299. **Rhabdopselaphus sigma** (Coq.)

Dee, VI-17 (Cole).

300. **Toxophora maxima** Coq.

Hood River, VI-13 to IX-4 (Cole).

## Family ASILIDÆ

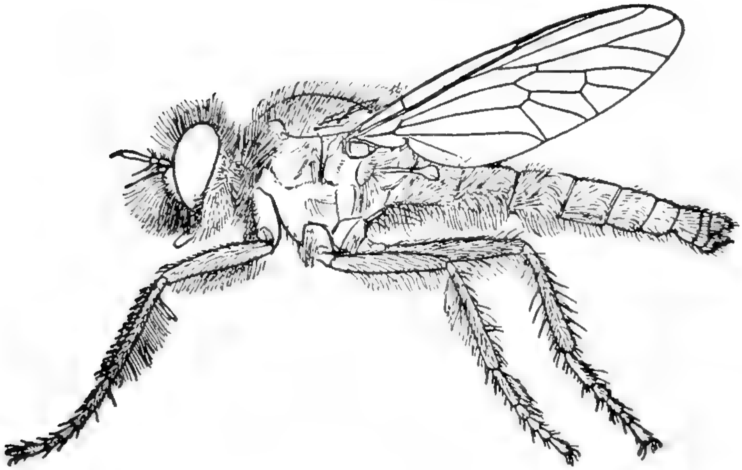


Fig. 22. *Cyrtopogon thompsoni* Cole, n. sp. Drawing of holotype.

The robber-flies vary in size from one-third of an inch to two inches in length. A few are bright colored, but the majority of the species are sober gray with black markings. The head is short, the eyes widely separated in both sexes and bulging out; the body is more or less bristly in all the species.

These flies are very savage and catch much of their prey in mid-air, even killing other asilids. Wasps, moths and even large grasshoppers are pounced upon, the choice of the victims depending upon the size of the brigand. Certain genera seem to prey on certain orders of insects. The larvæ are generally beneficial, as probably all prey upon other insect larvæ, either in the ground or in rotten wood.

301. **Leptogaster aridus** Cole

Hood River, VII-17 (Childs); Forest Grove, VII-12 (Cole). 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 229.

302. **Stenopogon breviusculus** Loew

Corvallis, VI-30; Ione, VII-22.

303. **Stenopogon californiæ** (Walk)

Mackenzie Ridge, alt. 6,000 feet, VIII-1; Detroit, VII-11 and Burns (Bridwell); Parkdale, VI-18 (Cole); High Ridges, 6,000-8,000 feet in Cascade Mts., Marion Co., VIII-1. In these last specimens the thorax is almost entirely covered with black pile, but otherwise they are typical.

304. **Stenopogon inquinatus** Loew

Hood River VI-7 (Cole); Bend, V-19.

305. **Stenopogon morosus** Loew

Ione, VII-22; Marysville, VII-15; Hood River, VII-9 (Cole).

306. **Docilonus simplex** Loew

Hood River, VI-5 to VI-26 (Cole).

307. **Dioctria media** Banks

Corvallis, VI-12 (Bridwell). 1917, Psyche XXIV, p. 118.

308. **Dioctria nitida** Will.

Large series from Rock Creek, near Corvallis, VI (Lovett).

309. **Dioctria sackeni** Will.

Listed from Mt. Hood by Dr. E. A. Back.

310. **Dioctria vertebrata** Cole

Parkdale, VI-12 (Cole). 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 230.

311. **Cyrtopogon anomalus** Cole

Hood River, VI-13 and Forest Grove, VII-10 to VIII-12 (Cole). 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 231.

312. **Cyrtopogon auratus** Cole

Joseph, Cascade Mts., Marion Co., VII-30. 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 230.

313. **Crytopogon bimacula** (Walk.)

One specimen, a male, Mt. Jefferson, VII-20 (Bridwell). This is considered an eastern species, but Dr. Back in his monograph mentions four males and two females collected on the peaks of Los Vegas Range, N. Mexico.

314. **Cyrtopogon dasylloides** Will.

Parkdale, VI-18 (Cole).

315. **Cyrtopogon dubius** Will.

Described from Oregon.

316. **Cyrtopogon infuscatus** Cole

Pamelia Lake, Mt. Jefferson, VII-12 (Bridwell). 1919, Proc. Cal. Acad. Sci. Ser. 4, IX, p. 233.

317. **Cyrtopogon leucozona** Loew

Joseph; Grant Co., VI-20 to VII-3.

318. **Cyrtopogon nebulo** O. S.

Subalpine regions on Mt. Jeffersons, VII-25 (Bridwell). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 232. Description of allotype.

319. **Cyrtopogon nugator** O. S.

Dee, VI-17 (Cole); Joseph, VII-17 (Chamberlin). The last mentioned specimens predaceous on Scolytidæ.

320. **Cyrtopogon perspicax** Cole

Hood River, VI-15 to VI-22 (Cole). Linn Co., V-24 (Lovett). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 233.

321. **Cyrtopogon præpes** Loew

Big Lake, VII-20 (Bridwell); Hood River, VI-13 (Cole); Burns, V (Thompson), a series which differs from the typical form in having the middle of the hind tibiæ red.

322. **Cyrtopogon princeps** O. S.

Subalpine regions of Mt. Jefferson, VII-20 (Bridwell); Horse Lake, 6,000 feet, VII-25; Mackenzie Ridge, 6,000 feet, VIII-1 (Bridwell). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 234.

323. **Cyrtopogon rejectus** O. S.

Dee, VI-17 and Parkdale, VI-12 (Cole).

324. **Cyrtopogon sudator** O. S.

Parkdale, VI-18 (Cole); Hood River, V-14 (Lovett).

325. **Cyrtopogon thompsoni** Cole, new species

Black, gray pollinose, with distinct black thoracic stripes; yellowish and white pile mixed with black.

Male: Length 11 mm. Face and frons whitish pollinose, the ground color more or less obscured. Black pile on sides of face on upper occiput next to eye margin and along lower occiput, cheeks, and oral margin. Pile of center of face and frons long and whitish. Antennæ black, the arista rather short and blunt; white pile below on first joint, a long black bristle under second joint. Occiput and head below with long, white pile.

Dorsum of thorax rather thinly gray pollinose, white pilose anteriorly and posteriorly, black across the middle. The two dorsal vittæ are narrow and distinctly separated, gray-black, somewhat shining, as are the side spots. The space in front of scutellum more or less destitute of pollen in this specimen. Scutellum slightly flattened on disk but with scarcely any pollen and thickly covered with long, erect, pale yellowish pile. Pleura gray pollinose, with some whitish pile on the meso- and sternopleura; a tuft of pile in front of the halteres. Halteres yellow. Whitish bristles on prescutellar callosities, the other thoracic bristles black.

Abdomen shining black with pollinose posterior borders, complete on second, narrowly interrupted on first, third, and following segments. Pile entirely whitish, longer and tuft-like on the sides of the first three but more or less covering all the segments, including the genitalia. Legs entirely black, including the ungues. Femora and basal two-thirds of tibiæ white pilose. First three joints of tarsi white pilose, especially long and tuft-like on the middle pair. Most of the bristles of the legs black but with a few white ones intermixed. Wings hyaline, the veins black; anterior cross vein a little before the middle of the discal cell.

Female: Resembling the male in many respects. White pile of face much thinner, the antennal arista a little longer and more slender and pointed. Thorax more thickly pollinose and the markings more distinct, the two dorsal vittæ interrupted some distance from the scutellum by gray pollen; pollen distinctly visible on the disk of the scutellum. Halteres reddish yellow. Second, third and fourth segments of abdomen with a complete pollinose band, the fifth interrupted, the following entirely shining black. Segments following the third with very short, sparse white pile.

*Holotype,* male, No. 836, and *allotype,* female, No. 837, Mus. Calif. Acad. Sci.; B. G. Thompson, collector, May 1919. These types are on the same pin and were taken in coitu.

*Type locality,* Burns, Oregon.

The species is quite a distinct one and is in the group which has the scutellum flattened and pollinose; it runs to couplet 17 in Back's synoptic table but is quite different from *evidens.*

326. **Cyrtopogon varipennis** Coq.

Parkdale, VI-8 (Cole). 1904, Proc. Ent. Soc. Wash. VI, p. 184.

327. **Lasiopogon bivittatus** Loew

Hood River, V-15 to VI-24 (Cole).

328. **Lasiopogon cinereus** Cole

Hood River, V-28 to IX-24 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 229.

329. **Heteropogon ludius** (Coq.)

Lookingglass, VI-14 (Black).

330. **Heteropogon senilis** Bigot

Mt. Hood (Coquillett).

331. **Pycnopogon cirrhatus** O. S.

Hood River, VI-6, VII-7 and Mosier, VI-14 (Cole). This species is not a typical *Pycnopogon*. It has more the appearance of *Heteropogon*.

332. **Lestomyia sabulonum** (O. S.)

Burns, VI-1 (Thompson); Ashland, VIII-2 (E. P. Van Duzee); Mosier, VI-14 (Cole). The Mosier specimens vary somewhat from the typical form but the species is apparently very apt to show slight variations in chætotaxy and color.

333. **Cophura brevicornis** (Will.)

Hood River, VI-20 to VIII-1 and Forest Grove, VI to VII (Cole); Ashland, VIII-2 (E. P. Van Duzee). This species is not typical of the genus but as many of the other species in the genus are just as aberrant it may as well be left there.

334. **Cophura cyrtopogona** Cole

Dee, VIII-1 (Childs). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 236.

335. **Nicocles æmulator** (Loew)

Forest Grove, VI (Lane), only one specimen taken. A series collected at Hood River in May and June is very near this species. Only males were taken and these had only the last abdominal segment silvery. Possibly it will prove to be an undescribed species.

336. **Nicocles dives** (Loew)

Large series taken at Hood River in V, VI and VII (Cole and Childs). They have the usual habits of the genus, perching on the tips of dead branches or tall grass stems. From these watch towers they flash out on some unsuspecting little wayfarer whose fate has been written. The silvery tips of the abdomen of the males glitter in the sunlight and are visible some distance away. Aphids, among other small insects, are a part of their food.

337. **Nicocles rufus** Will.

Hood River, VI-5 (Cole). One female taken.

338. **Pogonosoma dorsata** (Say)

Mary's Peak, VII-1891; Sherwood; Santiam Nat. Forest, VIII-11.

339. **Laphria felis crocea** McAtee

Mt. Hood (H. K. Morrison). 1918, Ohio Journ. Science, XIX, p. 163.

340. **Laphria ferox** Will.

Corvallis (Lovett). J. S. Hine det.

341. **Laphria gilva** (Linn.)

Hood River, VI-16 (Cole).

342. **Laphria sadales** Walk.

Described from Oregon as *pubescens* by Williston. Parkdale, Dee, and Hood River in June (Cole); Corvallis, VII-7 (Lovett); subalpine regions on Mt. Jefferson, VII-12 (Bridwell).

343. **Laphria vivax** Will.

Corvallis, one specimen, collector unknown; Corvallis, VIII-18 (Lovett).

344. **Laphria vultur** O. S.

Hood River and Parkdale, VI-12 to VII-5 (Cole); Lava Lake, VII-25 (Lovett); Corvallis, V-19 to VIII-23; Big

Lake; Mary's Peak; Mt. Jefferson; Santiam Nat. Forest. These big flies are usually found on old pine logs in the sunlight and are very wary; they usually return to the same place however, after a rather abrupt and rapid flight. In some specimens the wings are much paler than in others.

345. **Laphria xanthippe** Will.

Horse Lake, VII-25 and Mt. Jefferson; Pamelia Lake, alt. 3,000 feet, VII-30 (Bridwell). McAtee has recently made this a variety of *felis* O. S.

346. **Dasyllis astur** Loew

Reported from Oregon by Williston.

347. **Dasyllis californica** Banks

Parkdale, VII-12 and Hood River, VI-6 (Cole); Pamelia Lake, Mt. Jefferson, VII-25 (Bridwell); Corvallis, V-29; Elk Beds, Mt. Hood, VIII-10 (Bridwell). 1917, Bull. Brookl. Ent. Soc., XII, p. 54.

348. **Dasyllis columbica** Walk.

Corvallis, V-11; Mt. Jefferson, VII-20 (Bridwell); Mary's Peak, VII-14 (Lovett).

349. **Dasyllis fernaldi** Back

Pamelia Lake, Mt. Jefferson, 3,000 feet, VIII-6 (Bridwell). 1904, Can. Ent., XXXVI, p. 290.

350. **Dasyllis sackeni** Banks

Corvallis, V-14 (Lovett); Colestin, VII-30 (E. P. Van Duzee). 1917, Bull. Brookl. Ent. Soc., XII, p. 54.

351. **Proctacanthus occidentalis** Hine

Corvallis, VII and VIII; Roseburg, VIII-19 (Black); Medford, VIII-25; Bend, V-19; Hood River, VII-25 (Cole). This species was predatory on grasshoppers at Hood River. 1911, Ann. Ent. Soc. Amer., IV, p. 159.

352. **Promachus princeps** Will.

Hood River, VII-2 (Cole).

353. **Tolmerus callidus** Will.

Described from Oregon and Washington. Bend, VI-10 (Thompson).

354. **Asilus affinis** Will.

Hood River, VII-7 (Cole). J. S. Hine det.

355. **Asilus auriannulatus** Hine

Mt. Jefferson, VIII-15 (Lovett); Parkdale, VI-12 (Cole). J. S. Hine det. 1909, Ann. Ent. Soc. Amer., II, p. 151.

356. **Asilus californicus** Hine

Forest Grove, IX-27 (Cole). J. S. Hine det. 1909, Ann. Ent. Soc. Amer., II, p. 164.

357. **Asilus mesæ** Tucker

Blitzen River, VII-6; Pamelia Lake, Mt. Jefferson, VII-19 (Bridwell). J. S. Hine det. 1907, Kans. Univ. Sci. Bull., IV, p. 92.

358. **Asilus nitidifascies** Hine

Mt. Hood (H. K. Morrison). 1908, Can. Ent., XL, p. 202.

359. **Asilus occidentalis** Hine

Hood River and Dee, VI-17 to VII-25 (Cole); Pamelia Lake, Mt. Jefferson, VII-16 (Bridwell); Mackenzie Ridge, VII-20; Cascade Mts., Marion Co. 1909, Ann. Ent. Soc. Amer., II, p. 147.

360. **Asilus willistoni** Hine

Brownsville, IX-11. Hine det. This is the same as the preoccupied name *angustifrons* Will.

## Family DOLICHOPODIDÆ

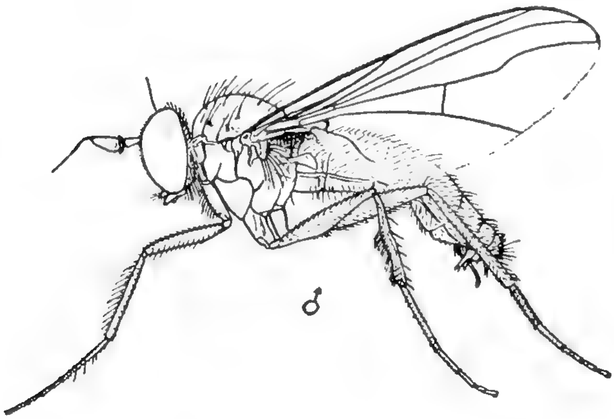



Fig. 23. *Argyra nigripes* Loew.

These flies are small and usually shining green in color but occasionally black or yellow. The tarsi are long and often ornamented in the males; these and the curiously modified claspers of the male genitalia furnish some of the best specific characters. The adults are slender and delicate and many are found about damp places in rank growth. They are predatory, darting over leaves or the surface of water in search of their prey.

Little is known of the early stages of American species. The larvæ have been recorded as predaceous on other larvæ and also as feeding in plant tissues. A great majority are aquatic, such as Dolichopus, Hydrophorus, and Campsicnemis.

361. **Sciapus pilicornis** (Aldr.)

Hood River, VI-2 and 20. (Cole). M. C. Van Duzee det. 1904, Trans. Amer. Ent. Soc., XXX, p. 282 (Psilopodinus.)

362. **Chrysotus choricus** Wheeler

Forest Grove, VI-2 (Cole).

363. **Chrysotus discolor** Loew

Narrows, VII-1.

364. **Chrysotus longimanus** Loew

Hood River, VI-1 and VI-5 (Cole); Narrows, VII-1.

365. **Campsicnemis claudicans** Loew

Forest Grove, V-5 to VI-6 and Hood River, IX-5 (Cole).

366. **Argyra albiventris** Loew

Forest Grove, V-5 to V-20 (Cole). The species was described from Sitka, Alaska, many years ago and, according to M. C. Van Duzee, who confirms my determination, has not been recorded since. It differs from *robusta* Johnson in several characters.

367. **Argyra nigripes** Loew

Hood River, VI-8 and VI-24, two males (Cole). The type was a single male, damaged by mould, which was collected at Sitka, Alaska, by Sahlberg, the description, however, is a very good one. The middle tibiæ are brownish yellow below, noticeably curved and enlarged near the middle and again near the tip; on the outside of the median enlargement is a cluster of rather long bristles. The few bristles on the underside of the front metatarsi are quite long and very slender. The genitalia are blackish brown and as in other species of the genus posses good specific characters.

368. **Sympycnus pugil** Wheeler

Hood River, IX-27 to X-11 (Cole).

369. **Nothosympycnus vegetus Wheeler**

Hood River, V-9 (Cole). M. C. Van Duzee det.

370. **Medeterus viduus** Wheeler

Hood River, VI-2 (Cole); Corvallis.

371. **Hydrophorus innotatus** Loew

Recorded from Oregon by Aldrich.

372. **Hydrophorus pensus** Aldr.

Forest Grove, VII-16 to IX-28 (Cole). A common species. 1911, Psyche, XVIII, p. 68.

373. **Hydrophorus philombrius** Wheeler

Hood River, VI-2 and Forest Grove, IX-27 (Cole).

374. **Scellus monstrosus** O. S.

Series taken at Burns in June (Thompson). The specimens do not tally exactly with the original description, but Dr. Aldrich, who examined specimens of this and the following species, is certain of the determination. The spoon-shaped appendages of the male genitalia are dark brown with a tuft of black hair. The appendage on the inner side of the base of the fore tibia ends in a short spine and has about seven short hairs on it. This species is very near *avidus*.

375. **Scellus vigil** O. S.

Corvallis, V-24; Forest Grove in May and September (Cole). These specimens lack the long white pile on the hind femora which Aldrich mentions in his table of species (1907, Ent. News XVIII, p. 136). The species is very close to, if not identical with, *filifer* Loew. Only females were taken in September, although about seventy specimens were collected, and these were darker and larger than the earlier forms. All were collected on the ground, many by sweeping over grass.

376. **Liancalus limbatus** V. D.

Mary's Peak, VI, one specimen collected. 1917, Ent. News, XXVIII, p. 127.

377. **Dolichopus aurifex** V. D.

Newport, VIII-13 (Aldrich). 1921, U. S. Nat. Mus., Bull. 116, p. 225.

378. **Dolichopus cavatus** V. D.

Hood River, VI (Cole); Corvallis. 1921, U. S. Nat. Mus., Bull. 116, p. 227. M. C. Van Duzee det.

379. **Dolichopus celeripes** V. D.

Hood River, VIII-2 (Childs). 1921, U. S. Nat. Mus., Bull. 116, p. 244. Two specimens collected.

380. **Dolichopus compactus** V. D.

Hood River, VII-4 (Cole). M. C. Van Duzee det. 1921, U. S. Nat. Mus., Bull. 116, p. 206.

381. **Dolichopus convergens** Aldr.

Described from Oregon.

382. **Dolichopus coquilletti** Aldr.

Forest Grove, VIII-29 (Creel); Hood River, VIII-9 (Aldrich).

383. **Dolichopus crenatus** (O. S.)

Hood River, VII-5 to X-3 and Forest Grove, VI-3 (Cole); Corvallis, VI-15 (Lovett). Very common in some localities.

384. **Dolichopus duplicatus** Aldr.

Hood River, IX-27 (Cole); Salem, VII-4 (Melander); Corvallis VII (Aldrich).

385. **Dolichopus hastatus** Loew

Collected on Mt. Hood (Aldrich).

386. **Dolichopus obcordatus** Aldr.

Hood River, VI to IX (Cole). Common in 1917.

387. **Dolichopus occidentalis** Aldr.

Hood River, VI-30, and Salem, VII-4 (Melander).

388. **Dolichopus paluster** M. & B.

Hood River, VI-3 to IX-5 (Cole). M. C. Van Duzee det.

389. **Dolichopus ramifer** Loew

Common at Hood River, June to October (Cole).

390. **Dolichopus socius** Loew

Hood River, VI-3 and 4 (Cole). M. C. Van Duzee det.

391. **Dolichopus tenuipes** Aldr.

Hood River, IX-24 to X-11 (Cole); Corvallis, VI-1 (Cole).

392. **Dolichopus variabilis** Loew

Hood River, VII-20 (Cole).

393. **Tachytrechus olympiæ** (Aldr,)

Hood River, VI-3 (Cole), M. C. Van Duzee det.

394. **Tachytrechus sanus** O. S.

Hood River, VI-21 (Cole), M. C. Van Duzee det.

395. **Pelastoneurus vagans** Loew

Forest Grove, IX-27 and Hood River, X-26 (Cole), M. C. Van Duzee det.

396. **Pelastoneurus occidentalis** Wheeler

Corvallis, VII-12 (Cole), M. C. Van Duzee det.

Family EMPIDIDÆ

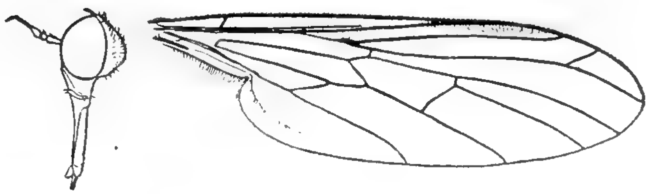


Fig. 24. *Empis poplitea* Loew.

The family is a very large one and there is a great variety in form and wing venation. The prevailing colors are dull, most of them brown, gray, or black. The mouth parts are usually long and beak-like. The adults congregate in swarms under trees or near shrubs and about brooks and dance up and down in the air, hence the name "dance-flies." They are predaceous, even cannibalistic, the female being "more deadly than the male." Many of the flies visit flowers and some species have very interesting habits. They perform quaint courtship dances and carry little balloon like veils or nets in some of their aerial maneuvers. The larvæ are found under leaves and decaying vegetable matter and are probably carniverous. Some species are aquatic or semi-aquatic. The species listed below were determined by Dr. A. L. Melander except where otherwise indicated.

397. **Platypalpus æqualis** Loew

Hood River, VI-3 (Cole).

398. **Platypalpus crassifemoris** Fitch

Hood River, VI-3 (Cole).

399. **Tachypeza inusta** (Mel.)

Viento, VII-1 (Melander).

400. **Leptopeza disparilis** Mel.

Forest Grove, VI-2 (Cole).

401. **Ocydromia glabricula** (Fall.)

Forest Grove, V-20 and VI-2 (Cole).

402. **Empimorpha barbata** (Loew)

Hood River, V-7 and Forest Grove, III, IV and V (Cole). Very common in April and May, especially around the flowers of Oregon grape.

403. **Empimorpha comantis** Coq.

Corvallis, IV-30.

404. **Empis aldrichii** Mel.

Rock Creek near Corvallis, VI-6 (Cole).

405. **Empis canaster** Mel.

Reported from Oregon by Melander.

406. **Empis poplitea** Loew

Hood River, V-5, and Forest Grove in May (Cole). Common, and often in swarms in the mating season. As in *Empimorpha barbata* the males carry their prey near the females as a lure.

407. **Hilara atra** Loew
Forest Grove, V-20 (Cole), Cole det.

408. **Brachystoma occidentalis** Mel.
Forest Grove, VI-13 (Rockwood). Cole det.

409. **Rhamphomyia amplicella** Coq.
Corvallis, IV; Forest Grove, IV-12 (Cole). Cole det.

410. **Rhamphomyia corvina** Loew
Forest Grove, IV-4 (Cole). Cole det.

411. **Rhamphomyia curvipes** Coq.
Corvallis, VI-3.

412. **Rhamphomyia nigricans** Loew
Forest Grove, III-20 (Cole). Cole det.

413. **Rhamphomyia sudigeronis** Coq.
Hood River, VI-8 (Cole).

414. **Anthalia stigmalis** Coq.
Corvallis, VI-2 (Cole).

## Family PLATYPEZIDÆ

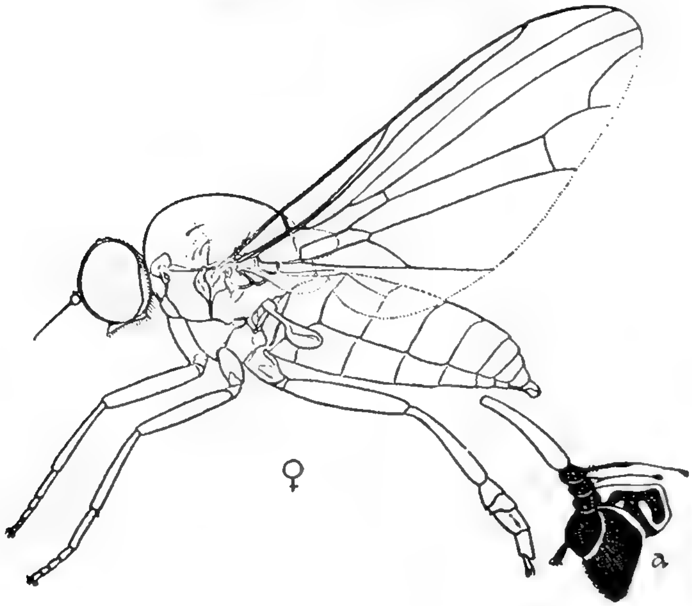



Fig. 25. *Calotarsa insignis* Aldr. a. Drawn from male.

In the "flat-footed flies" the posterior tarsi are broad and flattened, especially in the males. The wings are proportionately large. They are quick little flies and are often seen darting around on leaves, active in the shade and at times seen hovering over foliage about sundown. The larvæ live in mushrooms and other fungi.

415. **Agathomyia lutea** Cole

Parkdale, IX-5 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 238.

416. **Platypeza abscondita** Snow

Hood River, VI-8 (Cole).

417. **Platypeza cinerea** Snow

Hood River, X-30 (Cole).

418. **Platypeza polyporus** Willard

Large series from Corvallis (Moznette). 1914, Psyche, XXI, p. 167.

419. **Calotarsa insignis** Aldr.

Hood River, X-11 (Cole). Thirty-five females of this remarkable fly were taken, but no males were seen. According to Aldrich this is the first record since the discovery of the species at Stanford University, California.

## Family LONCHOPTERIDÆ

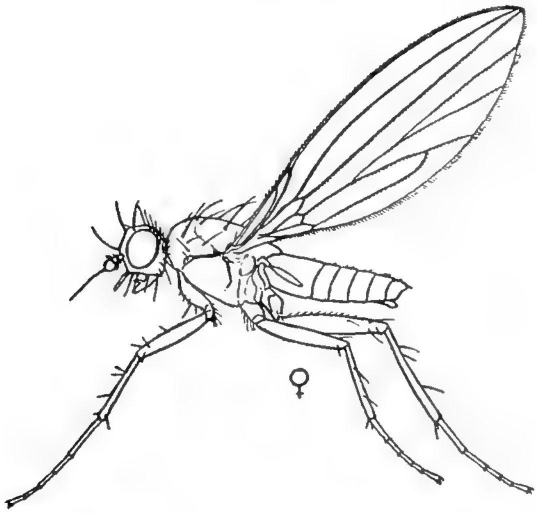



Fig. 26. *Lonchoptera lutea* Panzer.

Very small flies with pointed wings, commonly known as "spear-winged flies." When at rest the wings are folded flat, one over the other, on the abdomen. The venation alone will distinguish them from all other families and suggests that of the Psychodidæ. They are found in grass along streams and the individuals are quite common. There is only one genus in the family and very few species, three occurring in North America. Little is known of their habits. The larvæ are found on the ground under vegetable material.

420. **Lonchoptera lutea** Panz.

Common everywhere. Hood River, VI-19 to X-26 (Cole). Lundbeck in "Diptera Danica" said that only six males of *furcata* Fallén were known and in this species the males are about as rare. The females undoubtedly reproduce parthenogenetically.

## Family PHORIDÆ


Fig. 27. *Chætoneurophora variabilis* Brues.

Small, usually dark colored, flies with large, broad wings and a peculiar venation. The thorax is large and the head small. They are commonly seen running about on leaves and on windows in houses; occasionally they swarm in the air. The larval habits are remarkably varied; some live in decaying animal and vegetable matter and others are true entoparasites.

421. **Phora velutina** Meig.

Hood River, V-20 to IX-5 and Forest Grove, VI-5 (Cole).

422. **Hypocera flavimana** Meig.

Forest Grove, III-28 (Cole), Malloch det. Previously recorded only from the east.

423. **Apiochæta borealis** Mall.

Forest Grove, IV-4, 10 (Cole). 1912, Proc. U. S. Nat. Mus., XLIII, p. 488. Recorded from B. C.

424. **Apiochæta rufipes** (Meig.)

Forest Grove, III-30 to V-14 (Cole).

425. **Conicera aldrichii** Brues

Forest Grove, III-30 to IV-20 (Cole).

426. **Chætoneurophora**[17] **spinipes** Coq.

Forest Grove, IV-4 (Cole); Corvallis, I-26 (Chamberlin).

[17] 1912, Proc. U. S. Nat. Mus., XLIII, p. 422.

427. **Chætoneurophora variabilis** Brues

Series of specimens collected at Corvallis, with no other data. 1908, Jl. N. Y. Ent. Soc. XVI, p. 199.

428. **Trupheoneura**[18] **fratercula** Brues

Hood River, X-30 (Cole). Doubtfully placed here, the third vein thickened more as in *pachyneura* Loew.

[18] 1909, Journ. Nat. Hist. Soc. Glasgow, I, p. 27.

## Family PIPUNCULIDÆ

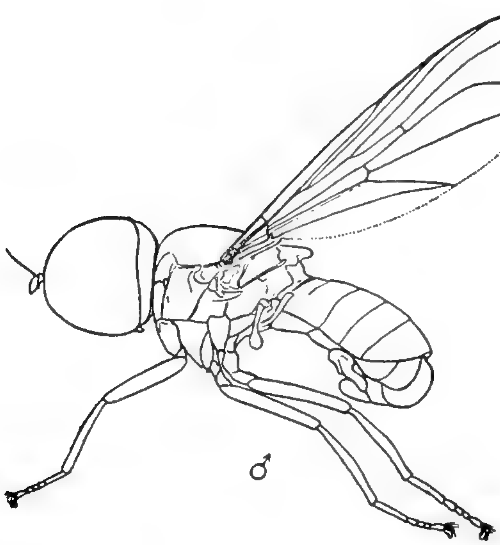



Fig. 28. *Pipunculus atlanticus* Hough.

Small flies with rather large heads composed almost entirely of the compound eyes. The wings are long and the venation like that of the Conopidæ. The body is usually almost bare of pile. The adults can be taken by sweeping plants and grass. Some are known to be parasitic in Jassids in the larval stages.

### 429. **Chalarus spurius** (Fall.)

Hood River, VII-28 (Cole).

### 430. **Pipunculus**[19] **atlanticus** Hough

Hood River, VI-6 to VII-28 (Cole). These specimens cannot be separated from the eastern species. They are the "slightly smaller" form with blackish antennæ mentioned by Cresson in his paper on this group.

[19] In this large genus there are evidently many undescribed species in the west. There is not sufficient material at present to make sure of some of the species collected in Oregon; at least six forms were taken at Hood River.

431. **Pipunculus confraternus** Banks

Hood River, IX-29 (Cole). One female taken. 1910, Trans. Amer. Ent. Soc., XXXVI, p. 285.

432. **Pipunculus proxima** Cress.

Hood River, VI-3 (Cole). 1910, Trans. Amer. Ent. Soc., XXXVI, p. 318.

433. **Pipunculus similis** Hough

Hood River, VI-4 (Cole).

Family SYRPHIDÆ

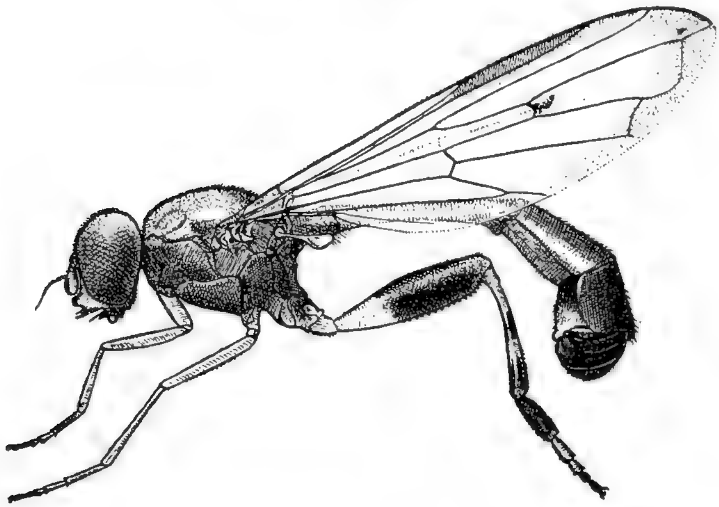


Fig. 29. *Sphegina punctata* Cole, n. sp. Drawing of holotype.

The adults are usually of moderate size and bright colors, black and yellow predominating. One of the distinguishing characteristics of the family is a thickening of the wing membrane, appearing as a spurious longitudinal vein. Over 700 described species occur in North America.

The more common forms of the genus Syrphus and its near relatives frequent fields and gardens, hovering here and there about the blossoms. Mimicry is well developed among the less typical forms, some are almost bare and mimic wasps, others are hairy and mimic bees. The adults feed upon the pollen and nectar of flowers and are of no economic importance.

The larvæ are typically slug-like in appearance. As a group they are considered beneficial and feed upon plant lice. As with the adults there is great variation in appearance among the less typical forms. In the genus Microdon the larvæ resemble molluscs and live in the nests of ants. Others are found in the nests of bumblebees and wasps. A large group, termed rat-tailed larvæ, have a slender posterior prolongation with terminal spiracles. These forms may live in stale pools of water or tunnel deeply into the sap or decay of trees. A few forms are injurious, tunneling into live bulbs and woody plants. These include such forms as the narcissus bulb maggot, *Merodon equestris;* the onion maggot, *Eumerus strigatus;* and *Chilosia alaskensis,* causing black check in Western Hemlock.

434. **Microdon cothurnatus** Bigot

Hood River, V-19 to 21 (Cole). Found mostly in an ant's nest under the bark of an old pine log, ten adults being taken and a number of pupæ. There is reason to believe that species of Microdon return to the old nest year after year and this certainly appeared to be the case here, as some of the old pupa cases had been there three or four years. The type of this species was taken on Mt. Hood.

435. **Microdon marmoratus** Bigot

Hood River, VI-14 (Cole); Mosier, VI-16 (Cole and Childs).

436. **Microdon piperi** Knab

Corvallis; Hood River, VI (Cole); Mt. Jefferson, VIII. Listed from Oregon by Williston as *tristis* Loew. On March 10, 1915, Childs collected larvæ in a colony of ants, under heavy bark of an old fir stump.

437. **Chrysotoxum derivatum** Walk.

Mt. Jefferson; Mary's Peak, VI-VIII (Lovett).

438. **Chrysotoxum ypsilon** Will.

Mary's Peak, VII-14 (Bridwell); Lakeview, VIII-18 (Thompson).

439. **Chrysogaster bellula** Will.

Mt. Jefferson, VIII (Bridwell).

440. **Chrysogaster lata** Loew

Williston records from Oregon.

441. **Chrysogaster parva** Shannon

Hood River, V-15 to VI-6 (Cole). 1916, Proc. Ent. Soc. Wash., XVIII, p. 104.

442. **Chrysogaster pulchella** Will.

Hood River, VI-17 (Cole).

443. **Chrysogaster sinuosa** Bigot

Hood River, VI-3 (Cole); Forest Grove, V-11 (Lovett).

444. **Chrysogaster stigmata** Will.

Pamelia Lake, VII-24 (Bridwell); Hood River, VI-3 and Forest Grove, IV-12 (Cole).

445. **Pipiza**[20] **femoralis** Loew

Hood River, VII-5 (Cole).

446. **Pipiza macrofemoralis** Curran MS.

Hood River, VI-8 (Cole).

[20] The group Pipizini is a difficult one, individuals varying considerably, having few outstanding characters sufficiently constant to be of service in establishing genera. Particularly in the females the characters for differentiation are more imaginary than real. In collecting where material in this group is plentiful, it is frequently possible to obtain individual females, which might provisionally be placed in each of the four genera, associating with males specifically of one form. It is our belief that a closer study will show this group to be in a transitional stage because of changes in food habits of the larvæ; the adults still mating more or less indiscriminately.

Mr. C. Howard Curran of Ontario, Canada, who has undertaken the very laudable task of straightening out this group, has kindly determined our Oregon material and his classification is used in cataloguing these forms. Mr. Curran's paper will appear in the succeeding number of these Proceedings.

447. **Pipiza oregona** Lovett

Hood River, V-8 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 246.

448. **Heringia californica** Davidson

Hood River, V-25 to VI-21 (Cole).

449. **Heringia cumuta** Curran MS.

Hood River, V (Cole).

450. **Cnemodon auripleura** Curran MS.

Hood River, VI-16 and Forest Grove, V (Cole); Corvallis, VI-14 (Lovett).

451. **Cnemodon corvallis** Curran MS.

Hood River, VI-16 and Forest Grove, IX-30 (Cole).

452. **Cnemodon lovetti Curran** MS.

Horse Lake, 6,000 ft., VII (Bridwell).

453. **Cnemodon pisticoides** Will.

Mackenzie R. ridge, in Cascades, 6,000 ft., VIII; Mary's Peak.

454. **Cnemodon placida** Curran MS.

Forest Grove, V-25 (Cole).

455. **Cnemodon rita** Curran MS.

Rock Creek, VII-14 (Lovett).

456. **Cnemodon sinuosa** Curran MS.

Forest Grove, V-25 (Cole).

457. **Paragus angustifrons** Loew

Corvallis (Bridwell); Forest Grove (Cole); Hood River, VI to VII (Cole).

458. **Paragus bicolor** (Fabr.)

Corvallis, V to VI (Lovett); Forest Grove, V (Cole).

459. **Paragus tibialis** (Fall.)

Forest Grove, VII and Hood River, V-16 (Cole).

460. **Chilosia aldrichi** Hunter

Mary's Peak, VI-14 (Lovett). Two male specimens, placed here provisionally. The abdomen is not "everywhere shining", but with subopaque cross band on hind margins of second and third segments, not reaching lateral margins and produced slightly forward in the center. Pile of disc short golden, longer golden on the margins. Scattering elongate bristle-like hairs on postalar callosities and on margin of scutellum. Otherwise fits description.

461. **Chilosia baroni** Will.

Mary's Peak, V-9 (Currey).

462. **Chilosia borealis** Coq.

Corvallis, IV-15. Doubtfully assigned here. Fits description except pile of eyes white. Length 8.5 to 9 mm.

463. **Chilosia chalybescens** Will.

Corvallis (Lovett).

464. **Chilosia chintimini** Lovett, new species.

Eyes pilose, arista nearly bare; color black throughout; face, legs, halteres and pile black; wings dark smoky, veins black. Length 11 mm.

Male: Face black shining with fairly abundant, moderately elongate, pile between tubercle and groove; indistinct, short, golden pile along groove. Face not produced, but slightly concave from antennæ to prominent tubercle, deeply concave between tubercle and prominent oral margin. Cheeks black, subshining, with golden pile. Frontal triangle strongly swollen, a deep median impression, pile coarse, elongate, black; vertical triangle small, black; ocelli brown; pile coarse, heavy, elongate, black. Antennæ small and brown; first two segments shining dark mahogany, third rounded, thin, coffee color. Arista black, longer than antennæ, thickened and briefly pilose on basal third. Eyes evenly and moderately elongate brown-pilose.

Thorax and scutellum shining black, scutellum with a hint of mahogany brown. Pile throughout elongate, black, coarser and shorter on pleura, spines everywhere absent. On humeral angles with small, half-concealed, areas of whitish pubescence.

Abdomen opaque black on disc, subshining along margins, pile moderately elongate, black, but with shorter, inconspicuous, brown pile in rows across disc of first three segments.

Legs black with black pile, briefly short golden pilose on under-surface of tibiæ and tarsi. Wings dark, smoky throughout; veins black. Tegulæ light with light yellow pile; halteres deep brownish black, a hint of gray on knob.

*Holotype,* male, No. 838, Mus. Calif. Acad. Sci. A. L. Lovett, collector, June 19, 1919. *Paratype,* same data, in collection of A. L. Lovett.

*Type locality,* Mary's Peak, Oregon.

Near *ferruginea* and *lasiophthalma* in size and length of pile. The uniformly attractive black color readily separates it.

465. **Chilosia ferruginea** Lovett

Corvallis, IV-14 (Chamberlin); Mary's Peak, III-30 (Lovett). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 238.

466. **Chilosia hoodiana** Bigot

Hood River, V-8 (Cole).

467. **Chilosia lævis** Bigot

Hood River, V-20 (Cole); Mary's Peak, VI-26; Lebanon, V-18 (Lovett).

468. **Chilosia lasiophthalma** Will.

Corvallis, IV (Lovett).

469. **Chilosia lugubris** Will.

Hood River V and VI (Cole).

470. **Chilosia nigripennis** Will.

Mt. Jefferson, VII-15 (Bridwell). Bigot also reported it from Mt. Hood as *Cartosyrphus infumatus*.

471. **Chilosia nigrovittata** Lovett

Corvallis, IV-22 (Neilson). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 239.

472. **Chilosia occidentalis** Will.

Mary's Peak III-30 (Black).

473. **Chilosia nigro-cœrulea** Lovett

New name for *pacifica* Lovett. Lava Lake, VII-15 (Lovett); Mt. Jefferson, VII (Bridwell); Corvallis, V-17. 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 240.

474. **Chilosia pallipes** Loew

Mt. Jefferson, Horse Lake, VII-25 (Bridwell); Mt. Jefferson, VIII-1; Mary's Peak, V to VII (Lovett). Occurs at lower altitudes in scattering numbers. A very common form in higher altitudes in midsummer in blossoms of Hellebore.

475. **Chilosia parva** Will.

Described from Oregon.

476. **Chilosia petulca** Will.

Mary's Peak, VI (Lovett).

477. **Chilosia signatiseta** Hunter

Hood River, V-5 (Cole).

478. **Chilosia sororcula** Will.

Mary's Peak, V-9 (Currey).

479. **Chilosia versipellis** Will.

Hood River, V-19 (Cole).

480. **Chilosia willistonii** Snow

Corvallis (Bridwell); Hood River, V-8 (Cole).

481. **Myiolepta bella** Will.

Mt. Jefferson; Mary's Peak; Horse Lake, 3,000 to 6,000 feet, VI-VIII (Lovett). Oregon is type locality.

482. **Myiolepta varipes** Loew

Corvallis, V-26. Bigot described it from Mt. Hood as *lunulata*.

483. **Pyrophæna granditarsus** Forst.

Hood River, V and VI (Cole). Common in marshy lands near Hood River, flying about plants of *Equisetum*.

484. **Platychirus æratus** Coq.

Mt. Jefferson, VIII-1 (Lovett). Doubtfully referred here; apparently agrees, except that legs are decidedly lighter in color and pile on face not especially heavy.

485. **Platychirus frontosus** Lovett

Corvallis, V-5 (Nichols); Mary's Peak, III-19 (Lovett). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 247.

486. **Platychirus hyperboreus** (Staeg.)

Corvallis; Alsea Valley, IV to VII (Lovett).

487. **Platychirus peltatus** (Meig.)

Hood River and Parkdale, V and VI (Cole).

488. **Platychirus quadratus** (Say)

Hood River (Cole); Mary's Peak, III-30 (Black). Common at Hood River.

489. **Melanostoma angustatum** Will.

Pamelia Lake, 3,000 ft., VII-27 (Bridwell).

490. **Melanostoma ambiguum** (Fall.)

Hood River, VII-25 (Cole).

491. **Melanostoma concinnum** Snow

Philomath, V (Lovett).

492. **Melanostoma cœrulescens** Will.

Mary's Peak; Mt. Jefferson (Lovett).

493. **Melanostoma dubium** Zett.

Rock Creek, III-30; Duffy's Prairie, VII-26 (Lovett). Doubtfully assigned here.

494. **Melanostoma mellinum** (Linn.)

Common in the Willamette and Hood River Valleys.

495. **Melanostoma obscurum** (Say)

Mary's Peak, VIII (Lovett).

496. **Melanostoma stegnum** (Say)

Common, V to VIII.

497. **Leucozona lucorum** (Linn.)

Mary's Peak, VIII (Lovett).

498. **Eupeodes volucris** O. S.

Common, V to VIII.

499. **Didea fasciata** Macq.

Common, VII to VIII, at altitude of 3,000 to 6,000 feet.

500. **Didea laxa** O. S.

Common, IV to VIII. Found at low altitudes during early summer and late fall, but most common at altitudes of 2,500 to 6,000 feet in forests near clearings, hovering in shafts of sunlight that strike down through little open glades.

501. **Didea pacifica** Lovett

Parkdale, VII-12 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 246.

502. **Lasiophthicus pyrastri** (Linn.)

Common.

503. **Lasiophthicus pyrastri unicolor** Curtis

In the early summer of 1914, the vetch aphis, *Macrosi-*

*phum pisi,* was unusually abundant, destroying great areas of vetch during June. One of the commonest beneficial insects preying on the aphids was the larvæ of *L. pyrastri.* Great numbers of these larvæ were collected to study possible parasites. About 3 per cent parasitism was observed. Of the adults emerging about 32 per cent were the melanic forms with black abdomens. A few specimens of *unicolor* were collected about aphids on "snow balls" in 1915. None has since been observed or collected in the valley, which would tend to substantiate Verral's report of their periodical appearance. Two females, one collected 1907 (Bridwell) and one VIII-'17 (Lovett) in the Cascades, alt. 6,500-7,000 feet, are smaller, but apparently belong here. In these two the interrupted cross band on the second abdominal segment persist as two elongate dots.

504. **Syrphus abbreviatus** (Zett.)

Corvallis, IV; Mary's Peak, VI (Lovett).

505. **Syrphus americanus** Wied.

Common. This species and *opinator* are two of the most common and generally beneficial forms of Syrphidæ feeding on aphids in Oregon. *L. pyrastri* proves the greatest feeder of all on *Aphis carbicolor* and *Macrosiphum pisi;* but on the basis of species attacked and general abundance *opinator* ranks first with *americana* a close second.

506. **Syrphus arcuatus** Fall.

Common, V-VIII. More abundant in higher altitudes 2,500 to 5,800 feet.

507. **Syrphus bimaculatus** Lovett

Mary's Peak, VI-15 (Lovett); Mt. Jefferson, VI (Bridwell). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 244.

508. **Syrphus diversipes** Macq.

Pamelia Lake; Mary's Peak, VII-VIII (Gentner); Lava Lake, VII-25 (Lovett).

509. **Syrphus grossulariæ** Meig.

Parkdale, VI-18 (Cole); Corvallis (Lovett).

510. **Syrphus intrudens** O. S.

Mt. Jefferson; Mary's Peak (Bridwell and Lovett); Hood River, V-20 (Cole). Fairly common in higher altitudes during August.

511. **Syrphus maculifrons** Bigot

Described from Oregon.

512. **Syrphus mentalis** Will.

Tillamook, III-26 (Burrill); Rock Creek, III-20 (Lovett). Type from Washington Territory. A rare species. Two males which I am satisfied belong here vary from the female in certain minor respects and the following notes are appended.

Male. Similar in general appearance and markings to the female, everywhere tending to be darker and with more elongate pile. Frontal triangle swollen, pile black, coarser and longer than in female. Antennæ darker, but, as in female, set in yellow field. Dark facial stripe much broader, the yellow on sides narrow and obscured by gray pollen. Pile on face elongate, black; cheeks black, narrowly yellowish below oral margin.

Abdominal cross bands similar in appearance to female, first and third do not reach lateral margins though this is evidently a variable character. Legs black, briefly brown at union of femora and tibiæ. Pile black, elongate.

513. **Syrphus opinator** O. S.

Common. See note under *americana.*

514. **Syrphus pacificus** Lovett

Corvallis (Lovett); Hood River, V (Cole). 1919, Proc. Cal. Acad. of Sci., Ser. 4, IX, p. 245.

515. **Syrphus perplexus** Osburn

Burns, V (Thompson); Philomath, V; Mary's Peak, VIII (Lovett). 1910, Jl. N. Y. Ent. Soc., XVIII, p. 55.

516. **Syrphus protritus** O. S.

Grant Co., one specimen, no other data.

517. **Syrphus ribesii** (Linn.)

Common in Willamette and Hood River Valleys.

518. **Syrphus ruficauda** Snow

Dee, VI-17 (Cole).

519. **Syrphus sodalis** Will.

Corvallis (Lovett).

520. **Syrphus torvus** O. S.

Common in many parts of Oregon.

521. **Syrphus umbellatarum** (Fabr.)

Freewater, IX-X (Moznette); Mary's Peak; Mt. Jefferson, VII and VIII (Lovett).

522. **Syrphus velutinus** Will.

Described from Mt. Hood.

523. **Allograpta fracta** O. S.

Common.

524. **Allograpta obliqua** (Say)

Common.

525. **Xanthogramma æqualis** (Loew)

Dee, VI-17 (Cole).

526. **Mesogramma boscii** (Macq.)

Forest Grove, V-5 and Hood River, VII-20 (Cole).

527. **Mosogramma gemminata** (Say)

Common.

528. **Mesogramma marginata** (Say)

Common.

529. **Sphærophoria cylindrica** (Say)

Common.

530. **Sphærophoria melanosa** Will.

Common, but not as abundant as *cylindrica*.

531. **Sphærophoria micrura** O. S.

Mt. Jefferson, VII (Bridwell); Corvallis, IX (Lovett).

532. **Sphærophoria sulphuripes** (Thoms.)

Common.

533. **Sphegina infuscata** Loew

Corvallis, IV-28 and Hood River, V-20 to VI-2 (Cole); Tillamook, III-26 (Burrill).

534. **Sphegina lobata** Loew

Oregon is type locality.

535. **Sphegina punctata** Cole, new species

General color yellowish, the hind femora with a broad dark band and the tip of the abdomen more or less blackish. Apical margin of the wing infuscated; a dark spot outside the anterior cross vein.

Male: Frons blackish gray, gray pollinose except for a narrow line, and yellowish at the base of the antennæ; rather long and narrow, of about equal width, widening a little from the ocelli back to the occiput; antennæ pale brownish yellow; the arista pale brown or yellow; cheeks and palpi yellow, the occiput blackish, gray pollinose.

Thorax, pleura, and scutellum orange-yellow, the color varied a little; thorax often reddish; thorax and pleura with short, yellow pile. Halteres pale yellow. Abdomen yellowish marked with blackish, the first segment short, second long and slender, third and fourth broader; a dark spot on the posterior margin of second segment, the third and fourth darkened above and below. Genitalia blackish, marked with yellow, gray pollinose. The first abdominal segment may be brown and all of the fourth blackish.

Legs yellow, the front two pairs with the last two tarsal joints dark brown; hind femora with a broad, blackish brown ring; tibiæ with two dark rings, one near the apex and a fainter one near the middle; hind metatarsi dark brown except the tip; last two joints of the tarsi blackish; spines under the hind femora strong and black; base of hind coxæ darkened in some specimens. Wings smoky hyaline with a very distinct blackish spot just outside the anterior cross-vein and a small spot in the submarginal near the tip of the wing (see fig. 29); apical half of wing smoky brown around the border, the stigma dark; the spot near the anterior cross-vein varies in size.

Female: Markings almost as in the male. First abdominal segment and posterior part of second darkened, the rest a reddish color; ring on the hind femur paler; base of abdomen narrow but suddenly widening, the third and fourth segments much wider than in male. Frons yellow and wider than in male.

*Holotype,* male, No. 839, Mus. Calif. Acad. Sci., F. R. Cole, collector, June 4, 1917; *allotype,* female, No. 840, Mus. Calif. Acad. Sci., F. R. Cole, collector, Hood River, Oregon, May 25, 1917.

*Type locality,* Hood River, Oregon.

This species is quite distinct from other described forms, especially in the wing markings. As in the other species the vein closing the first posterior cell has a characteristic angle.

536. **Sphegina rufiventris** Loew

Mt. Jefferson, VII-15 (Bridwell); Mary's Peak (Lovett); Hood River, V-20 (Cole). The two commonest species at Hood River and vicinity are undescribed forms and will be described in a later paper.

537. **Neoascia globosa** (Walk.)

Mt. Hood (Bigot); Corvallis (Lovett). Common in April and May in low marshy areas and about margins of small lakes. "Large series taken at Hood River in May" (Cole).

538. **Brachyopa gigas** Lovett

Corvallis, IV (Thompson). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 243.

539. **Brachyopa media** Will.

Hood River, V-17 (Cole); Corvallis, V-15 (Lovett).

540. **Brachyopa notata** O. S.

Corvallis (Preston); Hood River, VI-6 (Cole).

541. **Volucella evecta** Walk.

Corvallis, V and VI (Lovett and Black); Forest Grove, IV-31 (Rockwood). Fairly common.

542. **Volucella tau** Bigot

Corvallis, V-10 (Lovett).

543. **Sericomyia chalcopyga** Loew

One of the commonest of midsummer forms in higher altitudes, 2,500 to 6,000 feet.

544. **Arctophila flagrans** O. S.

Wallowa Co., VI (Ault).

545. **Arctophila harveyii** Osburn

Nine specimens, Mt. Jefferson, 5,800 ft., VIII (Lovett). Would make the following additions to description to fit our specimens: Margin of fourth segment of abdomen of female not reddish, scutellum of male below translucent reddish, disc of abdomen sometimes with distinct, dull reddish tinge. 1906, Can. Ent. XXXVIII, p. 1.

546. **Pyritis kincaidii** (Coq.)

Corvallis, V (Lovett); Forest Grove, V-3 (Cole).

547. **Pyritis montigena** Hunter

Baker, IV (Entermille).

548. **Eristalis flavipes** Walk.

Moderately common, a very diversified species.

549. **Eristalis latifrons** Loew

Corvallis, V-27 (Lovett).

550. **Eristalis meigenii** Wied.

A widespread species occurring from New England to Alaska.

551. **Eristalis occidentalis** Will.

Common.

552. **Eristalis temporalis** Thoms.

Common.

553. **Eristalis tenax** (Linn.)

Common.

554. **Tropidia quadrata** (Say)

Hood River (Cole); Corvallis (Lovett). Fairly common.

555. **Helophilus latifrons** Loew

Corvallis and Hood River, V and VI (Cole and Lovett). Williston in his Synopsis says, "Mass. to Cal. and Wash."

556. **Helophilus polygrammus** Loew

Osten Sacken had specimens from Oregon collected by H. Edwards.

557. **Helophilus similis** Macq.

Fairly common.

558. **Asemosyrphus mexicanus** Macq.

Reported from Oregon by Osten Sacken. It is a fairly common species in higher altitudes and scatteringly on plains in midsummer.

559. **Mallota sackeni** Will.

Corvallis, V and VI; Mosier, VI-14 (Cole).

560. **Syritta pipiens** (Linn.)

"Everywhere and at all times abundant from spring to autumn."

561. **Xylota analis** Will.

Detroit, VII (Bridwell); Mt. Jefferson, VIII (Lovett).

562. **Xylota barbata** Loew

Hood River, V and VI (Cole); Mt. Jefferson; Corvallis, V to VIII (Lovett).

563. **Xylota ejuncida** Say

Hood River, V and VI (Cole).

564. **Xylota flavitibia** Bigot

Hood River, X-3 (Cole).

565. **Xylota fraudulosa** Loew

Hood River and Corvallis, V to VII (Cole and Lovett).

566. **Xylota nemorum** (Fabr.)

Hood River and Forest Grove, V (Cole); Corvallis, IX-18.

567. **Xylota obscura** Loew

Williston lists from Oregon.

568. **Xylota pigra** (Fabr.)

Horse Lake, VII-25 (Bridwell).

569. **Xylota scutellarmata** Lovett

Hood River, V-17 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 241.

570. **Xylota stigmatipennis** Lovett

Hood River, VI (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 242.

571. **Xylota subfasciata** Loew

Corvallis, V-15 (Lovett). Bred from larvæ collected in decayed heart of fir, *Pseudotsuga taxifolia.*

572. **Eumerus strigatus** Fall.

Corvallis, V; Hood River, VII-20, breeding in onions. (Cole and Childs).

573. **Chrysochlamys crœsus** O. S.

Corvallis, V; Mt. Jefferson, VIII (Lovett and Smith); Hood River, V-24 to VI-9 (Cole).

574. **Brachypalpus parvus** Will.

Corvallis; Hood River VI (Cole).

Female: Face and cheeks black, heavily white pollinose. Cheeks with broad shining stripe from oral margin to base of eye. Front above, vertex and a triangle on antennal prominence white pollinose; on the sides below, shining. Cheeks, just below antennæ, front, and vertex golden pollinose.

Abdomen opaque black with areas of opaque blue-gray pollen as follows: First segment, except hind margin, quadrangles on second segment reaching neither front, posterior, nor lateral margins; similar areas on third reaching anterior margin and brief crescents on anterior margin of fourth. Otherwise as male.

575. **Brachypalpus pigra** Lovett

Mt. Jefferson, VIII-15 (Lovett). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 241.

576. **Caliprobola pulcher** (Will.)

Mt. Jefferson, Mary's Peak, Hood River and Corvallis, VII to VIII (Bridwell, Cole, Lovett and Childs). Found commonly in midsummer on flowers in clearings in higher altitudes, 4,800 to 6,000 feet where it frequents edges of clearings, resting on low shrubs; or on bark of trees in sunlight at lower altitudes. It has been collected at Corvallis in October, resting on a window.

577. **Caliprobola crawfordi** Shannon

Hood River, Mary's Peak and Corvallis (Cole, Lovett, Chamberlin). Fairly common in unusual situations. Bred adult from larvæ collected in decayed heartwood of Douglas Fir (Lovett). Not uncommon near Forest Reserve west of Parkdale. Three specimens collected at Hood River along railroad track, crawling under old ties. Those at Parkdale were flying around scarred or burned trees (Cole and Childs). 1916, Proc. Ent. Soc. Wash., XVIII, p. 112. The median cross bands on third and fourth segments often are interrupted; occasionally anterior cross band on fourth entirely concealed under posterior margin of third segment and median band reduced to two narrow elongate spots.

578. **Crioprora alopex** (O. S.)

Forest Grove, III-20 (Cole); Tillamook, III-26 (Burrill); Mary's Peak, III-30 (Lovett).

579. **Crioprora cyanella** (O. S.)

Corvallis, V-15 (Black).

580. **Crioprora femorata** Will.

Dee and Hood River, V and VI (Cole); Mary's Peak, VI (Lovett).

581. **Cynorhina armillata** (O. S.)

Mary's Peak, VI-15; Lebanon, V-18 (Lovett).

582. **Cynorhina humeralis** (Will.)

Corvallis, V (Summers); Hood River, VI (Cole).

583. **Cynorhina scitula** (Will.)

The most common midsummer species on blossoms in higher altitudes, 3,000 to 6,000 feet, outranking even *Sericomyia chalcopyga* (Lovett).

584. **Pocota grandis** (Will.)

Mt. Jefferson, VII and VIII (Bridwell and Lovett). A large, showy creature, occurring in blossoms of yarrow at an altitude of 4,000 to 6,000 feet. Found generally just at the edge of the forest and in small sunny clearings. Its flying period is from 9 to 11 A. M., and it is seldom seen later. Considering its size, it is swift in flight, alighting but seldom and then for a brief time.

585. **Criorhina grandis** Lovett, new species

Length 15 to 17 mm. A conspicuous black and yellow species. Black with elongate black pile, across thorax in front of wings and on 4th segment of abdomen golden yellow pilose. Superficially resembles *Pocota grandis*.

*Female*: Face and front dull black; tubercle and vertex bare of pollen, subshining, front and face on the sides heavily brown pollinose; cheeks shining black; pile on sides of face golden, coarser, more elongate and mixed brown and black from antennal prominence to eye margin; front, vertex and cheeks black pilose, elongate on vertex and cheeks, on latter mixed with brown. Antennæ brown, first and second segments deep shining mahogany, sub-equal in length, third segment dull brownish black, lighter basally, the segment thick, about one-half broader than long, not produced materially at any angle, arista deep brownish black. Proboscis produced, heavy and blunt.

Thorax and scutellum black, subshining. Pile elongate, dense, yellow in front of wings on dorsum and pleura, black behind wings and on scutellum.

Abdomen black subshining, fourth segment with obscure metallic reflections; pile elongate black; on apical two-thirds of fourth segment yellow, on fifth segment elongate, coarse, mixed brown and black.

Legs black, knees briefly reddish brown; pile on femora elongate black, mixed with brown on under surface of hind femur; tibia and tarsi with short golden pile; at base of hind coxa a heavy tuft of coarse golden, brown and black pile. Wings subhyaline, veins black with extended brownish margins.

*Holotype,* female, No. 841, Mus. Calif. Acad. Sci.; A. B. Black, collector, June, 1919. A second female, *paratype,* was collected at the same time and place by A. L. Lovett and is in his collection.

*Type locality,* Mary's Peak, Oregon.

This species is very near *coquilletti* Will. and may prove to be a synonym. The extreme disparity in size and apparent facial and antennal differences are all that seem specific. No opportunity has been afforded to compare the two.

586. **Criorhina kincaidi** Coq.

Horse Mt., VII; Mary's Peak, V to VII (Lovett).

587. **Criorhina luna** Lovett

Alsea; Tillamook, III-26 (Burrill); Mary's Peak, V and VI (Lovett). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 249.

588. **Criorhina nigripes** (Will.)

Corvallis; Forest Grove, IX-14 and Hood River, IV and V (Cole). A specimen believed to be a male labelled "Stanford Univ., Cal., Feb. 28, 1909," has certain markings varying from the female as follows: Face similar, tubercle more prominent; fairly abundant elongate yellow pile from base of antennal prominence out to and extending down along eye margin. Above antennal prominence with a transverse appressed line; vertical triangle opaque. Thorax and abdominal markings similar to female except fifth segment with short black pile. Legs black with elongate light yellow pile. Tarsal claws yellow at base.

589. **Criorhina quadriboscis** Lovett

Mt. Jefferson, IV-16 (Hartley). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 250.

590. **Criorhina tricolor** Coq.

Mt. Jefferson, VII-VIII (Bridwell); Hood River, VI-17 (Cole). Redescribed in 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 251.

591 **Spilomyia interrupta** Will.

Corvallis, IX (Bridwell); Hood River, VIII-24 (Childs).

592. **Sphecomyia brevicornis** O. S.

Hood River, VI-6 (Cole). One pair taken.

593. **Sphecomyia nasica** Osburn

Mt. Jefferson, VII-VIII (Bridwell, Lovett).

594. **Sphecomyia pattoni** Will.

Mt. Jefferson, VII-VIII (Bridwell, Lovett). These last two species as I have observed them in August are rare, found entirely in the forenoon, occurring just at the edge of clearings and flying swiftly, close to the ground, resting occasionally in low growing shrubbery at the very edge of dense forests.

595. **Ceria tridens** Loew

Pendleton, VIII-18 (Black, Thompson).

Family CONOPIDÆ

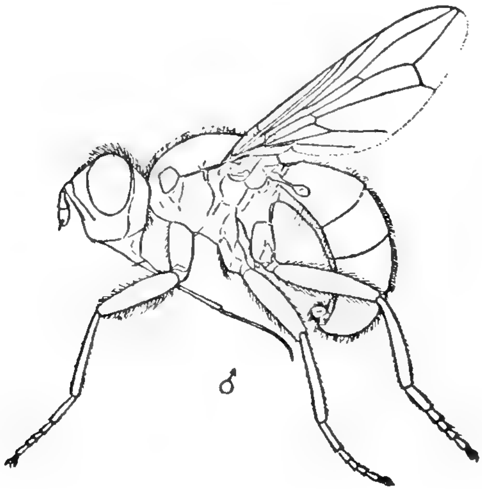


Fig. 30. *Dalmannia pacifica* Banks.

These are flower flies and are not usually very conspicuous. Some of the species resemble slender wasps while others are more thick-set. The term "thick headed flies" is sometimes applied to them, this being no reflection on their mentality. Not much is known of the early stages but certain species have been bred from adult Hymenoptera, and, according to Dr. Williston, from Orthoptera. The flies evidently deposit their eggs on the bodies of some bees in flight and have been observed several times attempting to do this.

596. **Physocephala affinis** (Will.)

Hood River, VII-7 to IX-4, and La Grande, IX-20 (Cole); Vale, VIII-15.

597. **Physocephala burgessi** (Will.)

Big Lake, VII-20 (Bridwell).

598. **Physocephala marginata** (Say)

Albany, VII-10; Corvallis, VI-5.

599. **Zodion fulvifrons** Say

Hood River, VI-16 (Cole); Mackenzie Ridge, alt. 6,000 ft., VIII-1. This species has been bred from the common honey bee.

600. **Zodion pygmæum** Will.

Hood River, VI-19 (Cole).

601. **Zodion occidentale** Banks

Hood River, VI-3 (Cole); Mary's River, V-2; Corvallis, V-13. 1916, Ann. Ent. Soc. Amer., IX, p. 194.

602. **Zodion triste** Bigot

Corvallis, V-13 (Lovett).

603. **Dalmannia pacifica** Banks

Mosier, VI-14 (Cole and Childs); Corvallis, VI-6, 1899, the type specimen. 1916, Ann. Ent. Soc. Amer., IX, p. 199. A number of freshly emerged specimens were taken at Mosier feeding at a yellow flower of the aster family. The females were observed striking a species of *Halictus*, as these bees passed by the flowers on the way to their nests in the ground. The two would often go to the ground together, rolling over and over in the dust. The flies probably succeed in some cases in depositing an egg on the body of the bee.

604. **Dalmannia vitiosa** Coq.

Forest Grove, IV-30 (L. P. Rockwood). One specimen.

605. **Oncomyia abbreviata** Loew

Corvallis, V-2 (Lovett).

606. **Oncomyia baroni** Will.

Corvallis, VI-2 (Lovett); Horse Lake, VII-25.

607. **Oncomyia loraria** Loew

Corvallis, V-2 and VI-5 (Lovett).

608. **Oncomyia modesta** Will.

Hood River, VI-2 to VI-25 (Cole). This is a very common species at Hood River and is apparently parasitic on a bee, determined by Mr. Crawford of the National Museum as *Halictus ligatus* Say. The flies are often taken on flowers and three specimens had the triangulin stage of some Meloid beetle attached to them. The females perch on grass stems or flowers near the underground colony of bees and swoop down on the unsuspecting pollen gatherers as they approach their burrows. The fly and bee usually go tumbling on the ground together, but the fly does not try to sit on the bee, and always manages to get away in a great hurry, returning to her observation post, there to clean off some of the dust and watch for more victims. It is amusing to watch them follow the bee with their eyes as it looms up on their horizon. They strike so quickly that their flight can scarcely be followed. The bees make no attempt to drive them away, but when attacked make frantic efforts to escape.

609. **Myopa longipilis** Banks

Corvallis, IV-22; Forest Grove, IV-12 (Rockwood); Hillsboro, IV-1 (Cole). 1916, Ann. Ent. Soc. Amer., IX, p. 197.

610. **Myopa melanderi** Banks

Hood River, V-10 and 16 (Cole). 1916, Ann. Ent. Soc. Amer., IX, p. 197.

611. **Myopa rubida** (Bigot)

Hood River, V-5 to VI-24 (Cole); Mosier, VI-14 (Childs and Cole); Forest Grove, IV-12 (Cole); Wheeler Co., VI-15; Corvallis, VI-3. This species is quite common in the Hood River Valley in the spring and early summer, frequenting various flowers.

612. **Myopa seminuda** Banks

Corvallis, IV-12 (Cotypes). This species is very near *rubida* and may be only a variety of that species. 1916, Ann. Ent. Soc. Amer., IX, p. 198.

613. **Myopa vicaria** Walk.

Hood River, V-19 (Cole).

614. **Myopa willistoni** Banks

Corvallis, V-20. New name for *pictipennis* Will.

Family ŒSTRIDÆ

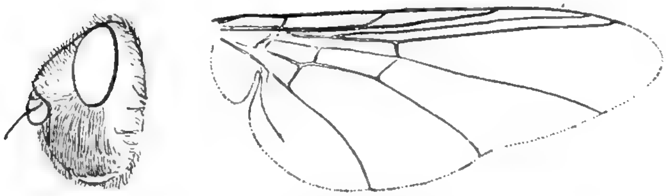


Fig. 31. *Gastrophilus nasalis* Linnæus.

Bot-flies are medium sized to quite large and have aborted mouth parts. Some are hairy and bee-like in appearance and others blue-black with spots of white bloom. Certain species are well known to all farmers and stockmen. The larvæ live under the skin of animals, in the nasal passages, and in the stomach. The bot-flies are thus an important family economically.

615. **Gastrophilus hæmorrhoidalis** (Linn.)

Occurs generally over North America, as do the other horse bots.

616. **Gastrophilus intestinalis** DeGeer

Commonly known as the "horse-bot."

617. **Gastrophilus nasalis** (Linn.)

Known as the "nose-fly".

618. **Œstrus ovis** Linn.

The sheep bot.

619. **Hypoderma lineata** (DeVill.)

The ox-bot. The only specimen with data was taken at Burns, V-19 (B. G. Thompson).

620. **Cuterebra fontinella** Clark

The same as *emasculator* Fitch. Buck Mt., VII-10; Corvallis.

621. **Cuterebra leporivora** Coq.

Corvallis, VIII-28. Reared from *Mus musculus* (Bridwell).

622. **Cuterebra tenebrosa** Coq.

La Grande, VII-6; Corvallis, IV.

## Family TACHINIDÆ

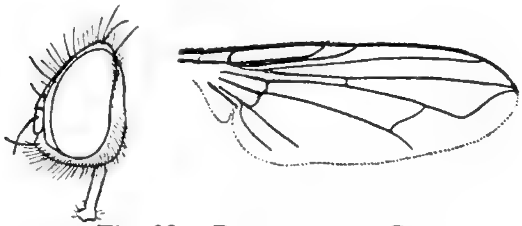


Fig. 32. *Dionæa nitoris* Coq.

The family is a large one, 957 species being listed in Aldrich's Catalogue. They are usually short, stout, unusually bristly flies. The antennal arista is always bare and the squamæ, large. Flowers attract many of the species and they are often seen flying about rank vegetation. Some of the smaller species resemble the common house-fly in general appearance.

Many of the species are very beneficial, the larvæ being parasitic on injurious insects. A few attack beneficial insects, but only a small percentage. They are the chief control of many caterpillars. From one to one hundred grubs may work on one host larva, much depending on the size of the victim.

Most of the species listed below were determined by Dr. J. M. Aldrich, or the determinations already made were verified by him.

623. **Gymnoclytia immaculata** Macq.

Dee and Hood River, VI-8 to VII-5 (Cole and Childs).

624. **Gymnoclytia occidua** (Walk.)

Hood River, VI-3 (Cole).

625. **Gymnosoma fuliginosa** Desv.

Hood River, VI-2 to VIII-20 (Cole and Childs). Common throughout the Northwest.

626. **Phorantha calyptrata** Coq.

Hood River, VIII-7 (Childs).

627. **Phorantha occidentis** (Walk.)

Hood River, VIII-7 (Cole).

628. **Alophora æneoventris** (Will.)

Hood River, X-3 (Cole).

629. **Myiophasia ænea (Wied.)**

Corvallis and Blitzen River, VI-16 to VII-6.

630. **Gymnophania montana** Coq.

Hood River, VII-18 (Cole).

631. **Hyperecteinia pergandei** (Coq.)

Corvallis; Seaside Beach, X-22.

632. **Hyperecteinia retiniæ** (Coq.)

Hood River, VIII-28 (Childs).

633. **Lasioneura johnsoni** Coq.

Hood River, VI-27 and VII-9 (Cole and Childs).

634. **Chætophleps setosa** Coq.

Forest Grove, IX-28 (Cole).

635. **Hypostena barbata** Coq.

Hood River, VI-16 (Cole) and VII-1 (Childs). Aldrich says in regard to material sent for determination: "They agree with what I call this, but *Hypostena* and *Masicera* run together, and this is not separable generically from some I put under the latter farther on. The supposed difference is that in *Masicera* the first posterior cell ends considerably before the apex of the wing, and in *Hypostena* close to the apex. The distinction breaks down completely in your material."

636. **Macquartia pristis** (Walk.)

Corvallis, V-21.

637. **Uramyia acuminata** (Bigot)

Corvallis, bred from *Halisidota argentata.* This species was described from Brazil and later found in Mexico. According to Aldrich, Townsend's *Uromacquartia halisidotae,* named without description, is a synonym of this species. Townsend's type is the single male mentioned by Coquillett under *Macquartia pristis* (Revision Tachinidæ, p. 64) from Aurora Mills, Oregon, and recorded as a parasite of *Halisidota argentata* on p. 18. This species, as Dr. Aldrich points out, has reversed the usual trend of distribution on the coast.

638. **Leskia gilensis** (Towns.)

Corvallis, VIII-25-1916 (B. G. Thompson). Bred from *Sesia rutilans.*

639. **Leucostoma atra** Towns.

Corvallis, V-17 (Lovett); Hood River, IX-2 (Childs); Forest Grove, V-28 to X-15 (Cole).

640. **Clausicella setigera** Thoms.

Forest Grove, VI-5 (Cole).

641. **Hyalomyodes triangulifera** Loew ....

Corvallis, VII-17 (Lovett); Forest Grove, V-20 and Hood River, VI-3 (Cole).

642. **Clytiomyia atrata** Coq.

Hood River, VI-3 (Cole).

643. **Dionæa nitoris** Coq.

Hood River, VI-26 and Forest Grove, V-20 to VII-26 (Cole).

644. **Xanthomelana arcuata** (Say)

Hood River, VII-9 and 25 (Cole).

645. **Hemyda aurata** Desv.

Corvallis, VII-16 (Lovett).

646. **Heteropterina nasoni Coq.**

Hood River, VI-14 to VI-28 (Cole and Childs).

647. **Paraplagia spinulosa** (Bigot)

Coos River, IX-25 (Rockwood).

648. **Plagia americana** V. d. W.

Common in Oregon.

649. **Pachyophthalmus floridensis** Towns.

Hood River, VIII-27 (Cole).

650. **Senotainia trilineata** (V. d. W.)

Hood River, VI-8 to IX-14 (Cole and Childs). This species is a parasite of *Sphecius speciosus.*

651. **Aphria ocypterata** Towns.

Hood River, VII-9 (Cole); Mary's Peak, V-15; Pamelia Lake, Mt. Jefferson, VII-23.

652. **Ocyptera**[21] **dosiades** Walk.

Forest Grove, VIII-18 (Cole).

653. **Panzeria ampelus** Walk.

Whitman Nat. Forest, VII-16 (Chamberlin).

654. **Panzeria radicum** (Fabr.)

Duffy's Prairie (Lovett); Mt. Jefferson, alt., 3,000 ft., VIII-12.

655. **Gymnochæta alcedo** Loew

Mosier, VI-14 (Cole and Childs). These specimens flew low over the ground and through the grass, seldom alighting. The species is rare in the Northwest.

[21] The species common throughout the Northwest is said by Aldrich to be an undescribed form, although usually placed in *carolinae.* The male genttalia show good specific characters.

656. **Exorista futilis** O. S.

Reported from Oregon by Coquillett. A parasite of the common butterfly, *Vanessa atalanta.*

657. **Exorista vulgaris** (Fall.)

Corvallis, VI.

658. **Phorocera claripennis** Macq.

Halsey, VIII-14 (Lovett). Bred from *Schizura concinna* at Corvallis, IX-4 (Gentner).

659. **Phorocera facialis** Coq.

Hood River, VI (Cole).

660. **Phorocera saundersii** Will.

Halsey, VIII-14 (Lovett); Hood River, VI (Cole).

661. **Frontina frenchii** (Will.)

Large series from Corvallis, IV-30 to IX-30, those on the last date bred from a sphingid on *Populus trichocarpa.* This parasite has a long list of lepidopterous hosts.

662. **Tachina**[22] **mella** Walk.

Corvallis, V-4 to VI-24.

663. **Tachina robusta** (Towns.)

Corvallis and Hood River, IV-28 to VI-3. Common.

664. **Tachina rustica** Fall.

Corvallis, V-28; Hood River, VI-12 (Cole and Childs); Forest Grove, IX-30 (Cole).

665. **Blepharipeza adusta** Loew

Hood River, VI-14 (Childs); Corvallis; Philomath, V-16 (Lovett).

22 Four additional species in this genus were collected at Hood River but none could be determined with certainty.

666. **Blepharipeza leucophrys** (Wied.)

Hood River, VI-9 (Cole).

667. **Winthemia quadripustulata** (Fabr.)

Not uncommon at Hood River and Corvallis in August. A parasite of the army worm and variegated cutworm.

668. **Metachæta helymus** (Walk.)

Corvallis, VIII-7 (Lovett).

669. **Metopia leucocephala** (Rossi)

Hood River, VI-12 to IX-2 (Cole).

670. **Hilarella fulvicornis** (Coq.)

Hood River, VI-5 to IX-2 (Cole). Aldrich states that this species is common on sand around fossorial hymenoptera.

671. **Brachycoma sarcophagina** (Towns.)

Corvallis, VII-30.

672. **Gonia exul** Will.

Corvallis, IX-11; Mt. Jefferson, 6,000 feet; Burns.

673. **Gonia frontosa** Say

Common at Hood River and Corvallis, VI to XI.

674. **Gonia porca** Will.

Described from Mt. Hood.

675. **Chætogædia monticola** (Bigot)

Hood River, IX-2 (Childs); Corvallis, V-4 and IX-5. A parasite of the variegated cutworm and of the larva of the common thistle butterfly (*Pyrameis cardui*).

676. **Cuphocera furcata** (V. d. W.)

Grant Co., IV-23.

677. **Peleteria robusta** (Wied.)

Common at Corvallis, Forest Grove and Hood River, V-19 to IX-29; Detroit and Grant's Pass.

678. **Peleteria tessellata** (Fabr.)

Corvallis; Mt. Jefferson; Hood River (Cole and Childs). Collected from V-17 to IX-31. Aldrich says, "I name these provisionally as Coquillett did, but this is a complex that will have to be worked out by genitalic studies."

679. **Echinomyia**[23] **algens** (Wied.)

Common in several localities in the Willamette Valley from May to August. Collected on Mt. Jefferson and at Seaside.

680. **Echinomyia dakotensis** Towns.

Hood River, IX-4 (Cole); Mt. Jefferson, subalpine, VII.

681. **Echinomyia decisa** (Walk.)

Mary's Peak, VII-18 (Lovett).

682. **Echinomyia hystricosa** (Will.)

Corvallis.

683. **Epalpus bicolor** (Will.)

Barton, VIII-22.

684. **Epalpus signiferus** (Walk.)

Corvallis, IV-26 to VII-4; Hood River, V-5 to VI-24 (Cole).

685. **Bombyliomyia abrupta** (Wied.)

Barton, VII-21.

686. **Jurinella soror** (Will.)

Hood River, VI-5 (Cole).

[23] One species, occasionally taken at high altitudes and found in several localities in the west is undescribed.

## Family DEXIIDÆ

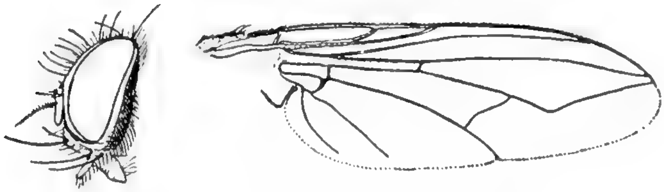


Fig. 33. *Thelaira levcozona* Panzer.

These are the "nimble flies" of Comstock. They are very close to the tachinids but usually have longer and more slender legs and the antennal arista plumose to the tip. The larvæ have been bred from beetles.

The species listed below were determined by Dr. Aldrich. In addition to these there are five undetermined species.

687. **Myiocera cremides** (Walk.)

Vale, VIII-15.

688. **Thelaira leucozona** (Panz.)

Hood River, VI (Cole).

689. **Melanodexia tristis** Will.

Corvallis.

690. **Trixia gillettei** Towns.

Mosier, VI-14 (Cole). This species has been considered a tachinid in the past and really does not belong in Trixia which is a tachinid genus; neither does it belong in *Paraphyto* where it was placed in Aldrich's Catalogue. It does not fit any of the dexiid genera in North America.

## Family SARCOPHAGIDÆ

Fig. 34. *Sarcophaga hunteri* Hough.

These much resemble the house-flies in general appearance. The antennal arista is plumose at the base and bare at the tip. The flies are very common about decaying vegetation, excrement, dead bodies, etc., and are called flesh-flies.

The larvæ are found in decaying vegetable and animal matter. A few are true parasites and are economically important. Many of the species are larviparous and some are known to strike grasshoppers on the wing and place their larvæ in a vulnerable spot.

The following species were determined by Dr. Aldrich.

691. **Sarcophaga aculeata** Aldr.

Specimens from Corvallis are probably a new variety. 1916, "Sarcophaga and Allies", p. 143.

692. **Sarcophaga bullata** Parker

Corvallis, X. 1916, Can. Ent., XLIII, p. 359.

693. **Sarcophaga cimbicis** Towns.

Corvallis.

694. **Sarcophaga eleodis** Aldr.

Corvallis, V-6. This species is remarkable, in that it parasitizes beetles of the genus *Eleodes*. 1916, "Sarcophaga and Allies", p. 128.

695. **Sarcophaga hæmorrhoidalis** (Fall.)

Corvallis, X-21. A scavenger of wide distribution, occasionally the cause of intestinal myiasis. The species occurs throughout Europe, Africa and Asia.

696. **Sarcophaga helicis** Towns.

Corvallis, IX-20; Forest Grove. One of the commonest North American species, largely a scavenger but also a true parasite of grasshoppers, *Eleodes*, etc.

697. **Sarcophaga hunteri** Hough

Corvallis, VI-2 to VII-22 (Rockwood); Forest Grove, X-2 (Creel). A grasshopper parasite.

698. **Sarcophaga kellyi** Aldr.

Corvallis (H. F. Wilson). A grasshopper parasite. Jl. of Agr. Research, II, p. 443.

699. **Sarcophaga pallinervis** Thoms.

Described from Hawaii in 1868 and probably a prior name for *S. communis* Parker. It is a very common scavenger. Freewater, IX-8; Corvallis, IV-VIII.

700. **Sarcophaga planifrons** Aldr.

Narrows, VII. 1916, "Sarcophaga and Allies", p. 249.

701. **Sarcophaga sarracenioides** Aldr.

Corvallis, V-11 and VIII-15 (Cole and Lovett). Both a scavenger and a parasite. 1916, "Sarcophaga and Allies," p. 227.

702. **Sarcophaga scoparia** Pand.

Corvallis, VII-8; Forest Grove, V-3 and II-1 (Cole). 1916, "Sarcophaga and Allies", p. 214. Dr. Aldrich says that North American specimens deserve a varietal name.

703. **Sarcophaga sinuata** Meig.

Corvallis, V-30. Europe and North America. "Easily recognized in both sexes by the patch of bright yellow tomentum on the front side of the middle femur."

704. **Sarcophaga tuberosa exuberans** Pand.

Corvallis. 1916, "Sarcophaga and Allies", p. 232.

705. **Megerlea rufocauda** Bigot

Described from Mt. Hood. The status of this species is not known, Coquillett placed it in the genus *Sarcophilodes* and Brauer considered it should have a new genus erected for it.

## Family MUSCIDÆ

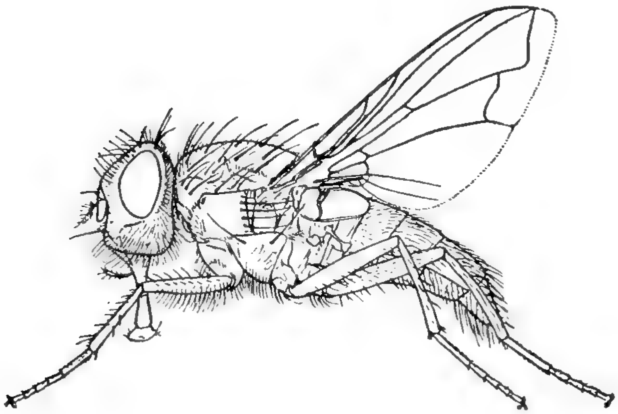


Fig. 35. *Pollenia rudis* (Fabr.)

Small to medium sized, short, and usually hairy flies. The antennal arista is usually plumose to the tip, the first posterior cell narrowed or closed and the squamæ are large. They are disease carriers and very important economically. The common house-fly, or typhoid-fly as it might better be called, is found all over the world. The blow-flies and blue-bottle flies are also widely distributed.

The Stomoxyinæ include blood-sucking species. In this group are the horn-flies, stable-flies and tsetse flies.

706. **Pollenia rudis** (Fabr.)

Medford, VIII-15; Corvallis, IX-4. The cluster-fly is known to be parasitic in earthworms.

707. **Cynomyia cadaverina** Desv.

Corvallis, IV-10 to VII-10.

708. **Calliphora erythrocephala** (Meig.)

Common III to XII. This is the common blow fly.

709. **Lucilia cæsar** (Linn.)

Common everywhere. Breeds in excrement, garbage and carrion.

710. **Lucilia sericata** (Meig.)

Common at Corvallis, IV to X.

711. **Phormia regina** (Meig.)

Common at Corvallis.

712. **Phormia terræ-novæ** Desv.

Common at Corvallis.

713. **Protocalliphora azurea** (Fall.)

Corvallis.

714. **Pseudopyrellia cornicina** (Fabr.)

Common, V to XI.

715. **Morellia micans** (Macq.)

Corvallis and Forest Grove (Cole).

716. **Mesembrina resplendens** Wahlbg.

Rock Creek Valley, Benton Co., X-12; Corvallis, IX-10.

717. **Musca domestica** Linn.

Early settlers in Oregon say that the common house-fly was not seen in the early days; they are by no means rare now.

718. **Stomoxys calcitrans** (Linn.)

The biting house-fly or stable-fly. This species is suspected of carrying infantile paralysis.

719. **Hæmatobia serrata** Desv.

The "horn-fly"; common. In his Catalogue, Aldrich reported that this fly had reached Idaho in 1901. There are specimens in the Corvallis collection taken Aug. 14, 1900.

720. **Myiospila meditabunda** (Fabr.)

Forest Grove, VII (Cole).

721. **Muscina assimilis** (Fall.)

Portland, VIII-14; Corvallis, V-19.

December 14, 1921

722. **Muscina stabulans** (Fall.)

Common. The larvæ breed in manure and may carry disease. They have also been bred from pupæ of other insects, but these were probably dead pupæ.

Family ANTHOMYIDÆ

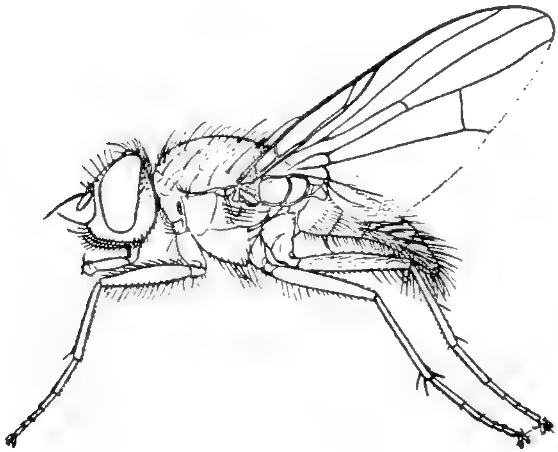


Fig. 36. *Limnophora narona* (Walk.)

This is a large family and, because of their general unattractiveness and the difficulties of differentiation, they have been rather neglected in North America in the past. They are blackish or grayish in color and some resemble the ordinary house-fly in appearance. Their larval habits are varied but most of them breed in decaying animal and vegetable matter.

723. **Hydrotæa orbitalis** Aldr.

Mt. Jefferson, VIII-1 and Cascadia, VII-21 (Lovett). Malloch det. 1918, Can. Ent., L, p. 311.

724. **Homalomyia manicata** (Meig.)

Corvallis, VI-28.

725. **Homalomyia scalaris** (Fabr.)

Corvallis.

726. **Aricia bicolorata** Mall.

Hood River, VI-21 (Cole). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 253.

727. **Aricia leucorum** (Fall.)

Pamelia Lake, Mt. Jefferson, 3,000 feet, VII-19 (Bridwell). Malloch det.

728. **Aricia lysinoë** Walk.

Forest Grove, IX-30 and Hood River, X-3 (Cole). Malloch det.

729. **Aricia nitida** Stein

Mt. Jefferson, VII-25, 5,000 feet (Bridwell). Malloch det.

730. **Aricia oregonensis** Mall.

Grant Co. 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 254.

731. **Spilogaster uniseta** Stein

Corvallis.

732. **Euphaonia houghii** (Stein)

Hood River, IX-5 (Cole). Malloch det. Described under *Hyetodesia*.

733. **Limnophora æquifrons** Stein

Hood River, VI-5 (Cole). Malloch det.

734. **Limnophora narona** (Walk.)

Gaston, VII-10 (Cole). Malloch det.

735. **Leucomelina discreta** (Stein)

Hood River, IX-5 (Cole). Malloch det.

736. **Cœlomyia subpellucens** (Zett.)

Hood River, VI-2 (Cole). Malloch det.

737. **Anthomyia pratincola** Panz.

Corvallis, VI-2 (Lovett). Malloch det.

738. **Hydrophoria divisa** (Meig.)

Hood River, VI-3 (Cole). Malloch det.

739. **Hylemyia alcathoë** (Walk)

Salem, VII-4; Hood River, VI-30 and Eagle Rock, VII-1 (Melander); Hood River, V-19 to X-30 and Forest Grove, V-25 to IX-27 (Cole).

740. **Hylemyia antiqua** Meig.

The onion maggot, widespread and often injurious.

741. **Hylemyia anthracina** Mall.

Hood River, VI-21 (Cole). 1918, Trans. Amer. Ent. Soc. XLIV, p. 314.

742. **Hylemyia fusciceps** (Zett.)

Corvallis, IV-30 to VI-6; Gaston, VII-10 (Cole); subalpine regions on Mt. Jefferson, VII-20 (Bridwell). Common in several localities. The larvæ feed in the roots of cabbages, radish, seed corn, etc.

743. **Hylemyia lipsia** (Walk.)

Grant Co., VII-11 (Chamberlin). Malloch det.

744. **Hylemyia** sp. nov. Mall.

Blitzen River, VII-6. The single specimen a paratype.

745. **Hylemyia piloseta** Mall.

Corvallis, IV-26. 1918, Trans. Amer. Ent. Soc. XLIV, p. 312.

746. **Hylemyia setiventris** Stein

Joseph. Malloch det.

747. **Hylemyia substriata** Stein

Forest Grove, IV-24 (Cole). Malloch det.

748. **Hylemyia variata** (Fall.)

Forest Grove, VII-5 (Melander); Hood River, VI-4 (Cole).

749. **Eremomyia apicalis** Stein

Forest Grove, V-12 (Cole).

750. **Hammomyia unilineata** (Zett.)

Hood River, V-16 (Cole). Aldrich det.

751. **Phorbia brassicæ** (Bouché)

Common, VII-IX. This is the cabbage-root maggot, and is very destructive in parts of Oregon. It was reported as a pest as early as 1891.

752. **Phorbia cinerella** (Fall.)

Tillamook, VIII-29 (Creel); Vale, VI-29. Malloch det.

753. **Phorbia rubivora** Coq.

Common in several localities in the state. The larvæ girdle the tips of raspberry, blackberry, dewberry, and loganberry vines. The flies appear early in April and are seen throughout May and June.

754. **Phorbia ruficeps** (Zett.)

Corvallis.

755. **Phorbia trichodactyla** (Zett.)

Corvallis (Lovett).

756. **Pegomyia affinis** Stein

Corvallis. Malloch det.

757. **Pegomyia bicolor** (Wied.)

Bred out at Corvallis, V-9-1915, from larvæ mining in the leaves of dock; Tillamook, III-26 (Burrill).

758. **Pegomyia hyoscyami** (Panz.)

Corvallis, V-2 (Lovett), other dates from V-3 to VII-3. The larvæ are leaf miners on beets and spinach.

759. **Chirosia idahoensis** Stein

Forest Grove, V-17 (Cole); Salem, VII-4 (Melander). Melander det.

Corvallis and Forest Grove, V (Cole).

761. **Fannia fuscula** (Fall.)

Forest Grove, V-17 and Hood River, VI-13 (Cole). Malloch det.

762. **Fannia ochrogaster** (Thoms.)

Forest Grove, VI-2 (Cole). Malloch det.

763. **Cœnosia ausoba** (Walk.)

Hood River, VI (Cole). Malloch det.

764. **Cœnosia flavicoxa** Stein

Hood River, VI-4 (Cole); Corvallis, VIII-2 (Lovett); Malloch det.

765. **Cœnosia oregonensis** Mall.

Corvallis, V-2 (Lovett). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 254.

766. **Machorchis nana** (Zett.)

Corvallis, V-2. Malloch det.

767. **Schœnomyza chrysotoma** Loew

Hood River, VI-19 to X-26 (Cole); Forest Grove, V-13 (Burrill).

768. **Schœnomyza dorsalis** Loew

Blitzen River, VII-1. Aldrich det.

769. **Lispa brevipes** Aldr.

Hood River, IX-29 (Cole). 1913, Jl. N. Y. Ent. Soc., XXI, p. 137.

770. **Lispa nasoni** Stein

Forest Grove, IX-27 (Cole).

771. **Lispa palposa** (Walk.)

Forest Grove, IX-27 (Cole).

772. **Lispa spinipes** Aldr.

Forest Grove, IX-28 (Cole). 1913, Jl. N. Y. Ent. Soc., XXI, p. 136.

773. **Lispa tentaculata** (DeG.)

Hood River and Forest Grove, VI to XI (Cole).

774. **Hebecnema fulva** (Bigot)

Hood River, IX-4 (Cole). Malloch det.

775. **Hebecnema umbratica** (Meig.)

Hood River, VI-21 (Cole).

## Family SCATOPHAGIDÆ

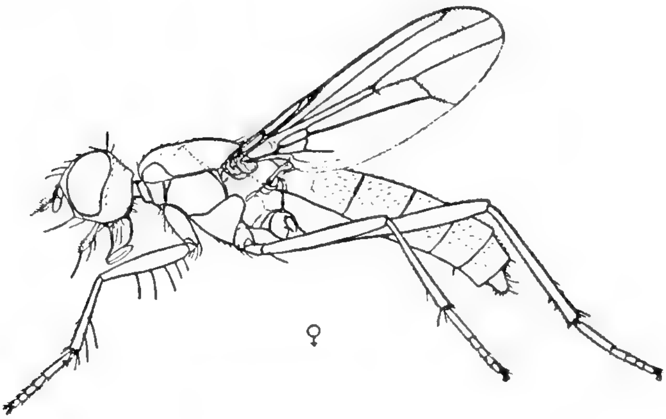



Fig. 37. *Parallelomma varipes* (Walk.)

These are commonly called dung-flies. Some of the species resemble Anthomyidæ, but the squamæ are quite small and there are more than four abdominal segments visible. Most of them are brownish or yellowish in color and are common in pastures about cow-dung. In some of the species the habits are predatory.

The larvæ have been bred from excrement and from the stems of plants. Aldrich lists 118 species from North America in his Catalogue.

776. **Cordylura**[24] **latifrons** Loew

Corvallis, V-2 (Lovett). Malloch det.

777. **Parallelomma**[25] **varipes** (Walk.)

Gaston, VII-10 (Cole).

778. **Scatophaga furcata** (Say)

Corvallis and Forest Grove, VI.

779. **Scatophaga merdaria** (Fabr.)

Hood River, X-29 (Childs); Forest Grove, III-14 (Cole). The adults are predaceous, having been taken with mycetophilids and leafhoppers.

780. **Scatophaga stercoraria** (Linn.)

Almost cosmopolitan. Many localities, V to X. The larvæ breed in excrement.

## Family CLUSIODIDÆ

This family can be recognized by the chætotaxy of the head. The cross-veins of the wings are closely approximated except in Clusia and the sixth vein does not reach the wing margin. The adults are rather rare. They may be found on tree trunks, where they sometimes feed on exuding sap.

781. **Clusia occidentalis** Mall.

Mary's Peak, at base, V-14 (Lovett); Pamelia Lake, Mt. Jefferson, VII-27 (Bridwell). 1918, Proc. Ent. Soc. Wash., XX, p. 4.

24 There are at least three undetermined species in material collected at Corvallis and Hood River, but the genus will have to be worked up before they can be named with certainty.

25 One undetermined species is not uncommon at Hood River.

## Family HELOMYZIDÆ

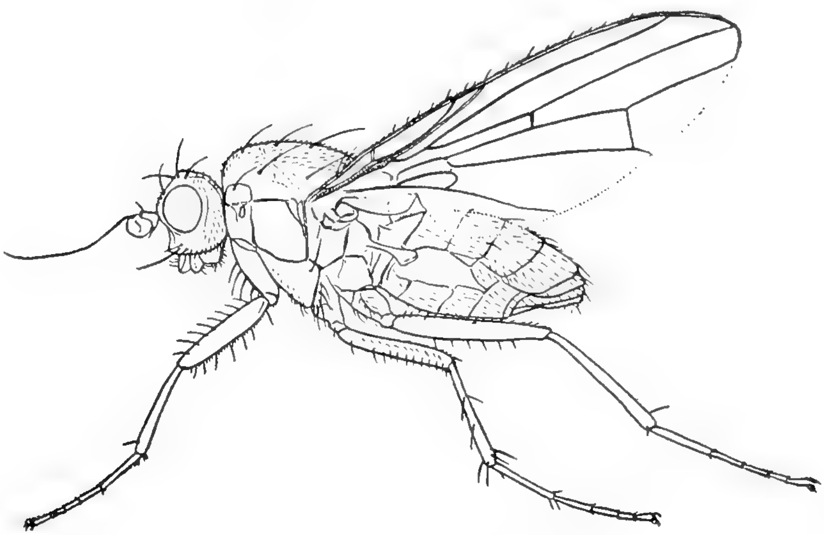


Fig. 38. *Œcothea fenestradis* (Fallén).

The flies of this family have the costa beset with prominent bristles and the wings are rather large. Some species live in caves and burrows, others are collected in damp meadows and shady places.

The larvæ have been bred from bat and rabbit-dung, from decaying wood, and from truffles.

782. **Helomyza barberi** Aldr.

Hood River, VI-3 and X-30 (Cole). 1908, Trans. Amer. Ent. Soc., XXXIV, p. 93.

783. **Helomyza limbata** Thoms.

Forest Grove, V-9 to IX-30 (Cole).

784. **Helomyza nemorum** (Meig.)

Hood River, X-11 (Cole). *H. assimilis* Loew is a synonym.

785. **Helomyza plumata** Loew

Mt. Jefferson, VII-12 (Bridwell); Mary's Peak, at base, V-14 (Lovett); Nashville, VIII-8; Corvallis, V-10. This was placed as a synonym of *quinquepunctata* Say in Aldrich's Catalogue.

786. **Œcothea fenestralis** (Fall.)

Forest Grove, VI-3 (Cole).

787. **Tephrochlamys rufiventris** (Meig.)

Newport (L. O. Howard); Forest Grove, III-6 to V-20 (Cole and Lane); Corvallis, V-10.

788. **Leria pectinata** (Loew)

Newport (L. O. Howard); Forest Grove, V-12 (Cole).

789. **Leria serrata** (Linn.)

Baker, IV-9. The earliest described species of the family. Aldrich reports it common in many parts of Europe and North America. The larvæ have been bred from fungi and from hen manure.

790. **Eccoptomera simplex** Coq.

Hood River, VI-4 (Cole).

Family BORBORIDÆ

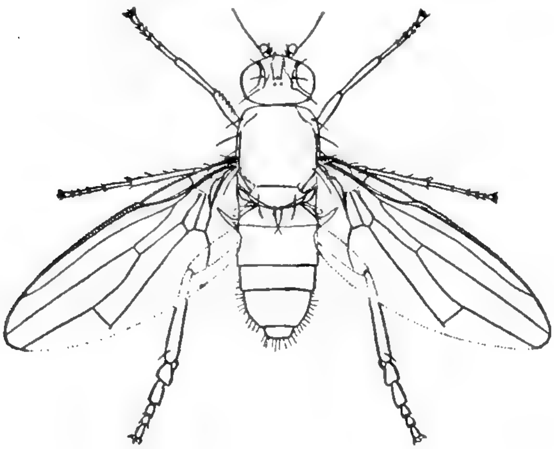


Fig. 39. *Copromyza equina* Fallén.

Most of these flies are quite small and black or brownish in color. They are found about decomposing vegetable and animal matter and are seen hovering over dung or sewage, in which the larvæ live. The larvæ of Leptocera are bred from fungi, diseased potatoes, etc., and are probably aquatic in some cases.

The following species were determined by Mr. A. Spuler, who has just completed a monograph of the family which should soon be published.

791. **Leptocera atra** (Adams)

Tillamook, III-26 (Burrill); Forest Grove, III-21 and Hood River, IX-29 to X-26 (Cole).

792. **Leptocera crassimana** (Halid.)

Tillamook, III-26 (Burrill); Forest Grove, III-21 and VI-2 (Cole).

793. **Leptocera fontinalis** (Fall.)

Portland, VIII-20 (Melander).

794. **Leptocera fuscipennis** (Halid.)

Hood River, VI-19 to X-26 (Cole).

795. **Leptocera** sp. nov. Spuler

Forest Grove, IV-2 and Hood River, IX-5 (Cole).

796. **Leptocera** sp. nov. Spuler

Hood River, IX-5 (Cole).

797. **Leptocera limosa** (Fall.)

Forest Grove, III-21 to IX-27 (Cole); Hood River, VI to IX and Corvallis, IX-10 (Cole); Tillamook, III-26 (Burrill).

798. **Leptocera** sp. nov. Spuler

Hood River, X-11 (Cole).

799. **Leptocera roralis** (Rond.)

Hood River, VI-4 to IX-29 and Forest Grove, III-21 (Cole); Portland, VIII-20 (Melander).

800. **Copromyza equina** Fall.

Everywhere abundant. Breeds in horse dung.

Family PHYCODROMIDÆ

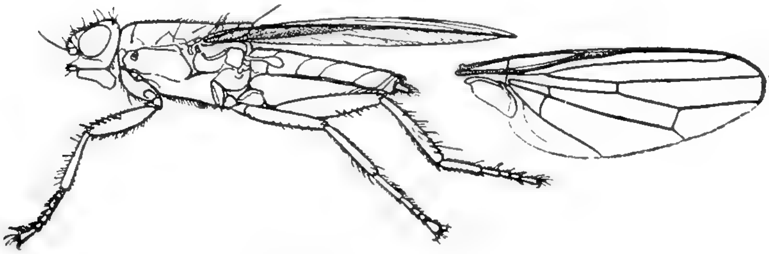


Fig. 40. *Cœlopa frigida* Fallén.

There are two genera, Cœlopa and Omomyia, in North America. Species of the former genus are found on the sea-beach, often in large numbers about piles of kelp and sea-weeds. They are about the size of species of Fucellia found with them and resemble them in general appearance, but when viewed under a lens are seen to be quite different.

801. **Cœlopa frigida** Fall.

Seaside and Newport Beach in July.

## Family SCIOMYZIDÆ

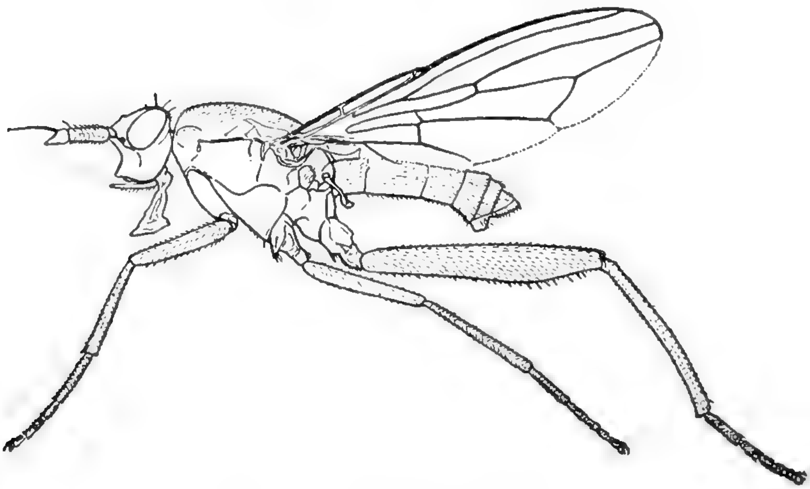


Fig. 41. *Sepedon pacifica* Cresson.

In these flies the head is short and broad and the face more or less retreating. The wings are long and are often spotted. The adults can be collected along the banks of small streams and in marsh and meadow land. The Tetanoceridæ are set aside in a separate family by some authors but they seem to be quite closely related. In flies of the genus Tetanocera the antennæ are very long and the wings usually pictured.

802. **Helcomyza mirabilis** Mel.

Tillamook, V (Reeher). 1920, Ann. Ent. Soc. Amer., XIII, p. 309.

803. **Sciomyza**[26] **simplex** Fall.

Oregon Agr. Exp. Station (G. F. Moznette).

804. **Melina nana** Fall.

Forest Grove, III-21 (Cole).

805. **Melina pubera** Loew

Corvallis, V-2 (Lovett); Hood River, VI-4 (Cole).

[26] According to the synonymy recently worked out by Dr. Melander the *Sciomyza* of authors becomes *Melina* Desvoidy.

806. **Neuroctena analis** Fall.

Corvallis (Moznette).

807. **Tetanocera vicina** Macq.

Common at Corvallis, V-15 to VII-17; Mary's Peak, IV-24; large series at Forest Grove, V-25 and IX-30 (Cole).

808. **Limnia pubescens** Day

Forest Grove, V (Cole).

809. **Limnia saratogensis** Fitch

Common at Corvallis, V-12 to IX-29; Mary's Peak, V-13; Forest Grove, V-25 (Cole).

810. **Dictya umbrarum** (Linn.)

Forest Grove, V-19 to IX-30 and Hood River, IX-4 to X-30 (Cole).

811. **Sepedon armipes** Loew

Corvallis; Hood River, VII-28 and IX-24 (Cole).

812. **Sepedon pacifica** Cress.

Forest Grove, IX-30 (Cole).

813. **Hedroneura rufa** (Panz.)

Forest Grove, IX-30 (Cole). This European species was first discovered at Potlatch, Idaho, by Dr. Melander; there the writer first collected them and later at Vernon, B. C. A good series was taken at Forest Grove in a small marsh.

Family SAPROMYZIDÆ

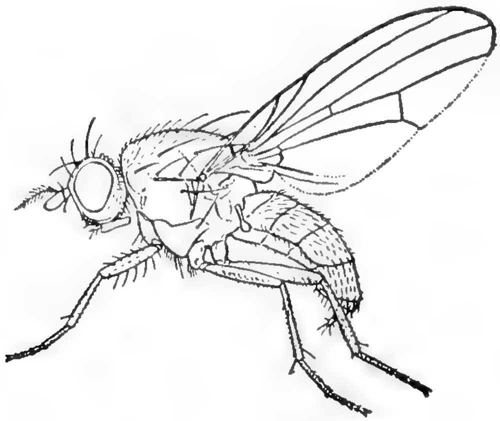


Fig. 42. *Minettia lupulina* (Fabr.)

The adults are comparatively small, with rather short legs. The wings are occasionally pictured, and the antennal arista usually plumose. The larvæ live in decaying vegetable matter or excrement.

814. **Sapromyza flaveola** Coq.

Corvallis, X-21; Mary's Peak, V-14; Hood River, VIII-21 (Cole); Talent, IX-30.

815. **Sapromyza planiscutum** (Thoms.)

Corvallis, V-2 and VI-14. Coquillett made this determination of the specimens in the Corvallis collection.

816. **Sapromyza univittata Coq.**

Corvallis, V-16 to VIII-13.

817. **Minnetia lupulina** (Fabr.)

Corvallis, V-16 to VII-17; Mt. Hood, VIII-10; Hood River, VI and VII (Cole).

818. **Minnetia nubila** Mel.

Recorded from Oregon by Aldrich. 1913, Psyche, XX, p. 74.

## Family LONCHÆIDÆ

This family is very nearly related to the Sapromyzidæ but several dipterists have recently separated it from that group. Both the larvæ and adults have characters that will differentiate them.

### 819. **Lonchæa polita** Say

Hood River, VI-24 (Cole).

### 820. **Lonchæa tarsata** Fall.

Forest Grove, V-20 (Cole).

### 821. **Palloptera jucunda** Loew

Yaquina Bay, V-16 (Lovett).

### 822. **Palloptera terminalis** Loew

Forest Grove, IX-27 (Cole).

## Family TRYPETIDÆ

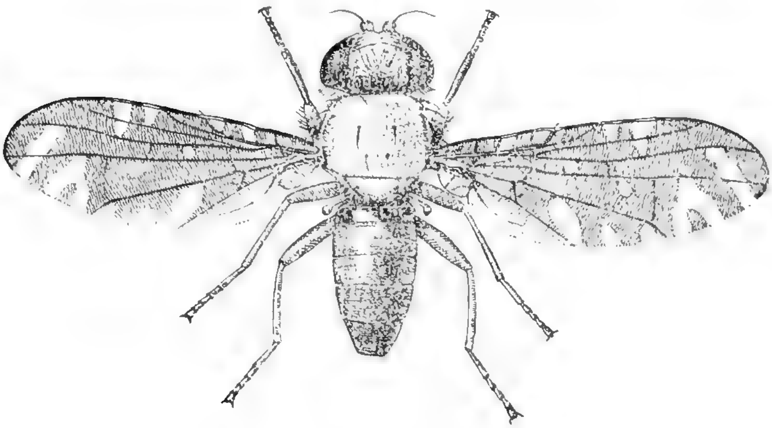


Fig. 43. *Aciura maculata* Cole.

These have been called "peacock-flies" because of their habit of elevating the wings and strutting about. The female usually has a large horny ovipositor. Many of the species have the wings marked and spotted in various ways.

The larvæ live in plant tissue, leaves, stems and fruits. Some of the species are gall-makers and the group contains many of our worst pests of fruit, both citrus and deciduous. They are especially injurious in tropical countries, in some places ruining nearly the whole fruit crop. Aldrich lists over 200 species from North America.

823. **Epochra canadensis** Loew

Common in western Oregon. The flies appear in May and June. The larvæ live in currants and gooseberries and are a serious pest.

824. **Œdaspis atra** Loew

Hood River, IX-8 (Cole).

825. **Rhagoletis caurina** Doane

Described from Oregon.

826. **Rhagoletis cingulata** (Loew)

Corvallis, Salem, Cove, Sheridan and vicinity of Portland. The larvæ are cherry-maggots.

827. **Rhagoletis pomonella** (Walsh)

Colestin VII-31 (E. P. Van Duzee). One specimen. This is the form bred from snowberry at Vernon, B. C., and recently published on by Mr. Downes. It cannot be distinguished from the eastern apple maggot but does not attack the apple here, confining itself to the snowberry, *Symphoricarpus racemosus.*

828. **Aciura maculata** Cole

Medford, V-28 (Noren); one specimen at Burns, V (Thompson). 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 252.

829. **Eutreta diana** O. S.

Corvallis, VI-21, with a label "sage brush"; Grant Co.; Narrows, VII-1. The type was bred from galls on wild sage, *Artemisia tridentata,* in Missouri by C. V. Riley.

December 14, 1921

830. **Eutreta longicornis** Snow

Blitzen River, VII-6. On examining one of the specimens Dr. Aldrich stated that it was not a true Eutreta.

831. **Carphotricha culta** (Wied.)

Albany, Corvallis, Vale and Forest Grove in June.

832. **Eurosta solidaginis** (Fitch)

Bred from galls on common golden-rod at Hood River (Childs).

833. **Xenochæta dichromata** Snow

Described from Mt. Hood.

834. **Neaspilota brunneostigmata** Doane

Duffy's Prairie, VII-26 (Lovett). The type was described without locality.

835. **Tephritis clathrata** (Loew)

Blitzen River, VII-6; Ashland, VIII-2 (E. P. Van Duzee).

836. **Tephritis despecta** (V. d. W.)

Narrows VII. This species is near *clathrata* Loew; it was described under the genus *Ensina*. Aldrich det.

837. **Tephritis finalis** (Loew)

Corvallis, VII, the larvæ and pupæ in seed pods and ovaries of *Eriophyllum lanatum*. It is a common species in the Northwest.

838. **Tephritis murina** Doane

Duffy's Prairie, 5,700 feet, VII-26 (Lovett).

839. **Tephritis variabilis** Doane

Corvallis, V-20 to VI-10 (Lovett); Horse Lake, alt. 6,000 feet, VII-25.

840. **Euaresta æqualis** (Loew)

Hood River, VIII-12 (Cole); Pendleton, VII-17 (Thompson). Breeds in seed pods of *Xanthium*.

841. **Euaresta araneosa** Coq.

Colestin, VIII-31 (E. P. Van Duzee). C. W. Johnson det.

842. **Urellia aldrichii** Doane

Corvallis, VII-22.

843. **Urellia mevarna** (Walk.)

Duffy's Prairie, VII-16 (Lovett).

844. **Urellia pacifica** Doane

Described from Oregon.

845. **Urellia solaris** Loew

Corvallis, VII-16.

## Family ORTALIDÆ

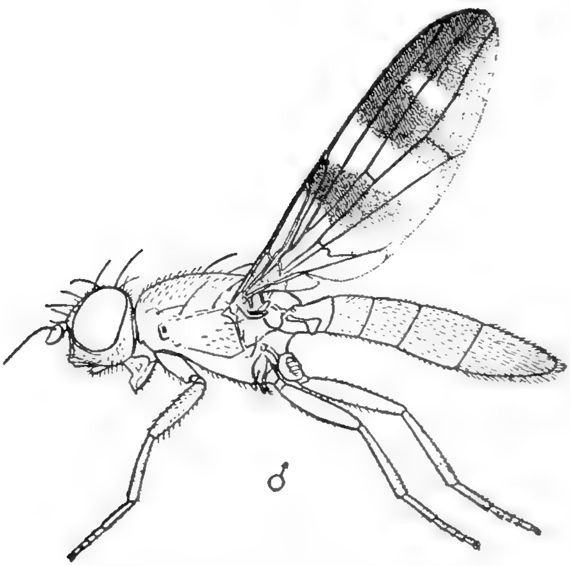



Fig. 44. *Chætopsis ænea* (Wied.)

These flies are small or of medium size and often with metallic colors. The head is of good size and the frons is broad; the legs are usually stout and rather short. Some species, but not especially those in North America, have grotesquely formed heads. The wings are often strikingly marked. The adults are taken in meadows and tall grass. A few species are of economic importance. Aldrich lists about 150 species in his Catalogue.

846. **Tritoxa cuneata** Loew

Corvallis, VII-17 (Lovett).

847. **Tritoxa pollinosa** Cole

Warm Springs Valley, VII-7; one specimen at Burns, V (Thompson), the second specimen known. 1919, Proc. Cal. Acad. Sci., Ser. 4, IX, p. 252.

848. **Melieria occidentalis** Coq.

Blitzen River, VII-6. This species is not uncommon in parts of California.

849. **Anacampta latiuscula** Loew

Forest Grove, I-28 and V-21 (Cole).

850. **Anacampta longicauda** Hendel

Burns, V. Aldrich det.

851. **Anacampta stigma** Hendel

Burns, V (Thompson). 1911, Wien. Ent. Ztg., XXX, p. 23.

852. **Tetanops aldrichi** Hendel

Burns, V (Thompson). 1911, Wien, Ent. Ztg., XXX, p. 20.

853. **Tetanops apicalis** Cole, new species

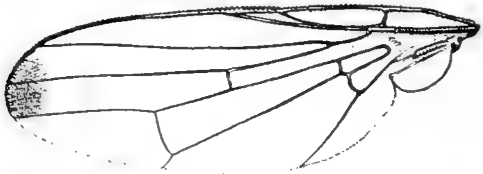


Fig. 45. *Tetanops apicalis* Cole, n. sp. Wing of holotype.

Body shining black, the eyes only slightly higher than long; wing with a small apical brown spot. Length 5.5 mm.

Female: Frons reddish brown, face yellow, occiput convex and black. Cheeks brownish yellow, gena corrugated to above antennæ. Frons deeply punctate almost to front ocellus. Eyes rounded, not much higher than long. Frons, occiput, and first two joints of antennæ with short, black, bristly hairs. First two joints of antennæ reddish, the third dark brown; arista blackish. Ocellar tubercle black. Palpi dark brown.

Thorax and pleura black, mesonotum opaque, the short hairs black and bristle-like; margins of the mesonotum shining black. Scutellum red with two apical black bristles; metanotum shining black; halteres reddish; several weak bristles along posterior edge of mesopleura and about eight weak propleural bristles; sternopleura below with a number of rather strong black bristles.

Abdomen entirely black, semishining above, with short black hairs which are sparse and hardly perceptible. Tibiæ, apices of femora, first two joints of tarsi and base of third brownish yellow; remaining tarsal joints and most of femora blackish brown. Middle tibiæ with three distinct apical spines which are lacking in the other tibiæ. Wings faintly infuscated, base and costal margin brownish, the veins mostly yellow; apical third of costal vein, posterior cross-vein, and apices of other veins dark brown. In the apex of the wing there is a rounded brown spot (see fig. 45).

*Holotype,* female, No. 842, Mus. Calif. Acad. Sci.; A. B. Black, collector, May 13, 1917.

*Type locality,* Corvallis, Oregon.

This species is in the group with *T. aldrichi* and *T. polita,* having rounded eyes, rugose and pitted frons, and black body.

854. **Tetanops luridipennis** Loew

Burns, VI-5 (Thompson). The single specimen is darker than the typical form and lacks the usual yellow color in the wings. It may be an undescribed species.

December 14, 1921

855. **Pseudotephritis vau** (Say)

Forest Grove, VII-12 (Cole).

856. **Chrysomyza demandata** (Fabr.)

Corvallis; Forest Grove, VII-5 (Cole). Reported breeding in horse-dung.

857. **Chætopsis ænea** (Wied.)

Hood River, VI-21 (Cole). Apparently rare in the Northwest.

858. **Seoptera vibrans** (Linn.)

Corvallis, VI-11.

Family SEPSIDÆ

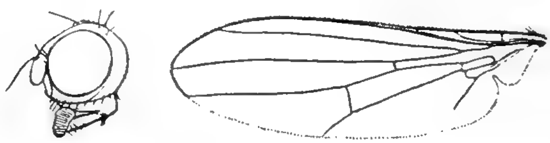


Fig. 46. *Sepsis violacea* Meigen.

Usually small, black, and slender flies, with the abdomen narrowed basally. The wings are hyaline and often with a spot near the apex. They run about actively and are quick of flight. The adults are commonly seen about excrement and decaying vegetation.

859. **Themira latitarsata** Mel.

Corvallis (Cordley); Forest Grove, IX-28 (Cole). 1917, Wash. Agr. Exp. Sta., Bull. 143, p. 45.

860. **Sepsis luteipes** Mel.

Forest Grove, III-3 (Cole). 1917, Wash. Agr. Exp. Sta., Bull. 143, p. 29.

861. **Sepsis neocynipsea** Mel.

Hood River, VIII-21 (Cole). 1917, Wash. Agr. Exp. Sta., Bull. 143, p. 28.

862. **Sepsis signifera curvitibia** Mel.

Series taken at Corvallis, VIII-13 (Lovett). 1917, Wash. Agr. Exp. Sta., Bull. 143, p. 28.

863. **Sepsis vicaria** Walk.

Portland (Melander).

864. **Sepsis violacea** Meig.

Common at Corvallis and Hood River.

865. **Sepsis violacea hecate** Mel.

Portland, V-22 (Melander). 1917, Wash. Agr. Exp. Sta., Bull. 143, p. 22.

866. **Sepsis violacea similis** Macq.

Oregon City (Melander). Melander makes this form a variety of *violacea* in his recent revision of the family.

Family PIOPHILIDÆ

This group is now separated from the Sepsidæ. The species are mostly black in color and quite small; they differ from the Sepsidæ in having the costa broken near the termination of the first vein, the third and fourth veins parallel or slightly diverging, mesonotum finely pubescent, abdomen never with bristles, etc. The larvæ of some have the peculiar power of "jumping."

867. **Piophila casei** (Linn.)

A species of general distribution, the larvæ of which are known as "skippers" or "cheese-mites"; they occur in cheese, rotten fungi, fatty tissues, the fat of ham and bacon, and in dead bodies. Cases of enteric and nasal myiasis are attributed to this species.

868. **Piophila pusilla** (Meig.)

Forest Grove, IV-8 (Cole). First recorded from North America in 1913 by Melander.

869. **Mycetaulus bipunctatus** (Fall.)

Forest Grove, VIII-1 (Cole). This European species has a very wide distribution.

## Family PSILIDÆ

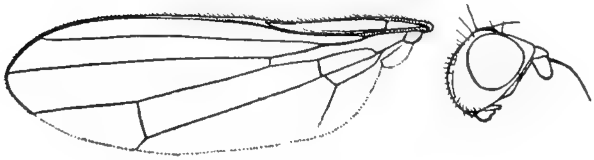


Fig. 47. *Psila rosæ* (Fabr.)

Small slender flies with long antennæ, usually shining and with a small clypeus. There are no oral vibrissæ. Some of the larvæ are known to live in roots and various plant galls. Melander records 38 species and subspecies in his recent synopsis of the family (Psyche, XXVII, no. 5, 1920).

870. **Loxocera collaris** Loew

Reported from Oregon by C. W. Johnson.

871. **Chyliza leguminicola** Mel.

Forest Grove, IV-23 (Rockwood). 1920, Psyche, XXVII, p. 99. Mr. Rockwood collected this species on plants of *Lupinus polyphyllus* Lindl., and found pupæ attached to the lower part of the plant in July.

872. **Chyliza scrobiculata** Mel.

Whitman Nat. Forest, VII-14 (Chamberlin). 1920, Psyche, XXVII, p. 98.

873. **Psila atrata** Mel.

Hood River, VI-10 (Cole). 1920, Psyche, XXVII, p. 97.

874. **Psila microcera** Mel.

Duffy's Prairie, VII-26 (Lovett). 1920, Psyche, XXVII, p. 95.

875. **Psila rosæ** (Fabr.)

Corvallis (Moznette). This is called the "carrot-rust fly" and is sometimes of economic importance.

## Family MICROPEZIDÆ

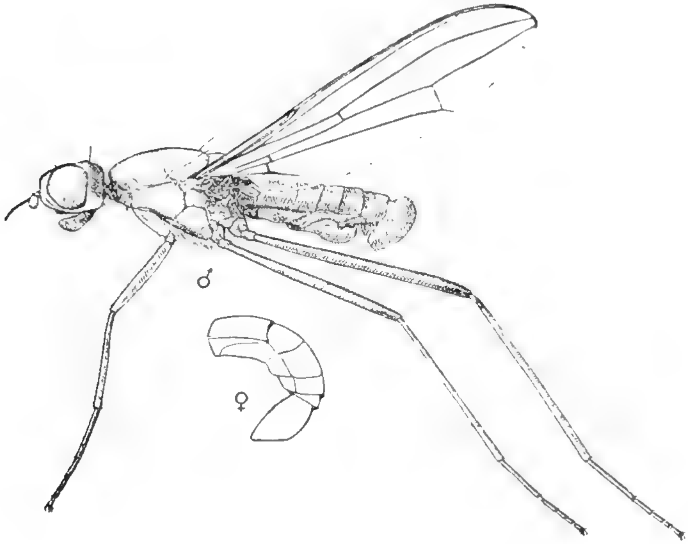



Fig. 48. *Calobata univitta* Walker.

Slender flies with large wings and long legs. The face is retreating in profile and the eyes comparatively small. The larval habits are unknown. The adults are predaceous on small insects.

876. **Calobata univittata** Walk.

Hood River VI (Cole). Rather common on rank foliage along a certain stretch of the Hood River.

## Family EPHYDRIDÆ

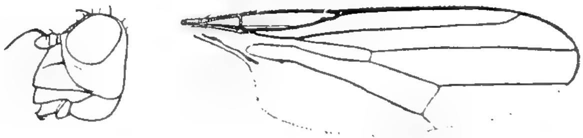


Fig. 49. *Parydra bituberculata* Loew. Head and wing.

These flies have a large head and most of them have a very large mouth. The costa is microscopically broken twice and the anal cell wanting. There are no oral vibrissæ. Most of the species are quite small and are found at the edges of streams or lakes, often in immense numbers.

The larvæ of some species are found in alkaline lakes and ponds, others in sap and in the stems of aquatic plants.

877. **Notiphila decoris** Will.

Hood River, VI-19 to X-26 and Forest Grove, VII-16 (Cole).

878. **Psilopa comta** Meig.

Baker City, VIII-2 (Creel); Hood River, VI-19 to IX-5 and Forest Grove, IV (Cole).

879. **Ilythea spilota** Curtis

Hood River, X-26 (Cole).

880. **Discocerina aliena** Cress.

Forest Grove, V-7 (Cole). Cresson det.

881. **Hydrellia hypoleuca** Loew

Narrows, VIII-1; Hood River, X-26 (Cole).

882. **Hydrellia scapularis** Loew

Forest Grove, VI-3 and Hood River, X-26 (Cole); Corvallis, V-2 (Lovett). Cresson det.

883. **Octhera mantis** (DeG.)

Corvallis, V-2 (Lovett); Corvallis, IX-12 (Cole).

884. **Pelina truncatula** Loew

Hood River, VII-10 to IX-29 (Cole). Cresson det.

885. **Pelomyia occidentalis** Will.

Hood River, X-26 (Cole).

886. **Parydra appendiculata** Loew

Hood River, VI-5 to X-26 (Cole). Common.

887. **Parydra bituberculata** Loew

Forest Grove, V-25 (Cole).

888. **Parydra limpidipennis** Loew

Forest Grove, VI-6 and Hood River, X-26 (Cole).

889. **Parydra pinguis** (Walk.)

Hood River, VI-6 (Cole).

890. **Parydra quadrituberculata** Loew

Hood River, VI-3 to X-26 (Cole).

891. **Ephydra hians** Say

Albert Lake (Aldrich).

892. **Scatella crassicosta** Beck.

Forest Grove, IX-28 (Cole).

893. **Scatella mesogramma** Loew

Hood River, VI-19 (Cole).

894. **Scatella pentastigma** (Thoms.)

Hood River, VI-21 to X-26 (Cole).

895. **Scatella picea** Walk.

Hood River, X-26 (Cole).

896. **Scatella stagnalis** (Fall.)

Hood River, VI-6 to X-26 (Cole).

897. **Lytogaster gravida** (Loew)

Hood River, VI-19 to VII-10 (Cole). Cresson det.

898. **Mosillus subsultans** (Fabr.)

Hood River, IX-29 (Cole).

## Family OSCINIDÆ

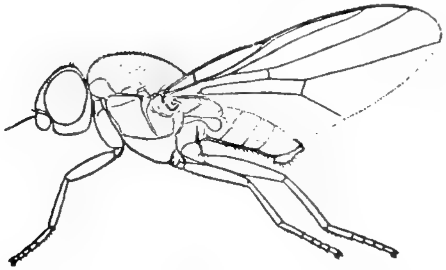


Fig. 50. *Chloropisca variceps* Loew.

These are sometimes called "frit-flies". They are small, bare, with a flat frons, short antennæ and wings, short legs, and ovate or elliptical abdomen. Many are colored or banded. The anal and second basal cells of the wing are absent. The postvertical bristles are converging. Swedish farmers apply the term "frits" to wheat ruined by the attacks of the wheat-fly. A few of the species in the family are blood suckers and probably carry putrefactive germs to open wounds.

Except where indicated the following determinations are by Dr. J. M. Aldrich.

### 899. **Meromyza americana** Fitch

Hood River, VI-2 and Parkdale, IX-5 (Cole). Cole det. The Wheat-stem Maggot, seldom of economic importance, but in local infestations it may destroy one per cent or more of the wheat heads, as it did in the Yakima Valley, Washington, in 1919.

### 900. **Diplotoxa unicolor** Beck.

Corvallis; Narrows, VII-1.

### 901. **Chlorops egregia** Beck.

Corvallis, V-24; Forest Grove, VI-6 (Cole).

### 902. **Chlorops obscuripennis** (Loew)

Corvallis.

903. **Chlorops sahlbergi** Loew

Forest Grove, V-2 (Cole). Cole det. Compared with a specimen determined by Becker.

904. **Chloropisca glabra** (Meig.)

Forest Grove, IV-22 to V-17 and Hood River, VI-3 to X-26 (Cole); Narrows, VII-1. Our commonest species.

905. **Chloropisca variceps** Loew

Corvallis, IV-9 and V-12; Hood River and Forest Grove, VI (Cole).

906. **Elachiptera decipiens** (Loew)

Forest Grove, IV-2 (Cole).

907. **Elachiptera nigriceps** (Loew)

Corvallis, V-2 (Lovett).

908. **Oscinis coxendix** Fitch

Corvallis, V-2 (Lovett).

909. **Oscinis frit** Linn.

Narrows, VII-1. A species of economic importance in Europe.

910. **Oscinis sulphurihalterata** Endl.

Corvallis, IV-2 (Chamberlin). Bred from cones of *Abies grandis.* 1911, Sitz. Ber. Ges. Natf. Freunde, Berlin, p. 222.

911. **Dicræus ruficeps** Meig.

Hood River, VI-3 (Cole). Cole det.

912. **Madiza conicola** Greene

Long's Ranch and Ashland, IX-2. Reared from cones of *Abies concolor.* 1919, Proc. Ent. Soc. Wash., XXX, p. 69.

## Family DROSOPHILIDÆ

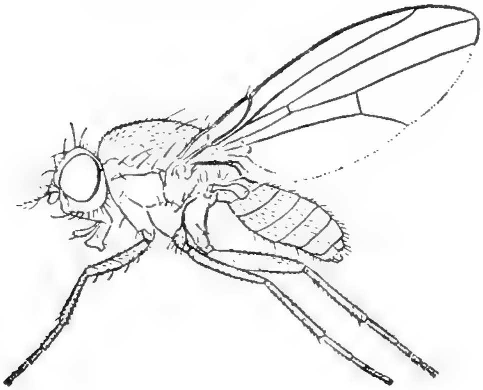


Fig. 51. *Drosophila busckii* Coq.

Small, usually yellow, flies, with a short and broad abdomen. Costa of the wing microscopically broken twice. Arista of antennæ plumose, the fronto-orbital bristles proclinate. They are often called "pomace-flies", and are found about cider mills and wine presses, also around decaying or fermenting fruit. The larvæ live in pomace and in the scum of fermenting juice. A few have quite different habits, one species has been reared from mealy bugs (*Pseudococcus*), one from spider's eggs and one is parasitic on the nymphs of the spittle bug, *Clastoptera obtusa.*

913. **Phortica humeralis** (Loew)

Hood River, VI-16 (Cole).

914. **Scaptomyza apicata** (Thoms.)

Corvallis; Forest Grove, V-11 (Creel); Hood River, IX-29 (Cole).

915. **Drosophila buskii** Coq.

Forest Grove, VIII-27, reared from clover heads (Rockwood); Corvallis, VI-15 and IX-14.

916. **Drosophila funebris** (Fabr.)

Corvallis, III-12 and IX-14; Hood River, X-11 (Cole).

917. **Drosophila melanogaster** Meig.

Hood River, X-11 (Cole). This species is better known as *D. ampelophila,* the subject of so many experiments in the study of heredity and evolution.

918. **Drosophila obscura** Fall.

Corvallis. Common European species. Melander det.

919. **Drosophila repleta** Wollas.

Corvallis, V-23. Melander det.

Family GEOMYZIDÆ

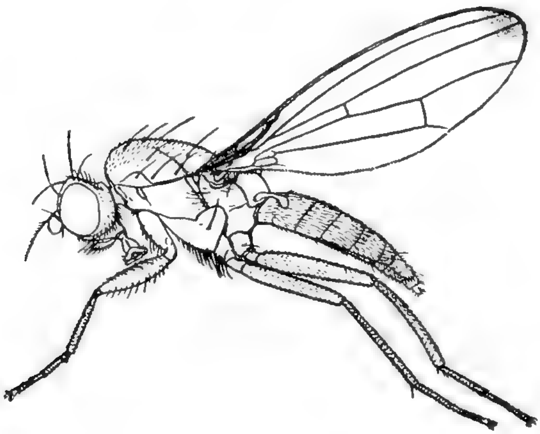


Fig. 52. *Geomyza lurida* (Loew)

Small or minute flies with rather large wings, the anal and basal cells complete. The clypeus is larger than in the Agromyzidæ and the foremost fronto-orbitals are directed backward; postvertical bristles convergent. The adults are collected by sweeping low plants and shrubbery, some species being quite common. The larvæ of some live in plant stems.

920. **Geomyza lurida** (Loew)

Hood River, VI-21 (Cole); Tillamook, III-26 (Burrill). Described in the genus *Balioptera.*

921. **Diastata eluta** Loew

Reported from Oregon by Melander.

922. **Anthomyza gracilis** Fall.

Forest Grove, VI-23 (Cole); Corvallis, VIII-12 (Lovett). According to Dr. Melander this species is common in Washington.

923. **Zagonia oregona** (Aldr.)

Hood River, VII (Aldrich).

924. **Tethina coronata** (Loew)

Forest Grove, V-12 (Cole).

925. **Tethina parvula** (Loew)

Narrows, VII-1; Blitzen River, VII-6.

926. **Trixoscelis frontalis** (Fall.)

Forest Grove, V-5 (Cole).

Family AGROMYZIDÆ

Small flies with widely separated eyes, bare or pubescent arista, and divergent postvertical bristles. The wings are rather short and rounded. The larvæ of most species are leaf miners; a few make galls.

927. **Cerodonta femoralis** (Meig.)

Gaston, VII-10 (Cole).

928. **Phytomyza albiceps** (Meig.)

Reported from Oregon by Melander. *P. genualis* Lw. is a synonym.

929. **Phytomyza chrysanthemi** Kowarz

Portland, III-10 (Lovett). Bred from larvæ mining chrysanthemum leaves.

930. **Phytomyza crassiseta** Zett.

Forest Grove, V-3 and VI-3 (Cole).

931. **Phytomyza flaviscutellata** Fall.

Reported from Oregon by Melander.

932. **Phytomyza ilicicola** Loew

Reported from Oregon by Coquillett.

933. **Phytomyza obscurella** Fall.

Forest Grove, IV-4 and Hood River, IX-5 (Cole).

934. **Agromyza abbreviata** Mall.

Hood River, VI-14 (Cole). Melander det. 1913, Ann. Ent. Soc. Amer., VI, p. 285.

935. **Agromyza æneiventris** Fall.

Corvallis, VII-28 (Lovett).

936. **Agromyza luctuosa** Loew

Forest Grove, IV-6 (Cole).

937. **Agromyza platyptera coronata** Loew

Hood River, VI-6 (Cole).

938. **Agromyza puella** Meig.

Hood River, VII-20 and Forest Grove, VII-26 (Cole).

939. **Agromyza reptans** Fall.

Reported from Oregon by Melander.

940. **Agromyza scutellata** Meig.

Forest Grove, V-20 (Cole).

941. **Agromyza scutellata orbona** Meig.

Hanging Valley, alt. 5,400 feet, collected VIII-2 (Lovett), emerged IX-1 from mines in lupine leaves.

942. **Agromyza scutellata variegata** Meig.

Forest Grove, VII-26 (Cole).

943. **Agromyza subvirens** Mall.

Hood River, VI-6 (Cole). 1915, Proc. U. S. Nat. Mus., XLIX, p. 105.

944. **Agromyza superciliosa** Zett.

Reported from Oregon by Melander.

945. **Agromyza tæniola** Coq.

Reported from Oregon by Melander.

## Family MILICHIIDÆ

This family has long been associated with the Agromyzidæ. The costa is microscopically broken twice and there is an anal cell. The clypeus is small. The antennal arista is pubescent.

946. **Milichiella lactipennis** (Loew)

Hood River, VII-9 (Cole).

947. **Paramadiza haletralis** (Coq.)

Very commonly seen in houses on the windows, from February to September.

## Family OCHTHIPHILIDÆ

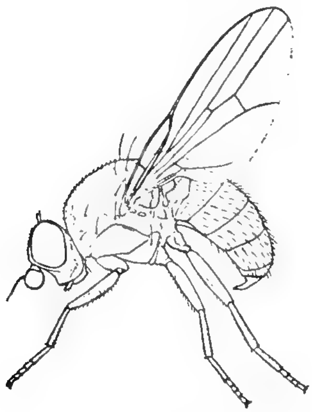


Fig. 53. *Leucopis griseola* Fallén.

A family closely related to the Agromyzidæ and until recently considered a subfamily of that group. There is no break in the costa of the wing and oral vibrissæ are absent. The species are densely gray pollinose. The larvæ have been bred from aphids and various soft scales.

948. **Ochthiphila juncorum** Fall.

Hood River, VI-28 (Cole).

949. **Leucopsis griseola** Fall.

Hood River and Forest Grove, VI (Cole); Corvallis, VII-6 (Lovett) and V-24 (Bridwell). This species is aphidophagous and was observed in the larval stage feeding on the vetch aphis at Forest Grove.

## Family HIPPOBOSCIDÆ

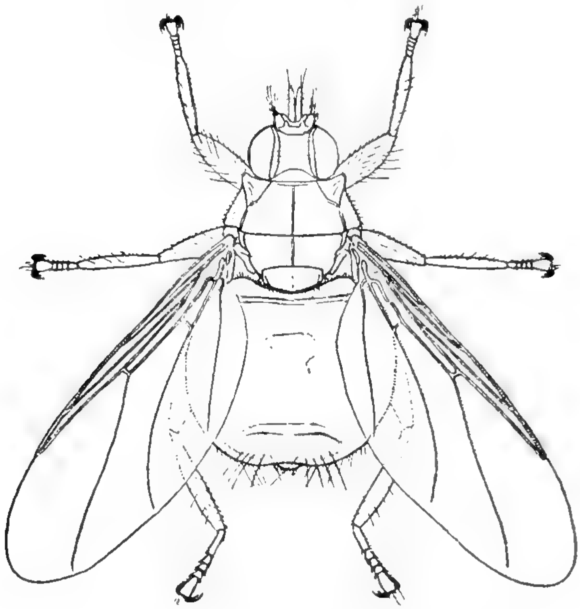


Fig. 54. *Olfersia americana* (Leach).

This peculiar group is quite different from any other in the Diptera, as we commonly think of that order. The adults are leathery in texture and resemble ticks. Some species are wingless and a few pass through the winged stage and lose these appendages. Most of the species are parasites on the bodies of birds. The horse-tick probably does not occur in North America. The sheep-tick occurs all over the world. The female brings forth young in the pupal stage and has an uterine sac which secretes a milk to feed them.

950. **Ornithomyia anchineura** Speis.

Upper Alsea Valley, Benton Co., on Steller's jay.

951. **Olfersia americana** (Leach)

On great horned owl at Corvallis (Thompson)

952. **Melophagus ovinus** (Linn.)

The common sheep tick.

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XVI

# REVISION OF THE PIPIZA GROUP OF THE FAMILY SYRPHIDÆ (FLOWER-FLIES) FROM NORTH OF MEXICO

BY

C. HOWARD CURRAN
*Orillia, Ontario, Canada*

The genus Pipiza, as generally accepted in North America, has long been regarded as one of the most difficult genera in the family. The reason for this is found in inadequate descriptions and the absence of outstanding specific characters which could be used for identification. Abundant material has revealed several characters which are of exceptional importance in this group and the old reliance upon the color of the pile is not adhered to in this work where other characters are sufficiently prominent to allow of their employment. The character of the pile often indicates species and is of considerable importance, as variation is not as great as is generally supposed. Many small differences usually accompany its variation in color, and these, together with more important structural differences, lead to the absolute determination of the specimens.

The present paper deals with forty-nine species of North American Pipizini. Their retention in a single genus makes their study very difficult. It has usually been the practice to break up a genus which has become unwieldy, provided definite and stable characters are available for the separation of the sexes into their respective genera. With the Genus Pipiza it is found that there is a natural subdivision into four well-marked groups. In Europe three genera are recognized, Pipiza, Pipizella and Cnemodon. The genus Heringia, established by Rondani for *Pipiza heringi* Zett., is also recognized in the present paper, and includes five North American species.

As to the wisdom of accepting four distinct genera I might point out that the material for study has invariably been scanty, that too much emphasis has been placed upon certain prominent characters (for example, hind trochanteral spur in Cnemodon) to the detriment of the further study of other characters; that the females, except in some species of Pipiza, have never been properly associated with the males, and that, on account of the confusion caused by the difficulty of proper identification, the genus has never received careful study.

With such a condition prevailing in these genera it is no wonder that the generic limitations prevailing in Europe have not been accepted in America. The difficulty of tracing the females to their proper relationships has now been largely overcome, so it is a simple matter to locate them in their proper genus.

I wish to express to Professor A. L. Lovett, of the Oregon Agricultural College, the greatest thanks for specimens loaned for study and for many suggestions. Upon learning of the scope of the present work, Professor Lovett unhesitatingly forwarded his whole collection of Pipizini for study, requesting that all new species be named and described, including such as he already had in manuscript. Mr. W. M. Davidson, of the Bureau of Entomology, supplied several specimens of California Pipizini which he considered new and offered a number of suggestions for which I am greatly indebted. I also wish to express my gratitude to Dr.

J. R. Malloch for the privilege of examining the paratype of *Cnemodon trochanterata*, and to Dr. Aldrich for several suggestions. To the late Doctor Williston I owe much for the determination of specimens, and for suggestions regarding several of the new species. To Mr. E. P. Van Duzee I am indebted for a critical reading of the manuscript.

The disposition of the type specimens of the new species is given following each description.

### Key to the Genera

1. Face considerably broader at the oral margin than at the antennæ. (If doubtful, compare Heringia) *Pipiza*
   Face but little or not at all broader at the oral margin than at the antennæ . . . . . . 2
2. Arista microscopically bare; eyes often with a horizontal bare stripe *Pipizella*[1]
   Arista microscopically pilose to the end; eyes always evenly pilose . . . . 3
3. Venter of fourth segment in the male only half as long as its dorsum; middle tibiæ in female slender; third antennal joint in female elongate *Heringia*[1]
   Venter of fourth segment three-fourths as long as its dorsum; middle tibiæ in female rounded in front, in male produced anteriorly; hind trochanters in male usually with long process *Cnemodon*

[1]In Pipizella and Heringia the middle tibiæ are narrow, often somewhat constricted in front; the females of Pipizella have the bare stripe on the eyes more marked, and, where present, this will at once distinguish them; more difficulty may be experienced with Cnemodon until the student becomes familiar with some species, but usually the shorter and more roundish antennæ will help to distinguish the females belonging to that genus.

### Genus **Pipizella** Rondani

*Triglyphus* Loew (Part), *P. modestus* and *pubescens*.
*Pipiza* Williston (Part), Synop. N. Am. Syrph., 1886.

Eyes in both sexes often with a median horizontal bare stripe; third antennal joint more than twice as long as wide, usually three or more times longer; arista microscopically bare or pilose at the immediate base only; species usually much shining, sometimes strongly metallic; *last section of fourth longitudinal vein bent or angulated at its middle*, usually forming a moderately acute, or almost a right angle, with the third vein.

(The genus Triglyphus is distinguished from other Pipizini by the abdomen being composed of only three visible segments. *P. pubescens* was therefore wrongly placed when attributed to the genus Triglyphus by Loew.)

### Key to Species of Pipizella

1. Face and frons entirely whitish pilose 2
   Face or frons partly blackish pilose 4
2. Third joint of antennæ four or five times as long as wide; wings dark brown *australis*
   Third joint about four times as long as wide; wings hyaline or almost so 3
3. Scutellum with apical groove; auxiliary vein ending well beyond apical cross-vein *pulchella*
   Scutellum without apical groove; auxiliary vein ending hardly beyond apical cross-vein *occidentalis*
4. Thorax conspicuously reddish pilose; abdomen with some reddish or reddish-yellow pile; antennæ entirely black (western species). *rufithoracica*
   Pile not so colored 5
5. Arista microscopically pilose on basal quarter; abdomen of male brassy *pubescens*
   Arista at most pilose at immediate base; abdomen of male not brassy 6
6. Arista pilose at immediate base (to end of first section) antennæ reddish below; moderately robust species; (6.5 to 7 mm.) *modesta*
   Arista bare (in all species examined); smaller and more slender, if very similar the antennæ are black throughout in the male 7
7. Wings with a large brown spot in the middle **bellula*
   Wings without median brown cloud 8
8. Third joint of antennæ partly reddish, about four times as long as wide *pulchella banksi*
   Third joint of antennæ usually entirely black, about three times as long as wide *fraudulenta*

### 1. Pipizella pubescens (Loew) (Figs. 7, 9, 10, 40)

*Triglyphus pubescens* Loew, Century, iv, No. 61, 1863.

*Pipiza pubescens* Williston, Synop. N. Am. Syrph., 23, 1886.

Habitat: Wisconsin (Lw.) Ontario! Shining black to brassy; front basitarsi slightly, the hind ones considerably, incrassate.

Length about 5 mm. Male: Face and frons metallic bluish black, moderately long white pilose; sides of face and frons to well above the antennæ narrowly whitish pollinose; eyes blackish pilose, across the middle with a well-marked horizontal bare stripe. Antennæ elongate, black, second and third joints testaceous below, third joint over twice as long as broad, the end evenly rounded. Thorax and scutellum shining black, the former with a coppery reflection; pile luteous, on the pleuræ white and longer. First segment of abdomen black; remaining segments shining greenish black with a brassy reflection, anterior and posterior margins of segments with ill-defined opaque bands not reaching lateral margins; pile short, white, the posterior margins of second to fourth segments and anterior margins of third and fourth, with rather narrow black pilose bands. Hypopygium with a few white hairs. Legs

*No description available.

black, tips of the four anterior femora, basal quarter of front and third of middle tibiæ and first two joints of their tarsi, together with tip of hind basitarsi and the following joint, yellowish; pile of legs sparse, long, whitish, hind tibiæ below with shorter black pile. Wings hyaline, stigma yellowish; last section of fourth longitudinal vein angulated at its middle, of fifth rectangular.

Female: Face and front shining greenish black, white pilose except across upper part of front and immediately above base of antennæ where the pile is black; sides of face and front to middle narrowly whitish pollinose; about middle of frontal orbits a small triangular spot, well separated from the lateral stripes. Antennæ black, all the joints yellowish below; eyes short black pilose, with bare stripe as in male; occipital cilia cinerescent. Thorax, scutellum and abdomen shining greenish black, short white pilose; pile of pleuræ longer; abdomen with black pile as in male; scutellum rather large and usually with a well-marked apical groove; legs as in male, but tip of hind femora and narrow base of its tibiæ yellow.

Five males and six females from various parts of Ontario, May to July (Curran). This is the only species I have examined which is distinctly brassy in some reflections. Only one female showed the same character very markedly. In good specimens the microscopic pile of the arista is very evident, but it may be hard to discern in specimens which have been wet.

### 2. **Pipizella pulchella** (Williston)

*Pipiza* (*Pipizella*) *pulchella* Williston, Synop. N. Am. Syrph., 29, pl. ii, figs. 1, 1a, 1b.; 1886.

Habitat: Connecticut, Massachusetts, (Will.)

"Female: Length, 5.5 mm. Shining greenish black, clothed with not very abundant nor long, nearly white, pile. Front and face wholly white pilose, the former with a small, triangular spot near each orbit, the latter with a narrow orbital margin, white pollinose; post orbital cilia white, the short pile of the eyes dark; face gently convex near the middle; antennæ elongate, but shorter than the face, the third joint three or four times as long as wide, black, yellowish on the lower basal part. Scutellum with a slender deep groove before its margin. Abdomen very short pilose; on the posterior parts of the second and third segments black, elsewhere nearly white. Legs black, white pilose; tip of all the femora, base and immediate tip of the anterior tibiæ, first two joints of the anterior and middle two of the hind tarsi, yellow; hind basitarsi considerably thickened. Wings grayish hyaline; last section of the fourth vein angulated at its middle; posterior cross-vein rectangular; stigma luteous." (Williston.)

### 3. **Pipizella pulchella banksi,** new subspecies (Figs. 102, 103)

Habitat: Virginia! Front basitarsi not thickened; bare stripe of eyes broad; third antennal joint about four times as long as wide, basal antennal joints yellow; wings hyaline.

Female: Length 5.5 mm. Face and lower fourth of frons shining metallic blue, frons elsewhere more blackish, steely; pile white, in front of ocelli black;

occipital cilia black face very gently convex in middle, its sides narrowly and two minute spots above middle of frons at orbits, white pollinose. Antennæ luteous, third joint above and apically brownish, about four times as long as wide; arista bare, its basal half luteous; eyes short black pilose, broadly bare across the middle. Thorax and scutellum shining black, slightly greenish; pile short, sparse, white; scutellum without apical groove. Abdomen shining black, the sides with a metallic bluish reflection; pile short, white; the broad posterior margins, not reaching the sides, of the second and third segments with black pile, fourth segment with cinereous pile on basal third. Legs black, tips of front four and narrow base of hind femora, base of front, basal half and extreme tip of middle tibiæ; first two joints of anterior four and middle two of hind tarsi, and tip of hind basitarsi, yellow; hind basitarsi slightly incrassate. Wings tinged with brownish, not clouded; last section of fourth vein subangulated immediately before its middle; of fifth, rectangular; halteres yellow.

From *P. pulchella* Williston, it differs in having basal antennal joints yellow, black pile on the front, black occipital cilia, and slightly brownish wings; other differences in color are also noteworthy. The wings are too light for *P. australis*.

The specimen is interesting as occurring practically between the range of *P. pulchella* and *P. australis*. It may be either a southern form of *pulchella* or a northern form of *australis*, or it may prove to be a good species, but without specimens of *pulchella* I refrain from giving it specific rank.

*Holotype*, female, from Mr. W. M. Davidson, labelled "Falls Church, Va. (N. Banks), Ceanothus (N. J. Tea), June 14," in U. S. National Museum.

### 4. **Pipizella occidentalis** (Townsend)

*Pipiza occidentalis* Townsend, Ann. Mag. Nat. Hist., 6th ser., xix, 140, 1897.

Habitat: New Mexico (Towns.) One female, Rio Ruidosa, four miles west of Dowling's Mill, 6660 ft., on flowers of *Rhus glabra* L., July 10. (Wooton.)

"Length, 5 mm. Differs from Williston's description of *P. pulchella* only in the following particulars: Abdomen less than twice as long as the thorax; no slender deep groove before the margin of the scutellum; legs black, tips of all the femora, bases of anterior tibiæ, basal two joints of the front and middle tarsi and tips of the hind basitarsi with the next joint, yellowish or reddish yellow; hind basitarsi not more swollen than the other joints; apical cross-vein sub-sinuate, abruptly straight at its base but curved on its final portion forming a right angle with the fourth vein; auxiliary vein terminating hardly beyond the anterior cross-vein. Closely like *pulchella* in all other points. This species is very distinct from the two described by Williston in the Biologia Centr. Am., Dipt., iii, pp. 6-7." (Townsend.)

## 5. Pipizella australis (Johnson)

*Pipiza pulchella* Johnson, Proc. Acad. Nat. Sci. Phila., XLVII, p. 329, 1895 (Not of Williston.)

*Pipiza australis* Johnson, Psyche, XIV, p. 77, 1907.

Habitat: Florida (Johns.)

"Head thorax and abdomen black, or very dark blue-black, shining, covered with a sparse, whitish pile. Antennæ brown black, length of third joint between four and five times its width, under side towards the base more or less reddish. Legs bluish black; tips of all the femora, basal half of the front and middle tibiæ, the basitarsi and two following joints of the tarsi, yellow; basal half of the posterior basitarsi and the last two joints of all the tarsi, black. Wings brown, somewhat lighter towards the base; last section of fourth longitudinal vein angulated in the middle. Length, 6 mm."

"It is distinguished from *P. pulchella* by its longer third antennal joint, dark brown wings and very dark blue black body." (Johnson.)

## 6. Pipizella rufithoracica, new species

Habitat: California! Antennæ black; eyes with horizontal bare stripe almost obsolete; pile on disc of thorax reddish; on abdomen black and reddish or luteous; hind tarsi black.

Male: Length, 6.5 mm. Pile of the head entirely black, moderately long and stiff on face; face and frons shining black, the sides narrowly gray pollinose; face slightly receding, gently rounded above middle, straight below. Antennæ black, third joint two-and-one-half times longer than wide; arista black, bare. Eyes with moderately short black pile. Thorax obscurely cupreous; pile fairly short, reddish, everywhere intermixed with stout, longer, black hairs, which are rather sparsely placed; front of dorsum, sides, and the pleuræ with black pile, except below the wings where it is reddish; scutellum with its apex compressed, its pile as on dorsum of thorax. Abdomen slender, scarcely wider than thorax, shining greenish black, the usual areas sub-opaque; pile short, black; basal angles and posterior sides of fourth segment with conspicuous reddish pile; shining portions of segments two and three also with reddish pile which does not reach the margins; on these segments the pile only shows red in some lights. Legs black, black and reddish pilose; tips of four anterior femora, bases of their tibiæ, and tips of middle ones, yellowish; narrow base of hind tibiæ luteous; middle basitarsi luteous; front basitarsi with red pubescence below; hind basitarsi not at all swollen. Wings tinged with blackish, especially just before middle; stigma luteous; last section of fourth vein bent at its middle, curving moderately outwards, then joining third vein at almost a right angle.

Female: Length, 5 to 6 mm. Arista yellow basally; face, except upper angles, and front broadly across middle, with yellow pile; a few yellow hairs over ocellar triangle. Sometimes face everywhere bordered with black pile, leaving only middle yellow pilose. Pile of thorax entirely reddish yellow, very short; scutellum with pile similar to that of thorax, its margin as in male. Abdomen broader than the thorax, its pile very similar to that of male, but light pile more yellowish and much more extended, in some specimens covering all but the moderately broad anterior and posterior margins and a median line on second segment. Legs and wings as in the male but the discal cell slightly shorter. Sides of face whitish pollinose, this stripe widely separated from minute spots on frontal orbits.

*Holotype*, male, No. 843, Mus. Calif. Acad. Sci., July 12, 1918, (E. P. Van Duzee). *Allotype*, female, No. 844, and two *paratypes*, females, same data, in Mus. Calif. Acad. Sci. One *paratype*, same data, in collection of the author.

*Type locality*, Cayton, Shasta Co., California.

A very distinct and beautiful little species. The black tarsi are distinctive and I know of no other American species with distinctly reddish pile on the thorax.

### 7. **Pipizella fraudulenta** (Loew) (Figs. 11, 39)

*Pipiza fraudulenta* Loew, Century, vi, No. 41, 1865; Williston, Synop. N. Am. Syrph., 26, 1886.

Habitat: New York (Lw.); Ontario! Black, considerably opaque, mostly whitish pilose; front basitarsi slightly, hind ones considerably, incrassate; wings cinereous or cinereous hyaline; last section of fifth longitudinal vein oblique in male.

Length, 5.5 to 7 mm. Male: Face and frons shining bluish black, black pilose, middle of face and vertex whitish pilose; sides of face and frons narrowly whitish pollinose; frontal triangle usually opaque above. Antennæ black, third joint slightly over twice as long as wide; eyes short black pilose, across middle with a narrow, almost bare, horizontal stripe; occipital cilia black, except at vertex. Thorax and scutellum shining bluish black, whitish pilose; scutellum sometimes with a shallow apical groove, its apex with a few black hairs. Abdomen opaque black, sides narrowly shining; sides of second segment in middle usually with a pair of large, shining, broadly separated spots, projecting from shining lateral margins; third segment always with large spots, apical one-half to two-thirds of fourth segment shining. Black pile covers the opaque areas except anterior half of second segment; tip of fourth segment and hypopygium also black pilose; elsewhere the pile is white. Legs black; tips of all the femora, base of anterior four tibiæ and basal joints of their tarsi, tip of hind basitarsi and the two following joints, yellowish. Sometimes basal half of front four tibiæ and base of hind tibiæ are yellowish. Front basitarsi slightly, the hind considerably, incrassate. Wings cinereous, except often basal third; stigma luteous; last section of fourth vein bent near its middle, of the fifth, oblique, straight or gently curved.

Female: Face and front shining black, white pilose; immediately above base of antennæ and across front above, black pilose; face slightly receding, rounded above the middle; antennæ black, base of third joint yellowish or entirely black; this joint slightly constricted on basal third and nearly three times as long as wide; arista yellow at base; eyes very short black pilose, with horizontal bare stripe; occipital cilia white but sometimes with a few black hairs; pollinose spots on front small, triangular, separated from side stripes by about half their width. Thorax and scutellum as in male; abdomen shining bluish black, with whitish pile, usual areas with black pile and usual areas opaque. Legs as in male. Wings cinereous hyaline; stigma luteous; last section of fourth vein bent slightly beyond its middle, of fifth rectangular, usually entirely straight.

Many of the males have ground color of face metallic bluish, and some have a very small tubercle above antennal base. Some females have front of same bluish color, and others a broad, shallow pit below middle of front.

Twenty-five males and seven females, Guelph and Vineland, Ontario, April to June.

### 8. **Pipizella modesta** (Loew) (Fig. 2, 12, 38)

*Triglyphus modestus* Loew (Female), Century, iv, No. 62, 1863.

*Pipiza nigribarba* Loew (Male), Century, vi, No. 40, 1865; Williston, Synop. N. Am. Syrph., p. 25, 1886.

*Pipiza modesta* (Loew) Williston, Synop. N. Am. Syrph., p. 24, 1886.

Habitat: New York, (Lw.) Ontario! Very much like *P. fraudulenta* but more robust, face entirely black pilose, antennæ more pointed at end, wings always lighter colored.

Length, 6.5 to 7 mm. Male: Face and front shining black; head entirely black pilose except a few hairs at vertex; horizontal bare stripe of eyes almost obsolete; Antennæ entirely black or sometimes reddish below at base, third joint usually reddish below. Pile of thorax luteous, of pleuræ whitish, mixed with black above; of scutellum lutescent with a row of longer black hairs around edge. Abdomen with usual opaque areas, pile of usual colors but the lighter pile inclined to be yellowish; legs as in *fraudulenta.* Wings cinereous hyaline with basal third clear; last section of third vein curved before its middle and much more parallel to edge of wing than in *fraudulenta;* last section of fifth vein nearly straight, subrectangular.

Female: Similar to female of *fraudulenta* but with the horizontal bare stripe of eyes narrower, almost obsolete; antennæ much more pointed below; pile inclined to be slightly yellowish. The shape of the antennæ, together with the pilose base of the arista and larger size, will at once distinguish the female.

I place *P. nigribarba* of Loew here, although not absolutely certain of the synonymy. In any case the above described sexes belong together, and, should this female prove to differ from *modesta*, the species would be *nigribarba*.

With regard to the validity of *fraudulenta*, I disagree with Williston. The two species are certainly distinct but very confusing, especially as *fraudulenta* may have the base of the third antennal joint somewhat reddish but the darker wings seem to be more constant. I have never seen *modesta* with cinereous wings.

Nine males and seven females, Vineland and Guelph, Ontario, April to late June. (Curran).

### Genus **Heringia** Rondani (Fig. 28 a-g, 42)

Face black, front slightly swollen; antennæ short in males, long in females; arista microscopically pilose to tip; males with venter of fourth segment only about half as long as its dorsum, and the hypopygium longer than in related genera, inclined to the right; middle tibiæ slender in both sexes; wings as in Pipiza. The females may be distinguished from allied genera by the narrow face, evenly pilose eyes, slender middle femora and larger size. Type of genus *Heringia heringi* Zett. (Europe).

#### Key to Species of Heringia

I. Females.

| | | |
|---|---|---|
| 1. | Antennæ entirely black | *comutata* |
| | Antennæ partly yellowish | 2 |
| 2. | Thorax entirely finely white pilose (eastern) | *salax* |
| | Thorax with longer, yellowish white pile (western, 9 mm.) | *californica* |

II. Males

| | | |
|---|---|---|
| 1. | Pile mostly reddish yellow (western) | *californica* |
| | Pile mostly whitish or blackish | 2 |
| 2. | Abdomen mostly whitish pilose | 3 |
| | Abdomen mostly brownish or blackish pilose | 4 |
| 3. | Front entirely black pilose | *canadensis* |
| | Front partly white pilose (larger, western) | *comutata* |
| 4. | Third joint of antennæ twice as long as wide, reddish yellow below; hypopygial grippers yellow | *salax* |
| | Third joint of antennæ $1\frac{1}{2}$ times as long as wide, bright yellow below; hypopygial grippers piceous; wings dark brownish | *intensica* |

### 9. **Heringia canadensis,** new species (Fig. 17, 32)

Habitat: Ontario! Small, black, whitish pilose; frontal triangle above and abdomen opaque.

Length, 5.5 mm. Male: Face and frons shining black, sides narrowly whitish pollinose; frons black pilose, opaque above; face white pilose, in profile gently rounded from antennæ to mouth; above antennæ a well marked carina, shaped like an inverted V; vertical triangle black pilose with whitish pile behind; eyes short brownish or blackish pilose with white pile below; posterior orbits white pollinose; below and at the vertex white pilose, elsewhere with black pile; occipital cilia black. Thorax and scutellum slightly shining, finely white pilose, with a few black hairs about humeri; scutellum with apical groove. Abdomen opaque black; first segment, a triangular spot on sides of two following, apical corners of fourth and its hind margin and hypopygium shining black; pile black, usual areas with whitish or cinereous pile; fourth segment below only half as long as above; hypopygium two-thirds as long as fourth segment. Legs black, blackish pilose; tips of femora, narrow base of hind and broader base of anterior four tibiæ, and first joints of middle tarsi, yellowish, other tarsal joints piceous. Wings infuscated; stigma yellowish; last section of fifth vein straight.

*Holotype*, male, No. 845, Mus. Calif. Acad. Sci., June 8, 1913 (Curran).

*Type locality*, Guelph, Ontario.

### 10. **Heringia intensica,** new species (Fig. 18)

Habitat: Ontario! Third joint of antennæ scarcely longer than broad, sub-oval; wings densely clouded, basal third and posteriorly lighter; pile mostly tawny.

Male: Length, 7 mm. Face in profile almost straight from antennæ to oral margin; pile black, tawny in middle; front moderately swollen, black pilose, opaque above; vertical triangle black pilose in front, tawny behind; occipital cilia black. Antennæ black; third joint with large basal bright yellow spot below, extended narrowly towards the tip; slightly longer than wide, sub-oval. Eyes brownish pilose. Thorax and scutellum slightly shining greenish black, sides purplish black; pile tawny, on pleuræ with some black hairs. Abdomen sub-opaque purplish black; first segment slightly shining black; usual areas shining brassy; hypopygium black, with a few long black hairs on basal half and white pile on apical half; abdominal pile long, tawny, the usual areas with black pile. Legs brownish black, brownish pilose; knees and first joint of middle tarsi yellow; basal two-thirds of front four tibiæ, second joint of middle and basal joint of the anterior tarsi, brown. Wings fuscous, more clouded across the middle; stigma luteous.

*Holotype*, male, No. 846, Mus. Calif. Acad. Sci., June 15, 1919 (Curran). *Paratype*, male, Jordan, Ont., August 27, 1920 (Curran), in collection of the author.

*Type locality*, Jordan, Ontario.

### 11. **Heringia salax** (Loew) (Fig. 16a)

*Pipiza salax* Loew, Century, VI, No. 39, 1865 (Berl. Ent. Zeit., IX, p. 152, 1865.)

Habitat: Pennsylvania (Lw.); Ontario! Wisconsin. Very similar to preceding, but antennæ longer, pile lighter in color and legs more largely yellow.

Male: Length, 8 to 8.5 mm. Face and frons shining greenish black, black pilose; face in middle with whitish pile; frons moderately swollen, opaque above; antennæ brownish; first joint black; third joint reddish yellow below, in shape oblong, twice as long as wide, obtusely pointed; arista black, its base yellow; pile of eyes black, brownish below; posterior orbits with white pile, above tawny; occipital cilia black. Thorax and scutellum shining greenish black, dorsum less shining; pile cinerescent, in some lights yellowish; on pleuræ, front border of thorax, and apex of scutellum, blackish. Abdomen opaque black, usual areas shining metallic black, somewhat brassy; first segment and hypopygium shining, not metallic; pile whitish or slightly grayish, usual areas with black pile; hypopygium, except tip, black pilose. Legs black; tips of all the femora, immediate base of hind, broad base and tips of front four tibiæ, yellow; front four tarsi luteous, their apical joints piceous. Wings cinereous, basal third more hyaline; stigma luteous.

Female: Length, 7 to 7.5 mm. Face and front shining bluish black, white pilose; front above and an area immediately above the base of the antennæ with black pile; front with the usual triangular pollinose spots. Antennæ black; third joint yellow below, elongate oval, slightly over twice as long as wide. Eyes evenly short whitish pilose; post orbital pile and cilia white. Thorax, scutellum and abdomen shining black; scutellum with or without a shallow apical groove; hind margins of second and third segments black pilose. Legs black; tips of all the femora, narrow base of hind and basal half of front four tibiæ and their tips, and basal two joints of their tarsi, yellowish; some; times the first three tarsal joints yellow with the apical black. Wings hyaline-stigma yellowish; last section of the fifth vein slightly bent at its middle.

Two males, three females, Guelph and Vineland, Ontario (Curran) and one pair, Wisconsin (Fluke).

I have no doubt that this is Loew's *Pipiza salax*. There are minor variations in my specimens in the color of the pile, which here appears to be darker. His description, "hypopygium much longer than in other species" undoubtedly applies here. The whole description applies very well. I give the synonymy of *P. radicum* Walsh & Riley and *P. pistica* Williston from a careful examination of the two species and an examination of the females of *H. comutata* and *H. californica* confirms my determination.

### 12. **Heringia comutata**, new species (Fig. 27)

Habitat: Oregon! California! Medium size; white pilose; third antennal joint less than twice as long as wide in the male.

Length 6.5 to 7 mm. Male: Face and frons shining metallic black with a bluish reflection; face receding, very slightly rounded above; white pilose, a few darker hairs on the cheeks; front black pilose, immediately above antennæ in middle and upper angle, with whitish pile; vertical triangle with whitish pile, sometimes a few black hairs in front. Antennæ black; third joint usually obscurely reddish below, one and one half times longer than wide, widest at the apical three-fourths then sharply rounded. Eyes brownish pilose, whitish below; post orbital pile and cilia white. Thorax, scutellum and abdomen shining black; thorax and scutellum white or slightly yellowish pilose, the pile more yellowish anteriorly; scutellum coarsely punctulate. Abdomen with the usual areas opaque; pile white, with the usual black pilose areas less extensive and less conspicuous than usual; left side of hypopygium white pilose, right side black pilose. Legs black; tips of all the femora, base of hind tibiæ, basal quarter of front and basal half of middle tibiæ, first two joints and tips of middle tarsi, yellow; first joint of anterior tarsi piceous yellow. Wings cinereous hyaline; stigma luteous.

Female: Very much like *H. salax*, but differs in having the antennæ entirely black and the third joint a little more pointed; pile slightly longer throughout and inclined to be yellowish on the front and thorax; black pile across the front less intense; scutellum with a well-marked apical groove; legs less extensively yellow, usually luteous or piceous instead of yellow; termination of the discal cell less acute; last section of the fifth vein nearly straight.

*Holotype*, male, No. 847, and *allotype*, female, No.

848, Mus. Calif. Acad. Sci., collected by F. R. Cole and received from Prof. A. L. Lovett. *Paratypes*, four males, same data, and one male, California, W. M. Davidson, in collections of Prof. Lovett, Mr. Davidson and the author.

*Type locality*, Hood River, Oregon.

### 13. Heringia californica (Davidson)

*Pipiza californica* Davidson, Ent. News, XXVIII, p. 417, 1917.

Habitat: California! Length 9 mm. Male: Face and front metallic bluish black; face receding, yellow pilose with a few darker hairs on the sides; front slightly swollen, black pilose with yellowish pile above; antennæ black, yellowish below, nearly twice as long as wide, sides parallel, apex obtusely rounded; vertical triangle with cinereous yellow pile; pile of eyes and posterior orbits yellowish; occipital cilia black. Thorax and scutellum shining metallic black, yellowish pilose, the latter with a shallow apical groove. Abdomen shining black, yellowish pilose; usual areas not so extensively blackish-pilose as usual; hypopygium with a few black hairs toward apex. Legs black; knees, front four tibiæ more broadly, and the basal two joints of their tarsi, yellowish. Wings cinereous hyaline; stigma luteous.

Female: Head and thorax shining purplish black; abdomen slightly brassy black, metallic. Antennæ black; third joint over twice as long as wide, more pointed and reddish below; face and front clothed with long yellowish white pile; immediately above each antenna with black pile, across the front above intermixed with black hairs; side spots of the front about twice as broad as long, separated by about two-thirds width of one spot. Eyes with rather long whitish pile. Thorax and abdomen white pilose, on dorsum of thorax more yellowish, on posterior margins of second and third abdominal segments black. Legs and wings as in the male.

Male and female, Walnut Creek, California, received from Mr. W. M. Davidson.

### Genus **Cnemodon** (Egger)

Middle tibiæ of males strongly produced anteriorly (Fig. 4), of the females rounded in front (Fig. 8); Males: Middle coxæ armed with a moderately long slender process (except in *unicolor*); hind trochanters armed with long processes (except in the first four species, see fig. 48), the hind coxæ often with a spur at the outer end. In four species the venter of the fourth segment is armed with a basal spur and a second spur or tubercle on the apical third; arista microscopically pilose to near tip (Fig. 41). The females are much alike, with few characters available for classification and these very difficult to use.

### Key to Species of Cnemodon

#### I. Males

| | | |
|---|---|---|
| 1. | Middle coxæ and hind trochanters without processes | *unicolor* |
| | Middle coxæ with slender process | 2 |
| 2. | Hind trochanters without the usual process | 16 |
| | Hind trochanters with long or short process | 3 |
| 3. | Venter of fourth segment with spur or tubercle on basal and apical thirds | 13 |
| | Venter of fourth segment without spurs | 4 |
| 4. | Process on hind trochanters moderately short; third antennal joint broader than long; a short rather stout white pilose species | *cevelata* |
| | Process on hind trochanters long and slender; third antennal joint not broader than long; neater appearing species | 5 |
| 5. | Hind coxæ without a spur, often with a tubercle on the outer end | 8 |
| | Hind coxæ with short sharp spur on outer end | 6 |
| 6. | Coxal spur small, slender, directed towards the femora (often difficult to discern because of the pile) | *lovetti* |
| | Coxal spur directed outwards, conspicuous | 7 |
| 7. | Face whitish pilose, at least in part, (eastern) | *coxalis* |
| | Face and vertical triangle entirely black pilose | *rita* |
| 8. | Venter of third segment carinate at apex | 10 |
| | Venter of third segment not at all carinate | 9 |
| 9. | Face entirely black pilose; abdomen inflated, slender | *elongata* |
| | Face white pilose in middle; abdomen not inflated; second segment of middle tarsi almost simple | *calcarata* |
| 10. | Wings pellucid hyaline; face entirely whitish pilose | *placida* |
| | Wings cinereous hyaline | 11 |
| 11. | Venter of fourth segment carinate at its immediate base | 12 |
| | Venter of fourth segment simple, not even rugose | *pisticoides* |
| 12. | Middle tibiæ produced from about the basal quarter, (western) | *auripleura* |
| | Middle tibiæ produced gradually from the base, (eastern) | *carinata* |
| 13. | Venter of fourth segment with tubercle on apical third | 14 |
| | Venter of fourth segment with spur on apical third | 15 |
| 14. | Tubercle on apical third considerably pilose; venter of third segment simple along carinate area | *ontarioensis* |
| | Tubercle larger, somewhat spur-like; venter of third segment rugose along carinate area | *trochanterata* |
| 15. | Wings evenly infuscated, (smaller) | *venteris* |
| | Wings with brownish cloud beyond the middle | *myerma* |
| 16. | Squamæ grayish fringed with cinereous pile | *squamulæ* |
| | Squamæ black or brown fringed with brown pile | 17 |
| 17. | Length about 8 mm: arista as long as the antennæ | *longiseta* |
| | Length under 7 mm: arista scarcely longer than third antennal joint; anterior legs considerably yellow | *intermedia* |

#### II. Females

| | | |
|---|---|---|
| 1. | Middle tibiæ not rounded in front | See *Heringia* |
| | Middle tibiæ rounded in front | 2 |
| 2. | Hind coxæ with a sharply pointed tubercle at outer end; pile of the venter depressed | 12 |
| | Hind coxæ with rounded tubercle or none | 3 |
| 3. | Third antennal joint clearly as broad as long, wings cinereous hyaline | *corvallis* |
| | Third joint at least slightly longer than broad | 4 |
| 4. | Wings purely hyaline, (western) | 5 |
| | Wings cinereous or brownish hyaline | 6 |
| 5. | Last section of fourth vein distinctly sinuous | *sinuosa* |
| | Last section of fourth vein nearly straight | *placida* |
| 6. | Pile of venter appressed or sub-appressed | 7 |

| | | |
|---|---|---|
| | Pile of venter mostly erect | 9 |
| 7. | Pile of venter sub-appressed | *auripleura* |
| | Pile of venter appressed | 8 |
| 8. | Median depression of frons transverse, broad, entire; wings cinereous hyaline | *pisticoides* |
| | Median depression of frons appearing circular; wings somewhat brownish, (western) | *albipleura* |
| 9. | Middle tibiæ with distinct groove below | *intermedia* |
| | Middle tibiæ not distinctly grooved below | 10 |
| 10. | Third joint of antennæ extremely large, obtusely oval; face with some black hairs on sides | *cevelata* |
| | Third joint more elongate, sub-rectangular | 11 |
| 11. | Last section of fifth vein nearly straight; third antennal joint brownish above | *coxalis* |
| | Last section of fifth vein bent at its middle; third antennal joint black above | *calcarata* |
| 12. | Thorax shining brassy | *myerma* |
| | Thorax shining black | 13 |
| 13. | Wings tinged with luteous | *ontarioensis* |
| | Wings cinereous hyaline, (smaller) | *venteris* |

The above key to the females is confessedly unsatisfactory, yet it is the best that I can devise at the present time. The females are evidently different, yet present so few characters which are available for a key that exceptional difficulty is encountered. I might add that the antennæ differ in all the species, as well as the coxal spurs and amount of production of the middle tibiæ, but it is apparent that these characters are of use only for comparison. I still have several females in my collection which are not named as I consider that the naming of unlocated females, unless their characters are outstanding, will merely lead to confusion as has been the case in the past.

The true relationship of the females in many cases can be determined only by rearing or capture of specimens in copulation. I secured one pair of *C. venteris* in this latter state. In studying the females the student must rely largely upon his sense of fitness in determining their relationship to the males. The females of the common species will be readily placed by careful collecting and labelling. A careful comparison with the figures in this work will also be of some help.

### 14. **Cnemodon unicolor,** new species (Figs. 13, 44)

Habitat: Ontario! Male: Length, 6 mm. Face and frons shining black, black pilose; face almost straight from antennæ to oral margin but slightly rounded above, sides whitish pollinose; frons opaque above; antennæ black; third joint bright yellow below, as broad as long; arista black; vertical triangle, post orbital cilia, and eyes black pilose, the latter whitish pilose below. Thorax and scutellum shining black, dorsum of former less shining; pile black, on disc and pleuræ more brownish; scutellum with a moderately well-marked apical groove. Abdomen opaque black; first segment in middle, margins of second, more broadly in middle, and posterior angles of third and fourth shining; apex of fourth segment opaque; pile black, moderately long, on sides of second segment in front brownish; hypopygium sub-opaque with short black pile. Legs black; tips of all the femora, narrow base of hind and broad base of front tibiæ and their tips, yellow; anterior tibiæ piceous in front; front tarsi yellow, their sub-apical joints and hind tarsi piceous; middle tibiæ produced anteriorly; pile of legs black. Wings evenly cinereous; last section of fourth vein bent at its proximal quarter; apex of discal cell very acute; last section of fifth vein almost straight; stigma luteous.

*Holotype*, male, No. 849, Mus. Calif. Acad. Sci., June 22, 1913 (Curran).

*Type locality*, Guelph, Ontario.

At once distinguished by the produced middle tibiæ and the absence of coxal or trochanteral processes.

**15. Cnemodon intermedia,** new species (Figs. 14, 16, 35, 45, 46)

Habitat: Ontario! Middle coxæ with processes, hind trochanters without processes; abdomen largely opaque, pile black, on the shining areas brownish; pile of thorax brownish with a black pilose band in front.

Male: Length, 6.5 mm. Face in profile almost straight from antennæ to oral margin, sides whitish pollinose; frons moderately swollen, opaque above; face and frons with moderately long black pile; antennæ black, second joint apically and third below, basally, yellowish; third joint sub-rectangular; vertical triangle and occipital cilia black pilose; eyes whitish pilose below, the pile becoming longer and brownish above. Thorax and scutellum black, the former slightly metallic; pile brownish, that of thorax in front and a few hairs on apex of scutellum black; scutellum moderately large, with an apical groove. Abdomen opaque; first segment, small lateral median spots on second, larger spots on third, sides of fourth segment posteriorly, and the hind margin, shining; pile black, on the sides of all segments in the middle and on the shining areas, brownish. Legs black; tips of all femora, base of hind tibiæ, front four tibiæ except a broad median black band, sometimes incomplete, and first two joints of front four tarsi, yellow; middle tibiæ produced anteriorly but not concave beneath; middle coxæ with a long slender process beneath. Wings cinereous, more hyaline on basal third and posteriorly; stigma luteous.

Female: Length, 5.5 mm. Face and front shining black; face and vertex white pilose; front black pilose, with lighter, somewhat yellowish pile across the middle; side spots of front separated by more than width of one spot; front with a broad depression below middle. Antennæ black; second joint and third below broadly yellow, third joint larger than in male, its apex more rounded. Pile of eyes rather sparse, short, dark. Thorax and scutellum shining black, slightly cupreous, whitish pilose. Abdomen shining, darker areas not distinct; pile black and white as usual. Legs colored as in the male; wings very slightly darkened.

*Holotype*, male, No. 850, Mus. Calif. Acad. Sci., June, 12, 1913 (Curran). *Allotype*, female, No. 851, Guelph, Ont., July 13, 1913, (Curran), Mus. Calif. Acad. Sci. *Paratypes*, two males, two females, Guelph, Ont., June and July (Curran), in collection of the author.

*Type locality*, Guelph, Ontario.

### 16. Cnemodon longiseta, new species

Habitat: Ontario! Very similar to *C. intermedia* but larger, the arista longer, legs less extensively yellow and the hypopygium different.

Length, 8 to 8.5 mm. Male: Head entirely black pilose except a few golden hairs at vertex and some cinereous pile on extreme lower part of eyes. Third joint of antennæ nearly twice as long as wide, bright yellow on basal third below; apex of second joint more or less yellowish or piceous; arista slender, long, its basal quarter yellowish. Thorax slightly shining black with three obscure opaque stripes on anterior half of dorsum, the middle one broadest and more distinct. Pile long, black; on dorsum more or less mixed with golden or reddish pile. Sometimes the pile may appear mostly reddish yellow on the disc. Scutellum black, with stouter black pile and with an apical groove and pre-apical impression. Squamæ brown, the edge darker, the fringe of hairs brownish. Abdomen opaque black, the usual areas shining; abdominal pile black with basal portion and margins more or less yellowish or tawny pilose, but not very conspicuously so. Legs black with black pile; tips of femora, basal third of front four and immediate base of hind tibiæ, yellow; front four tibiæ and first two joints of their tarsi reddish yellow; middle tibiæ more produced in front than in *C. intermedia*. Wings cinereous across the middle, the venation slightly variable.

*Holotype*, male, No. 878, Mus. Calif. Acad. Sci., July 11, 1920, H. Curran, collector. *Paratype*, male, Jordan, Ontario, June 20, 1920 (Curran), in Canadian National Museum.

*Type locality*, Jordan, Ontario.

### 17. Cnemodon squamulæ, new species

Habitat: Ontario! Very similar to *C. longiseta*, but the eyes and thorax wholly, and the abdomen largely, whitish pilose; the squamæ grayish, thus differing from the other two species of the group.

Length, 7.5 mm. Male: Face and front black pilose; vertical triangle and posterior orbits whitish pilose, the occipital cilia and a few hairs on the front of the vertical triangle black. Antennæ black, third joint below and apex of second reddish yellow: this joint one and one-half times longer than wide, its end obtusely rounded; arista slender, a little longer than third joint of antennæ, its basal third luteous. Thorax and scutellum shining, somewhat bronzed black, the former with an obscure opaque median stripe on front half; pile wholly whitish. Squamæ grayish, fringed with cinereous pile. Abdomen opaque black, the usual areas shining; pile black, the base, margins and lateral triangles in the middle of each segment whitish pilose. Legs black; tips of all the femora, narrow base of hind and basal third of front four tibiæ and their apices, and first two joints of front four tarsi, reddish yellow. Wings hyaline, stigma luteous.

*Holotype*, male, No. 879, Mus. Calif. Acad. Sci., May 16, 1920, H. Curran collector.

*Type locality*, Jordan, Ontario.

### 18. **Cnemodon cevelata**, new species (Figs. 50, 51)

Habitat: Ontario! Small; hind trochanteral process short, compressed and broadened; third antennal joint broader than long.

Length, 5.5 mm. Male: Face and frons shining bluish black; face whitish pilose, with a few black hairs on sides; frons with black vertical triangle with cinereous pile; antennæ black, third joint orbicular, yellowish basally below; eyes with short black pile, almost bare below. Thorax and scutellum shining black; pile sparse, long, wavy, whitish. Abdomen slightly shining black, opaque markings not conspicuous; pile inconspicuous except on the sides where it is long, whitish; the usual areas with blackish pile; hypopygium shining, inconspicuously short black pilose. Legs black; tips of all the femora, front tibiæ and their tarsi, base and apex of middle tibiæ and their tarsi, and base of the hind tarsi narrowly, piceous; middle tibiæ produced in front; hind basitarsi slightly incrassate; trochanteral process short, compressed and broadened, piceous; middle coxal processes black, the ends rounded. Wings cinerescent, more marked anteriorly about the middle; last section of fifth vein almost straight.

Female: Very similar to *intermedia* but third antennal joint shorter, only one and one-half times as long as wide (in *intermedia* it is twice as long); second joint black; face considerably black pilose about the oral margin; lighter pile of the front brownish intermixed with black; thorax and abdomen similar; legs black, tips of all the femora, broad base of all and tips of front four tibiæ and first two joints of their tarsi, yellowish; wings very slightly yellowish.

*Holotype*, male, No. 852, Mus. Calif. Acad. Sci., June 2, 1913 (Curran). *Allotype*, female, No. 853, Mus. Calif. Acad. Sci., Jordan, Ont., June 22, 1919 (Curran).

*Type locality*, Guelph, Ontario.

The extremely large roundish third joint of the antennæ is a good character for distinguishing the female while the short trochanteral process will at once distinguish the male from other species. The foregoing species form a very interesting series, representing the primary stages in the development of the long processes on the hind trochanters.

### 19. **Cnemodon elongata**, new species (Fig. 47)

Habitat: Ontario! Differs from *calcarata* in the abdomen being inflated and conspicuously narrower and not white pilose; the middle tibiæ with more abrupt and shorter production and third joint of the antennæ shorter and rounder.

Male: Length, 5.5 mm. Face and frons shining greenish black, black pilose; face considerably receding, rounded above, sides whitish pollinose, the pollen produced just below the antennæ to form a small triangular spot; frons swollen, opaque above; vertical triangle black pilose, with cinerescent pile across middle; occipital cilia black; antennæ black, third joint with quadrate yellow spot at base below; only slightly longer than wide, end obtusely rounded; arista black; eyes black pilose, becoming brownish or whitish below. Thorax and scutellum shining black, pile luteous, in front broadly black, especially at the humeral angles where it extends back along sides a short distance, on the pleuræ brownish; scutellum with apical groove. Abdomen narrow, thickened, opaque; sides of second segment, more broadly in middle, sides of third, broadly in middle, and sides and apical half of fourth, shining; pile black, on sides in front and the usual areas cinerescent or brownish. Legs black; knees, basal third of front four tibiæ and their tips and tarsi yellow, the latter piceous apically; second and third joints of hind tarsi piceous or brown; hind basitarsi slightly thickened; legs wholly black or brownish pilose. Wings cinereous; stigma luteous; last section of fifth vein sub-angulate at its middle; halteres brownish.

*Holotype*, male, No. 854, Mus. Calif. Acad. Sci., June 22, 1914 (Curran). *Paratype*, male, Jordan, Ont., June 15, in collection of the author.

*Type locality*, Orillia, Ontario.

### 20. **Cnemodon calcarata** (Loew) (Figs. 4, 5, 6, 8, 49)

*Pipiza calcarata* Loew Century, vi. No. 42, 1865; Williston, Synop. N. Am. Syrph., p. 24, 1886.

Habitat: New York (Lw); Ontario! Mostly whitish pilose, coxal spurs absent, scutellum usually with a shallow apical groove.

Length, 5.5 to 7 mm. Male: Face and frons shining black, black pilose, middle of face usually with whitish pile; vertical triangle usually whitish pilose behind; apex of the frons opaque; sides of the face and frons narrowly whitish pollinose; antennæ black, third joint subquadrate, not twice as long as wide, yellowish at base below; eyes brownish pilose; occipital cilia black. Thorax and scutellum shining bronze black, whitish pilose, the scutellum with or without an apical groove. Abdomen opaque black; sides, an interrupted fascia on third segment and apical half of fourth shining bronze black, the second segment often with large shining lateral spots of similar color; pile whitish, with the usual areas black pilose. Legs black; tips of all the femora, front tibiæ and tarsi, except sometimes the apical joints, middle tibiæ except a median piceous ring, with first three joints of their tarsi, base of hind tibiæ, tip of basitarsi and the following joint, yellow; anterior tibiæ with an incomplete brownish or piceous median band; apical joints of the tarsi black or piceous; coxal spur absent, hind trochanteral spur long. Wings cinerescent except the basal third which is hyaline; last section of fifth vein slightly curved at its middle.

Female: Face entirely white pilose; front blackish pilose, with white pile across middle and at vertex; antennæ black; second and third joints yellow below, third joint large, twice as long as broad. Scutellum usually with an apical groove. Fifth abdominal segment usually wholly white pilose, the black pile on anterior area of third and fourth segments extending only two-thirds the width of the segments. Front and middle tibiæ with broad blackish median bands; hind tibiæ with only the basal quarter yellow; first two joints of front and three of middle tarsi, yellow, the remaining joints becoming brownish. Last section of the fifth vein rectangular, curved outwards at apical third or quarter.

Twenty-five males and 14 females, Guelph, Orillia and Vineland, Ontario, (Curran).

I have no doubt about this being Loew's *Pipiza calcarata*, as my specimens agree entirely with his description. No mention is made of the process on the middle coxæ, but, as the hind coxal spur is not mentioned, it cannot be any of the following species. The female has been largely confused with *pisticoides*.

**21. Cnemodon corvallis,** new species (Figs. 25, 34)

Habitat: Oregon! Anterior four tarsi with only the first joint yellow; pollinose spots on the front separated by not quite the width of one spot; middle femora considerably rounded in front; third joint of antennæ rather large, slightly longer than wide; wings hyaline.

Female: Length, 5.5 mm. Face and front shining black; face receding to below middle, thence perpendicular to oral margin; sides narrowly whitish pollinose; frons white pilose at vertex and very narrowly across the middle, elsewhere blackish; pollinose spots large, their ends rounded, not separated by more than width of one spot and not connected with the side stripes; antennæ black; third joint reddish yellow below, rather large, slightly longer than wide, evenly rounded above, more pointed below; arista black, yellowish at base. Thorax and scutellum shining metallic black, short white pilose, the latter with a shallow apical groove. Abdomen shining black, short white pilose, with the usual areas black pilose. Legs black, knees and first joint of middle tarsi yellow; first joint of front tarsi piceous yellow. Wings hyaline, stigma luteous; last section of fourth vein bent at its proximal third, of the fifth curved beyond its middle.

*Holotype*, female, No. 855, Mus. Calif. Acad. Sci., A. L. Lovett, collector.

*Type locality*, Hood River, Oregon.

While I have several female specimens belonging to this genus which I cannot place but which evidently are not those of described species, I consider the characters of this form so distinct that I describe it here as a new species. I have no doubt that the male, when found, will be readily associated with the female.

**22. Cnemodon placida,** new species (Figs. 20, 22)

Habitat: Oregon! Wings pellucid hyaline; stigma luteous; projection of the middle tibiæ very broad, its lower corner rectangular, the tibiæ then gradually narrowing to apex. In the female the pile of the venter is appressed, that of the eyes very short, white.

Length, 7 mm. Male: Face and front shining black; face slightly rounded below antennæ, thence gradually receding to just above oral margin; entirely white pilose; frontal triangle wholly shining, black pilose; antennæ black; third joint yellow below basally, in shape orbicular; vertical triangle black pilose in front; occipital cilia black except at vertex; pile of eyes short, black, becoming shorter and white below. Thorax shining greenish black, thickly short white pilose, with luteous pile about base of wings; scutellum luteous pilose with a broad apical groove. Abdomen shining bronze black, the usual areas opaque; pile short, black; sides of abdomen, more broadly on first two segments, and a small rounded area on each side of third segment, separated from the lateral margin, white pilose; the usual lighter area on the fourth segment brownish pilose; hypopygium with black pile. Legs black; knees, broad base of front four tibiæ and their tips, first three joints of front and two of middle tarsi, yellow; middle basitarsi much hollowed beneath. Wings pellucid hyaline; stigma luteous.

Female: Face less receding than in the male, entirely white pilose; whitish pollinose stripes on the sides broadened just below the antennæ; front black pilose, across the middle with cinereous pile, with white at the vertex; frontal pollinose spots connected with the side stripes, very large, separated by less than the width of one spot. Antennæ black; second joint luteous; third yellow below at base, in shape elongate-rounded; arista yellow on basal third; eyes very short white pilose. Thorax and scutellum with pile shorter than in the male but entirely white. Abdomen silvery white pilose, the usual areas black pilose. Legs colored as in the male. Last section of fifth vein nearly straight and oblique in both sexes.

*Holotype*, male, No. 856, and *allotype*, female, No. 857, Mus. Calif. Acad. Sci., May 25, 1918, F. R. Cole, collector.

*Type locality*, Forest Grove, Oregon.

### 23. **Cnemodon lovetti,** new species (Figs. 26, 53)

Habitat: Oregon! Very closely allied to *coxalis* and *rita* but differing in the hind coxal spur which is directed backwards or towards the femora; the pile is darker, the discal cell is widened considerably towards the margin of the wing, and the last section of the fifth vein is long and straight.

Male: Length, 6.5 mm. Face and frons shining bluish black, black pilose; face somewhat brownish pilose in the middle, slightly rounded above, thence nearly straight to oral margin, sides with a short white pollinose stripe; frons considerably swollen, with a small roundish tubercle above the antennæ; vertical triangle and eyes black pilose the pile becoming brownish on lower part of eyes; post orbital cilia and pile black. Antennæ black; second and third joints yellowish below; third slightly longer than broad, sub-circular, flattened above toward base; arista black, slender. Thorax and scutellum shining bluish black, slightly metallic, the scutellum without an apical groove; pile whitish, the front of dorsum and the scutellum with brownish or black pile. Abdomen shining black, black pilose; sides of each segment in middle whitish pilose. Legs black, tips of femora, narrow base of hind tibiæ, front tarsi except the apical joints, yellowish; middle joints of hind tarsi piceous; hind coxal spur small, slender, inconspicuous, pointing backwards, not downward as in other species. Wings cinereous hyaline; stigma luteous; last section of fourth vein angulated at its proximal quarter; of the fifth straight.

*Holotype*, male, No. 858, Mus. Calif. Acad. Sci., July 25, 1909, 6000 feet elevation, J. C. Bridwell, collector.

*Type locality*, Horse Lake, Oregon.

In this species the spur is very slender and difficult to detect owing to the long pile.

### 24. **Cnemodon rita**, new species (Fig. 21)

Habitat: Oregon! California! Coxal spur stout, pointing downwards; antennæ entirely black or third joint yellow below basally; pleuræ black pilose.

Male: Length, 5.5 to 6.5 mm. Face and frons shining bluish black, black pilose; face receding, almost straight; frons considerably swollen, with a small elongate depression above the antennæ, not at all opaque. Antennæ black, the apical two joints appearing brownish; third joint as broad as long, subrectangular, the end almost evenly rounded, sometimes yellow basally, below; arista black; pile of eyes brownish, lighter below; post orbital pile white on lower half, black above; occipital cilia black. Thorax and scutellum shining bluish black with light pile, the humeri, pleuræ and scutellum with black pile; scutellum without apical groove. Abdomen shining purplish black with the usual areas opaque; pile black, with the usual areas whitish or cinereous pilose; hypopygium black pilose. Legs black; knees, tips of front four tibiæ and first three joints of their tarsi, yellowish; hind trochanteral processes moderately short, stout, somewhat pointed; middle coxal processes rather stout, long, pointed; middle tibial production gradually widening from base, terminating abruptly. Wings cinereous hyaline; stigma luteous; last section of fifth vein straight.

*Holotype*, male, No. 859, Mus. Calif. Acad. Sci., July 14, A. L. Lovett, collector. *Paratypes*, three males, Huntington Lake, Fresno Co., Calif., July 17, 1919, E. P. Van Duzee collector, and one male, same place, July 20, in Mus. Calif. Acad. Sci., and in collection of the author.

*Type locality*, Rock Creek, Oregon.

### 25. **Cnemodon coxalis**, new species (Figs. 15, 52)

Habitat: Ontario! Wisconsin! Male: Length, 6.5 to 7.5 mm. Face and frons shining bluish black, black pilose, middle of the face whitish pilose; vertical triangle whitish pilose behind; occipital cilia black; sides of face narrowly white pollinose. Antennæ black; third joint yellow below, longer than broad, end almost evenly rounded. Eyes blackish pilose. Thorax and scutellum shining brassy black, with long white pile, appearing yellow in some lights. Abdomen shining black, the usual areas opaque; shining areas inclined to be cupreous; pile short, black, the usual areas with white pile. Legs black; tips of all the femora, front tibiæ except a broad pre-apical piceous band, base four tibiæ except a median broad, incomplete band, and front and middle of middle and narrow base of hind tibiæ, first three joints of front and two of middle tarsi, yellowish; pile whitish; middle tibiæ produced in front; hind coxal spur sharp, its base large, tip directed outward; trochanteral process moderately long. Wings cinereous hyaline; stigma luteous; last section of fifth vein straight.

Female: White pilose; front black pilose, across the middle with cinereous or white pile; vertex with white pile; pile of the posterior orbits, including occipital cilia, white; face receding to below the middle, thence perpendicular. Antennæ black, second joint apically and the third below, yellow; third joint nearly twice as long as wide, the end rounded more gradually above. Side stripes of the face markedly enlarged below the antennæ; of the frons elongate triangular, their upper ends rectangular; eyes with short cinereous pile above, white below. Thorax shining greenish black; scutellum black, densely punctured, appearing granulated. Abdomen purplish black, white pilose with the posterior margins of the second to fifth segments black pilose. Legs as in the male. Wings hyaline; last section of fifth vein bent outwards beyond the middle.

*Holotype*, male, No. 860, Mus. Calif. Acad. Sci., June 8, 1919, H. Curran collector. *Allotype*, female, No. 861, Mus. Calif. Acad. Sci., Orillia, Ont., Sept. 1, 1914, H. Curran collector. *Paratypes*, six males and four females, Orillia and Jordan, Ont., May to September, and one pair, Madison, Wisconsin (Fluke collector), in collection of the author.

*Type locality*, Jordan, Ontario.

### 26. **Cnemodon nudifrons,** new species

Habitat: Oregon! Female: Length, 5 mm. Wholly shining black. Face and frons whitish pilose; frons without white pollinose spots; sides of face narrowly whitish pollinose; epistoma prominent; eyes extremely short brown pilose. Antennæ luteous; first joint black, third orbicular; occipital cilia cinerescent. Thorax light pilose, the pile longer on the pleuræ. Abdomen two-thirds as broad as long; pile short, whitish, the posterior margins of the segments inconspicuously black pilose; ovipositor brownish, its tip bifurcate. Legs black; knees, tips of all the tibiæ and all the tarsi, yellowish, the apical joints of the tarsi reddish. Wings hyaline; stigma luteous; last sections of fourth and fifth veins almost straight. Halteres whitish yellow.

*Holotype*, female, No. 877, Mus. Calif. Acad. Sci. , collected by Prof. A. L. Lovett, received from Mr. P. W. Fattig, Gainsville, Florida, and presented by him to the California Academy of Sciences.

*Type locality* ,Mount Jefferson, Oregon.

Easily recognized by the absence of the white pollinose spots on the frons possessed by all other known American species. It may prove to be an European species.

### 27. Cnemodon sinuosa, new species (Figs. 19, 31, 33)

Habitat: Oregon! Easily recognized by the sinuous last section of the fifth vein.

Female: Length, 5.5 mm. Face slightly rounded above, a little concave below the middle; oral margin very slightly produced; entirely white pilose; dust area at sides slightly produced below antennæ; front black pilose, across the middle and above with white pile; triangular spots small, separated from the side stripes; eyes extremely short black pilose, becoming white below. Antennæ black; tip of the first and the second and third joints below, yellow; third joint very large, broadest just before the tip which is rounded, more pointed below; arista yellow, tip darker. Thorax and scutellum slightly shining greenish black, white pilose; scutellum with a well-marked apical groove. Abdomen slightly shining purplish black, white pilose, the usual areas with black pile; fifth segment black pilose at apex. Legs black; knees, broad bases and tips of front four tibiæ and first two joints of their tarsi, tip of the hind basitarsi and the following joint, yellow. Wings cinereous hyaline; stigma dilutely luteous.

*Holotype*, female, No. 862, Mus. Calif. Acad. Sci., May 25, 1918, F. R. Cole, collector.

*Type locality*, Forest Grove, Oregon.

### 28. Cnemodon pisticoides (Williston) (Figs. 54, 58)

*Pipiza pisticoides* Williston, Synop. N. Am. Syrph., p. 29, 1886.

Habitat: White Mountains (Will.); Ontario! Mostly white pilose; middle coxal process pointed; hind trochanteral process long; third segment below carinate at apex; fourth segment below not carinate or rugose at base.

Male: Length, 6 mm. Face and frons shining black, slightly greenish; face slightly receding to below the middle, thence perpendicular to the oral margin; sides whitish pollinose; pile whitish, some black hairs about the mouth; frons swollen, black pilose; vertical triangle black pilose in front, occipital cilia black, at immediate vertex white; eyes short whitish pilose. Antennæ black, third joint yellow at base below, sub-quadrate. Thorax and scutellum shining greenish black, white pilose, middle of pleuræ with reddish yellow pile; scutellum with apical groove. Abdomen shining, slightly purplish black, the usual areas opaque; pile white, on the usual areas shorter, black, lateral margins entirely white pilose. Venter of third segment carinate at apex, fourth segment simple. Legs black; tips of all femora, base of hind four tibiæ, first three joints of front and two of middle tarsi, yellow; front tibiæ piceous, ends yellow. Wings hyaline; stigma luteous; last section of fifth vein straight, parallel to margin of wing.

Female: Length, 5.5 mm. Pile of venter appressed. Face receding, rather long; sides narrowly whitish pollinose, produced below the antennæ; spots of front large, nearly round; face, vertex and a narrow stripe across below the middle of the front, white pilose; elsewhere the front is black pilose. Antennæ black, second and third joints yellowish below; third joint short oval; arista black, its base luteous. Thorax and scutellum shining greenish black, white pilose; scutellum with apical groove. Abdomen shining black, pile short, white; apex of all the segments, narrow anterior margins and a narrow median connecting stripe on second and third segments, with black pile. Venter entirely white pilose, the pile of the third and fourth segments appressed. Legs colored as in the male; middle tibiæ more rounded in front than usual. Wings hyaline; stigma luteous; last section of fifth vein bent at its middle.

Male and female, Orillia, Ontario (Curran.) I do not give various reported localities as I consider the determinations doubtful.

**29. Cnemodon auripleura,** new species (Figs. 23, 24)

Habitat: Oregon! California! British Columbia. Closely related to *carinata*, but the face more largely black pilose; pile of the pleuræ more reddish; wings cinereous or luteous hyaline; projection of middle tibiæ strongest at the middle.

Male: Length, 6 to 6.5 mm. Face and frons shining bluish black, black pilose; face in middle white pilose; sides narrowly white pollinose, in profile slightly receding; frons slightly swollen, with small, roundish tubercle above the antennæ; vertical triangle white pilose, with a few black hairs in front; post orbital pile whitish; occipital cilia black; eyes brownish pilose, lighter below. Thorax yellowish white pilose; humeri with brown, pleuræ with reddish, pile; scutellum with shallow apical groove, the pile yellowish white. Abdomen shining metallic black, the usual areas opaque; pile black, with the usual areas whitish; venter of third segment at apex and of fourth segment at base, sharply carinate. (In this species there is some variation in the base of the fourth segment, in some specimens the carina is not very distinct, but the base is strongly rugose.) Legs black; knees, anterior tibiæ except an incomplete median piceous band, tips of middle tibiæ and first three or four joints of anterior four tarsi, yellowish; middle tibiæ piceous, its projection when viewed from above abrupt at both ends; processes on middle coxæ and hind trochanters black. Wings cinereous- or luteous-hyaline; stigma luteous; last section of fifth vein nearly straight.

Female: Length, 5.5 mm. Face white pilose; frons brownish pilose, across the middle and at the vertex with white pile. (In the two specimens it is impossible to determine the extent of the pollinose spots.) Antennæ black; second and third joints yellowish below, third one and one half times longer than wide, end evenly rounded; arista yellow at base. Thorax and scutellum white pilose: scutellum distinctly rugose, with an apical groove; pile towards the end grayish. Abdomen rather broad; white pilose, with the usual areas shorter black pilose; pile of venter sub-appressed. Legs black; tips of all femora, narrow base of hind tibiæ, and four anterior tarsi, yellow, the tarsi becoming darker toward the apical joints which are blackish; front four tibiæ yellow, piceous on outer side. Wings luteous hyaline, basal third more clear; stigma yellowish; last section of fifth vein bent before its middle.

Twenty-five males and two females, Hood River, Oregon (F. R. Cole), received from Professor Lovett. One male, California, Mr. W. M. Davidson, and one female, Cranbrook, B. C. (Garrett).

*Holotype*, male, No. 863, Mus. Calif. Acad. Sci., June 16, 1917, F. R. Cole, collector. One male *paratype* in Canadian National Collection.

*Type locality*, Hood River, Oregon.

**30. Cnemodon albipleura,** new species (Figs. 100, 101)

Habitat: California! Differs from *auripleura* in having broader middle tibiæ, front less swollen above the antennæ, frontal depression circular and deeper and pile of the venter appressed, not sub-appressed.

From *pisticoides* it differs as from *auripleura* but the pile of the venter is appressed in both species.

Female: Length, 5.5 mm. Face and frons shining metallic greenish black, whitish pilose; frons black pilose except across the middle and at the vertex; the depression on the frons well marked, much deeper in the middle than in most species and more shallow at the sides where it is almost obsolete, although a distinct transverse line can be observed when viewed from above. Face considerably receding, epistoma slightly produced. Antennæ black, tip of second joint luteous, third below broadly yellow at base, in shape slightly longer than wide; arista luteous at base; eyes inconspicuously pilose; occipital cilia white. Thorax and scutellum shining black, white pilose; scutellum with well marked apical groove. Abdomen shining black, very short white pilose; broad apical area on second and third segments not reaching the sides, with black pile. Legs black; tips of femora, base of front and hind tibiæ, broad base of middle tibiæ, with tips of the front four, and first two joints of their tarsi, reddish yellow. Wings slightly brownish; stigma luteous; last section of fourth vein bent near its basal quarter; of the fifth oblique, slightly sinuous. Halteres yellow. Middle tibiæ strongly rounded in front, more so than usual, the frons less rounded than in allied forms.

One female specimen from Mr. W. M. Davidson, dated, "16 viii, 1911." Of this specimen he writes: "The specimen without locality record was collected in California, I think at San Jose, but am not positive." Type placed in the United States National Museum.

**31. Cnemodon carinata,** new species (Fig. 59)

Habitat: Ontario! Black, shining and opaque; apical third of third abdominal segment and immediate base of fourth, below, carinate; face white pilose.

Male: Length, 6 mm. Face and frons shining black; face rounded above, receding, sides narrowly whitish pollinose, white pilose; a few black hairs at sides of the mouth; front moderately swollen, black pilose; a very conspicuous pit above the base of the antennæ. Antennæ black, third joint obscurely yellowish at base below, in shape oval; arista black. Vertical triangle whitish pilose, a few black hairs in front; eyes black pilose, below whitish; posterior orbital pile cinerescent; occipital cilia black. Thorax and scutellum shining greenish black; white pilose. Abdomen shining slightly purplish black; pile white, the usual areas black pilose, the usual opaque areas indefinite; the light pile cinerescent in some lights. Legs black; tips of all the femora, base of all the tibiæ, whole of the anterior ones in front, tips of anterior four and first three joints of their tarsi, yellow; pile white except at ends of the femora where it is blackish. Wings hyaline; stigma luteous; last section of fourth vein almost parallel to margin of wing; of the fifth straight.

*Holotype*, male, No. 864, Mus. Calif. Acad. Sci., June 22, 1919, H. Curran, collector. *Paratypes*, three males;

Jordan, Ont., June (W. A. Ross); Guelph, Ont., June, 1913, and Jordan, Ont., June 13, 1920 (Curran). One *paratype* in Canadian National Collection.

*Type locality*, Jordan, Ontario.

**32. Cnemodon venteris,** new species (Figs. 60, 63, 64, 65)

Habitat: Ontario! Small, whitish pilose; middle coxal process slender, black; hind trochanteral process short, stout, the end whitish; fourth ventral segment with two spurs.

Male: Length, 6.5 mm. Face very slightly rounded above, almost straight from the antennæ to the oral margin; sides narrowly whitish pollinose, a few black hairs about the oral margin, elsewhere the pile is white; frons black pilose, not noticeably opaque above. Pile of vertical triangle tawny, black in front; occipital cilia black. Antennæ brownish black; second joint and tip of the third below, yellowish; third joint one and one half times longer than wide, sub-pointed below. Eyes black pilose, the pile shorter and whitish below. Thorax and scutellum metallic black, the scutellum less so; pile tawny, in some reflections whitish, on the pleuræ distinctly white. Abdomen shining black, the usual areas opaque; pile whitish or slightly yellowish, shorter on the usual black areas; fourth ventral segment with a basal pointed spur, partly concealed beneath the venter of the third, and a second stouter, less pointed spur on apical quarter. Legs black; tips of all the femora, base of all the tibiæ, tips of the front four and their tarsi, yellowish, the apical tarsal joints darker; white pilose, ends of hind femora black pilose. Wings cinereous hyaline; stigma luteous.

Female: Length, 5.5 mm. Antennæ yellow, all the joints black above; third two and one-half times as long as wide; face straight, white pilose; front black pilose above the antennæ and in front of the ocelli. Eyes short white pilose; occipital cilia white. Thorax shining greenish black, white pilose; scutellum with an apical groove. Abdomen shining black, the last two segments metallic deep bluish; pile short, whitish, but appearing darker on the apical segments, the usual areas inconspicuously black pilose. Legs as in the male but the last three joints of anterior four tarsi piceous. Wings hyaline; last section of fifth vein curved beyond the middle.

*Holotype*, male, No. 865, and *allotype*, female, No. 866, Mus. Calif. Acad. Sci., June 15, 1919, H. Curran collector.

*Type locality*, Jordan, Ontario.

**33. Cnemodon myerma,** new species (Figs. 62, 66, 69)

Habitat: Ontario! Differs from *ontarioensis* in having the spur on the apical third of the segment well developed; projection of middle tibiæ slightly greater and the wings more densely clouded.

Male: Length, 8 mm. Face and frons shining greenish black; face rounded above, moderately receding; pile tawny, on the sides and cheeks black; frons swollen, black pilose except a few whitish hairs above. Occipital cilia black except at vertex; vertical triangle tawny pilose with a few black hairs in front. Antennæ black; third joint yellow below, large, subrectangular, more pointed below; arista brown, the base lighter. Pile of eyes tawny brown. Thorax and scutellum slightly shining black; pile tawny; scutellum with a shallow apical groove. Abdomen opaque, the usual areas shining purplish black; pile tawny, the usual areas with shorter black pile; venter of third segment with apical half carinate; fourth segment with a small basal spur and a larger, slightly pointed one on apical third; hypopygium mostly black pilose. Legs black; tips of all the femora, basal third of the hind and basal half of the front four tibiæ, and their tips and tarsi, yellow; apical joints of tarsi and hind basitarsi, piceous; hind coxal spurs short and pointed; hind trochanteral processes short, tipped with whitish. Wings densely clouded with pale brownish, except at the base and posteriorly where the cloud is fainter.

Female: Length, 7.5 mm. Head and thorax shining greenish black; white pilose except immediately above the antennæ and across the front above, where the pile is black; spots of the front large, sub-triangular, not touching the eye on their upper half; face rounded above, slightly less receding than in the male; eyes short white pilose. Antennæ yellow, third joint blackish on upper third, slightly larger than in the male; arista brown, its base reddish. Scutellum with an apical groove. Abdomen shining black; pile short, white; apical margins of second and third segments shorter black pilose; black pile nowhere reaching the sides. Legs colored as in the male but the tarsi entirely yellow except basal half of hind basitarsi, which is blackish; hind coxæ with a small conical spur. Wings hyaline; stigma yellowish; halteres yellow.

*Holotype*, male, No. 867, Mus. Calif. Acad. Sci., June 13, 1913, H. Curran, collector. *Allotype*, female, No. 868, Mus. Calif. Acad. Sci., Jordan, Ont., June 8, 1919, H. Curran collector.

*Type locality*, Jordan, Ontario.

### 34. **Cnemodon ontarioensis,** new species (Figs. 61, 67, 68)

Habitat: Ontario! Male: trochanteral spurs short, slightly pointed; fourth ventral segment with a tubercle on apical third.

Male: Length 7 mm. Face and frons shining bluish black; pile cinerescent, above antennæ and in front of ocelli, blackish; eyes with short brown pile. Antennæ short, luteous; third joint brownish above, one and one-half times longer than wide; arista luteous at base. Thorax scutellum and abdomen shining black, the latter with the usual areas opaque; pile of thorax luteous; abdominal pile whitish or yellowish, the usual areas with black pile; spur at base of fourth segment straight; tubercle on apical third rather sharp, pilose. Femora black, tips yellow; hind tibiæ with base and apex yellow; anterior four tibiæ yellow, with broad piceous ring below the middle; tarsi except apical joints, yellow; pile cinereous, on the hind tibiæ in front shorter and black. Wings slightly brownish, less so on basal third.

Female: Length, 6 mm. Shining black, white pilose; front above and immediately above the antennæ with black pile. Antennæ large, black; second joint at apex and third below, yellow; third joint large, twice as long as wide. Face receding, straight to just above the oral margin. Scutellum with an apical impression. Abdomen with the usual areas and apex of the fourth and fifth segments black pilose. Legs colored as in the male; coxal spur small. Wings tinged with luteous; last section of fifth vein bent beyond its middle.

*Holotype*, male, No. 869, Mus. Calif. Acad. Sci., June 13, 1913, H. Curran collector. *Allotype*, female, No. 870, Mus. Calif. Acad. Sci., Jordan, Ont., June 15, 1919, H. Curran, collector.

*Type locality*, Guelph, Ontario.

**35. Cnemodon trochanterata** Malloch (Figs. 96, 97, 98, 99)

Malloch, Proc. Ent. Soc., Wash., XX, p. 127, 1918.

Habitat: Illinois! Pile mostly tawny; posterior ventral tubercle large; wings clouded with luteous brown; hind trochanteral spur small.

Male: Length, 7 mm. Antennæ brownish, second and third joint basally, below, yellowish; third joint twice as long as broad, less rounded below; face and front shining bluish black, light yellowish pilose, above the antennæ and the front of the vertical triangle with blackish pile. In profile the face is receding, slightly rounded above; eyes brownish pilose; occipital cilia yellowish, the lateral hairs black. Thorax and scutellum æneous black, the latter slightly bluish at the apex; pile tawny, on the pleuræ lighter. Abdomen opaque black, first segment and the usual areas shining, metallic; pile tawny, the usual areas with shorter black pile; hypopygium black pilose; venter of third segment carinate, the middle of the carina flattened and transversely rugose; basal spur on fourth segment conspicuous, the process on apical third large, tuberculate. Femora black, tips yellowish; tibiæ and tarsi yellowish; middle tibiæ with broad band beyond the middle and hind tibiæ except the broad base and end, blackish; front tibiæ posteriorly blackish beyond the middle; last one or two joints of all the tarsi brownish, the hind basitarsi obscurely brownish; middle tibiæ slightly produced anteriorly; middle coxal process slender, short, not very conspicuous; hind coxal spur small, not conspicuous; hind trochanteral process slender, over twice as long as thick, luteous, its base black; hind coxal articular surface luteous, bell-shaped, but more produced behind and not reaching the base of the coxæ. Wings luteous-brown, more deeply so across the middle; stigma yellow; halteres yellow, the knobs slightly brownish.

The above description was made from a paratype loaned by Dr. J. R. Malloch, labelled, "St. Joseph, Ill., May 10, 1914, Salt Fork."

The outstanding differences distinguishing *ontarioensis* from this species are: *ontarioensis*—middle coxal process smaller; hind coxal spur larger, stouter; hind trochanteral process half black, the end slightly compressed; articular surface on outer side of hind coxæ much smaller, but broader at base; wings darker; hypopygium not all black pilose; face more projecting below; ventral tubercles smaller, and *venter of third segment not rugose.*

These species are of much interest, evidently representing an evolutional stage. (See note in appendix.)

Genus **Pipiza** Fallén (Fig. 43)

Face much broader at oral margin than at base of antennæ; antennæ short, third joint never elongate, rarely almost twice as long as wide (Europe); abdomen often with yellow markings; hind femora slightly to much thickened, if much thickened the ventro-apical region bearing two rows of very short spine-like hairs; females more often than the males with yellow markings. In our species the development of the hind femora is equal in the two sexes.

### Key to Species

1. Abdomen with yellow spots 2
   Abdomen wholly black 5
2. Abdomen with four yellow spots *quadrimaculata*
   Abdomen with only two yellow spots 3
3. Hind femora considerably incrassate and bearing spinules near the end 4
   Hind femora only slightly incrassate; spinules wanting; wings never clouded *nigripilosa*
4. The spinelike hairs not borne on a triangular projection; tarsi wholly yellow *festiva*
   Spinelike hairs borne on a triangular projection; apical one or two tarsal joints blackish *femoralis*
5. Hind femora with spinose area near the end, often greatly enlarged 6
   Hind femora without rows of spinules, never much enlarged 11
6. Legs and tarsi entirely black; hind femora considerably enlarged; face without shining median stripe *oregona*
   Legs or tarsi in part yellow; hind femora variously enlarged 7
7. Hind femora very much enlarged; wings hyaline or tinged with luteous between veins 8
   Hind femora moderately enlarged; wings darkened or clouded 9
8. Hind femora with greatest enlargement beyond the middle; antennæ entirely blackish *macrofemoralis*
   Hind femora with greatest enlargement at the middle; second antennal joint reddish *grandifemoralis*
9. Ventral apex of fourth segment narrowly emarginate at its middle; face partly black pilose; (about 9 mm., eastern) *severnensis*
   Ventral apex not emarginate 10
10. Second segment with faint indications of yellow spots; face chiefly whitish pilose *femoralis*
    Second segment entirely black; wings not clouded, evenly diluted with pale brownish; face chiefly black pilose *tricolor*
11. Squamæ dark, fringed with black hairs *distincta*
    Squamæ fringed with whitish hairs 12
12. Abdomen wholly with black or brownish black pile *nigripilosa*
    Abdomen in large part whitish pilose 13
13. Face wholly white pilose or with shining median stripe, (larger, 7.5 to 9 mm.) 14
    Face black pilose near the mouth only (6 to 8 mm.) *puella*
    Face entirely black pilose (about 6 mm.) *vanduzeei*
14. Pile short; face short, third antennal joint rather long; front very broad; thorax brassy black *latifrons*
    Pile long; thorax steely black; face rather long, with slender median shining stripe *davidsoni*

### 36. Pipiza distincta, new species

Habitat: California! Mostly black pilose; legs entirely slender; squamæ with fringe of black hairs.

Male: Length, 5 mm. Face and frons shining black; eyes luteous pilose, elsewhere the pile of the head black. Antennæ black; third joint more brownish, sub-rectangular, yellowish below; arista luteous, microscopically p.'ose to tip. Face in profile slightly receding, a little rounded in the middle and slightly concave above and below this. Thorax and scutellum shining black, black pilose; disc of thorax with brownish red pile. Abdomen shining, the usual areas sub-opaque; pile black, the anterior angles and the sides of the third and fourth segments in the middle with reddish pile which is obscure on the distal segments and does not noticeably reach the sides: pile on middle of second segment reddish in some lights; last section of hypopygium broad, rather short. Legs black; anterior four knees, tips of anterior tibiæ and all the tarsi, luteous, the posterior tarsi darker apically. Wings slightly clouded with brownish, more marked on the antero-middle; stigma luteous; discal cell very acute apically; squamæ dark, fringed with black hairs. The pile throughout dense, stout and rather long.

*Holotype*, male, No. 871, Mus. Calif. Acad. Sci., July 5, 1919, E. P. Van Duzee collector, 7000 feet elevation.

*Type locality*, Huntington Lake, Fresno Co., Calif.

This species will at once be recognized by its small size and the fringe of black hairs on the squamæ.

### 37. Pipiza vanduzeei, new species

Habitat: California! British Columbia! Squamæ and fringe of hairs whitish; thorax white pilose; pile of abdomen not at all reddish; wings hyaline.

Male: Length about 5 mm. Face and frons shining black, thinly whitish pollinose, black pilose; face receding. Antennæ short, black; third joint reddish below, broader than long (arista missing). Eyes brownish pilose, lighter below; vertical triangle white pilose behind; posterior orbits with whitish pile and black occipital cilia. Thorax and scutellum shining black, with obscure bronze reflection; pile on dorsum and pleuræ whitish, on the margins of the dorsum black; scutellum with light pile and a fringe of isolated long black hairs. Abdomen opaque black, with the usual areas shining coppery or bronzed; pile white, posterior margins of segments two and three, anterior margins of segments three and four and the hypopygium, with black pile. Legs black; tips of femora, anterior tibiæ except a piceous band on apical half, broad base and tip of middle tibiæ, immediate base of hind tibiæ and all the tarsi, yellowish; hind basitarsi basally, and apical three joints of all the tarsi slightly brownish. Wings hyaline; stigma luteous; discal cell less acute than in *distincta*. Halteres luteous, the knobs darker. Squamæ whitish, fringed with white hairs.

*Holotype*, male, No. 872, Mus. Calif. Acad. Sci., May 25, 1919, E. P. Van Duzee, collector. *Paratypes*, two males, Cranbrook, B. C., 1918 (Garrett), in collections of Mr. Garrett and of the author.

*Type locality*, Fairfax, Marin Co., Calif.

Close to *puella*, from which it may be distinguished by the entirely black pilose face and frons; broad third antennal joint; black pile on margins of thorax and apex of scutellum and the absence of a brownish cloud on the wings.

### 38. Pipiza puella Williston

*Pipiza puella* Williston, Synop. N. Am. Syrph., p. 27, 1886.

Habitat: N. H. (Will.) Ontario! Pile chiefly whitish, moderately long for a Pipiza; hind femora without a spinulose triangle near the end.

Male: Length 6 to 8 mm. Face metallic bluish black, thinly dusted with white pollen, in profile considerably retreating from the antennal base to just above the oral margin; Antennæ black, third joint thinly whitish pubescent, giving a brownish appearance, and usually with the basal half below obscurely reddish; in shape elongate sub-cordate; arista wholly rather stout and not much longer than third joint. Pile of the eyes tawny, of the head elsewhere moderately long, whitish; except just above the base of the antennæ where it is black; sometimes a few black hairs among the occipital cilia. Thorax and scutellum shining black, wholly whitish pilose. The white squamæ with a yellow margin and a fringe of whitish pile. Abdomen chiefly whitish pilose, the usual areas with shorter black pile; apex of fourth segment wholly whitish pilose. Legs black, tips of all the femora, front four tibiæ except a broad blackish ring beyond the middle, sometimes almost wanting on the front pair, basal third of hind tibiæ and their ends obscurely, and the first two tarsal joints yellowish; hind basitarsi brownish apically. Wings more or less brownish beyond the middle.

Three specimens, Ontario (Curran). One specimen was very kindly compared with the type in the National Museum at Washington by Mr. R. C. Shannon, and differed but slightly. The type, according to Mr. Shannon, is somewhat teneral.

### 39. Pipiza nigripilosa Williston (Figs. 30, 70, 71)

Williston, Synop. N. Am. Syrph., p. 28, 1886.

Habitat: Pennsylvania (Will.); Quebec; Ontario! Blackish pilose; female with an arcuate interrupted yellow band on second abdominal segment; hind femora slightly enlarged, not bearing spinose hairs at the outer end.

Length, 7 to 8 mm. Male: Face and frons shining black, lightly dusted with whitish pollen, black pilose; antennæ black, third joint rather lighter, elongate cordate; arista brownish black, its base yellow; eyes brownish pilose, post orbital pile lighter below. Thorax and scutellum brownish or blackish pilose, the upper portion of the pleuræ always black pilose. Abdomen shining black, the usual areas somewhat opaque; pile black, but sometimes brownish on the broad median lateral margins of each segment. Legs black; tips of femora, basal quarter of hind and half of front four tibiæ, tips of all the tibiæ and the tarsi, yellow; tarsi with last two or three joints darker; pile of legs black or brownish black; hind femora gradually broadened to near the end where they are somewhat suddenly constricted to about three-fourths their greatest width. Wings cinereous hyaline; stigma luteous.

Female: Not at all similar to the male. Face and front shining black; face lightly dusted with whitish pollen; front with a rather large triangular dusted spot on each orbit below the middle; pile white, black immediately above the base of the antennæ; across front before ocelli brownish black pilose. Antennæ black, tip of second and whole of third joint brownish; arista yellow at base. Eyes very short white pilose; post-orbital pile and occipital cilia entirely white. Thorax and scutellum with short white pile. Abdomen shining black, second segment with an arcuate, broadly interrupted, yellowish red cross-band, often resembling two large sub-quadrate yellow spots, the outer ends usually more rounded in front. These spots do not vary much and are about 1½ times as long as wide. Pile of abdomen short, white, except the usual areas where the pile is very short and black. Legs as in male except that the pile is shorter and white. Wings as in male.

Numerous specimens of both sexes from various parts of Ontario. The male cannot well be confused with any other species, but the female is easily confused with *femoralis* but can be readily distinguished by the absence of the spinose area on hind femora. There can be no question about this female belonging here. *Pipiza femoralis* is common in Ontario and the hind femora in both sexes bear spinose hairs.

### 40. **Pipiza davidsoni,** new species (Figs. 104, 108)

Habitat: California! Rather robust; metallic blackish, the thorax metallic bluish black; hind femora very slender.

Length, 7.5 to 9 mm. Male: Face and frons shining metallic bluish black; thinly covered with whitish pollen which leaves a very narrow median facial stripe extending onto the front, bare and shining; pile rather long, black; on the face appearing lighter colored, sometimes white on cheeks; vertical triangle with lighter pile behind. Antennæ black; third joint obscurely reddish, in shape sub-cordate, scarcely longer than broad; second joint sometimes luteous apically. Eyes with brownish or tawny pile above, more whitish below; post orbital pile and cilia blackish. Antennal process less produced and less conical than usual. Thorax and scutellum shining metallic bluish; finely and sparsely long white pilose, on the humeri slightly grayish pilose; on apical portion of scutellum with long black hairs intermixed; scutellum without a groove. Abdomen shining metallic black, the usual areas opaque; pile moderately long, light colored, the usual areas reaching sides, with black pile; hypopygium entirely black pilose; basal portion of sexual organ broader than long. Legs black, white pilose; tips of all femora, narrow base of hind, base of front four tibiæ and their tips and tarsi, luteous reddish; hind basitarsi and apical joints of all tarsi darker; hind femora very slender, not spinose. Wings hyaline; stigma luteous; halteres blackish.

*Holotype*, male, Walnut Creek, California, no date or collector's label, but probably taken by Mr. Davidson, in the United States National Museum.

*Paratype*, male, Fairfax, California, April 16, 1913, in the Museum of the California Academy of Sciences.

This species is very readily recognized by the slender femora and the peculiar narrow shining facial stripe.

### 41. **Pipiza latifrons,** new species

Habitat: California! Front very broad, nearly as wide as face; face scarcely widened below; abdomen sparsely and very short white pilose; hind femora slender.

Female: Length, 7.5 mm. Face and front deep shining black, very thinly covered with whitish dust, with a few black hairs above the antennæ (the pile of the head has been brushed off to a large extent but from a careful examination I believe the front to have been almost entirely white pilose, although it may have been cinereous in front of the ocelli). Sides of face and front to above middle narrowly, not very conspicuously, whitish pollinose. Antennæ black, second and third joints more brownish, second at tip and third below obscurely luteous. Eyes with very short, sparse white pile. Occipital cilia and pile of posterior orbits white. Thorax and scutellum black with a brassy reflection on the dorsum, leaving two broad median stripes shining steely black; pile very short, white; scutellum very densely punctured, finely granulate. Abdomen somewhat shining deep black, densely finely punctulate, with short white pile; pile longer on basal angles, on the usual dark pilose areas cinereous, not conspicuous. Legs black; tips of femora, narrow base of hind and base of anterior four tibiæ, apices of all the tibiæ, the hind ones very narrowly, and all the tarsi, yellowish; apical joints of all the tarsi a little darker; pile all white, on femora and hind tibiæ moderately long. Wings hyaline; auxiliary vein and stigma luteous.

*Holotype*, female, No. 873, Mus. Calif. Acad. Sci., May 12, 1910, J. A. Kusche collector.

*Type locality*, Sobre Vista, Sonoma Co., Calif.

Evidently close to *P. davidsoni* but the color is markedly different and the face is much too short and not rounded so it cannot be the female of that species. There are other differences.

### 42. **Pipiza quadrimaculata** (Panzer)

*Syrphus quadrimaculata*, Panzer Fauna Germ., LXXXVI, tab. 19, 1802.

Habitat: Europe; Ontario! United States; British Columbia. "Abdomen with two pairs of yellow spots; antennæ short and blunt.

"The two large spots near the base of the abdomen more conspicuous than the next two, which are smaller and redder; wings only a little darkened on the middle; face and eyes with white hairs; frons chiefly black haired about the vertex and base of the antennæ, whitish between. Legs black, knees, base of the tibiæ broadly, and the tip narrowly, and tarsi, reddish yellow; last three joints of all tarsi browned, hind basitarsi quite yellowish and rather dilated. Pubescence of the thorax, abdomen, pleuræ and femora almost all whitish. Length 9 mm.

"An examination of several European specimens causes me to add: Male: Abdomen with a pair of transverse oblong yellowish or reddish yellow spots on the second and third segments; frons more shining; third joint of the antennæ short and stumpy, dark brown above but reddish brown beneath [this may refer to an individual specimen]; arista short but longer than the antennæ and thickened for about two-thirds its length. Abdomen with a little pale pubescence on and about the pale spots and about the end of the fourth segment.

"Female: More shining. Abdomen with very little black pubescence. Dust spots on sides of the front hardly visible." (Verrall).

This species has been recorded from some of the States and I have a female from Ontario. I give Verrall's description almost word for word although it is not a systematic one. No doubt can exist in the determination of typical specimens but the second pair of spots are often obsolete or nearly so. In such cases, the females may be easily confused with *nigripilosa;* but the males will be recognized by the slender hind femora and the yellow spots on the second segment.

### 43. **Pipiza tricolor,** new species

Habitat: Ontario! Yellowish white pilose; face entirely black pilose; hind femora with inconspicuous spines behind; wings slightly brownish in front, the basal quarter of the sub-marginal cell purely hyaline.

Male: Length, 7.5 mm. Face and frons shining black, thinly covered with white pollen; face receding, but less so on lower half, black pilose; frons black pilose, above with dilutely yellowish pile. Antennæ black, third joint brown, sub-cordate; arista brown, its base luteous; vertical triangle black pilose in front, yellow behind; eyes with luteous pile, lighter below; occipital cilia black except at the vertex, where there are a few yellowish hairs; pile of posterior orbits whitish below, black in middle, yellowish above. Thorax and scutellum shining bluish black, with luteous pile; an area of black pile crosses the front of the thorax and the pleuræ above and connects with the black of the humeri; tip of scutellum with cinereous pile. Abdomen shining black with the usual areas sub-opaque; yellowish and yellowish white pilose, with the usual areas and the hypopygium black pilose. Legs black; tips of all the femora, broad base and tips of tibiæ, and the first three joints of tarsi, piceous yellow. Wings tinged with brownish in front, basal quarter of sub-marginal cell hyaline; stigma luteous.

*Holotype,* male, No. 874, Mus. Calif. Acad. Sci., June 15, 1919, H. Curran collector. *Paratype,* male, Orillia, Ont., May 4, 1914 (Curran) in author's collection.

*Type locality,* Jordan, Ontario.

**44. Pipiza femoralis** Loew (Figs. 1, 3, 36, 72, 73, 74)

Loew, Century, vi, No. 38, 1865; Williston, Synop. N. Am. Syrph., p. 26 (and 28 *albipilosa*).

Habitat: Ontario! Quebec, Ohio, Pennsylvania. A medium sized, moderately pilose species, male usually and female always, with two yellow spots forming an arcuate band on second segment; hind femora with a spinose area behind near end; face whitish pilose.

Length, 8 to 9 mm. Male: Face and front shining, slightly metallic bluish black, ground color slightly obscured by whitish pollen; face receding, white pilose, sometimes with a few black hairs near the mouth and on the sides above; front black pilose with white pile above and often on the sides. Antennæ black, second joint often partly luteous, third usually yellow below basally, in shape sub-cordate; arista brownish, its base sometimes lighter; vertical triangle white pilose, a few dark hairs in front; post orbital pile white; occipital cilia black; eyes with cinerescent pile. Thorax and scutellum shining bluish black, white pilose, usually with a few black hairs on the humeri. Abdomen shining bluish black, with sub-opaque areas as follows: one on second segment, narrowed in middle and omitting the sides, an abbreviated fascia on anterior margin of third and fourth segments and a similar fascia on apex of third segment, widened in the middle so as almost to join the anterior fascia; second segment with an interrupted yellow band terminating some distance from the side margins; these spots vary in size and become obsolete (var. *albipilosa* Will.) or sub-obsolete, appearing as yellowish patches in certain lights, but they are never very large; their inner ends are truncate, the outer more or less pointed, the longer side of the triangle formed by each spot being in front. Pile white, moderately long, with shorter black pile on the opaque areas except those on anterior half of second segment. Legs black; hind femora incrassate, near end below bearing one or two rows of spinose hairs; tips of all femora, anterior four tibiæ and base of hind ones, and first two joints of front four tarsi, yellow; front and middle tibiæ with a piceous band beyond middle, hind tibiæ and basal two joints of their tarsi piceous; apical three tarsal joints blackish. Wings faintly or moderately clouded with brownish across middle, fading out apically and posteriorly, almost hyaline in some specimens; stigma luteous.

Female: Front slightly narrowed above, white pilose, with black pile immediately above the base of the antennæ and a few black hairs in front of the ocelli; pollinose side spots broadly connected with side stripes of face, their upper ends rounded. These spots leave a polished area between them about 1½ times width of one spot. Spots on second segment broader and more squarish than usual in male, with outer ends more rounded. Fifth segment black pilose; tarsi lighter colored, mostly yellowish. Wings usually more distinctly clouded. Pile sparser and shorter.

Twenty specimens from various parts of Ontario.

Very great confusion exists at present as regards the identity of *femoralis* and *festiva*, and I am not able entirely to clear up the matter. So far as I know, the only specimens of *festiva* (?) which have been taken in America, are females with much darkened wings; of these I have taken several specimens. In 1914 Dr. Williston determined for me two females as this species, together with a male, which I am sure does not belong to *festiva*. He also determined as *albipilosa* two males which are distinctly different; one of these bears almost obsolete yellow spots and is certainly *femoralis*, while the other is larger, fully 10 mm., and much more like my *severnensis* which he labelled as a new species near *puella*. This larger specimen, which is not described in this work, apparently is different from *severnensis* and *femoralis* and has the wings very slightly clouded. Until more specimens are available for examination I prefer to retain this as doubtful. I do not believe the true *festiva* occurs in America. I have European specimens of *festiva*, *noctiluca*, *luteitarsis*, and all the closely allied species. In most of these the hind femora are more enlarged than in *femoralis* but in no case is the triangular production near the end present to a marked degree. *P. luteitarsis* has the hind femora (fig. 37) slightly less produced. I reproduce the description of *festiva* as given by Williston, but believe we must discard this species as American.

### 45. Pipiza festiva (Meigen)

Meigen, Syst. Beschr., III, 243, 2, 1822.

Habitat: Europe; North America? "Male and female: Length, 6.5 to 10.5 mm. Front and face long white pilose, below the ocelli and above the base of the antennæ in the female blackish pilose. Antennæ brown, third joint trapezoidal. Thorax white pilose; posterior parts of second and third segments black pilose; second segment with a variable yellow band, 'sometimes sulphur yellow, at other times reddish yellow; anterior margin concave (?) or straight; sometimes interrupted by a distinct black space, at other times only by a dark line' (Schiner). Legs yellow, with black femora; tibiæ more or less brown in the middle. Wings hyaline on basal half, externally blackish or smoky brown fading out towards the margin; stigma dark luteous." (Williston).

The species varies considerably and the range in area of the yellow spots is much as in *femoralis*. In my specimens of *luteitarsis* the wings are only slightly darkened apically.

### 46. Pipiza severnensis, new species

Habitat: Ontario! Whitish pilose; venter of fourth segment slightly emarginate in the middle; femora with spinose area.

Male: Length, 9 mm. Face broad, thinly whitish pollinose except a very narrow shining central stripe; black pilose, the frons and middle of face with lighter pile; pile of vertical triangle long, whitish. Antennæ black, whitish pollinose; third joint nearly as broad as long, sub-quadrate. Eyes whitish pilose, appearing yellowish in some lights; pile of posterior orbits long, whitish; occipital cilia blackish. Thorax and scutellum slightly shining bluish black with long whitish pile. Abdomen bluish black, not much shining, black pilose; on each segment a large pair of triangular spots of long white pile, narrowly separated; sides of abdomen mostly long whitish pilose; hypopygium black pilose; venter of fourth segment a little emarginate in middle at apex. Legs black, whitish pilose except apical quarter of hind femora which bear black pile; tips of all femora and tibiæ at base yellow; anterior tibiæ and the tarsi piceous, the last two joints of hind tarsi black; hind femora moderately enlarged, near end with the usual spinose area. Wings luteous hyaline, the basal third lighter.

*Holotype*, male, No. 875, Mus. Calif. Acad. Sci., July 31, 1913, H. Curran collector.

*Type locality*, Severn River, Ontario.

Allied to *femoralis*, but slightly larger, with the black and white pile clearly defined, giving a neater appearance even though the pile is longer. The mostly black pilose face, more yellowish wings and emarginate venter of fourth segment will at once distinguish this species. The Severn River here referred to is a small river running from Lake Simcoe to Georgian Bay, and not the river of that name emptying into Hudson Bay.

### 47. **Pipiza oregona** (Lovett) (Fig. 29)

Lovett, Proc. Cal. Acad. Sci., 4th ser., vol. ix, p. 246, August, 1919, (New Oregon Diptera)

Habitat: Oregon! California! An entirely black, light pilose species; readily distinguished from any other by the entirely black legs and narrowly contiguous eyes.

Length, 7.5 to 9 mm. Male: Face and frons shining black, lightly dusted with whitish pollen; face entirely whitish pilose or with a few black hairs in middle; front black pilose, lighter above; vertical triangle cinerescent pilose, with black hairs in front. Antennæ black; third joint sub-cordate, reddish brown or brownish, with the rather thick arista of the same color but darker towards tip. Eyes only actually touching for about seven facets, whitish pilose; post orbital pile whitish; occipital cilia black. Thorax and scutellum slightly shining black, with luteous or yellowish white pile; thorax across the front narrowly blackish pilose, continued back on the sides behind the humeri, or with only a few black hairs in front; pleuræ whitish pilose. Pile of scutellum more whitish than on the thorax. Abdomen slightly metallic bluish black, the usual areas darker and with black pile; elsewhere the pile is lighter and longer; hypopygium mostly whitish pilose above, black pilose below. Legs entirely black, white pilose; anterior tibiæ yellow pubescent below apically; knees black pilose; tarsi below velvety reddish pubescent; femoral spinose area well marked. Wings clouded with luteous or brownish, more so in the middle; stigma luteous.

Redescribed from two paratypes and an additional specimen from Walnut Creek, Calif. This latter specimen was destroyed in transit at a later date.

In this species the face is short and evenly thinly pollinose with no median bare stripe.

48. **Pipiza macrofemoralis,** new species (Figs. 55, 56, 57)

Habitat: Oregon! Dark species; hind femora exceptionally thickened for a Pipiza; eyes contiguous for a slightly shorter distance than usual; antennæ entirely blackish; hind femora thickest beyond the middle.

Male: Length, 7.5 to 8 mm. Face and frons shining black, slightly obscured by whitish pollen; pile black, rather long. Antennæ black; third joint rather finely whitish pollinose, in shape square with the lower corner produced forward. Eyes brownish black pilose; vertical triangle with lighter pile behind and a few yellowish hairs at vertex. Thorax and scutellum shining black with a slightly bluish reflection; pile whitish, across front of thorax and anterior sides of dorsum blackish pilose; pile of pleuræ white. Abdomen shining black, the usual areas sub-opaque; pile black, with the usual areas white or whitish; first segment short black pilose; hypopygium black pilose. Legs black; knees except hind ones, and tips of front four tibiæ and their tarsi, reddish yellow; hind basitarsi and following joint dilutely reddish; anterior four tarsi more distinctly reddish at base, the tips becoming almost black; hind femora very much thickened, with a well marked spinose area. Wings cinereous hyaline; stigma brown; last section of fourth vein moderately curved.

*Holotype*, male, No. 876, Mus. Calif. Acad. Sci., June 8, 1917, F. R. Cole, collector. *Paratype*, male, Hood River, Oreg., May 25, 1917, F. R. Cole, collector.

*Type locality*, Hood River, Oregon.

A very well marked species. The shape of the third antennal joint is peculiar and cannot be accurately described as sub-cordate. Since this description was prepared a female of a second species, described below as *grandifemoralis*, has been received from Mr. W. M. Davidson, which I at first thought might belong here. However, upon examination several marked differences were noted. In *grandifemoralis* the hind femora are more swollen and broadest at the middle, the third antennal joint is larger and marked with yellow, the pile of the head is almost entirely white, the color of the thorax is more metallic bluish and the fly is slightly more robust.

49. **Pipiza grandifemoralis,** new species (Figs. 105, 106, 107)

Habitat: California! Mostly whitish pilose; hind femora greatly enlarged, largest at the middle.

Length, 9.5 mm. Female: Antennæ black; second joint luteous, third sometimes reddish brown, sub-cordate, 1½ times longer than wide; arista brownish. Face and front shining black, the former covered with whitish dust extending narrowly up sides of front and enlarging below middle to form sub-triangular spots which do not occupy half the width. Immediately below these spots is a rather broad transverse carina occupying over ¼ the width on each side. Except for a few black hairs above the antennæ the pile is whitish; a bare area below the antennæ extending as a narrow V to oral margin. Front noticeably wider than usual with the pile over the pollinose spots directed inwards. Thorax and scutellum slightly shining with an obscure metallic bluish or greenish blue tinge, entirely whitish pilose; scutellum without a groove. Abdomen shining metallic bluish black, only the broad black pilose hind margins of second and third segments appearing darker, these pilose areas not reaching sides; elsewhere the pile is rather short grayish white, longer basally; apex of terminal segments with a few scattered black hairs. Legs black; tips of all the femora, base of hind tibiæ, broad base of anterior four tibiæ and their tips, and first two joints of anterior four tarsi, yellowish; middle of anterior four tibiæ and apical joints of their tarsi, piceous. Wings hyaline or with cells on the apical half luteous in their middle; stigma luteous; halteres yellow.

*Holotype*, female, reared by Mr. W. M. Davidson, labelled: "Bred from larva aphidophagous on *Heteromeles arbutifolia*, San Jose, Cal., July 24, 1912."; in the United States National Museum.

*Paratype*, female, Mus. Calif. Acad. Sci., Sobre Vista, Sonoma Co., Calif., May 12, 1910, (J. A. Kusche) collector.

Unfortunately no pupal case accompanied the holotype. The note on the larval habit is of interest as showing the habits of the immature stages of this genus. I have frequently observed that Syrphid larvæ of some species are more common than the adults, due, no doubt, to the fact that these larvæ are very often heavily parasitized. For further notes see *macrofemoralis*.

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## Unrecognizable Species.

### Pipiza(?) crassipes (Bigot)

Bigot, Ann. Soc. Ent. France, Ser. 6, III, p. 557, 1884.

Habitat: North America. Length, 7 mm. "Female: Black, a little shining, almost bare; antennæ with third joint and arista yellow; face evenly finely grayish pollinose. Slightly white pubescent on the pleuræ and femora. Halteres testaceous. Wings a little brownish, hyaline at base; stigma brownish. Knees yellow, hind legs and basitarsi considerably swollen." (Bigot: translation.)

### Pipizella(?) apisaon (Walker)

*Chrysogaster Apisaon* Walker, List, III, p. 572, 1849.

Habitat: New York. Williston, Synop. N. Am. Syrph., p. 291, makes the following remark on this species: "It is not impossible that *Chrysogaster apisaon* Walker, is the same as this (*C. pulchellus*). At least the hairy eyes and elongate antennæ indicate that it is a *Pipiza* (*Pipizella*) or *Psilota*."

There is little doubt in my mind but that the above species is one of those described in this paper, but which species it is impossible to tell without an examination of the type.

## Appendix

### Evolution in the Genus Cnemodon

While it is not intended in this paper to go into the evolution of the genera, it has been found that the genus Cnemodon as limited in the body of this paper, presents many characters of interest to the student of evolution. It seems that this genus is at the present time undergoing many modifications in structure. The specimens before me exhibit an exceptionally wide range of characters and it is an easy matter to trace the species through from the most simple form, *unicolor*, to the more specialized *myerma*, which is evidently the highest form known.

*C. unicolor* possesses neither the usual slender processes on the middle coxæ nor the hind trochanteral processes. It does, however, possess the typically produced middle tibiæ, and for this reason is included in the genus Cnemodon. It has also the typical Cnemodon shape, but is closely approached in that by *Pipizella fraudulenta*. From this species the natural step is to *C. intermedia*, which possesses only the processes on the middle coxæ and because of this fact is a species of especial interest. *C. cevelata* has developed the hind trochanteral processes but, although of the typical shape, they are not as long as in the following species, and are not shortened with the ends rounded, as occurs in the more specialized forms. *C. calcarata* and *elongata* are closely related but the latter has the longest processes to be found in the genus. The next step is apparently the development of hind coxal spurs, found to be small and inconspicuous in *lovetti* but stronger in *coxalis* and *rita*.

A new development occurs in all the species following these In *pisticoides* the venter of the third segment is carinate at the end; in *auripleura* the venter of the fourth segment also is carinate at the immediate base, but here the carina of the fourth segment is sometimes very slight and rugose while in *carinata* it is well-marked.

In the species which follow the hind trochanteral process is much shorter with the end rounded. With the development of the ventral spurs there is, also, a marked tendency for the middle coxal processes to disappear.

No one seems ever to have understood the reason for the development of these remarkable processes on the legs. It is possible that they serve some purpose during copulation. Possibly the knobs on the end of the trochanteral processes fit into the abdomen of the female at its base, or into the sides of the scutellum, but they are rather close together for the latter purpose.

However, with the development of the ventral abdominal spurs, it appears that the use for the trochanteral processes is disappearing. It would therefore seem that the two must serve the same purpose. If such is the case, a most interesting question arises: Why should it be necessary to develop the coxal and trochanteral processes in order to later develop the ventral spurs? It would seem that the development of the ventral spurs should have occurred naturally without the intervening development of the processes, but the evidence indicates that this was not the case. It is also remarkable that so far all the species bearing the ventral spurs occur in the vicinity of the Great Lakes. That such species may be developed on the Pacific Coast is to be expected because of the presence there of two species, *albipleura* and *auripleura*, which fall immediately below the spur bearing forms. It will be interesting to watch the development in this region and to note the first appearance of the more specialized forms.

My first record of the ventral spur bearing species is *ontarioensis*, at Guelph, Ontario, June 13, 1913. The next record is *trochanterata*, Illinois, May 10, 1914. The former species is undoubtedly the lowest member of the group, with the second following. Both of these are larger than the average Cnemodon. *C. myerma* and *venteris* were both taken in 1919. In appearance *venteris* approaches more closely the typical Cnemodon.

It must not be thought that the other genera are devoid of evolutional interest. Pipizella and Pipiza both present forms which are very important. In the latter genus species occur with slender hind femora and others with remarkably thickened femora with many forms intermediate between these extremes. Heringia shows a great deal of variation in the hypopygium and in the specialization of the fourth segment, as well as in other structures. In these genera many gaps occur and it is not possible to trace the species definitely from one to the other, although I have examined most European and all North American species but one. Pipizella is even more difficult to trace through although it is quite evident that *P. fraudulenta* is either the highest or the lowest form.

A suggested tree of relationship is given on the next page. It will be noticed that all the genera are traced from a common ancestor, but all developed along different lines and for the genus Pipiza no direct connection can be found. Its broad face, with practically nothing in common with the other genera except the dark color and the pilose face, eyes and abdomen, clearly indicates considerable separation.

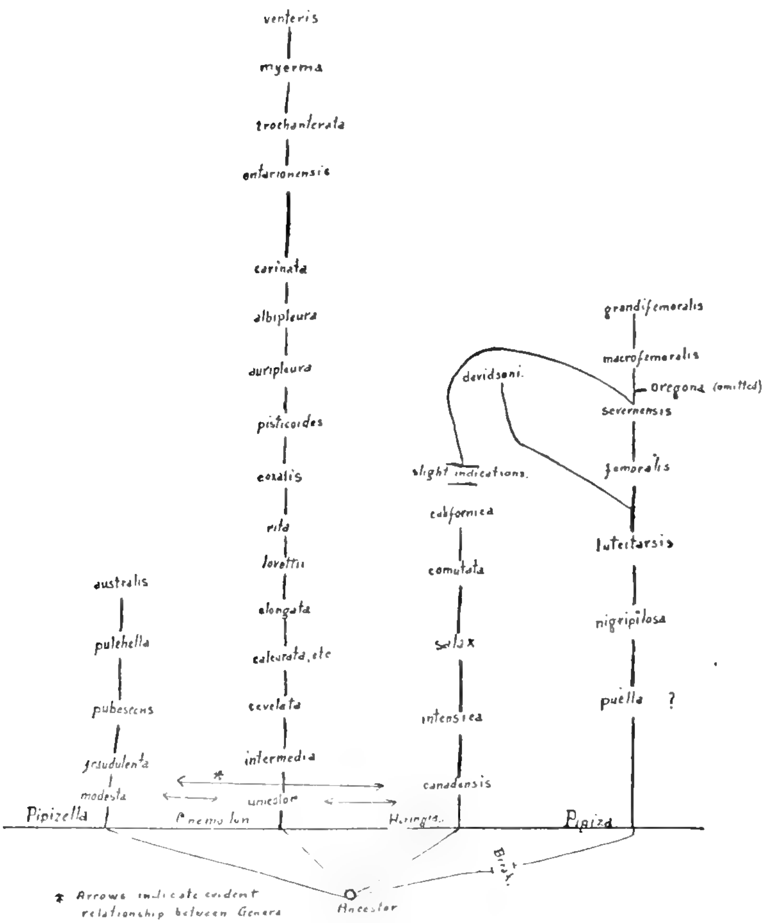
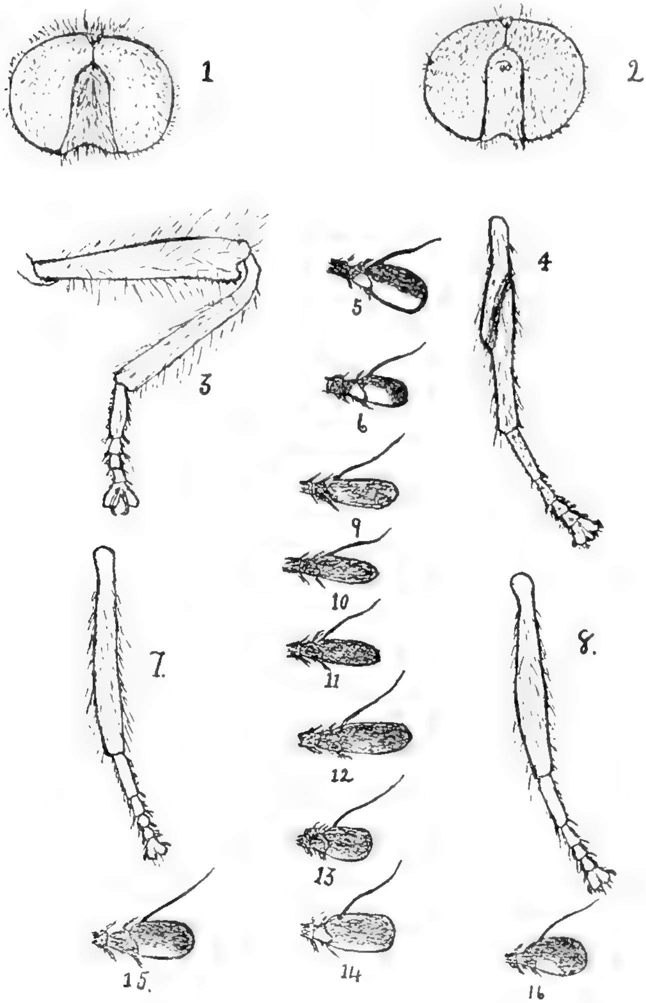
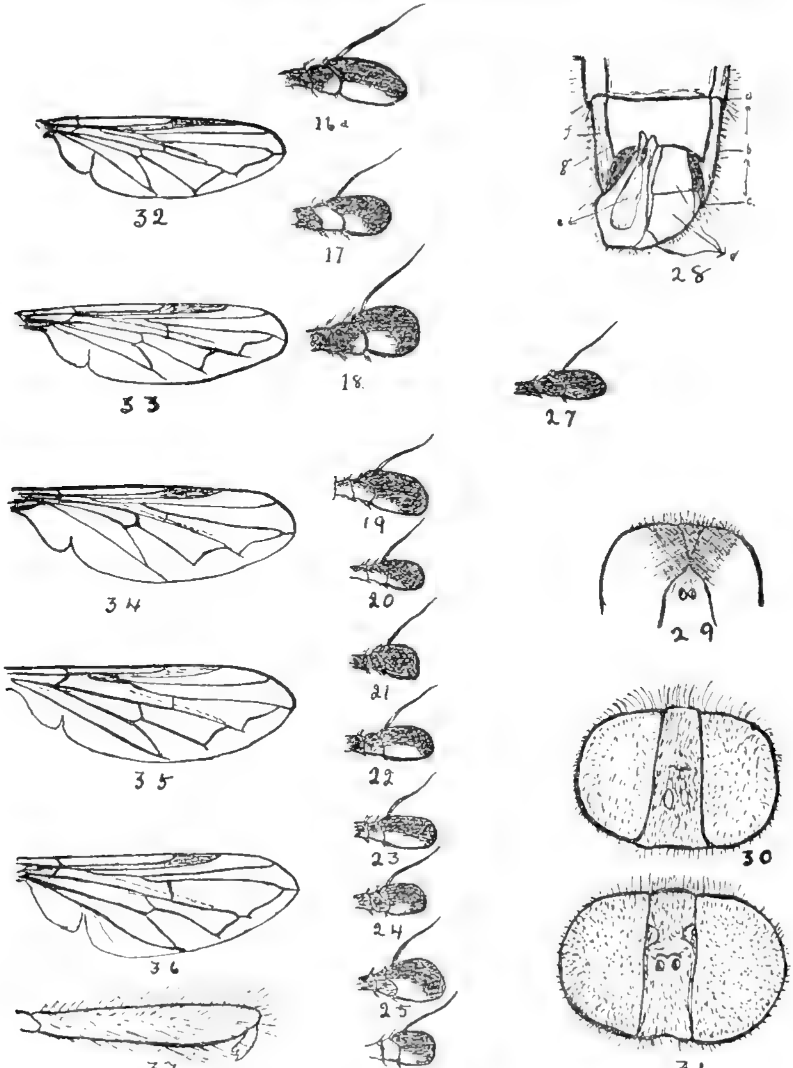


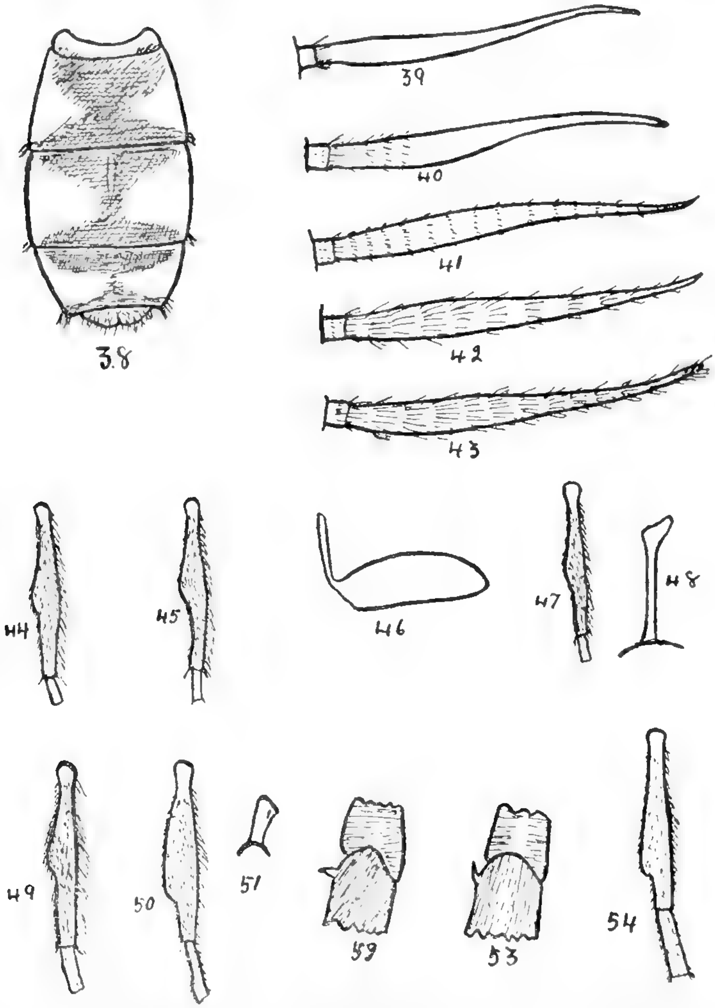

Diagram showing a suggested phylogeny for the Pipiza group of the Syrphidæ



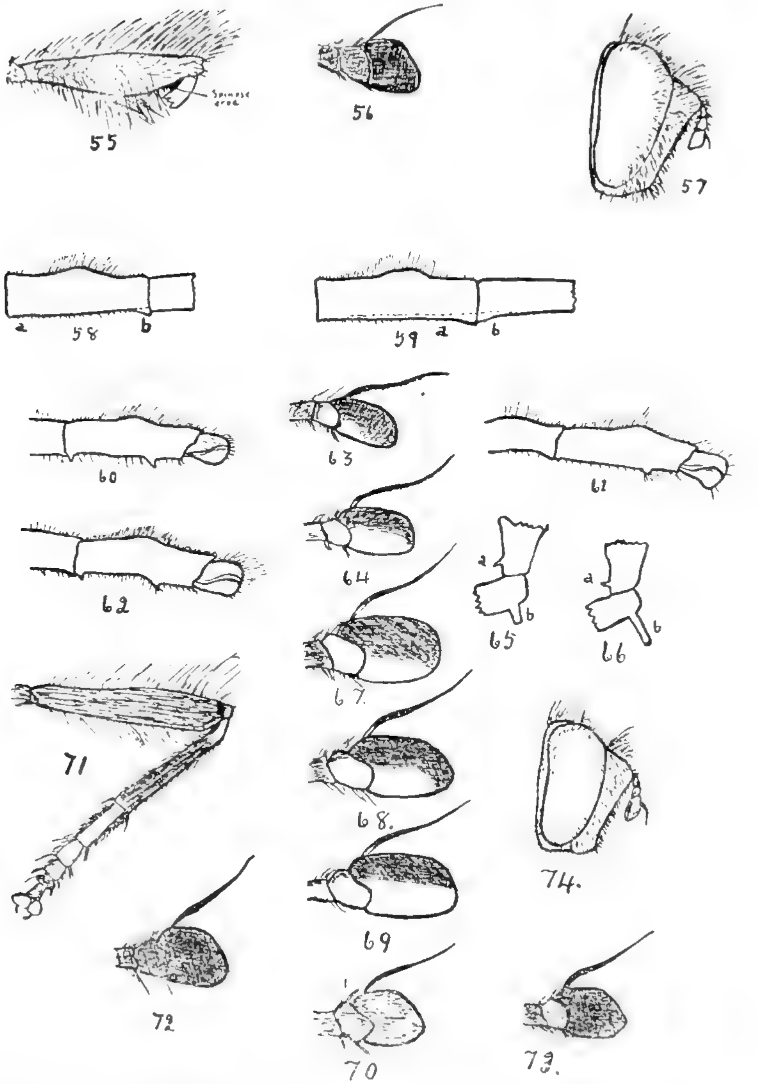

1. Pipiza femoralis, head, showing wide face.
2. Pipizella modesta, male, showing narrow face and horizontal bare stripe on eyes.
3. Pipiza femoralis, hind leg.
4. Cnemodon calcarata, middle tibia showing groove beneath.
5. Cnemodon calcarata, female, antenna.
6. Cnemodon calcarata, male, antenna.
7. Pipizella pubescens, middle tibia, female.
8. Cnemodon calcarata, middle tibia, female.
9. Pipizella pubescens, female, antenna.
10. Pipizella pubescens, male, antenna.
11. Pipizella fraudulenta, antenna.
12. Pipizella modesta, antenna
13. Cnemodon unicolor, male, antenna.
14. Cnemodon intermedia, male, antenna.
15. Cnemodon coxalis, male, antenna.
16. Cnemodon intermedia, female, antenna.



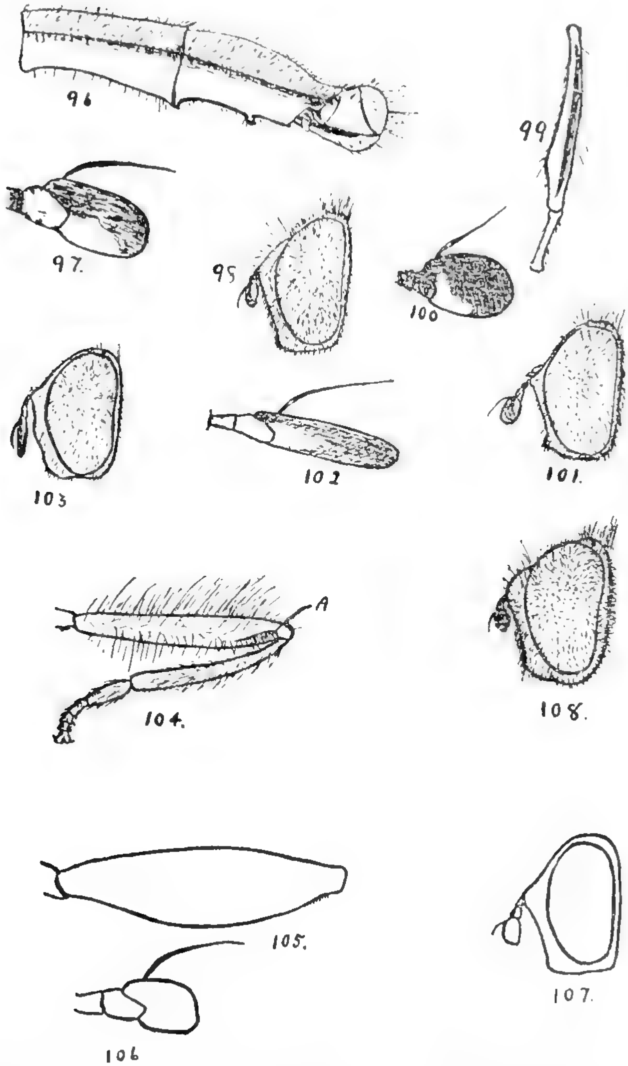

**16a.** Heringia salax, male, antenna.
**17.** Heringia canadensis, male, antenna.
**18.** Heringia intensica, male, antenna.
**19.** Cnemodon sinuosa, female, antenna.
**20.** Cnemodon placida, male, antenna.
**21.** Cnemodon rita, male, antenna.
22. Cnemodon placida, female, antenna.
23. Cnemodon auripleura, female, antenna.
24. Cnemodon auripleura, male, antenna.
25. Cnemodon corvallis, female, antenna.
26. Cnemodon lovetti, male, antenna.
27. Heringia comutata, male, antenna.
**28.** Venter of Heringia: **a-c**, length of fourth segment;
**b-c**, length of venter of fourth segment;
**d**, hypopygial segments; **e**, hypopygium;
**f**, membrane; **g**, chitinous ventral plate.
**29.** Pipiza oregona, upper portion of head, showing narrowly contiguous eyes.
**30.** Pipiza nigripilosa, head of female.
**31.** Cnemodon sinuosa, head of female.
**32.** Heringia canadensis wing
**33.** Cnemodon sinuosa,wing.
34. Cnemodon corvallis, wing.
35. Cnemodon intermedia, female, wing.
36. Pipiza femoralis, wing.
37. Pipiza luteitaris, hind femora.




38. Abdomen of Pipizella modesta, male. The cross lines show usual opaque areas; vertical-oblique lines, the usual black pilose areas.
39. Pipizella fraudulenta, arista.
40. Pipizella pubescens, arista.
41. Cnemodon, arista, showing pilosity.
42. Heringia, arista.
43. Pipiza, arista.
44. Cnemodon unicolor, male, middle tibia.
45. Cnemodon intermedia, male, middle tibia.
46. Cnemodon intermedia, male, middle coxa, showing process.
47. Cnemodon elongata, male, middle tibia.
48. Cnemodon, typical hind trochanteral process.
49. Cnemodon calcarata, male, middle tibia.
50. Cnemodon cevelata, male, middle tibia.
51. Cnemodon cevelata, male, hind trochanteral process.
52. Cnemodon coxalis, male, hind coxal spur.
53. Cnemodon lovetti, male, hind coxal spur.
54. Cnemodon pisticoides, male, middle tibia.



55, 56, 57. Pipiza macrofemoralis, male, hind femora, antenna and head.
58. Cnemodon pisticoides, male, cross section of third segment; **a**, rugose base; **b**, carinate end of segment.
59. Cnemodon carinata, male; **a**, carinate venter of third segment; **b**, carinate base of fourth segment.
60. Cnemodon venteris, male, cross section of fourth segment.
61. Cnemodon ontarioensis, male, cross section of fourth segment.
62. Cnemodon myerma, male, cross section of fourth segment.
63. Cnemodon venteris, male, antenna. 64. Cnemodon venteris, female, antenna.
65. Cnemodon venteris, male; **a**, hind trochanteral process.
66. Cnemodon myerma, male; **a** and **b** as in 65.
67. Cnemodon ontarioensis, female, antenna.
68. Cnemodon ontarioensis, male, antenna.
69. Cnemodon myerma, antenna, male and female.
70. Pipiza nigripilosa, antenna. 71. Pipiza nigripilosa, hind femora.
72, 73, 74. Pipiza femoralis, antennae of two extremes and head of male.




96, 97, 98, 99. Cnemodon trochanterata, abdomen, antenna, head, and middle tibia.
100, 101. Cnemodon albipleura, antenna and head.
102, 103. Pipizella pulchella banksi, head and antenna.
104. Pipiza davidsoni, hind leg; a, longitudinal carina with subappressed pile below.
105, 106, 107. Pipiza grandifemoralis, hind femora, antenna and head (outline only).
108. Pipiza davidsoni, head.

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# XVII

# PRELIMINARY DIAGNOSES OF MORE NEW SPECIES OF REPTILES FROM ISLANDS IN THE GULF OF CALIFORNIA, MEXICO

BY

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AND

JOSEPH R. SLEVIN
*Assistant Curator of the Department of Herpetology*

A number of new reptiles secured by the Academy's expedition to the Gulf of California were described in these Proceedings in July of this year. (Vol. XI, 1921, pp. 95-98). Preliminary diagnoses of several others are given in the following pages.

## **Uta nolascensis,** new species

*Diagnosis.*—A member of the *U. stansburiana* group. Size small. Dorsal scales very small but imbricate and keeled. Caudals keeled and mucronate. Color above grayish or light blue becoming yellowish or olive on the head and tail, without any dark or light markings except sometimes a few scattered pale blue dots on single scales. A large blackish blue blotch behind axilla and often another in front of shoulder. Jaws and side of head sometimes yellowish. Lower surfaces light indigo throughout or whitish on feet, distal part of tail, and middle of chest and belly. Femoral pores 13 to 16, average in twenty thighs 14.5.

*Type.*—California Academy of Sciences No. 50508; collected by Joseph R. Slevin, on San Pedro Nolasco Island, Gulf of California, Mexico, April 17, 1921.

### **Sceloporus monserratensis,** new species

*Diagnosis.*—Closely related to *S. rufidorsum*, *S. zosteromus*, and *S. lineatulus*. Middorsal and dorsolateral light lines usually present. Dorsal scales in a row between interparietal plate and base of thighs 26 to 30. Femoral pores 18 to 22; average in twenty-four specimens 19.7. Adult males with parallel dark lines on lateral scales. Back usually conspicuously spotted with pale blue.

*Type.*—California Academy of Sciences No. 50509; collected by Joseph R. Slevin on Monserrate Island, Gulf of California, Mexico, May 24, 1921.

### **Cnemidophorus catalinensis,** new species

*Diagnosis.*—Anterior nasal not in contact with second supralabial. A few rows of moderately enlarged granules on posterior surface of forearm. No longitudinal markings. Color above grayish brown, paler on head and tail, with granular surfaces of limbs, body and neck, except central nuchal region, finely reticulated with darker brown and with very numerous small discrete whitish spots two to five granules in diameter. Lower lateral regions of body and neck and most of the lower surfaces suffused with black. Femoral pores 15 to 18; average of twenty-four thighs 17.

*Type.*—California Academy of Sciences No. 50507; collected by Joseph R. Slevin on Santa Catalina Island, Gulf of California, Mexico, June 12, 1921.

### **Verticaria ceralbensis,** new species

*Diagnosis.*—Two or three dorsal lines. Supraoculars three. Scales of collar normally smaller at its edge. Second supraocular in contact with frontal. No red on sides or back of body. No orange below. Tip of tail not blue. Size much larger than any other *Verticaria*. Ground color between lateral light stripes with light spots or vertical bars. Hind limbs coarsely reticulated with black and gray. Tail not striped. Throat often slaty or black.

*Type.*—California Academy of Sciences No. 50510; collected by Joseph R. Slevin on Ceralbo Island, Gulf of California, Mexico, June 6, 1921.

**Verticaria espiritensis,** new species

*Diagnosis.*—A single middorsal line, forked on the neck for a distance of two to fourteen millimeters, not forked posteriorly. Supraoculars normally three. Scales on collar largest at its edge. Second supraocular usually in contact with frontal. No red on back or sides of body. Often orange below.

*Type.*—California Academy of Sciences No. 50511; collected by Joseph R. Slevin on Espiritu Santo Island, Gulf of California, Mexico, June 1, 1921.

**Verticaria hyperythra schmidti,** new subspecies

*Diagnosis.*—A single middorsal line, forked anteriorly for a distance of one to fifteen millimeters, not forked posteriorly. Supraoculars normally four. Scales of collar largest at its edge. Second supraocular usually without granules between it and frontal plate. No red on sides or back of body. Usually more or less orange below.

*Type.*—California Academy of Sciences No. 50512; collected by Joseph R. Slevin on San Marcos Island, Gulf of California, Mexico, May 12, 1921.

This subspecies occurs also on the peninsula of Lower California. It gives us pleasure to name it for Mr. Karl P. Schmidt.

**Verticaria franciscensis,** new species

*Diagnosis.*—A single middorsal line, forked anteriorly for a distance of two to eight millimeters, usually forked or broadened posteriorly. Supraoculars normally three. Scales of collar very rarely largest at its edge. Second supraocular usually in contact with frontal. No red on back of body and usually none on sides. Blue below, without orange.

*Type.*—California Academy of Sciences No. 50513; collected by Joseph R. Slevin on San Francisco Island, Gulf of California, Mexico, May 30, 1921.

**Lampropeltis catalinensis,** new species

*Diagnosis.*—No transverse markings; a dark purplish brown longitudinal dorsal band about five scales wide from head to end of tail. All lateral scales yellowish white with narrow purplish brown borders. Along the middorsal line, at nearly regular intervals of three or four scales, are small yellowish white spots on single scales. Head dark brown above and laterally, with small yellowish white markings on internasals, prefrontals, temporals, oculars, loreal, nasals, rostral, and labials. Lower surfaces chiefly black, marbled with yellowish white laterally on most of the gastrosteges, and centrally on a few; the distal urosteges and the genials and gulars yellowish white with black or dark brown margins. Superior labials 8-8. Scale rows 23. Gastrosteges 228. Urosteges 63.

*Type.*—California Academy of Sciences No. 50514; adult male, collected by Joseph R. Slevin and Joseph C. Chamberlin, on Santa Catalina Island, Gulf of California, Mexico, June 12, 1921.

**Crotalus tortugensis,** new species

*Diagnosis.*—Similar to *Crotalus atrox*, but with dorsal rhombs differently marked. Margins of rhombs much darker than central portions which usually include on each side a group of lighter scales as pale as the general dorsal ground color. These light areas in the rhombs may spread and be connected across the back. The coloration suggests that of *C. molossus*, although the light borders of the rhombs are very incomplete.

*Type.*—California Academy of Sciences No. 50515; collected by Joseph R. Slevin, on Tortuga Island, Gulf of California, Mexico, June 22, 1921.

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XVIII

# FOSSIL CHITONS OF WESTERN NORTH AMERICA.

BY

S. STILLMAN BERRY

REDLANDS, CALIFORNIA

## INTRODUCTION

Begun primarily as a simple record of the occurrence of chitons in the later Tertiary and Quaternary deposits of southern California, the unexpected accretion of altogether unusual amounts of material from ever-increasing sources has necessarily impelled a widening in scope of the work in hand until it is now frankly offered as a monographic survey of the known fossil Polyplacophora of western North America.

Chitons are not generally considered as having much importance as fossils, and, taking the world as a field, surprisingly few fossil species or even specimens have been brought to light and recorded. Yet there are reasons for believing that the members of this group, when they do occur, have an intrinsic value as paleontologic criteria rather above that of most groups of Mollusca. At any rate, it is not altogether well to neglect them. The chief reasons for believing that the chitons furnish relatively conservative, and therefore correspondingly dependable, indices are: firstly, that on the Pacific Coast of North America this group is by no means of rare occurrence in the later fossiliferous horizons, as has been more or less implicitly assumed in the past, but attains a development paralleled only by the remarkable amplification of the entire class in the recent fauna of the same region; secondly, that both individually and in associations of species, these animals are remarkably definite in their latitudinal distribution; and thirdly, that this definiteness of geographical area inhabited extends even more sharply to station as well. The bathymetric range of most chitons is curiously narrow.

It is accordingly the writer's belief that far from being justly negligible, it is possible that the chitons will prove among the best criteria for determining the age and relationships of any formation in which they can be found with appreciable frequency. It is in this connection, as well as the inherent interest of one of our most characteristic, yet strangely neglected, faunal groups, that this paper is chiefly of consequence.

## Acknowledgments

Among the many who have furnished material aid during the prosecution of this work, and to all of whom I wish gratefully to acknowledge my due indebtedness, I am under chief obligation to Mr. and Mrs. Emery P. Chace of the Lorquin Natural History Club of Los Angeles. They have been both assiduous and successful in the search for additional material and new horizons in the field, have been unfailingly generous and self-sacrificing in the disposition of their specimens, and have managed to maintain an enthusiastic interest throughout the course of the investigations.

Scarcely less credit belongs to Dr. Frank C. Clark of Santa Monica and Los Angeles, who has ransacked his wonderful material from the Pleistocene of his vicinity that no possible specimen might escape examination, and to Mr. and Mrs. Frank Stephens of San Diego, whom I must thank for many valuable specimens, as well as field data, which in some cases have cost them considerable trouble to secure.

To Dr. William E. Ritter and the Scripps Institution for Biological Research, under whose auspices the work was begun and in large part carried on, I am indebted for aid of a nature which has very much expedited the progress of the work.

Dr. Bruce L. Clark of the University of California has been instrumental in securing me material for study, including the interesting series of specimens from Vancouver Island Oligocene, and has been unfailingly helpful throughout in evincing interest and giving useful advice.

Acknowledgments are further due to Dr. James Perrin Smith and Mr. and Mrs. T. S. Oldroyd of the Department of Geology at Stanford University, for the loan of the very considerable fossil chiton material in the collections under their care; and to Dr. Barton Warren Evermann, Director of the California Academy of Sciences, Dr. Roy E. Dickerson, formerly of the same institution, and Dr. Ralph Arnold of Los Angeles, for courtesies of various sorts.

Thanks are due to Miss Mary J. Rathbun of the United States National Museum for the identification of some crab claws from the Pleistocene of Point Loma, and to Dr. Henry A. Pilsbry of the Academy of Natural Sciences of Philadelphia for determining some barnacle fragments from the same locality.

Finally, I must not omit mention of my indebtedness to Mr. Herbert J. Powell of Redlands, for his patient work on the drawings used in the accompanying plates. Even though it must be said that we have found that stipple is not, on the whole, the most satisfactory method of illustrating chitons, his results in this direction have added very materially to the completeness and practical working value of this paper.

## Review of Literature

The literature of Pacific Coast fossil chitons is of scanty extent. It is so scattered that an exhaustive compilation has been rendered correspondingly difficult. Nevertheless, and in spite of insufficient library facilities, the following survey is believed to be reasonably complete.

The first published mention of the presence of chiton remains in any geological formation within the area under consideration, is, so far as the writer has been able to discover, that of Dr. J. G. Cooper in his "Catalogue of Californian Fossils" ('88, p. 237, 244). He records:

*Cryptochiton stelleri* (Middendorff)—*Pleistocene* San Diego.

*Ischnochiton magdalensis* (Hinds)—*Pleistocene* Santa Barbara.

In the succeeding year, Orcutt ('89, p. 71) reports the finding of "Chiton (valves)" from "about two miles south of Ocean Beach [San Diego], near the top of the cliff."

Ashley ('95, p. 327, 343) records *"Cryptochiton* c.f. *stelleri"* from Purissima in San Mateo County, and *Ischnochiton regularis* from the "Pliocene" (Pleistocene) at San Pedro.

I find nothing further until the publication of Arnold's great monograph on the Tertiary and Quaternary of the San Pedro region ( :03, p. 15, 19, 28, 40, 42, 68, 85, 342-343), where the following three fossil species are recognized:

*Ischnochiton regularis* (Cpr.)—*Pleistocene* San Pedro.
*Cryptochiton stelleri* (Midd.)—*Pliocene* Deadman Island.
*Pleistocene* " "
*Mopalia ciliata* (Sby.) [=*muscosa* of this work]—
*Pleistocene* San Pedro.

The same three species are also listed by Arnold three years later in his monograph of the Californian Tertiary and Quaternary Pectens ( :06, p. 31, 35, 36).

Oldroyd ( :14, p. 81) records *Ischnochiton conspicuus* Cpr. from the Pleistocene of Signal Hill, Long Beach, California.

Moody ( :16, p. 42) records an undetermined chiton from the Fernando Formation of the Pliocene at Los Angeles, California.

Chace ( :16, p. 71-72) lists the following from the Pleistocene of Deadman Island, California, thus increasing the number of chiton species up to this time identified as fossils to seven:

*Katherina tunicata* "Sby."
*Ischnochiton conspicuus* Carpenter.
*Mopalia hindsii* "(Sby.) Reeve."

The next year the same writer materially increased the list by reporting the following from the Pleistocene of Santa Monica, California ( :17, p. 30):

*Ischnochiton acrior* Carpenter
" *conspicuus* Carpenter
" *clathratus* (Reeve) [=*sanctæmonicæ* Berry of the present paper]

*Callistochiton crassicostatus* Pilsbry
" *palmulatus* Carpenter
" " var. *mirabilis* Pilsbry. [These both given as *C. p. mirabilis* in the present paper]
*Trachydermon dentiens* Carpenter [=*Mopalia acuta* (Carpenter) of the present paper]
*Mopaliidæ* sp.

B. L. Clark (:18, p. 191) records and figures an undetermined chiton valve from the San Lorenzo Oligocene near Walnut Creek, Contra Costa County, California.

The most extensive published list of fossil chitons from any part of the area under study is that of E. P. and E. M. Chace (:19, p. 42-43), based on determinations made by the present writer on material which is part of that forming the subject of this report. The exposure from which the material was obtained has been termed by Mr. and Mrs. Chace, "The Chiton Bed," and is situated at Point Fermin, Los Angeles County, California. They list the following species:

*Tonicella lineata* (Wood)
*Cyanoplax hartwegii* (Carpenter)
*Nuttallina* cf. *fluxa* (Carpenter) [=*N. californica* (Nuttall) of the present paper]
*Mopalia ciliata* (Sowerby)
" *lignosa* (Gould)
" *muscosa* (Gould)
*Placiphorella velata* Carpenter
*Chætopleura gemmea* Carpenter
*Ischnochiton magdalenensis* (Hinds)
" *cooperi* Carpenter
*Callistochiton crassicostatus* Pilsbry
" *decoratus* Carpenter

This brings the total number of fossil species hitherto recorded from our area to 21, all from the Pleistocene and Pliocene, with an uncertain representative from the Oligocene. In the present work the number is increased to 33 which are clearly distinct, besides two or three uncertain ones. Of these one only is of Oligocene age; a few are Pliocene; most are from the Pleistocene formations. No chitons of any description appear to have been discovered to date in the Miocene[1] or in the West American formations earlier than the Sooke Formation of the Oligocene. As the number of described recent species from the adjacent coasts is in excess of one hundred, the occurrence of most of which in the Pleistocene at least is undoubtedly possible, it is evident that scarcely more than a beginning has been made with the fossils.

## Material

The material utilized in the preparation of this survey is believed to include most of the extant specimens. It comprises some 1065 valves, obtained chiefly from the following sources:

1. The Delos and Ralph Arnold collections, the Arnold and Hannibal Oligocene collection, and the Oldroyd collection —all now contained in the museum of the department of geology, Leland Stanford Junior University.
2. The museum of the California Academy of Sciences.
3. The museum of the department of paleontology, University of California.
4. The private collection of S. S. Berry.
5. The private collection of Mr. and Mrs. E. P. Chace, Los Angeles, California.
6. The private collection of Dr. Frank C. Clark, Santa Monica, California.
7. The Mrs. Kate Stephens collection, now contained in the museum of the San Diego Society of Natural History.

Much of the more critical material studied from the private collections mentioned has, through the generosity of their owners, been assembled permanently in the author's study collection.

The Chace collection has been of principal importance, as it is not only extensive, but representative of several exposures, some of them apparently owing their initial discovery and exploration to Mr. and Mrs. Chace, while the specimens as a rule are accompanied by the most careful data.

Dr. F. C. Clark's enormous material from the Santa Monica Pleistocene is probably the most complete that has been taken

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[1] cf. especially the check-lists of the Miocene Fauna in California given by J. P. Smith in Proceedings California Academy of Sciences, (4), v. 3, p. 170-182, April, 1912. I know of no additions since that time which would concern us here.

from any single geological horizon within our area, and so is of hardly less consequence.

The Stephens collection does not contain so many specimens as the others, but these are representative of various important formations in the vicinity of San Diego.

The Arnold and Oldroyd collections are remarkably rich in their representation of species, but the maximum value of much of this material has been lost by inadequate station labeling. Evidently, also, there has been some mixture of specimens. However, the material is included in this report both for the sake of completeness and because many of the specimens had already been utilized for purposes of illustration before the better ones came to hand.

In the Arnold and Hannibal collection and that of the California Academy of Sciences are specimens of the interesting new chiton described from the Vancouver Island Oligocene. The museum of the latter institution has also furnished specimens from one of the Point Loma Pleistocene exposures.

The University of California collection contains mainly recent chitons, but some of these have been valuable for purposes of comparison.

## Summary of Stations

### OLIGOCENE

*Sooke Formation:*

1. Sea cliff between mouths of Muir and Kirby creeks, Vancouver Island, British Columbia (Harold Hannibal, N. P. 129; Cal. Acad. Sci. Loc. 231).

It is through the kindness of Dr. B. L. Clark, who is engaged in working up the fauna of this formation, that the single chiton species obtained can be included here. It is

*Oligochiton lioplax* Berry, new species

*San Lorenzo Formation:*

2. Walnut Creek, Contra Costa County, California (B. L. Clark).

I have had no material from this horizon, but Clark ( :18, p. 191, pl. 14, f. 2) records and figures the valve of an undetermined chitonid species. Unfortunately the original specimen has since been lost and the figure is indeterminate, so its real identity for the present must remain problematical. Very possibly it represents an undescribed form.

## PLIOCENE

Owing to the comparative scarcity of chiton remains in the deposits of Pliocene age, they have been discovered at but few localities, all southern and central California. In the literature the classification of the several formations in this part of our area is rather confusing, so that which I have adopted is in part tentative.

*Purisima Formation:*

3. Purisima, San Mateo County, California. *"Cryptochiton* c. f. *stelleri"* is reported from the "Neocene" at Purisima by Ashley ('95, p. 327). As his work was done before the local geological nomenclature was far developed, the exact vertical position of his specimens is probably uncertain.

*San Diego Formation:*

4. Sea cliff at Pacific Beach, San Diego County, California (Mrs. Kate Stephens).

Fossils from this exposure have been listed and their relationships discussed by Arnold ( :03, p. 57-58, 60-64; :06, p. 28), who, however, records no chitons. The following are now listed:

*Cryptochiton stelleri* (Middendorff)
*Ischnochiton conspicuus* Carpenter

Regarding one of these, Mrs. Stephens writes, "I got it from the Pliocene beds, but I believe that Pleistocene beds are found there, too, so it may have fallen down from that. I can't be sure." It is apparent that there is here an uncertainty, probably applicable to all the specimens seen from this exposure, which can only be removed by further work in the field.

5. Rustic Canyon, Santa Monica, California (F. C. Clark).

*Mopalia* sp.

This locality is quoted as Pliocene on the authority of Dr. F. C. Clark. I have not visited it, nor seen the association of species, and am therefore uncertain to which formation the horizon belongs. The small *Mopalia,* a single valve of which is the only chiton discovered, seems, however, to be inseparable specifically from those occurring so commonly in the Pleistocene of the same vicinity.

6. Excavation on Fourth Street, between Hill Street and Broadway, Los Angeles, California (Moody).

Moody (:16, p. 42) has recorded an undetermined chiton from this exposure. In the same paper he described the associated fauna and its relationships in some detail.[2]

*Santa Barbara Formation:*

7. Deadman Island, San Pedro, California (Chace).

This deposit has been described very fully by Arnold (:03, p. 14-17). He records one chiton:

*Cryptochiton stelleri* (Middendorff)

To this is here added:

*Katharina tunicata* (Wood)

PLEISTOCENE

The chiton fauna of the Pleistocene deposits studied, again all southern Californian, shows near relation to the living fauna not only by essential identity of species, but by the comparatively great development of this portion of the fauna when considered with relation to the weak position it occupies in the Pliocene. In the San Pedro Formation, which is the only one from which we have any chitons, they divide as readily as the remaining molluscan fauna into the two primary series established by Arnold.

*Lower San Pedro Series:*

8. Deadman Island, San Pedro, California (Arnold).

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[2] Since this paper was written, the recovery of two of Moody's specimens enables them to be recorded as follows:

1. *Callistochiton crassicostatus* Pilsbry. The single specimen seen is a well preserved head valve of somewhat peculiar aspect, and it is possible that this determination will have to be revised later on.

2. *Callistochiton palmulatus* Carpenter. The single specimen is a well preserved tail valve measuring, long. 4.3, diam. 5.2, alt. 4.8 mm. It seems much nearer typical *palmulatus* than most of the other fossil specimens seen, although a few of those from Long Wharf Canyon, Santa Monica, are somewhat similar.

This exposure has received very full treatment at the hands of Arnold (:03, p. 18-21, 35-47). The single chiton recorded is:

*Cryptochiton stelleri* (Middendorff)

I have seen no chiton material definitely known to be from this horizon, but it is possible that a portion of the miscellaneous material in the Arnold and Oldroyd collections came originally from these beds.

9. "The Chiton Bed," near the pavilion, Point Fermin, Los Angeles County, California (E. P. Chace, E. M. Chace and S. S. Berry). (Plate XVI).

This interesting exposure is the one which has been recently described by Mr. and Mrs. Chace (:19, p. 41-43). So unusual is the deposit from the large number of chiton valves contained in it that they have termed it "The Chiton Bed," a usage so convenient as a brief means of distinguishing it from neighboring deposits of the same formation that I retain it in the following pages. Besides giving a considerable faunal list, their paper described the field relations of the exposure as follows:

It is situated a few yards west of the western boundary of the picnic grounds around Peck's Pavilion, and hardly more than ten feet below the upper edge of the bluff. Directly below the rather sandy topsoil a thin layer of red-brown sandstone is exposed, then comes the fossil-bearing stratum: a gray sand, in some places so hard as to offer considerable resistance to the caseknife, in others weathered to a loose, trickly deposit. Immediately below this is another layer of the red-brown previously seen. Owing to the conformation of the bluff I am unable to say what lies beneath the second red layer. There are numerous small stones in the fossiliferous layer, some of them apparently chalcedony, others our common white quartz, still others are fragments of a dark shale. These stones have probably prevented a previous report of this exposure, as at a little distance the shells are thoroughly masked by these bits of rock. It is an odd fact that although the gray sandstone layer continues, apparently unchanged, both to the east and west of the ten-foot section in which we have worked, we were unable to find any shells except in that small space."

Later in their paper these authors express some doubt as to the geologic age of these strata, but it seems to me that the evidence of the lithology, of the fauna in general, and especially of the chitons themselves, is conclusive that they should be correlated with the Lower San Pedro. The latter in its characteristic form is likewise a rather hard gray sandstone, and the aspect of the embedded fauna, as here, is quite distinctly northern. As will be noticed from the following list, the chitons are for the most part species still to be found living in this vicinity, but several of these are decidedly rare at so low a latitude, and the entire facies of the association, as will be brought out more fully a little later, is strikingly that of the shores of Monterey and San Luis Obispo counties at the present day.

*Tonicella lineata* (Wood)
*Cyanoplax hartwegii* (Carpenter)
" *fackenthallæ* Berry
*Nuttallina californica* (Nuttall)
*Mopalia muscosa* (Gould)
" *lignosa* (Gould)
" *ciliata* (Sowerby)
*Placiphorella velata* Carpenter
*Cryptochiton stelleri* Middendorff
*Chætopleura gemma* Carpenter
*Ischnochiton magdalenensis* (Hinds)
" *cooperi* Carpenter
*Callistochiton decoratus punctocostatus* Pilsbry
" " *ferminicus* Berry, new subspecies
" *crassicostatus* Pilsbry

By all odds the most abundant chiton in the bed is *Nuttallina californica*, to which species are referable over two-fifths of the 350 specimens obtained. *Ischnochiton magdalenensis* accounts for another fifth, and *Mopalia muscosa* for nearly a seventh of the total, a proportion probably not very different from that one would encounter in tide-pool collecting in the Monterey region at the present time. Of the remaining species, *Callistochiton crassicostatus, Cyanoplax hartwegii, Tonicella lineata*, and *Mopalia ciliata*, rank in abundance in the order named. The others are scattering.

10. Near the lighthouse, Point Fermin, Los Angeles County, California (E. P. and E. M. Chace).

This appears to be an exposure from which no faunal reports have been published. Like the preceding, it appears to be Lower San Pedro, and perhaps represents part of the same general deposit, but the chitons are relatively fewer and *Nuttallina*, the most abundant form at the Chiton Bed, is lacking from the list.

*Tonicella lineata* (Wood)
*Mopalia lignosa* (Gould)
" *ciliata* (Sowerby)
*Placiphorella velata* Carpenter
*Ischnochiton magdalenensis* (Hinds)
" *cooperi* Carpenter

Of the 39 specimens taken, about three-fifths are *Ischnochiton magdalenensis,* an eighth are *Mopalia ciliata,* an eighth are *Ischnochiton cooperi,* and a tenth are *Tonicella lineata.*

11. Nob Hill Cut, San Pedro, California (Oldroyd).

I have not been successful in finding a published account of this very interesting exposure, although to judge from the chitons (I have seen no other representatives) it must possess a somewhat remarkable fauna. The chitons attain a considerable development here and include the following species:

*Lepidochitona dentiens* (Gould)
*Nuttallina californica* (Nuttall)
*Mopalia muscosa* (Gould)
" *acuta* (Carpenter)
*Cryptochiton stelleri* (Middendorff)
*Ischnochiton fallax* Carpenter
" *cooperi* Carpenter
*Callistochiton crassicostatus* Pilsbry
" *palmulatus mirabilis* Pilsbry

Over half of the 117 specimens obtained here by Mr. Oldroyd are *Lepidochitona dentiens,* nearly one-fifth are *Mopalia acuta,* and about one-eighth are *Callistochiton crassicostatus.*

12. "Crawfish George's", near Yacht Club, San Pedro, California (Arnold, Chace).

This exposure has been very comprehensively treated by Arnold ( :03, p. 24-27, 35-47). He records no chitons. Mr. Chace's material, however, includes the following three:

*Mopalia muscosa* (Gould)
" sp.
*Ischnochiton cooperi* Carpenter

The fauna as listed by Arnold includes a remarkable number of northern types, mingled as well with some of the more southern. In many respects the association appears more or less transitional between the Lower San Pedro Series and the Upper, so perhaps is an older deposition than the typical Upper San Pedro. It is the only supposedly Upper San Pedro horizon in which *Ischnochiton cooperi* has been found. Possibly there has been a confusion of horizons, and both Upper and Lower are really present here. I have accordingly treated it as Lower San Pedro in my table. Further chiton material from this locality is badly needed and might throw valuable light on the relationships involved. Ashley's record of *Ischnochiton regularis* ('95, p. 343), from a supposedly Pliocene exposure which Arnold ( :03, p. 24) identifies with the present one, also requires confirmation.

*Upper San Pedro Series:*

13. Lumber yard, San Pedro, California (Arnold).

This is the type locality of the Upper San Pedro Series as described by Arnold. He records an extensive fauna ( :03, p. 27-29, 35-47), but only two chitons are included:

*Mopalia ciliata* (Sowerby) [=*muscosa* (Gould) of the present paper]
*Ischnochiton regularis* (Carpenter)

I have had no material known with certainty to be from this horizon. The specimens upon which Arnold based the determinations cited appear to have been lost and attempts to trace them have met with no success.

14. Signal (or Los Cerritos) Hill, Long Beach, California (Oldroyd).

Accounts of the stratigraphic relations and fauna of the Pleistocene of Los Cerritos Hill have been published by Arnold ( :03, p. 30-32, 35-47), who lists no chitons, and by Oldroyd ( :14, p. 81), who records one,

*Ischnochiton conspicuus* Carpenter

The further material afforded by the Oldroyd collection contains in addition to this species three others,

*Mopalia acuta* (Carpenter)
***Ischnochiton*** sp.
*Callistochiton palmulatus mirabilis* Pilsbry

15. Long Wharf Canyon, Santa Monica, California (F. C. Clark).

This extremely rich deposit has never been thoroughly dealt with in the literature, although a number of species, including many novelties, have at various times been described from it. Chace (:17, p. 30-31) has listed several of the chitons. From the faunal evidence the stratigraphic affiliations are unqualifiedly with the Upper San Pedro. The majority of the species are essentially identical with those inhabiting the waters of the adjacent coast at the present day, but they are also usually species whose present metropolis lies to the south rather than to the north, or even in some instances, as *Ischnochiton acrior* of our list, no longer occur north of Lower California. The following chitons have been recognized from the material submitted by Dr. Clark:

*Leptochiton clarki* Berry, new species
*Mopalia acuta* (Carpenter)
" sp.
*Acanthochitona avicula* (Carpenter)
*Ischnochiton conspicuus* Carpenter
" *acrior* Carpenter
" *pectinulatus* Carpenter
" *sanctæmonicæ* Berry, new species
*Callistochiton crassicostatus* Pilsbry
" *palmulatus mirabilis* Pilsbry

The most remarkable faunal feature here is the enormous relative abundance of the two species of *Callistochiton*. Out of 330 valves, 197, or nearly two-thirds, are *C. p. mirabilis*, and 71, or nearly one-fifth, are *C. crassicostatus*. The unidentified *Mopalia* with 18, *Ischnochiton acrior* with 14, and *I. sanctæmonicæ* with 13, are the only others met with in any number.

16. "Coal mine", west side of Point Loma, San Diego County, California (Mr. and Mrs. Frank Stephens, Carl L. Hubbs).

This horizon, always referred to by Mrs. Stephens as "the coal mine", offers a fauna which is in some respects quite unique, yet seems to have had very little attention from previous workers.[8] It is situated in the sea cliff about half way of the peninsula on the western or ocean side. After revisiting the locality at my request, Mr. Stephens writes under date of June 5, 1918: "The bed containing the fossil shells lies unconformably on the strata containing the lignite, and is of much later age. Only fragments of the fossil bed are left as the sea is wearing the cliff away." He failed to find any further chitons, but the following had been secured previously:

*Mopalia muscosa* (Gould)
*Cryptochiton stelleri* (Middendorff)
*Ischnochiton conspicuus* Carpenter
" *acrior* Carpenter
*Callistochiton crassicostatus* Pilsbry

*Cryptochiton stelleri* and *Acmæa mitra* seem to be adventitious northern elements, the presence of which is not at first glance easy to understand, as the aspect of the remaining fauna is decidedly southern. For the latter reason I correlate the exposure with the Upper San Pedro, although the faunal list finds no complete parallel in that of any of the previously described horizons.

17. Along the sea cliff between one and two miles north of Point Loma and Ocean Beach, San Diego County, California (Cal. Acad. Sci. Loc. 108).

"The fossils were obtained from coarse sand and gravel which occurs just above the contact between the cretaceous(?) and the overlying late formation. The fossils occur about 50 ft. from the water. The formation in which they occur is almost horizontal."

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[8] The full list of species identified other than the chitons listed above seems worthy of record, so is appended here.:

*Acmæa scabra* Gould (=*spectrum* Nuttall)
" *mitra* Eschscholtz
*Fissurella volcano* Reeve
*Diadora aspera* (Eschscholtz)
*Haliotis cracherodii* Leach
*Tegula (Chlorostoma) funebralis* (A. Adams)
*Tegula (Chlorostoma)* sp.
*Norrissia norrissii* (Sowerby)
*Astræa undosa* (Wood)
*Crepidula aculeata* Gmelin
" cf. *lessonii* Broderip and *explanata* Gould
*Hipponix tumens* Carpenter
" cf. *cranioides* Carpenter
*Littorina scutulata* Gould
" *planaxis* Philippi
*Cerithidea sacrata* Gould
*Thais* cf. *emarginata* (Deshayes)
*Acanthina lugubris* (Sowerby)
*Alectrion cooperi* (Forbes)
*Gadinia reticulata* Sowerby
*Pecton (Plagioctenium) circularis* Sowerby (*aequisulcatus* Carpenter)
*Hinnites giganteus* Gray
*Septifer bifurcatus* (Conrad)
*Cardita subquadrata* Carpenter
*Chama exogyra* Conrad
*Phacoides californicus* (Conrad)
*Petricola carditoides* Conrad
*Cumingia lamellosa* Sowerby
*Saxicava* sp.
*Pholad* sp.
*Cancer productus* Randall
*Tetraclita rubescens* Darwin

This locality is known to me only as above quoted. Quite possibly it is the same, or part of the same deposit as the "coal mine" referred to as No. 15 above. Two chitons were obtained,

*Cryptochiton stelleri* (Middendorff)
*Ischnochiton acrior* Carpenter

The appearance of the individual specimens is much like those from the preceding station. I refer them to the Upper San Pedro.

18. Spanish Bight, North Island, San Diego, California (Mrs. Kate Stephens).

This exposure has been given detailed treatment by Arnold (:03, p. 59-64), but without recording any chitons. Two species are represented in the material before me:

*Ischnochiton conspicuus* Carpenter
" *pectinulatus* Carpenter

STATIONS OF UNCERTAIN RELATIONSHIP

In the Oldroyd collection with the scant label "Upper San Pedro" are the following chitons, all from Southern California, and presumably from the neighborhood of San Pedro, but the exposure and exact locality unknown:

*Mopalia muscosa* (Gould)
" *lignosa* (Gould)
" *acuta* (Carpenter)
" sp.
*Ischnochiton conspicuus* Carpenter
" *fallax* Carpenter
" *cooperi* Carpenter
" cf. *sinudentatus* Carpenter
" sp.
*Callistochiton crassicostatus* Pilsbry

If, as seems probable, all of the above are from the same exposure, the association would seem to be much more that of the Lower than of the Upper San Pedro, as labeled.

In the Arnold collection labeled Deadman Island, California, (formation unknown) are the following:

*Mopalia lignosa* (Gould)
" *acuta* (Carpenter)
? *Lepidochitona dentiens* (Gould)
*Nuttallina californica* (Nuttall)

All of these are no doubt from the Pleistocene, but whether from the Lower or Upper Series it would serve no good purpose to hazard a guess.

The exact formation from which Cooper recorded *Cryptochiton stelleri* as of the Pleistocene of San Diego, and *Ischnochiton magdalenensis* from the Pleistocene at Santa Barbara are not known to me.

It is strange that no chitons have been reported from the rich Pleistocene deposit on the beach behind the bathhouse at Santa Barbara. I did not find any during my exploration of these beds in 1903, although they must occur there.

## Relative Abundance of Species

Chiton valves do not seem to be very common in most horizons and are really abundant only in four of those examined,—the Upper San Pedro Beds of Long Wharf Canyon, the Lower San Pedro at Nob Hill Cut, and the two Point Fermin exposures, especially that known as the "Chiton Bed." Out of a total of 1040 valves which constitute the principal subject matter of this paper, over one-half are the result of our few trips to the "Chiton Bed", and the overhauling of Dr. Clark's material from Long Wharf Canyon.

The most abundant species as fossils are not by any means always those most commonly taken in present day collecting. No less than 203 of the fossil valves are *Callistochiton palmulatus mirabilis,* and another *Callistochiton* (*crassicostatus*) stands second in point of abundance with 131, largely the consequence in both instances of their plentiful occurrence at Long Wharf Canyon. The only other species of which 25 or more specimens have come to hand are *Nuttallina californica* (161), *Lepidochitona dentiens* (63), *Mopalia muscosa* (80), *Ischnochiton magdalenensis* (92), *Mopalia acuta* (49), *Mopalia ciliata* (47), *Ischnochiton acrior* (31), and *Ischnochiton cooperi* (26).

It is of some interest in this connection to note that the most abundant living species in the region whence practically all the fossils came are probably *Lepidochitona dentiens, Cyanoplax hartwegii, Nuttallina fluxa, Ischnochiton conspicuus, Ischnochiton pectinulatus, Mopalia muscosa,* and *Leptochiton rugatus.*

## Faunal Relations

It is too early in the study and the available material still far too scanty to permit much indulgence in the pastime of generalizing with any great degree of safety, but a few points which can be brought out with some measure of clearness by a study of the accompanying table are perhaps worthy of brief summarization. We are better protected than otherwise in proceeding thus because the facts in evidence stand fairly in corroboration of the major conclusions to which students of the other animal groups have been impelled by working out parallel data.

A recapitulation of the table shows the total number of species and subspecies for each of the principal formations to be as follows:

| | | Specifically determinable | Total |
|---|---|---|---|
| Oligocene | | 1 | 1 |
| Pliocene | | 2 (3?) | 3 (4?) |
| Pleistocene | | 28 | 33 |
| Lower San Pedro | 19 | | |
| Upper San Pedro | 11 | | |
| Uncertain | 4 | | |

## Pliocene

Leaving out the unique and extinct Oligocene species as insufficient of itself to point conclusively one way or the other, we find that the only certainly Pliocene species are *Katharina tunicata* and *Cryptochiton stelleri,* both northern forms, as would be expected by analogy with the remainder of the Pliocene fauna. These two species, however, happen both to be of wide distribution, ranging from south-central California as far north as Bering Sea, so do not help greatly in determining just how much colder than now the southern Californian waters of that period probably were.

| | RECENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | LIVING | | | | | | | | |
| | Indian Middens | Bering Sea | Southern Alaska | Puget Sound Region | Northern California | Monterey Region | Southern California | Lower California | Panamaic | Bathymetric Range in Fathoms |
| 1. Leptochito | | | | | | | | | | |
| 2. Oligochitor | | | | | | | | | | |
| 3. Tonicella | | × | ×× | ×× | ×× | ×× | × | | | 0–30 |
| 4. Cyanopla | | | | | | ×× | ×× | ×× | | 0 |
| 5. Cyanopla | | | | | | × | | | | 0 |
| 6. Lepidochi | | | | × | × | × | ×× | ×× | | 0 |
| 7. Nuttallina | | | | × | | ×× | ? | | | 0 |
| 8. Mopalia | ×× | | × | ×× | ×× | ×× | ×× | × | | 0–30 |
| 9. Mopalia | | | ×× | ×× | ×× | ×× | × | | | 0–30 |
| 10. Mopalia | | | | | | × | ×× | × | | 0 |
| 11. Mopalia | | | × | ×× | ×× | ×× | ? | ? | | 0–30 |
| 12. Mopalia | | × | ×× | ×× | ×× | ×× | × | × | | 0–50 |
| 13. Mopalia | | | ? | ? | ? | | | | | 0–30 |
| ..* Mopalia | | | | | | | | | | |
| ..* Mopalia | | | | | | | | | | |
| 14. Placiphor | | | × | × | ×× | ×× | × | × | | 0–50 |
| 15. Katharina | × | × | ×× | ×× | ×× | ×× | × | | | 0–20 |
| 16. Acanthoch | | | | | | | × | | ? | 0 |
| 17. Cryptochi | × | ×× | ×× | ×× | ×× | ×× | × | | | 0–20 |
| 18. Chaetople | | | | × | ×× | ×× | × | × | | 0–15 |
| 19. Ischnochi | | | | | × | ×× | × | | | 0–15 |
| 20. Ischnochi | | | | | ×× | ×× | ×× | × | | 0 |
| 21. Ischnochi | ×× | | | | | ? | ×× | ×× | ? | 0 |
| 22. Ischnochi | | | | | | | | ×× | ? | 0 |
| 23. Ischnochi | | | | | × | ×× | × | | | 0 |
| 24. Ischnochi | | | | | | × | ×× | ×× | | 0 |
| 25. Ischnochi | | | | | × | ×× | × | | | 0 |
| 26. Ischnochi | | | ×× | ×× | ×× | ×× | × | × | | 0–50 |
| 27. Ischnochi | | | | | | ? | | | | 0 |
| 28. Ischnochi | | | | | | | | | | |
| 29. Ischnochi | | | | | | | | | | |
| 30. Callistochi | | | | | | × | ×× | × | | 0–10 |
| 31. Callistochi | | | | | | | | | | |
| 32. Callistochi | | | | | | ×× | ×× | × | | 0–15 |
| 33. Callistochi | | | | | | ×× | ×× | | | 0–15 |

per or on good authority elsewhere.
ce.

# TABLE I. Distribution of West American Fossil Chitons.

| | Oligocene | Miocene | Pliocene | | | | Pleistocene | | | | | | | | | | Uncertain Horizons (probably Pleistocene) | Recent | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sooke Formation | ........ | Purisima Formation | San Diego Formation | Santa Barbara Formation | | Lower San Pedro Series | | | | | Upper San Pedro Series | | | | | | Indian Middens | Living | | | | | | | | |
| | Vancouver Island | | Purisima | Pacific Beach | Santa Monica | Deadman Island | Deadman Island | Pt. Fermin (Chiton Bed) | Pt. Fermin (Lighthouse) | Nob Hill Cut | Crawfish George's | San Pedro Lumber Yard | Signal Hill | Santa Monica | Pt. Loma | Spanish Bight | | | Bering Sea | Southern Alaska | Puget Sound Region | Northern California | Monterey Region | Southern California | Lower California | Panamic | Bathymetric Range in Fathoms |
| 1. *Leptochiton clarki* Berry | | | | | | | | | | | | | | × | | | | | | | | | | | | | |
| 2. *Oligochiton lioplax* Berry | × | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. *Tonicella lineata* (Wood) | | | | | | | | × | × | | | | | | | | | | × | ×× | ×× | ×× | ×× | × | | | 0–30 |
| 4. *Cyanoplax hartwegii* (Carpenter) | | | | | | | | ×× | | | | | | | | | | | | | | | ×× | ×× | ×× | | 0 |
| 5. *Cyanoplax fackenthallae* Berry | | | | | | | | × | | | | | | | | | | | | | | | × | | | | 0 |
| 6. *Lepidochitona dentiens* (Gould) | | | | | | | | | | ×× | | | | | | | ? | | | | × | × | × | ×× | ×× | | 0 |
| 7. *Nuttallina californica* (Nuttall) | | | | | | | | ×× | | × | | | | | | | × | | | | × | | ×× | ? | | | 0 |
| 8. *Mopalia muscosa* (Gould) | | | | | | | | ×× | | × | × | × | | | × | | × | ×× | | × | ×× | ×× | ×× | ×× | × | | 0–30 |
| 9. *Mopalia hindsii* (Sowerby) | | | | | | | | | | | | | | | | | × | | | ×× | ×× | ×× | ×× | × | | | 0–30 |
| 10. *Mopalia acuta* (Carpenter) | | | | | | | | | | ×× | | | × | × | | | × | | | | | | × | ×× | × | | 0 |
| 11. *Mopalia lignosa* (Gould) | | | | | | | | × | × | | | | | | | | × | | | × | ×× | ×× | ×× | ? | ? | | 0–30 |
| 12. *Mopalia ciliata* (Sowerby) | | | | | | | | × | ×× | | | | | | | | × | | × | ×× | ×× | ×× | ×× | × | × | | 0–50 |
| 13. *Mopalia cf. sinuata* (Carpenter) | | | | | | | | | | | | | | | | | × | | | ? | ? | ? | | | | | 0–30 |
| ..* *Mopalia sp* | | | | | ? | | | | | | | | | ×× | | | | | | | | | | | | | |
| ..* *Mopalia sp* | | | | | | | | | | | × | | | | | | | | | | | | | | | | |
| 14. *Placiphorella velata* Carpenter | | | | | | | | × | × | | | | | | | | × | | | × | × | ×× | ×× | × | × | | 0–50 |
| 15. *Katharina tunicata* (Wood) | | | | | | × | | | | | | | | | | | × | × | × | ×× | ×× | ×× | ×× | × | | | 0–20 |
| 16. *Acanthochitona avicula* (Carpenter) | | | | | | | | | | | | | | × | | | | | | | | | | × | | ? | 0 |
| 17. *Cryptochiton stelleri* (Middendorff) | | | × | × | | × | × | × | | × | | | | | × | | × | × | ×× | ×× | ×× | ×× | ×× | × | | | 0–20 |
| 18. *Chaetopleura gemma* Carpenter | | | | | | | | × | | | | | | | | | | | | | × | ×× | ×× | × | × | | 0–15 |
| 19. *Ischnochiton fallax* Carpenter | | | | | | | | | | × | | | | | | | × | | | | | × | ×× | × | | | 0–15 |
| 20. *Ischnochiton magdalensis* (Hinds) | | | | | | | | ×× | ×× | | | | | | | | × | | | | | ×× | ×× | ×× | × | | 0 |
| 21. *Ischnochiton conspicuus* Carpenter | | | | ? | | | | | | | | | × | × | × | × | × | ×× | | | | | ? | ×× | ×× | ? | 0 |
| 22. *Ischnochiton acrior* Carpenter | | | | | | | | | | | | | | ×× | ×× | | × | | | | | | | | ×× | ? | 0 |
| 23. *Ischnochiton regularis* (Carpenter) | | | | | | | | | | | ? | ? | | | | | | | | | | × | ×× | × | | | 0 |
| 24. *Ischnochiton pectinulatus* Carpenter | | | | | | | | | | | | | | ? | | × | | | | | | | × | ×× | ×× | | 0 |
| 25. *Ischnochiton cooperi* Carpenter | | | | | | | | × | ×× | × | × | | | | | | × | | | | | × | ×× | × | | | 0 |
| 26. *Ischnochiton mertensii* (Middendorff) | | | | | | | | | | | | | | | | | × | | | ×× | ×× | ×× | ×× | × | × | | 0–50 |
| 27. *Ischnochiton cf. sinudentatus* Carpenter | | | | | | | | | | | | | | | | | × | | | | | | ? | | | | 0 |
| 28. *Ischnochiton sanctaemonicae* Berry | | | | | | | | | | | | | | ×× | | | | | | | | | | | | | |
| 29. *Ischnochiton sp* | | | | | | | | | | | | | × | | | | | | | | | | | | | | |
| 30. *Callistochiton decoratus punctocostatus* Pilsbry | | | | | | | | × | | | | | | | | | × | | | | | | × | ×× | × | | 0–10 |
| 31. *Callistochiton decoratus ferminicus* Berry | | | | | | | | × | | | | | | | | | | | | | | | | | | | |
| 32. *Callistochiton crassicostatus* Pilsbry | | | | | | | | × | | ×× | | | | ×× | × | | × | | | | | | ×× | ×× | × | | 0–15 |
| 33. *Callistochiton palmulatus mirabilis* Pilsbry | | | | | | | | | | × | | | × | ×× | | | × | | | | | | ×× | ×× | | | 0–15 |

*not separately numbered as may possibly prove conspecific with one or another of the other species listed.

× designates occurrence recorded in this paper or on good authority elsewhere.
×× designates a degree of relative abundance.

## Pleistocene

### *Lower San Pedro Series:*

The Pleistocene chiton faunas are sufficiently extensive to enable finer conclusions to be drawn. Recorded from the Lower San Pedro are 19 species and subspecies. All are forms which we know are accustomed to live between tides or in comparatively shallow water. Compared with the recent fauna these show the following interesting relationships:

Relations of Lower San Pedro Chiton Fauna with Living Fauna of Corresponding Latitude

| | Number of species | Per cent. of total |
|---|---|---|
| Extinct or unknown living | 1 | 5.3 |
| Now living commonly in same region | 8 | 42.1 |
| Now living in same region but more or less rare | 4 | 21.1 |
| Now living on other parts of the coast, but not known to occur in same latitude as fossils | 6 | 31.6 |
| Now living more commonly to north than south | 6 | 31.6 |
| Now living more commonly to south than north | 0 | 0 |
| Known to occur only on shores to north | 6 | 31.6 |
| Known to occur only on shores to south | 0 | 0 |

It is evident from this that the Lower San Pedro chitons abundantly support Arnold's conclusions[4] that as compared with the present, *relatively* "boreal conditions still preponderated during this period." They show just as conclusively, however, that these conditions were "cold" only in a relative way, and by no means *actually* boreal as this term is generally understood by the zoo-geographer. To one familiar with the recent chitons this whole Lower San Pedro association is strikingly reminiscent of that which now occurs on the shores of central California, notably Monterey Bay and the coasts of Monterey and San Luis Obispo counties just to the southward. Not only are all the species, save one *Callistochiton,* still to be found living in that region, but those most abundant and characteristic in the Lower San Pedro are similarly abundant and characteristic in the Monterey County fauna today. Among the fossils it is quite true that when an attempt is made to apply the reverse of this dictum a few conspicuous absences are found, but these are very conceivably due to the incompleteness of the record and may well be filled in later. In any event, nowhere else in the recent fauna can be found such a peculiar assemblage of species in association as *Tonicella lineata, Cyanoplax hart-*

[4] :03, p. 66.

*wegii* (not known to occur north of Monterey), *Nuttallina californica, Mopalia lignosa* (not positively recorded south of San Luis Obispo County), *M. acuta* (unrecorded north of Monterey), *M. ciliata, Placiphorella velata, Cryptochiton stelleri, Chaetopleura gemma, Ischnochiton fallax, I. magdalenensis, I. cooperi, Callistochiton decoratus punctocostatus* (this one barely recorded from as far north as Monterey), *C. palmulatus mirabilis,*—as far as it goes it is like calling the roll on a Pacific Grove beach! This is again brought out rather better by means of a table. *Callistochiton decoratus ferminicus,* because unknown in the recent fauna, is left out of account.

RELATIONS OF LOWER SAN PEDRO CHITON FAUNA WITH LIVING FAUNA OF MONTEREY REGION

| | Number of species | Per cent. of total |
|---|---|---|
| Common and characteristic at Monterey or not known to occur elsewhere | 15 | 83.3 |
| More common to north or south but recorded from Monterey | 3 | 16.7 |
| Living rarely to north of Monterey region | 4 | 22.2 |
| Living rarely to south of Monterey region | 2 | 11.1 |
| Not known to occur north of Monterey region | 5 | 27.8 |
| Not known to occur south of Monterey region | 7 | 38.9 |
| Not known to occur in region of Monterey | 0 | 0 |

Summing up it may be said that the chiton remains offer decided evidence that while the oceanic temperatures of southern California were very distinctly cooler during the Lower Pleistocene period than at the present time, the difference was nevertheless very little, if any, greater than that now prevailing between the waters of Monterey and Los Angeles counties, and, if the chitons are a true criterion, was quite probably about the same.

*Upper San Pedro Series:*

The total number of species here listed from the Upper San Pedro is 11. These may be given tabular treatment as follows:

RELATIONS OF UPPER SAN PEDRO CHITON FAUNA WITH LIVING FAUNA OF CORRESPONDING LATITUDE

| | Number of species | Per cent. of total |
|---|---|---|
| Extinct or unknown living | 2 | 18.2 |
| Now living commonly in same region | 5 | 45.5 |
| Now living in same region but infrequent | 2 | 18.2 |
| Now living on other parts of coast, but not known to occur in same latitude as fossils | 2 | 18.2 |
| Now living more commonly to north than south | 2 | 18.2 |
| Now living more commonly to south than north | 2 | 18.2 |
| Known to occur only to north | 1 | 9.1 |
| Known to occur only to south | 1 | 9.1 |

The evidence here is not altogether clear cut, but is easily indicative of higher oceanic temperatures than prevailed during the preceding period. This is better brought out when the fauna of a single horizon is taken by itself, the conflicting evidence being largely due to the peculiarities found in the faunas of such exposures as those at Point Loma. Taken as a whole, however, agreement is good with Arnold's statement ( :03, p. 66) that "the fauna of the upper San Pedro series is southern in character, and, as would be expected, approaches more nearly the present living fauna of the San Pedro region." The chitons do not, however, well support his further conclusion that deposition during this period occurred in shallower water than during Lower San Pedro times. The chitons of the Lower San Pedro exposures on Point Fermin, as we have already seen, are practically exclusively shore species, a few only of which have been found extending to a few fathoms depth. Those of Long Wharf Canyon, which is unqualifiedly an Upper San Pedro horizon, even though mainly shore forms, include a few species like *Leptochiton clarki* and *Ischnochiton sanctæmonicæ* which have the aspect of off-shore types from at least moderate depths. No doubt different horizons within each period will show considerable modifications in this respect. As an association the Upper San Pedro chitons are not easy to bring into correlation with those of any restricted region of the coast at the present time. By itself, the Long Wharf Canyon fauna is rather strongly reminiscent of that of the west coast of Lower California in the neighborhood of the 28th parallel. This impression is probably due very largely, if not wholly, so far as the chitons are concerned, to the presence as a strong element in the fauna of the now characteristically Lower Californian *Ischnochiton acrior*. At the same time we find at the "coal mine" locality on Point Loma, this same southern species occurring simultaneously with the strongly northern *Cryptochiton stelleri*, an association which for the present we can only regard as anomalous. Dr. Clark has so far failed to find the slightest trace of *Cryptochiton* in all his quarrying and sifting at Santa Monica.

Formational Inter-relationships of Chiton Fauna

| | Oligocene | Pliocene | Lower San Pedro | Upper San Pedro | Recent |
|---|---|---|---|---|---|
| Oligocene | 1 | | | | |
| Pliocene | 0 | 3 | | | |
| Pleistocene: | | | | | |
| Lower San Pedro | 0 | 1 | 19 | | |
| Upper San Pedro | 0 | 2 | 5 | 11 | |
| Recent | 0 | 3 | 18 | 9 | 110+ |

A conspicuous fact brought out in several of the tables is the small number of species appearing in all formations which are extinct or not yet known to occur living. The single Oligocene species is unique and, as would be anticipated, is probably extinct. But with one exception all the Pliocene and Lower Pleistocene forms which have been specifically determined are also of recent occurrence. This is likewise true of most of the fauna from the Upper (San Pedro) Pleistocene, but two species here described as new from the rocks of this period have not yet been discovered in the recent state.

The species peculiar to each formation are:

| | Number of species | Per cent. of total |
|---|---|---|
| Oligocene | 1 | 100 |
| Pliocene | 1* | 33 |
| Pleistocene: | | |
| Lower San Pedro | 13** | 68.4 |
| Upper San Pedro | 5*** | 45.5 |

*all occur also in living fauna.
**all but one also known to occur in living fauna.
***all but two also known to occur in living fauna.

No doubt these figures will be very greatly modified by the results of later investigation, but to some degree are probably dependable. An analysis in detail would probably show the more characteristic species of the respective formations to be somewhat as follows, all but *Mopalia acuta* being, so far as is known, confined to the formation under which they are listed:

Oligocene: *Oligochiton lioplax*

Pliocene: *Katharina tunicata*

Pleistocene—

Lower San Pedro *Tonicella lineata*
*Cyanoplax hartwegii*
" *fackenthallæ*
*Nuttallina californica*
*Mopalia lignosa*
" *ciliata*

| | |
|---|---|
| | *Placiphorella velata* |
| | *Ischnochiton fallax* |
| | *Ischnochiton magdalenensis* |
| | " *cooperi* |
| Upper San Pedro | *Mopalia acuta* |
| | *Ischnochiton acrior* |
| | " *pectinulatus* |
| | " *sanctæmonicæ* |

Here, too, later work will no doubt bring about appreciable modification. One feels inclined to prophesy that *Katharina tunicata* will be found to occur in the Lower San Pedro as well as in the Pliocene, while it also seems reasonable that a large proportion of the species just now apparently characteristic of the Lower Pleistocene will eventually be discovered in the Pliocene as well. In addition to the forms specifically characteristic as noted, the Upper San Pedro horizons seem generally to be marked by an extraordinarily abundant development of *Callistochiton* as compared with individuals of other genera.

## Parts of Animal Preserved as Fossils

In chitons, as probably in every division of animals, all normal structures possess some special element to contribute toward a properly phylogenetic classification of the group. In such a classification it is no more proper to neglect a certain organ or group of organs than it is to leave out of consideration some difficult species or genus. Probably no one would dispute this, theoretically at least, but as a matter of actual practice, and with no more data to work with than we have at present, it is quite impossible, as in almost all other groups, even reasonably to approach so ambitious an ideal. For the time being, we must perforce be content with putting our reliance upon those structures which by reason of hardness, like the shell, or of adaptability to mounting, like the radula and girdle scales, are readily susceptible of preservation.

In the case of fossils the very nature of things limits us to consideration of the shell, or, rather, to the shelly plates, eight in number, into which the chiton shell is divided. In life these are regularly meristic in position and are held together by the stout chitinous or leathery girdle, itself variously beset, both above and below, with scales, spines, setæ, or other horny or calcareous appendages. When some of our fossiliferous rocks have had their due of microscopic investigation, no doubt chiton girdle scales will be found, perhaps sometimes even in abundance. But up to the present there has been no recovery of any remains beyond the valves of the shell. All other structures, being of but problematic value to the paleontologist, will be dealt with only incidentally in this paper. Except where for special reasons it becomes hardly avoidable, discussion of all such will be left for papers dealing primarily with the recent chitons, to which the student who wishes to push the matter further may readily refer.

The paleontologist, *as such,* has to content himself with an odd valve pried here and there from the rocks, rarely with any evident remaining connection with any of the other valves originally its fellows, so the systematic discussion in a work of this scope necessarily must take purview of the situation and concern itself chiefly with the description and identification of such fragmental remains.

## The Shell of Chitons

The valves of the chiton shell are not alike, nor are any two of them absolutely so, though the more central ones are very similar. To the casual observer they fall easily into three principal categories: the anteriormost, or *"head" valve,* as it is commonly called, the six intermediate or *median valves,* and the posteriormost or *"tail" valve.* Perhaps these terms are not strictly scientific either in etymology or application, but they are the ones generally in use and the most convenient we have. Each valve in articulating with its neighbors juts under the one just in front and over the one just behind. Consequently the head valve differs from all the others in being not only more or less evenly crescentic, due to its terminal position, but without accessory plates in front other than the marginal *insertion plate* present in nearly all chitons except a part of the family *Lepidopleuridæ.* All the other valves have a pair of sharp, plate-like apophyses projecting on either side in front, the *sutural laminæ.* The tail valve is, however, not straight or angular behind, as are usually the intermediate valves, but is evenly crescentic or specially shaped in some other way. Its oldest or umbonal portion, technically known as the *mucro,* is usually evident as a submedian, conical projection of greater or less prominence, and is a characteristic feature.

The shelly substance in all the valves is characteristically formed of two layers,—an inner, usually hard, semi-porcellanous tissue known as the *articulamentum,* and an outer, usually softer, very different appearing, surface layer, the *tegmentum.* The articulamentum generally projects past the tegmentum on the sides and in front to form the mechanism of articulation, namely the sutural laminæ already described, and the toothed or simple *insertion plates* which serve for the attachment of the girdle at the sides of the median valves and around the ends, anterior or posterior as the case may be, of the terminal valves. The insertion plates are usually divided by one or more *slits* into more or less evident *teeth.* Sometimes evident in the articulamentum are thread-like lines, or lines of pores, running radially from the valve umbo and leading one into each slit, thus marking the position of the slit through the previous stages of growth. The sutural laminæ are separated in the central line by a sort of bay leading back nearly or quite to the margin of the tegmentum, the *sutural* or *jugal sinus.*

Those portions of the tegmentum just over where the insertion plates push from under are referred to as the *eaves,* and the tissue of the little cliffs so formed as *eave tissue.* This tissue sometimes evinces special structural features of value.

Dorsally, the tegmentum is typically capable of delimitation into several distinct areas, which, in spite of modifications in a considerable number of species, yet maintain themselves through the group with a somewhat remarkable constancy. In the median valves the regions of the tegmentum lying back of the radial articulamental lines above mentioned, and thus overlying and coinciding with the old insertion plate tissue, are generally a little elevated, or may be bounded by a ridge or line of sculpturing in front. Their sculpture is subject to elaboration on a different plan from that of the rest of the valve and is primarily radial, rather than longitudinal as elsewhere. They are apt to be very definite in their boundaries and are known as the *lateral areas.* The area lying in front of them is called the *central area.* The region adjacent to the *ridge* or *jugum* of the valve, except, of course, in the head valve, is known as the *jugal tract* and the more lateral portions occupying the side slopes as the *pleural tracts.* In *Acanthochitona* and some other forms, the boundary between the jugal and pleural tracts is better marked than that of the lateral areas, and the entire region of the slopes is called the *latero-pleural areas.* The tegmentum of the median valves sometimes shows an angular projection in the median line behind, the *beak,* and more rarely a similar forward projection between the sutural laminæ in front. This, when present, is known as the *false beak.*

The tegmentum of the head valve is not so divisible into areas. Its sculpture is almost uniformly developed on the same general plan as that of the lateral areas, and, as with them, is primarily radial. The articulamentum of this valve is of course entirely made up of insertion plate tissue. The tail valve, on the other hand, has sutural laminæ similar to those of the median valves and its tegmentum is typically divided into two regions, a *central area* in front of the mucro, and a *posterior area* behind it. The central area coincides in significance and essential plan of sculpture with the central areas of the median valves. The posterior area is homologous with the lateral areas and is usually similar to them in sculpture, though it develops peculiarities of its own now and then. It is sometimes convenient to refer to the tegmental surface of the head valve and the posterior area of the tail valve together as the *terminal areas,* as they are frequently so similar in sculpture. The articulamentum, and sometimes the tegmentum also, of the tail valve is sometimes emarginated in the median line behind to form a *posterior sinus.*

## SYSTEMATIC ACCOUNT

### General Remarks

The general purport of the systematic portion of this paper is to give a catalogue of the known species of fossil chitons of western North America, systematically arranged, and in connection with each species to present

1. A brief summary of the synonymy, with those references to the literature as seem of special importance to the paleontologist, especially such as are accompanied by useful figures;

2. A short diagnosis of the more important differential characters based upon the shell alone, and rendered as concise as possible consonant with a reasonably certain identification of the species;

3. In the case of hitherto undescribed species, a full description;

4. A statement of the known geologic and geographic range;

5. A list of the specimens examined, with pertinent data;

6. Figures of the shell, including both exterior (dorsal) and interior (ventral) views of a head, a median, and a tail valve, wherever the condition of the specimens available makes this possible;

7. Special remarks.

No figures of any of the fossil species have been prepared from recent specimens, and the diagnoses likewise are drawn as exclusively from fossil specimens as the material has permitted. In several instances both figures and diagnosis could have been decidedly improved and amplified by a more extended use of recent specimens, but it has seemed best for the present to avoid this wherever possible. Similarly it has been thought best to mention only shell characters in the diagnoses, not because of any desire to place an exclusive systematic value upon them, but because, as has been stated, they are the only ones preserved by the fossils.

## New Taxonomic Terms Proposed

The following taxonomic terms are published for the first time in the present paper:

*Oligochiton lioplax,* new genus and species
*Leptochiton clarki,* new species
*Ischnochiton (Lepidozona) sanctæmonicæ,* new species
*Callistochitoninæ,* new subfamily
*Callistochiton decoratus ferminicus,* new subspecies

## Key to Genera

The following key to the genera mentioned in this paper, it is hoped, will prove reasonably workable. It is in considerable degree artificial, but a purely phylogenetic key based upon the shells alone, as must necessarily be done in this instance, seems impossible at this time.

1. Small species without insertion plates or slits at margin of articulamentum (Family Lepidopleuridæ) .................... Leptochiton
1′. Valves with slitted or toothed insertion plates....... 2
2. Valves in adult composed of articulamentum only, in the living animal entirely covered by the girdle ........................... Cryptochiton
2′. Valves showing both tegmentum and articulamentum.. 3
3. Valves with tegmental area greatly restricted, due to encroachment by girdle......................... 4
3′. Valves with tegmental area not greatly restricted and girdle not greatly encroaching.................. 5
4. Valves massive; tegmentum without striking sculpture ........................... Katharina
4′. Valves comparatively delicate; tegmentum sculptured with a more or less scaly pattern..... Acanthochitona
5. Eave tissue spongy............................ 6
5′. Eave tissue solid (Family Ischnochitonidæ)........12
6. Lateral areas always poorly differentiated.......... 7
6′. Lateral areas generally distinct, often bounded in front by a diagonal rib; tail valve with a single pair of slits and a posterior sinus (Family Mopaliidæ, in greater part) ..................................11
7. Valves normally proportioned; sculpture obsolete or of relatively simple type (Family Callochitonidæ).... 8
7′. Valves narrow, of more or less bizarre form; sculpture of tegmentum strongly granular............ Nuttallina
8. Surface of tegmentum smooth.................... 9
8′. Surface of tegmentum finely granulose.............10
9. Sutural laminæ and teeth very short and weakly developed; more than one slit on each side in median valves ............................ Oligochiton
9′. Sutural laminæ and teeth well developed; median valves with a single slit on each side............. Tonicella
10. Valves stout; teeth oblique and more or less pointed in tail valve .......................... Cyanoplax
10′. Valves delicate; teeth small and very numerous in end valves .......................... Lepidochitona

11. Valves normally proportioned . . . . . . . . . . . . . . . Mopalia
11′. Valves excessively short and wide . . . . . . . . . Placiphorella
12. Valves with beaded sculpture; tegmentum strongly developed behind the articulamentum; median valves distinctly narrowed at sides; tail valve with short, stubby teeth and posterior mucro . . . . . . . . Chætopleura
12′. Lateral and terminal areas having heavy radial ribs; the insertion plates short and curving out into the slits, which correspond in position with the radial ribs . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Callistochiton
12″. Valves normal, with variously developed sculpture and sharply cut, even teeth throughout . . . . . . Ischnochiton

## Description of Species

### Family **Lepidopleuridæ**
### Genus **Leptochiton** Gray, 1847

#### 1. **Leptochiton clarki** Berry, new species
(Plate I, fig. 10.)

*Diagnosis:* Valves small, delicate, without insertion plates; sculpture weak, consisting of rows of small granules, coalescing or overlapping to form weak longitudinal riblets on the central areas and radial ones on the lateral areas; sutural laminæ very low and wide, blending evenly into the shell margin.

*Type:* An intermediate valve, entered as Cat. No. 3987 of the writer's collection [S. S. B. 605].

*Type Locality:* Upper San Pedro Pleistocene of Long Wharf Canyon, Santa Monica, California; collector, Dr. F. C. Clark; 1 median valve.

*Range:* Unknown except type locality as given above.

*Description: Intermediate valve* small, high-arched, subangular on the ridge, the side slopes arcuate. Lateral areas

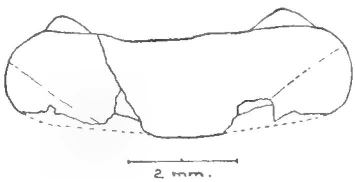


**Fig. 1**

Fig. 1. *Leptochiton clarki* Berry, new species. Dorsal aspect of type valve [605]; camera outline.

scarcely raised, sculptured all over by numerous, crowded, low, rounded granules, radially arranged and more or less coalescent to form low radial riblets (17-20 on a side ? ), separated from each other by shallow, but quite distinctly cut, sulci. Central areas everywhere sculptured by numerous, more pointed, backwardly directed, more overlapping granules, which coalesce strongly to form about 55-60 low, granular, longitudinal riblets on each slope, their interspaces about half as wide as the riblets themselves and traversed by a rather weak, transverse threading which shows up more plainly where the tegmentum is slightly worn; riblets more or less oblique on the sides, bending inward as they approach the lateral areas, those nearer the center of the shell becoming straighter, and passing smoothly over the jugal region where they become a little narrower and more numerous than on the slopes.

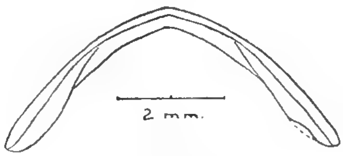


**Fig. 2**

Fig. 2. *Leptochiton clarki* Berry, new species. Anterior elevation of type valve [605]; camera outline.

Interior of valve with a rather strong, anterior, transverse callus. Insertion teeth obsolete. Slits none. Sutural laminæ very low, wide, evenly rounded in front, their outer slope only a little more abrupt than the inner and passing smoothly into the lateral margin of the shell.

*Measurements:* Caliper measurements of the type are,—long. 2.2, lat. 6.1, alt. 2.6 mm.

**Fig. 3**

Fig. 3. *Leptochiton clarki* Berry, new species. Dorsal aspect of right side of type valve [605]; camera outline.

*Remarks:* It is unfortunate that only a single valve has been discovered in all Dr. Clark's screenings of the only fossil Lepidopleurid we have seen. It is a modest little species, apparently

Fig. 4

Fig. 4. *Leptochiton clarki* Berry, new species. Ventral aspect of same; same scale as Fig. 3; camera outline.

allied to the prevailing group of species now living along the coast, although, chiefly because of the peculiar form of the sutural laminæ, I have been unable to identify it with any of them. From *L. nexus* (Carpenter), as represented by a specimen from off Laguna,[5] it differs in the much less sharply defined lateral areas and their much more distinct radial liration, as well as rather more numerous liræ of the central areas (55-60 instead of 50), which are not separated into distinct scales or granules.

Fig. 5

Fig. 5. *Leptochiton heathi* Berry. Dorsal aspect of right side of valve v of paratype [124a] a recent specimen from 15 fathoms, off Monterey, California; same scale; camera outline.

Fig. 6

Fig. 6. *Leptochiton heathi* Berry. Ventral aspect of same; same scale; camera outline.

From valves of *L. heathi* Berry, that of the fossil specimen differs in being shorter and wider, in having a more angular

[5] c. f. Proc. Cal. Acad. Sci., (4), v. 9, p. 8.

dorsal ridge, in the more numerous liræ of the central areas (40-45 in *heathi*), in the more definite radial arrangement of the granules on the lateral areas, and in the conspicuously shorter and less pointed sutural laminæ.

From *L. rugatus* (Carpenter) it is separated by the weaker growth lines and consequently less conspicuous terracing of the lateral areas, together with the less crowded and more distinctly radial arrangement of the granules in this region, the more angular ridge, and the shape and position of the sutural laminæ.

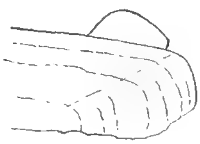

Fig. 7

Fig. 7. *Leptochiton rugatus* (Carpenter). Dorsal aspect of right side of valve iv of recent specimen from La Jolla, California, [111a]; same scale; camera outline.

Fig. 8

Fig. 8. *Leptochiton rugatus* (Carpenter). Ventral aspect of same; same scale; camera outline.

The fossil species differs from both *L. rugatus* and *L. heathi* in the very short and wide sutural laminæ, which in *L. rugatus*, moreover, are not marginal, but abruptly set over and separated by a sharp notch from the lateral margin of the shell. The differences in form of the sutural laminæ in these three species are very clearly brought out in the accompanying camera drawings (text figs. 3-8). *L. nexus* I have unfortunately not had opportunity to disarticulate.

The specific name is chosen in honor of Dr. F. C. Clark of Santa Monica, California.

## Family **Callochitonidæ**

### Subfamily Lepidochitoninæ

### Genus **Oligochiton** Berry, new genus

Chiton with valves of normal form; insertion plates and teeth present, but very short. Surface of tegmentum smooth. Lateral areas scarcely defined. Sutural plates low and wide, separated by a wide and shallow sinus. Eaves spongy. Slits numerous in the end valves; probably 2 or 3 on a side in the median valves.

*Type:* the following species:

### 2. **Oligochiton lioplax** Berry, new species

(Plate I, figs. 1-6.)

*Diagnosis:* Valves of moderate size, without sculpture except lines of growth; lateral areas weakly delimited; mucro nearly median; slits numerous—13 in head valve, probably 2 or 3 on a side in median valves, about 15 in tail valve; teeth short; sutural laminæ short and broad, well separated.

*Type:* A tail valve [S. S. B. 608] in the collection of the department of geology, Leland Stanford Junior University.

*Paratypes:* A median valve [607] in the collection of the department of geology, Leland Stanford Junior University, and a head valve [606] in the writer's collection.

*Type Locality:* "N. P. 129", Sooke Formation Oligocene, "from conglomerates and sandstones found along the sea cliff between the mouths of Muir and Kirby creeks, west of Otter Point, southern Vancouver Island", British Columbia; 3 valves.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Original Number | Number in Author's Register | Remarks | Formation | Period |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ant. | Sea cliff, between mouths of Muir and Kirby creeks, Vancouver Id., B. C..... | H. Hannibal | Berry Coll. Cat. 5052 | N. P. 129 | [606] | Paratype | Sooke | Oligocene |
| 1 | Int. | Sea cliff, between mouths of Muir and Kirby creeks, Vancouver Id., B. C..... | H. Hannibal | Dept. Geology Stanford Univ. | N. P. 129 | [607] | Paratype | Sooke | Oligocene |
| 1 | Post. | Sea cliff, between mouths of Muir and Kirby creeks, Vancouver Id., B. C.... | H. Hannibal | Dept. Geology Stanford Univ. | N. P. 129 | [608] | Type | Sooke | Oligocene |
| 1 | Post. | Sea cliff, between mouths of Muir and Kirby creeks, Vancouver Id., B. C.... | Cal. Acd. Sci. | Cal. Acd. Sci. | C. A. S. 231 | [939] | | Sooke | Oligocene |

*Description: Head valve* evenly crescentic, the slopes only slightly convex. Exterior somewhat worn and pitted; surface everywhere very finely and microscopically punctate, otherwise practically smooth, without any well developed pattern of sculpturing, except a few weak, concentric growth lines (marked in the specimen at hand by faint, narrow, alternating color bands of a darker tone than the body of the shell). Interior not examined, but the principal portion of the shell so delaminated as to reveal the presence of a number of strong radiating lines or grooves coincident with the marginal slits. Slits and grooves about 13 in number. Insertion teeth smooth, beveled somewhat at margin, but not very sharp.

*Median valve* not beaked, relatively short and wide, moderately high-arched; jugum with a strong but somewhat rounded angle, the specimen being somewhat abraded in this region; side slopes nearly straight. Tegmental surface unsculptured throughout except for a fine punctation and growth striæ like those of the head valve above described, the lines of growth and concentric color bands here rather more conspicuous; lateral areas flattened, only weakly elevated and therefore very indistinctly marked off from the pleural regions. Sutural laminæ short and broad, their margins arcuate, with the inner slopes more gradually tapering than the outer; well separated in the median line. Interior little calloused, the radial grooves on the sides 3-2; slits indistinct, but evidently 2-1, or 3-2, if the posterior groove on each side be assumed to have originally terminated in a slit.

*Tail valve* rather triangular in outline, the mucro nearly median; depressed, the side slopes flat and straight, posterior slope slightly concave; anterior margin strongly concave between the sutural laminæ; boundary between central and posterior areas clearly marked, forming an obtuse angle at the mucro and thence extending straight to the sharp antero-lateral angles of the tegmental margin. Sculpture exactly similar to that of the median and head valves. Sutural laminæ excessively short and broad, well separated. Interior with a strong, triangular, median callus bearing numerous lateral branches. Slits numerous but not everywhere definitely distinguishable in specimen examined; on the right side about 9 in number.[6] Insertion teeth smooth, very short.

[6] In the California Academy specimen the total number of radial lines can be counted from above and appears to be 15.

Eaves on all valves badly worn, but apparently rather spongy.

*Measurements:* Long. of head valve 6.+ mm., diameter 13+ mm.; long. of median valve 6.0 mm, diameter 20.0 mm.; long. of tail valve [608] 10.4, [939] 11. mm., diameter [608] 18.+, [939] 19.4+ mm.

*Remarks:* The specimens upon which the description of the present species is based, though none of them entire, have their various fragments for the most part in a fairly good state of preservation. The characters in which they are peculiar are not very striking, and it is therefore quite difficult at the present time to arrive at any precise determination of their relationships. The numerous slits, as well as the shorter teeth, preclude reference to *Tonicella,* and recall in some degree the description of the two species of *Spongioradsia (aleutica* and *multidentata),* but the very spongy shell substance described for the latter group, and the fact that the teeth are even more poorly developed than in the fossil forms, militates against any attempt to join them. In other respects likewise, *Oligochiton* and *Spongioradsia* do not seem to have much in common. *Cyanoplax* and *Lepidochitona* have a differently formed tail valve, longer teeth, and a wider separation of the much better developed sutural laminæ. Nevertheless it is clear that the association of the Oligocene chiton should be more or less intimately with the genera named in the family *Callichitonidæ.* The comparatively weak development of the sutural laminæ and insertion plates perhaps indicates that *Oligochiton* is a primitive form, perhaps ancestral to some of the modern members of the family.

It is of particular interest as the oldest chiton thus far recorded from the West American formations.

### Genus **Tonicella** Carpenter, 1873

### 3. **Tonicella lineata** (Wood, 1815)

(Plate II, figs. 1-5.)

1815. *Chiton lineatus* Wood, Gen. Conch., p. 15, pl. 2, f. 4-5.
1847. *Chiton lineatus* Middendorff, Mal. Ross., I, p. 109, pl. 12, f. 8-9.
1847. *Chiton lineatus* Sowerby, Conch. Ill., f. 77.
1847. *Chiton lineatus* Reeve, Conch. Icon., v. 4, Chiton, sp. 33, pl. 7, f. 33; detail pl., f. 33.

1857. *Chiton lineatus* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1856, pp. 208, 214, 223.

1857. *Tonicia lineata* Carpenter, op. cit., p. 317.

1864. *Chiton lineatus* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, pp. 523, 648, 684.

1864. *Tonicia lineata* Carpenter, op. cit., pp. 648, 684.

1879. *Tonicella lineata* Dall, Proc. U. S. Nat. Mus., v. 1, p. 296, 326, pl. 1, f. 5 (radula).

1892. *Tonicella lineata* Pilsbry, Man. Conch., (1), v. 14, p. 42, pl. 11, f. 25-28.

1919. *Tonicella lineata* Chace and Chace, Lorquinia, v. 2, p. 43 [3] (recorded from Pleistocene of Point Fermin, California).

*Diagnosis:* Valves low[7]; surface smooth, except for growth lines; lateral areas indistinct; traces of a color pattern of clean-cut wavy or zig-zag, oblique, longitudinal lines often persistent, becoming crescentic on the terminal valves; sutural laminæ short and wide, separated by a narrow sinus; tegmental margin often with an indication of false beaking in front; teeth short, but sharply cut, slightly projecting; eaves spongy; mucro high and very anterior in position; slits generally 8 to 10, 1-1, 8 to 10.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—"Chiton Bed", Point Fermin, California (Chace and Chace, !); near lighthouse, Point Fermin, California (!).

*Living:* Plover Bay, Siberia, to Japan; Norton Sound, Bering Sea, to San Miguel Island, Santa Barbara County, California (!); between tides; juvenals to 30 fathoms.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4079. | [1183] | Lower San Pedro... | Pleistocene |
| 1 | Post | Chiton Bed, Pt. Fermin, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4079. | [1041] | Lower San Pedro.. | Pleistocene |
| 1 | Ant.. | Chiton Bed, Pt. Fermin, Cal | E. P. Chace, 1920 | Chace Coll.......... | [1366] | Lower San Pedro... | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal | E. P. Chace, 1920.... | Chace Coll.... | [1366] | Lower San Pedro | Pleistocene |
| 6 | Int.. | Chiton Bed, Pt. Fermin, Cal | E. P. Chace & S. S. Berry, 1920 | Chace Coll; Cal. Acd. Sci......; Berry Coll. Cat. 4079 | [1400] | Lower San Pedro.. | Pleistocene |
| 3 | Int | Near lighthouse, Pt. Fermin, Cal.............. | E. P. & E. M. Chace..... | Berry Coll. Cat. 4107. | [1096] | Lower San Pedro... | Pleistocene |
| 1 | Post | Near lighthouse, Pt. Fermin, Cal.................... | E. P. & E. M. Chace. .. | Berry Coll. Cat. 4107. | [1097] | Lower San Pedro... | Pleistocene |

[7] Varying to high in recent specimens from northern localities.

*Remarks:* Some of these specimens still retain well preserved traces of the original color pattern, as has already been remarked for other Lower San Pedro fossils by Arnold ( :03, p. 20). The evidence thus afforded, as well as that of the flattish outline of the valves, indicates that this Lower Pleistocene race was closely similar to the more southern form of the species as now existing, for instance, along the coast of Monterey County, California, which has an aspect quite recognizably different from the Puget Sound and Alaskan shells.

### Genus **Cyanoplax** (Pilsbry, 1892)

### 4. **Cyanoplax hartwegii** (Carpenter, 1855)

(Plate II, figs. 6-8.)

1855. *Chiton hartwegii* Carpenter, Proc. Zool. Soc. Lond., 1855, p. 231.
1855. *Chiton nuttalli* Carpenter, Proc. Zool. Soc. Lond., 1855, p. 231.
1864. *Trachydermon hartwegii* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 649.
1864. *Trachydermon nuttallii* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, pp. 627, 649.
1879. *Chætopleura hartwegii* Dall, Proc. U. S. Nat. Mus., v. 1, pp. 296, 329, pl. 1, f. 10 (radula).
1879. *Chætopleura nuttallii* Dall, Proc. U. S. Nat. Mus., v. 1, p. 330.
1892. *Tonicella (Cyanoplax) hartwegii* & var. *nuttallii,* Pilsbry, Man. Conch., (1), v. 14, p. 45, 46, pl. 14, f. 81-85.
1894. *Trachydermon (Cyanoplax) hartwegii* Pilsbry, Nautilus, v. 8, p. 45.
1909. *Cyanoplax hartwegii* Thiele, Rev. Syst. Chit., I, p. 4, 7.
1909. *Trachydermon hartwegii* Thiele, id., p. 16.
1910. *Trachydermon hartwegii* Thiele, Rev. Syst., Chit., II, p. 107.
1919. *Cyanoplax hartwegii* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, California).

*Diagnosis:* Valves low, relatively short and wide; sculpture, when not eroded, comprising a fine granulation overlain by larger irregularly scattered warts, the lateral areas distinctly defined only in well preserved specimens; a color pattern of brownish flames or stains sometimes persistent; sutural laminæ short and wide, the sinus wide and shallow; tegmental border straight or only slightly sinuous in front; teeth short, not projecting; eaves spongy; mucro low, nearly median in position; slit formula 8 to 11, 1-1, 9 to 12, the slits and teeth of the tail valve very oblique.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—"Chiton Bed", Point Fermin, California (Chace and Chace, !).

*Living:* Monterey, California, to Magdalena Bay, Lower California; between tides.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918. . . . . . . | Berry Coll. Cat. 4039. | [943] | Lower San Pedro. . . | Pleistocene |
| 3 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918. | Berry Coll. Cat. 4075. | [1030] | Lower San Pedro. . . | Pleistocene |
| 1 | Ant. . | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918. | Berry Coll. Cat. 4075. | [1079] | Lower San Pedro. . . | Pleistocene |
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918. | Berry Coll. Cat. 4075. | [1081] | Lower San Pedro. . . | Pleistocene |
| 2 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918. | Chace Coll. . . . . . . . . . | [1080] | Lower San Pedro. . . | Pleistocene |
| 1 | Ant. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920. . . . . . . | Chace Coll. . . . . . . . . . | [1367] | Lower San Pedro. . . | Pleistocene |
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920. . . . . . . | Chace Coll. . . . . . . . . . | [1367] | Lower San Pedro. . . | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920. . . . . . . | Chace Coll. . . . . . . . . . | [1367] | Lower San Pedro. . . | Pleistocene |
| 1 | Ant. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920. . . . . . . . . . . . . . . . . | Cal. Acd. Sci. . . . . . . . . | [1401] | Lower San Pedro. . . | Pleistocene |
| 6 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920. . . . . . . . . . . . . . . . . | Cal. Acd. Sci. . . . . . . . . | [1402] | Lower San Pedro. . . | Pleistocene |

*Remarks:* This species comes near to being the most abundant chiton now living on the coasts of California south of Monterey, with the possible exception of *Lepidochitona dentiens,* and from analogy with other species, one would naturally expect it to occur commonly in the Pleistocene. Such, however, is not the case. As a matter of fact, it has been unknown as a fossil until very recently, and seems to be very rare except at the Point Fermin "Chiton Bed", whence all my specimens were obtained. Most of these are too worn to show well the characteristic warty sculpture which in the shells of living animals can usually be relied on to separate *hartwegii* from all our other chitons.

### 5. **Cyanoplax fackenthallæ** Berry, 1919

(Plate II, figs. 9-10.)

1919. *Cyanoplax fackenthallæ* Berry, Lorquinia, v. 2, p. 45 [5].

*Diagnosis:*[8] Valves low, relatively short and wide, median ones distinctly beaked; sculpture comprising a fine, close, shagreen-like, quincuncial granulation over the entire surface, and a few rather irregular grooves on the terminal areas; lateral areas rather poorly defined; color pale, usually without markings; sutural laminæ triangular, projecting well forward, the sinus wide and deep; tegmental border sinuous in front; teeth of head and median valves very long and projecting, the slits extending only part way to base, in tail valve projected somewhat anteriorly, those on the sides of this valve oblique and distinctly pointed; eaves spongy; mucro low, somewhat posterior; slit formula 8, 2-2 (?), 11.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series — Chiton Bed, Point Fermin, California (!).

*Living:* Pacific Grove, California; between tides.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4103. | [1082] | Lower San Pedro. | Pleistocene |

*Remarks:* The single head valve seen seems to be conspecific with a similarly unique recent specimen at hand from Pacific Grove, which I recently ventured to describe as new under the name given above. It is also very near to another recent species lately described from Southern California, the *C. lowei* (Pilsbry), but the fossil agrees rather better in its lack of lines of pores in the articulamentum and in the more solid nature of the eaves and other parts of the shell, with the Pacific Grove form.

[8] It has been necessary to draw a portion of this description from a recent specimen.

## Genus **Lepidochitona** Gray, 1821

### 6. **Lepidochitona dentiens** (Gould, 1846)

(Plate I, figs. 7-9.)

1846. *Chiton dentiens* Gould, Proc. Bost. Soc. Nat. Hist., v. 2, p. 145.
1852. *Chiton (Onithochiton) dentiens* Gould, Moll. U. S. Expl. Exped., p. 321, pl. 28, f. 433-433b.
1857. *Chiton (?) dentiens* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1856, pp. 209, 318, 348.
1862. *Chiton dentiens* Gould, Otia Conch., p. 6.
1864. *Trachydermon pseudodentiens* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, pp. 530, 606, 612, 649.
1865. *Ischnochiton (Trachydermon) pseudodentiens* Carpenter, Proc. Acad. Nat. Sci., Phila., 1865, p. 60.
1879. *Trachydermon dentiens* Dall, Proc. U. S. Nat. Mus., v. 1, p. 323.
1892. *Ischnochiton (Trachydermon) dentiens* Pilsbry, Man. Conch. (1), v. 14, p. 73, pl. 8, f. 61-65.
1893. *Trachydermon dentiens* Pilsbry, Man. Conch., (1), v. 15, p. 65, pl. 15, f. 26 (girdle scales).
*not* 1917. *Trachydermon dentiens* Chace, Lorquinia, v. 2, p. 30 (=*Mopalia acuta*).

*Diagnosis:* Valves small, delicate, low, median ones more or less obscurely beaked; sculpture consisting of numerous low, flat, round, even granules over the entire surface, showing more or less tendency to form into longitudinal lines on the central areas; lateral areas fairly well defined in good material; sutural laminæ wide and low, separated by a moderately wide but shallow sinus; tegmental border of median valves gently arcuate in front; teeth thin, sharp, barely projecting, in tail valve very numerous and often bifid; eaves spongy; mucro a little anterior of the middle, rather elevated, its posterior slope concave; slits 11, 1-1, 10 to 15.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Nob Hill Cut, San Pedro, California (!).

*Living:* Esquimalt, British Columbia (Carpenter), to Socorro Island, Revillagigedo Group, Mexico (Pilsbry); between tides.

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 57 | Int.. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll............ | Dept. Geology, Stanford Univ..... | [659] | Lower San Pedro... | Pleistocene |
| 5 | Int.. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll............ | Berry Coll. Cat. 4122. | [65 [illegible] | Lower San Pedro... | Pleistocene |
| ?1 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll............. | Dept. Geology, Stanford Univ..... | [711] | ? | ?Pleistocene |

*Remarks:* The sculpture of *L. dentiens* is extremely similar to that of *Cyanoplax raymondi* (Pilsbry), but the short, wide valves, delicate structure of the shell, and short sutural laminæ lead me to refer the fossil specimens to the former species. Mr. and Mrs. Oldroyd obtained it so abundantly in the Nob Hill Cut that it seems strange that, except for one perhaps questionable specimen from Deadman Island, it has not been detected in any of the other horizons. The specimens are so fragile that none were obtained in an altogether perfect condition, but in spite of this and the lack of any terminal valves in the series, the identification seems reasonably certain.

### Genus **Nuttallina** Carpenter, 1879

### 7. **Nuttallina californica** (Nuttall, 1847)

(Plate III, figs. 1-12.)

1847. *Chiton californicus* Nuttall in Reeve, Conch. Icon., v. 4, Chiton, sp. 90, pl. 16, f. 90; detail pl., f. 89.
1864. *Acanthopleura scabra* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 527, 603, 649.
1893. *Nuttallina californica* Pilsbry, Man. Conch., (1), v. 14, p. 279, pl. 54, f. 23-24; pl. 56, f. 12-18.
1919. *Nuttallina* cf. *fluxa* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, Cal.).

*Diagnosis:* Valves heavy, low, more or less triangular, median ones strongly beaked, though beaks and entire posterior portion often lost by erosion; sculpture comprising a narrow sulcus bounding the jugal tract on each side, an oblique ridge dividing the lateral and pleural areas, and a coarse, rather zigzag granulation over the two latter regions, the jugal tract smooth; traces of the color pattern of white jugal triangles often persistent, these giving way rather abruptly on the sides to brown; sutural laminæ very long, pointed on the inner front margin, the wide sinus steep-sloped and deep; tegmental border of median valves strongly arcuate in front; teeth of head valve long and projecting, of median valves very weakly developed, of tail valve low, thickened, very irregular in width, and strongly directed forward; eaves and sinus spongy; mucro strongly posterior, often overhanging; slits 10 to 11, 1-1 (though with slit-rays 2-2), 7 to 9.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series — Chiton Bed, Point Fermin, California (!); Nob Hill Cut, San Pedro, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Vancouver Island, British Columbia (Pilsbry), to Piedras Blancas, San Luis Obispo County, California (Pilsbry); between tides.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 5 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Chace Coll. | [ 944] | Lower San Pedro | Pleistocene |
| 3 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4040 | [1026] | Lower San Pedro | Pleistocene |
| 31 | Int. | Chiton Bed, Pt. Fermin, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4040 | [1027] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4040 | [1028] | Lower San Pedro | Pleistocene |
| 20 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4040 | [1083] | Lower San Pedro | Pleistocene |
| 3 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4040 | [1084] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1361] | Lower San Pedro | Pleistocene |
| 6 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1362] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Berry Coll. Cat. 4964 | [1362] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1363] | Lower San Pedro | Pleistocene |
| 3 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Berry Coll. Cat. 4964 | [1403] | Lower San Pedro | Pleistocene |
| 71 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Cal. Acd. Sci | [1404] | Lower San Pedro | Pleistocene |
| 11 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1405] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [ 652] | Lower San Pedro | Pleistocene |
| 1 | Int. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [ 653] | Lower San Pedro | Pleistocene |
| 2 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [ 678] | Lower San Pedro | Pleistocene |

*Remarks:* Specimens of *Nuttallina* are far from widely distributed as fossils in spite of their present day abundance. I have seen them in numbers only from the Point Fermin "Chiton

Bed". The two principal living species are very similar to each other but are supposed to be quite distinctly separable geographically, *N. californica* occurring from the neighborhood of Point Concepcion as far north, perhaps, as British Columbia, while *N. fluxa* (Carpenter) is recorded from Southern and Lower California.

When first received the median valve figured was thought to be referable to *N. fluxa* rather than to *N. californica*. Receipt of better material has caused me to revise this opinion, but I must admit that even with recent material I am not always confident that I am able to draw a proper dividing line between these two species. The *fluxa*-like outline of the specimen under consideration, however, seems clearly due to the erosion of the entire posterior portion of the valve. It has the following caliper measurements: length 5.3, diameter 6.8, alt. 3.6 mm.

The largest perfect specimen seen is an intermediate valve from the Chiton Bed [1027], and measures: length 8.7, diameter 9.0, alt. 3.2 mm. A worn and eroded median valve from the same exposure [1404] is much larger, its length 12.0, diameter 16.7, and alt. 5.8 mm.

### Family **Mopaliidæ**

### Genus **Mopalia** Gray, 1847

### 8. **Mopalia muscosa** (Gould, 1846)

(Plate IV, figs. 1-9.)

1846. *Chiton muscosus* Gould, Proc. Bost. Soc. Nat. Hist., v. 2, p. 145.

1847. *Chiton ciliatus* Reeve, Conch. Icon., v. 4, Chiton, sp. 124, pl. 19, f. 124; detail pl., f. 124 (not of Sowerby, 1840).

1847. *Chiton collei* Reeve, id., sp. 136, pl. 21, f. 136.

1852. *Chiton muscosus* Gould, Moll. U. S. Expl. Exped., p. 313, f. 436.

1862. *Chiton muscosus* Gould, Otia Conch., p. 6.

1893. *Mopalia muscosa* Pilsbry, Man. Conch., (1), v. 14, p. 295, pl. 63, f. 46-56; pl. 64, f. 74.

1903. *Mopalia ciliata* Arnold, Mem. Cal. Ac. Sci., v. 3, p. 28, 42, 85, 343 (recorded from Pleistocene of San Pedro, Cal.).

1906. *Mopalia ciliata* Arnold, Pectens of Calif., p. 36 (recorded from Pleistocene of San Pedro, Cal.).

1919. *Mopalia muscosa* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, Cal.).

*Diagnosis:* Valves moderately heavy, barely beaked; lateral areas distinct, bounded by a strong rib-like series of more or less overlapping tubercles in front, and a similar but more or less obsolete series of wider tubercles on the sutural margin, the area between closely and finely tubercular; head valve similarly sculptured with 8 strongly tuberculose radial ridges in addition to the tubercled thickenings on the sutural margin; central areas sculptured throughout with numerous low, rather crenulate, longitudinal riblets, sometimes weakly interlatticed by traces of a fine radial liration across the sulci; sutural laminæ low and broad, the sinus rather shallow; tegmental border of median valves with a distinct, obtusely rounded, beak-like projection in front; teeth of first 7 valves strongly projecting, those of head valve vertically grooved outside; tail valve with a single pair of lateral slits and a small angular sinus in the articulamentum which barely indents the tegmental border; mucro low and strongly posterior; eaves spongy and crenulated; slit formula 8, 1-1, 1-1.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Formation—Chiton Bed, Point Fermin, California (Chace and Chace, !); Nob Hill Cut, San Pedro, California (!).

Upper San Pedro Formation—"Crawfish George's", San Pedro, California (!); "lumber yard", San Pedro, California (Arnold, as *ciliata*); "coal mine", Point Loma, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Indian middens:* Near Cypress Point, Monterey County, California (!); mouth of Topanga Canyon, near Santa Monica, California (Dr. F. C. Clark, Coll., !); La Jolla, California (!).

*Living:* Shumagin Islands, Alaska (Dall), to Cedros Island, Lower California; usually between tides.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 2 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4041 | [1034] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Cal. Acd. Sci. | [1088] | Lower San Pedro | Pleistocene |
| 1 | Int | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4041 | [945] | Lower San Pedro | Pleistocene |
| 12 | Int | Chiton Bed, Pt. Fermin, Cal | E. P. & E. M. Chace, 1918 | Chace Coll. / Berry Coll. Cat. 4041 | [1035] | Lower San Pedro | Pleistocene |
| 5 | Int | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Cal. Acd. Sci. / Berry Coll. Cat. 4105 | [1089] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4105 | [1090] | Lower San Pedro | Pleistocene |
| 4 | Int | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1364] | Lower San Pedro. | Pleistocene |
| 3 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1406] | Lower San Pedro | Pleistocene |
| 14 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1407] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll | Dept. Geology, Stanford Univ | [654] | Lower San Pedro | Pleistocene |
| 2 | Int | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll | Dept. Geology, Stanford Univ | [655] | Lower San Pedro | Pleistocene |
| 1 | Post | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [656] | Lower San Pedro | Pleistocene |
| ?2 | Ant. | Crawfish George's, San Pedro, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4046 | [952] | Lower San Pedro. | Pleistocene |
| 1 | Int | Crawfish George's, San Pedro, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4046 | [953] | Lower San Pedro | Pleistocene |
| ?1 | Int | Crawfish George's, San Pedro, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4046 | [953] | Lower San Pedro | Pleistocene |
| 1 | Int | Coal mine, Pt. Loma, Cal | C. L. Hubbs | Berry Coll. Cat. 3932 | [550] | Upper San Pedro | Pleistocene |
| ?4 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [689] | ? | ? Pleistocene |
| ?1 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [697] | ? | ? Pleistocene |
| ?12 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [719] | ? | ? Pleistocene |
| 4 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [690] | ? | ? Pleistocene |
| ?2 | Int | Deadman Id., San Pedro, Cal. | R. Arnold, May, 1901 | Dept. Geology, Stanford Univ. | [692] | ? | ? Pleistocene |
| ?2 | Int | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [702] | ? | ? Pleistocene |
| ?1 | Int | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [720] | ? | ? Pleistocene |
| ?1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [703] | ? | ? Pleistocene |
| ?1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [721] | ? | ? Pleistocene |

*Remarks:* Valves of this species are not always easy to discriminate from those of several of its living allies, especially as they are so often worn and broken. Well preserved specimens should be quite readily identifiable by their coarse sculpturing, the longitudinal ribs of the central areas being heavier and fewer than in such species as *M. hindsii*, while the ribs bounding the central areas, as well as these areas themselves, are more strongly granose. In shape the valves are generally quite elevated and have an unusually shallow jugal sinus.

Dall and Pilsbry have already called attention to the fact that in this species the tegmentum of the median valves has a sort of rounded, false beak in the middle in front, which is an aid in the separation of the species from *M. ciliata,* but this beak is sometimes eroded away in fossils.

Practically all the fossil Mopalias will require re-examination after those of the recent fauna have become better understood than they are at present.

### 9. **Mopalia hindsii** (Sowerby, 1847)

(Plate IV, figs. 10-12.)

1847. *Chiton Hindsii* Sowerby, in Reeve, Conch. Icon., v. 4, Chiton, sp. 67, pl. 12, f. 67a-b; detail pl., f. 67.
1847. *Mopalia Hindsii* Gray, Proc. Zool. Soc. Lond., p. 69, 169.
1893. *Mopalia muscosa* var. *hindsii* Pilsbry, Man. Conch., (1), v. 14, p. 296, pl. 62, f. 99-100; pl. 63, f. 57.
1916. *Mopalia hindsii* Chace, Nautilus, v. 30, p. 71 (recorded from Pleistocene of Deadman Id., Cal.).

*Diagnosis*[9]: Valves moderately heavy, barely beaked; lateral areas distinct, bounded in front by a low, sometimes obsolete, rather indistinctly granose rib, and behind by a much weaker sutural thickening, the area between showing an interwoven basket-like pattern of varying distinctness; head valve similarly ornamented with 8 low, indistinctly granose, radiating ribs, showing the basket-like sculpturing between; central areas sculptured with numerous fine longitudinal riblets, either weakly interlatticed, or so broken as to have a zigzag appearance, sometimes nearly obsolete; jugal tracts with a sharp longitudinal divergent ribbing, or with sculpture obsolete; sutural laminæ low and broad; sinus narrow and rather shallow; tegmental border of median valves with a distinct, rounded beak-like projection in front; teeth of head valve moderately long, rather weakly vertically grooved outside; teeth of median valves projecting, less distinctly grooved; tail valve with a single pair of lateral slits and an angular posterior sinus in the articulamentum, the tegmentum rather broadly emarginate above it; mucro a little behind the center; eaves spongy and somewhat crenulate; slits 8, 1-1, 1-1.

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[9] Description drawn in part from recent specimens.

*Recorded Range:*

*Pleistocene:* Formation doubtful—Deadman Island, San Pedro, California (Chace, !).

*Living:* Forrester Island, Alaska, (!) to Ventura County, California (!); usually between tides, but recorded to 30 fathoms. Also recorded from Laguna Beach, Orange County, California (Guernesey), and San Diego, California (Kelsey).

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | ii.... | Deadman Id., San Pedro, Cal. | E. P. Chace............ | Berry Coll. Cat. 3935. | [578] | —San Pedro....... | Pleistocene |
| 1 | Int . | Deadman Id., San Pedro, Cal. | Arnold Coll............. | Dept. Geology, Stanford Univ..... | [691] | ? | ? Pleistocene |

*Remarks:* One of the two specimens here referred to *M. hindsii* is that previously reported from the San Pedro Formation by Chace. While I am unable to place it elsewhere, it nevertheless does not seem to be entirely characteristic for this species. In this specimen even the central areas have a beautiful basket-like, interwoven appearance to the sculpturing, something like that of the lateral areas but finer. It has been found hopeless to depict this with any real faithfulness in a stipple drawing, but perhaps the illustration will give a hint of what is meant. In all recent specimens I have examined, as well as in the fossil from the Arnold collection, the longitudinal sculpture of the central areas is much more marked and results in an effect of fine, rather wavy fluting, instead of interweaving. The divergent riblets on the jugal area of the second valve are generally quite well marked. On the other valves this is less evident.

Well preserved specimens are readily distinguished from all forms of *M. muscosa* by the peculiar cloth-like sculpturing, and the usually flatter outline. In living specimens the girdle characters of the two species are widely different.

### 10. **Mopalia acuta** (Carpenter, 1855)

(Plate V, figs. 10-11.)

1855. *Chiton acutus* Carpenter, Proc. Zool. Soc. Lond., 1855, p. 232.

1864. *Mopalia acuta* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 527, 648.

1893. *Mopalia muscosa* var. *acuta* Pilsbry, Man. Conch., (1), v. 14, p. 297, pl. 64, f. 75-81.

1917. *Trachydermon dentiens* Chace, Lorquinia, v. 2, p. 30 (*not Chiton dentiens* of Gould; recorded from Pleistocene of Santa Monica, California).

*Diagnosis:* Valves small to moderate in size, rather delicate; sculptured in similar fashion to *M. lignosa,* but the sutural rib in valves i-vii typically ornamented by series of delicate denticles; sutural laminæ short and wide; sinus narrow and rather shallow; tegmental border of median valves weakly

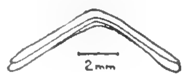


Fig. 9

Fig. 9. *Mopalia acuta* (Carpenter). Anterior elevation of valve illustrated in Plate V, figs. 10-11; camera outline.

false-beaked in front; teeth rather short, only moderately projecting; tail valve with a single pair of lateral slits, one or more of which may be duplex, and a small posterior sinus, often showing a small tooth at the apex; eaves spongy; slits 8, 1-1, 1-1.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Nob Hill Cut, San Pedro, California (!).

Upper San Pedro Series—Long Wharf Canyon, Santa Monica, California (!); Los Cerritos Hill, Long Beach, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Monterey, California (!) to Todos Santos Bay, Lower California (!)[10].

[10] The record by Baker from Ellamar, Alaska, surely requires confirmation.

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 21 | Int.. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll............ | Dept. Geology, Stanford Univ... Berry Coll. Cat. 3971 | [657] | Lower San Pedro... | Pleistocene |
| 1 | Post. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll............ | Dept. Geology, Stanford Univ..... | [658] | Lower San Pedro... | Pleistocene |
| ?2 | Ant.. | Deadman Id., San Pedro, Cal. | Arnold Coll............. | Dept. Geology, Stanford Univ..... | [693] | ? | ? Pleistocene |
| ?12 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll............. | Dept. Geology, Stanford Univ..... | [695] | ? | ? Pleistocene |
| ?2 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll............. | Dept Geology, Stanford Univ..... | [696] | ? | ? Pleistocene |
| ?1 | Ant.. | ?Deadman Id., San Pedro, Cal. | Oldroyd Coll............ | Dept. Geology, Stanford Univ..... | [673] | ?"Upper San Pedro" | Pleistocene |
| ?1 | Post. | ?Deadman Id., San Pedro, Cal. | Oldroyd Coll............ | Dept. Geology, Stanford Univ..... | [674] | ?"Upper San Pedro" | Pleistocene |
| 3 | Ant.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............. | F. C. Clark Coll...... | [760] | Upper San Pedro... | Pleistocene |
| 4 | Int.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............. | F. C. Clark Coll...... | [761] | Upper San Pedro... | Pleistocene |
| 1 | Int.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............. | Berry Coll. Cat. 3966. | [762] | Upper San Pedro... | Pleistocene |
| 1 | Int.. | Los Cerritos Hill, Long Beach, Cal...................... | T. S. Oldroyd........... | Dept. Geology, Stanford Univ..... | [665] | Upper San Pedro... | Pleistocene |

*Remarks:* Specimens of a nearly smooth *Mopalia,* believed for the most part to be identical with the recent *M. acuta* (Carpenter), have been seen from several horizons, but the material is frequently so poor that one cannot be absolutely certain of the identification, especially since the recent forms themselves belonging to this group are still very insufficiently known. Most of the specimens are very small, and this, with the yellow-brown maculation still visible now and then, gives support to the view that they are not forms of *lignosa.* On the other hand only one or two of the valves possess even a trace of the delicate sutural denticulation supposedly characteristic of *acuta,* the sutural margin in most instances being smooth. The largest of the specimens listed [695] is but 15.8 mm. in diameter. The largest of the Long Wharf Canyon specimens [762], which is believed to be more surely identified, has a diameter of only 9.2 mm. The largest of those from the Nob Hill Cut [657] is 12.3+ mm. in diameter. These two lots at least, as well as the specimen from Los Cerritos Hill, appear to represent the same species, but it may be that some of the Deadman Island specimens are really young *lignosa.*

### 11. Mopalia lignosa (Gould, 1846)

1846. *Chiton lignosus* Gould, Proc. Bost. Soc. Nat. Hist., v. 2, p. 142.
1846. *Chiton Merckii* Middendorff, Bull. Imp. Ac. Sci. St. Petersb., v. 6, p. 20.
1846. *Chiton Eschscholtzii* Middendorff, id., p. 118.
1847. *Chiton Merckii* Middendorff, Malac. Ross., v. 1, p. 114, pl. 11, f. 5-6.
1847. *Chiton Eschscholtzii* Middendorff, id., p. 114, pl. 11, f. 4.
1847. *Mopalia Simpsoni* Gray, Proc. Zool. Soc. Lond., 1847, p. 69 (teste Carpenter; name only).
1852. *Chiton vespertinus* Gould, Moll. U. S. Expl. Exped., p. 323, f. 426-426a.
1855. *Chiton montereyensis* Carpenter, Proc. Zool. Soc. Lond., 1855, p. 231.
1862. *Chiton lignosus* Gould, Otia Conch., p. 3.
1862. *Chiton (Chaetopleura) vespertinus* Gould, Otia Conch., p. 230, 242.
1864. *Mopalia lignosa* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 530, 533, 554, 598, 648.
1879. *Mopalia ciliata lignosa* Dall, Proc. U. S. Nat. Mus., v. 1, p. 304.
1893. *Mopalia muscosa lignosa* Pilsbry, Man. Conch., (1), v. 14, p. 299, pl. 63, f. 58-59.
1919. *Mopalia lignosa* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Point Fermin, California).

*Diagnosis*[11]: Valves of moderate thickness, barely beaked; lateral areas usually distinct, bounded in front by a low, often more or less obsolete diagonal rib; head valve bearing 8 similar, low, radial ribs; entire surface of all valves between ribs covered by a very fine latticed ribbing showing small pit-like interstices, sometimes with sculpture nearly obsolete; traces of brownish or grayish flammules sometimes still persistent; sutural laminæ low and broad; sinus narrow and rather shallow; tegmental border in median valves with a distinct, rounded, median, beak-like projection in front; teeth of head valve projecting, moderately long, sharply beveled and more or less grooved at edges; teeth of median valves projecting, less dis-

[11] Description drawn in considerable part from recent specimens.

tinctly beveled or grooved; tail valve with a single pair of lateral slits and a small posterior sinus, often showing a minute tooth at its apex; eaves spongy; slits 8, 1-1, 1-1.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Chiton Bed, Point Fermin, California (Chace and Chace, !); near lighthouse, Point Fermin, California (!).

Formation doubtful— ? Deadman Island, San Pedro, California (!).

*Living:* Sitka, Alaska, to Morro, San Luis Obispo County, California (!); also reported from Point Fermin, Los Angeles County, California (Williamson); usually between tides, but recorded to 30 fathoms.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. . | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4078. | [1039] | Lower San Pedro. . . | Pleistocene |
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920. . . . | Chace Coll. . . . . . . . . | [1410] | Lower San Pedro. . . | Pleistocene |
| 1 | Post. | Near lighthouse, Pt. Fermin, Cal. . . . . . . . . . . . . . . . . . . . | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4109 | [1100] | Lower San Pedro. . . | Pleistocene |
| 1 | Int. . | Deadman Id., San Pedro, Cal. | Arnold Coll | Dept. Geology, Stanford Univ. . . . . | [ 694] | ? | ? Pleistocene |
| ?1 | Ant. . | ?Deadman Id., San Pedro, Cal. | Oldroyd Coll | Dept. Geology, Stanford Univ. . . . | [ 672] | ?"Upper San Pedro" | Pleistocene |

*Remarks:* Several fossil valves seem referable to this species, as they are not only of a size commensurate with that of recent *lignosa,* but when moistened still exhibit distinct traces of the peculiar flamed color pattern so characteristic of the shell of the living animal. The largest entire specimen [694] has a diameter of 21.2 mm.

The condition of none of the material at hand is such as to render an illustration worth while.

### 12. **Mopalia ciliata** (Sowerby, 1840)

(Plate V, figs. 1-9.)

1840. *Chiton ciliatus* Sowerby, Ann. Mag. Nat. Hist (n.s.), v. 4, p. 289.
1840. *Chiton ciliatus* Sowerby, Conch. Ill., fig. 79.
1864. *Mopalia Kennerleyi* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 648.

1864. *Mopalia Kennerleyi* var. *Swanii* Carpenter, id., p. 627, 648.
1864. *Mopalia Kennerleyi* var. *Swannii* Carpenter, Ann. Mag. Nat. Hist., (3), v. 14, p. 426.
1865. *Mopalia Kennerleyi* Carpenter, Proc. Acad. Nat. Sci. Phila., 1865, p. 59.
1879. *Mopalia Wossnessenskii* Dall, *(pars)* Proc. U. S. Nat. Mus., v. 1, p. 305.
1893. *Mopalia ciliata* Pilsbry, Man. Conch., (1), v. 14, p. 303, pl. 64, f. 64-68.
1919. *Mopalia ciliata* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, Cal.).

*Diagnosis:* Valves moderately heavy, rather distinctly beaked; lateral areas distinct, bounded by a low, granose rib in front, and with the sutural margin also more or less granose, the area between filled with rows of smaller grains; head valve similarly sculptured, bearing 8 radial series of low tubercles; pleural tracts somewhat excavated, sculptured by numerous fine, sinuous, rather granular, weakly interlatticed, longitudinal riblets, the jugal tract with sharper, finer and closer sculpture; sutural laminæ and teeth long and projecting; sinus wide and spongy; tegmental border of median valves sinuous in front, but not false beaked; tail valve with a single pair of lateral slits and a large, rounded, posterior sinus; mucro well behind the middle; eaves spongy and crenulated; slits 8, 1-1, 1-1.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series — Chiton Bed, Point Fermin, California (Chace and Chace, !); near lighthouse, Point Fermin, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Aleutian Islands (Keep), to Todos Santos Bay, Lower California (!); between tides and to 50 fathoms.

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Cal. Acd. Sci. | [1036] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4077 | [1036] | Lower San Pedro | Pleistocene |
| 1 | Int | Chiton Bed, Pt. Fermin, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4077 | [1037] | Lower San Pedro | Pleistocene |
| 2 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Cal. Acd. Sci. | [1037] | Lower San Pedro | Pleistocene |
| 1 | Post | Chiton Bed, Pt. Fermin, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4077 | [1038] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1408] | Lower San Pedro | Pleistocene |
| 3 | Int | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1409] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Near lighthouse, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4108 | [1098] | Lower San Pedro | Pleistocene |
| 4 | Int | Near lighthouse, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4108 | [1099] | Lower San Pedro | Pleistocene |
| 6 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [727] | ? | ? Pleistocene |
| 17 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [698] | ? | ? Pleistocene |
| ?2 | Int | Deadman Id., San Pedro, Cal. | Arnold Coll. | Berry Coll. Cat. 5183 | [700] | ? | ? Pleistocene |
| 2 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [699] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Berry Coll. Cat. 5183 | [701] | ? | ? Pleistocene |
| 1 | Ant. | ? Deadman Id., San Pedro, Cal | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [675] | ?"Upper San Pedro" | Pleistocene |
| 2 | Int | ? Deadman Id., San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [676] | ?"Upper San Pedro" | Pleistocene |
| 1 | Int. | ? Deadman Id., San Pedro, Cal. | Oldroyd Coll. | Berry Coll. Cat. 5181 | [676] | ?"Upper San Pedro" | Pleistocene |

*Remarks:* There are numerous *Mopalia* valves in the collections seen which have given more than their share of trouble to identify. Most of them are quite close to common forms of the recent *M. ciliata,* and one encounters little difficulty in so naming them. But other specimens appear to have an aspect of their own, especially two or three intermediate valves which show a peculiar, broad, triangular, finely longitudinally striate jugal area. There is also variation in several other directions so that a thorough revision of the recent forms may show that I have included more than one species here. For the present there is little to be done but follow Pilsbry in his redefinition of *ciliata.* He regards the common Monterey form as typical for Sowerby's species. If this be so, then some at least of the fossils are correctly determined. Head valves are probably the hardest to satisfactorily identify, as they so often closely resemble those of *M. muscosa.*

### 13. **Mopalia** cf. **sinuata** Carpenter, 1864

(Plate VI, figs. 7-8.)

1864. ? *Mopalia sinuata* Carpenter, Rep. Brit. Assoc. Adv. Sci. 1863, p. 648.

1865. ? *Mopalia sinuata* Carpenter, Proc. Acad. Nat. Sci. Phila., 1865, p. 59.
1879. *Mopalia sinuata* Dall, Proc. U. S. Nat. Mus., v. 1, p. 303, 306.
1886. *Placiphorella (Osteochiton) sinuata* Dall, Proc. U. S. Nat. Mus., v. 9, p. 211.
1893. *Mopalia sinuata* Pilsbry, Man. Conch., (1), v. 14, p. 303, pl. 62, f. 95-97.

*Recorded range: Pleistocene (?):* Deadman Island, San Pedro, California (!).

*Living (sinuata):* Forrester Island, Alaska (!), to San Francisco Bay, California (Newcomb); 0-30 fathoms.

*Material Examined:* A single anterior valve in the Arnold collection from Deadman Island, San Pedro, California [717], exact horizon unknown.

*Remarks:* The single specimen seen is remarkably close to the recent *Mopalia sinuata* Carpenter, and further material may confirm my surmise that it belongs to this northern species. The fossil agrees with recent shells in its relatively clean-cut, continuous ribs, and the peculiar, deeply pitted reticulum which occupies their interspaces, a sculpturing wholly unlike that of any other of the Mopalias thus far described. It is very unfortunate that the exact formation from which the specimen was taken is unknown.

### 14. **Mopalia,** sp. indet.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Rustic Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 4052 | [957] | Santa Barbara | Pliocene |
| 2 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 4002 | [931] | Upper San Pedro | Pleistocene |
| 3 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [932] | Upper San Pedro | Pleistocene |
| 2 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 4002 | [933] | Upper San Pedro | Pleistocene |
| 7 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [934] | Upper San Pedro | Pleistocene |
| 3 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [935] | Upper San Pedro | Pleistocene |
| 1 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 4002 | [936] | Upper San Pedro | Pleistocene |

*Remarks:* The 18 small *Mopalia* valves listed in the table above from the Pleistocene of Santa Monica are mostly in very mediocre condition and cannot be referred with certainty to any of the known species. The largest [934] has the following caliper measurements: long. 3.2; diam. 8.5; alt. 3.1 mm. Perhaps it is possible that the specimens represent juvenals of the foregoing species *(ciliata)* or even of *muscosa,* but further material is needed to settle the question. Where the sculpture is at all well preserved it is very sharp and beautiful. A single specimen of undoubtedly the same species is here recorded from the Pliocene of Rustic Canyon, Santa Monica. The Pliocene age of this specimen is therefore desirable of confirmation.

### 15. **Mopalia,** sp. indet.

A single badly worn intermediate valve of what seems to be an indeterminate Mopalia [954] is before me from Mr. Chace's collections at Crawfish George's (Lower San Pedro Pleistocene), San Pedro, California.

## Genus **Placiphorella** Carpenter, 1879

### 16. **Placiphorella velata** Carpenter, 1879

(Plate III, figs. 13-15.)

1879. *Placiphorella velata* Carpenter in Dall, Proc. U. S. Nat. Mus., v. 1, pp. 298, 303, 307, pl. 4, f. 36-36a (radula).
1893. *Placiphorella velata* Pilsbry, Man. Conch., (1), v. 14, p. 306, pl. 66, f. 6-12.
1919. *Placiphorella velata* Chace and Chace, Lorquinia, v. 2, p. 43 [3] (recorded from Pleistocene of Pt. Fermin, Cal.).

*Diagnosis*[12]*:* Valves heavy, the median ones not beaked; straight or even distinctly concave behind, extremely short and wide; practically unsculptured except for the lines of growth; lateral areas distinct and well raised, separated into low ribs by a shallow central sulcus; tegmental border slightly false beaked in front; teeth of head valve short, numerous, primarily

[12] Description drawn in part from recent specimens.

with 8 slits, but in adult very imperfectly and irregularly developed, with numerous secondary slits; median valves with short but well projecting teeth and very wide sutural laminæ, continuous across the narrow, abrupt sinus; tail valve with a single pair of nearly obsolete lateral slits, rugose insertion plates, and weak or nearly obsolete, posterior sinus; mucro posterior; eaves spongy; slits 8+, 1-1, 1-1.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Chiton Bed, Point Fermin, California (Chace and Chace, !); near lighthouse, Point Fermin, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Forrester Island, Alaska (!), to Todos Santos Bay, Lower California (!); between tides to 50 fathoms.

*Material Examined:*

| No. 81 Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int.. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4106. | [1092] | Lower San Pedro... | Pleistocene |
| 1 | Ant.. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920....... | Berry Coll. Cat. 4106. | [1358] | Lower San Pedro... | Pleistocene |
| 1 | Int.. | Near lighthouse, Pt. Fermin, Cal.................... | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4110. | [1101] | Lower San Pedro... | Pleistocene |
| 1 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll........... | Dept. Geology, Stanford Univ..... | [677] | ? | ? Pleistocene |

*Remarks:* A valve in the Arnold collection from one of the Deadman Island formations is apparently referable to the bizarre *P. velata,* although it seems more than usually short and broad even for this species. Though somewhat chipped and worn it is on the whole in a very fair state of preservation, and is here figured. That the specimen is a second valve is indicated by the anteriorly projecting angle of the tegmentum and the very oblique insertion slits. It has the following caliper measurements: long. 7.0, diam. 26.7, alt. 8.4 mm.

Three valves, mainly fragmentary, from the Point Fermin exposures are the only additional fossil specimens which have been seen.

### Genus **Katharina** Gray, 1847

### 17. **Katharina tunicata** (Wood, 1815)

(Plate VI, figs. 1-6)

1815. *Chiton tunicatus* Wood, Gen. Conch., p. 11, pl. 2, f. 1.
1828. *Chiton tunicatus* Wood, Index Test., p. 2, Chiton, pl. 1, f. 10.
1847. *Katharina tunicata* Gray, Proc. Zool. Soc. Lond., 1847, p. 69.
1893. *Katharina tunicata* Pilsbry, Man. Conch., (1), v. 15, p. 41, pl. 1, f. 1-11.
1919. *Katherina tunicata* Chace, Nautilus, v. 30, p. 71 (recorded from Pleistocene of Deadman Id., Cal.).

*Diagnosis:* Valves massive; tegmentum greatly restricted, more or less flask-shaped in the median valves, with an elongate, neck-like projection in front jutting into the sinus; areas not well delimited, except for the slightly elevated jugal tract extending back from the anterior process; sculpture obsolete except for the rather strong lines of growth and about 8 weak, radial ribs on the head valve; insertion plates in valves ii-viii coalescent with the immensely developed and flaring sutural laminæ, in valve i long with strong grooves radiating to short slits at the margin, in valve viii directed abruptly forward from the blunt, posteriorly projected mucro; articulamentum of tail valve with a distinct posterior sinus; eaves and sinus spongy; slits 8+, 1-1, 1-1.

*Recorded Range:*

*Pliocene:* Santa Barbara Formation—Deadman Island, San Pedro, California (!).

*Pleistocene:* Formation doubtful—Deadman Island, San Pedro, California (Chace, !).

*Indian Middens:* Near Cypress Point, Monterey County, California (!).

*Living:* Kamtschatka and Aleutian Islands to Santa Catalina Island, California; between tides, but occasionally to 20 fathoms (Pilsbry).

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll............. | Dept. Geology, Stanford Univ..... | [ 726] | Santa Barbara..... | Pliocene |
| 1 | Ant.. | Deadman Id., San Pedro, Cal. | E. P. Chace............ | Berry Coll. Cat. 3936. | [ 345] | —San Pedro....... | Pleistocene |

*Remarks:* The specimen previously reported by Chace from the Pleistocene of Deadman Island is the one before me. It is an anterior valve of this very peculiar and unmistakable species, the first to be reported in the fossil state, and perfect except for the loss of the tegmentum by delamination. The Arnold collection has since proved to contain a large and finely preserved intermediate valve of the same species from the Pliocene of this island. Mr. Chace seems to be reasonably positive that his specimen came from the Pleistocene and not from the Pliocene, though whether from the Upper or Lower San Pedro Series he cannot now be certain. The Stanford specimen has quite a different appearance lithologically and is plainly marked "Pliocene" on the accompanying label. The measurements of this specimen by caliper are: long, 22.8, diam. 26.7, alt. 8.5 mm. Both specimens are figured herewith.

## Family ACANTHOCHITONIDÆ

### Genus **Acanthochitona** Gray, 1821

### 18. **Acanthochitona avicula** (Carpenter, 1864)

(Plate VI, fig. 9)

1864. *Acanthochites avicula* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 612, 650.
1866. *Acanthochites avicula* Carpenter, Proc. Cal. Ac. Nat. Sci., v. 3, p. 211.
1893. *Acanthochites avicula* Carpenter, Man. Conch., (1), v. 15, p. 24 (after Carpenter).
1893. *Acanthochites avicula* var. *diegoensis* Pilsbry, id., p. 25, pl. 12, f. 52-54.

*Diagnosis*[13]*:* Valves rather delicate, carinated, sharply beaked; pleural and terminal areas ornamented with a "snake-skin pat-

[13] Description drawn largely from recent specimens.

tern" of regular, flat, scale-like pustules; jugal tract sculptured with 8-12 (fewer in juvenile specimens), closely placed, low, flattened, diverging ribs, separated by narrow, incised grooves; sutural laminæ large, rounded; jugal sinus moderate; tail valve with mucro nearly median but strongly directed posteriorly; teeth very long and projecting, slit in only a little way; eaves scarcely developed; slits 5, 1-1, 1-1.

*Recorded Range: Pleistocene:* Upper San Pedro Series—Long Wharf Canyon, Santa Monica, California (!).

*Living:* 6 miles north of Santa Monica, California (E. P. Chace, coll.,!), to San Diego, California; between tides to 20 fathoms.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int.. | Long Wharf Canyon, Santa Monica, Cal............ | F. C. Clark............ | Berry Coll. Cat. 4022. | [940] | Upper San Pedro... | Pleistocene |

*Remarks:* A single fragment of a median valve, still showing, however, its characteristic sculpture, was among Dr. Clark's material from the Santa Monica Pleistocene. The condition of the specimen leaves much to be desired, but the scaly sculpturing of the central areas, reminding one of a bit of rattlesnake skin, is unlike that of any other of our chitons.

The species has not been previously recorded as a fossil, and even in the recent state it seems to have an unusually limited geographical range.

### Genus **Cryptochiton** Middendorff, 1847
(also of Gray, 1847)

### 19. **Cryptochiton stelleri** (Middendorff, 1846)

(Plate VI, figs. 10-12.)

1846. *Chiton stelleri* Middendorff, Bull. Ac. Sci. St. Pétersb., VI, p. 116 (fide Pilsbry).

1847. *Chiton (Cryptochiton) stelleri* Middendorff, Malac. Ross., I, p. 93, pl. 1-9.

1849. *Chiton (Cryptochiton) stelleri* Middendorff, Mem. Acad. Imp. Sci. St. Pétersb., (6), v. 6, p. 101, 157 (fide Pilsbry).

1869. *Cryptochiton stelleri* Gabb, Paleont. Calif., II, p. 87.

1888. *Cryptochiton stelleri* Cooper, 7th Ann. Rep. Cal. State Miner., p. 237 (recorded from Quarternary of San Diego, Cal.).

1893. *Cryptochiton stelleri* Pilsbry, Man. Conch., (1), v. 15, p. 48, pl. 6, f. 6; pl. 7, f. 7-13.

1895. *Cryptochiton c. f. stelleri* Ashley, Proc. Cal. Acad. Sci. (2), v. 5. p. 327 (recorded from Neocene of Purissima, Cal.)

1897. *Cryptochiton stelleri* Heath, Proc. Acad. Nat. Sci. Phila., 1897, p. 299 (description of young stage).

1903. *Cryptochiton stelleri* Arnold, Mem. Cal. Acad. Sci., v. 3, pp. 15, 19, 40, 68, 85, 342 (recorded from Pliocene and Pleistocene of San Pedro, Cal.).

1906. *Cryptochiton stelleri* Arnold, Pectens of Calif., pp. 31, 35 (listed from Pliocene and Pleistocene of San Pedro, Cal.).

*Diagnosis:* Valves large, solid, heavy; visible tegmentum entirely wanting in all later stages of growth; both anterior and posterior outlines of valves ii-viii bilobate; jugal sinus very deep; tail valve with a well developed posterior sinus; slits 4 to 7, 1-1, 1-1.

*Recorded Range:*

*Pliocene:* Purisima Formation—Purisima, California (Ashley). San Diego Formation—Pacific Beach, California (!).

Santa Barbara Formation—Deadman Island, San Pedro, California (Arnold).

*Pleistocene:* Lower San Pedro Series—Deadman Island, San Pedro, California (Arnold); Nob Hill Cut, San Pedro, California (!); Chiton Bed, Point Fermin, California (!).

Upper San Pedro Series—"Coal mine", West side of Point Loma, California (!); C. A. S. Loc. 108, 2 miles north of Point Loma, California (!).

Formation doubtful—San Diego, California (Cooper).

*Indian middens:* La Push, Washington (Reagan); near Cypress Point, Monterey County, California; San Nicolas Island, California (!).

*Living:* Northern Japan, Sakhalin, Kuril Islands, Kamtschatka, and Bering Sea, to Monterey Bay and the Santa Barbara Islands, California.

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Pacific Beach, Cal. | Mrs. Kate Stephens | Berry Coll. Cat. 112 | [ 505] | San Diego | Pliocene |
| 4 | Int. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [ 643] | Lower San Pedro | Pleistocene |
| 2 | Post. | Nob Hill Cut, San Pedro, Cal. | | Berry Coll. Cat. 3972 | [ 644] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Berry Coll. Cat. 4944 | [1359] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Loc. 108, 2 mi. N. of Pt. Loma, Cal. | Cal. Acd. Sci. | Cal. Acd. Sci. | [ 517] | Upper San Pedro | Pleistocene |
| 1 | Int. | "Coal Mine," W. side Pt. Loma, Cal. | C. L. Hubbs | S. Diego. Soc. Nat. Hist. | [ 506] | Upper San Pedro | Pleistocene |

*Remarks:* This characteristically boreal Pacific species is not common in any of the formations where it has been reported to occur. The large size and massive formation of the valves, however, render it a difficult species to overlook, and hence we find that it has been reported from more horizons in the area studied than any other chiton. Its occurrence in the Point Loma Pleistocene in the same exposure as the decidedly southern *Ischnochiton acrior* came as a distinct surprise.

I have been unable to differentiate any of the fossil shells from the recent ones morphologically in any way. One of the fossil specimens, however, a head valve in the collection of the California Academy of Sciences [517], is remarkable for the fact that the calloused inner layer of the shell has been entirely delaminated, exposing the internal and usually invisible radial grooves and concentric growth lines with exquisite perfection (Pl. VI, f. 10). Of the radial grooves, the six posterior radiate toward, and as usual are in correspondence with, the insertion slits. Another pair of grooves diverges anteriorly on each side of the sinus. Caliper measurements of this specimen are: Max. long. 27.2, max. diam. 32.1, alt. 10.0 mm.

Family **Ischnochitonidæ**

Subfamily **Chætopleurinæ**

Genus **Chætopleura** Shuttleworth, 1853

Subgenus **Pallochiton Dall, 1879**

### 20. Chætopleura (Pallochiton) gemma Carpenter, 1879

(Plate VIII, figs. 10-12.)

1879. *Chætopleura gemma* Carpenter, in Dall, Proc. U. S. Nat. Mus., v. 1, p. 296, pl. 1, f. 9 (radula).
1892. *Chætopleura gemmea* Pilsbry, Man. Conch., (1), v. 14, p. 31, pl. 13, f. 69-74.
1919. *Chætopleura gemma* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, California).

*Diagnosis*[14]: Valves small, elevated, of moderate thickness, the median ones but weakly beaked, yet leaning strongly backward; lateral areas elevated, ornamented with 5-8 radiating series of small, strong, closely placed, projecting, cylindrical pustules, fewer in young shells; head valve similarly sculptured with very numerous (25-35) series of pustules, usually abraded toward the apex; central areas with 12-18 narrow, rather irregularly beaded, longitudinal liræ; tail valve with slightly raised, posterior mucro, the posterior slope steeply terraced and irregularly tubercled; sutural laminæ short; sinus wide, rather deep and angular; tegmentum projecting over and under articulamentum at suture, especially toward middle of median valves, where such inner surface is even more or less pustulose; teeth short and robust, slightly projecting; eaves roughened, but apparently not spongy; slits 9 to 12, 1-1, 7 to 8.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Chiton Bed, Point Fermin, California (Chace and Chace, !).

*Living:* Straits of Georgia, British Columbia (!), to Cedros Island, Lower California (Lowe); between tides to 15 fathoms.

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[14] Description drawn in part from recent specimens.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4074. | [1025] | Lower San Pedro. . . | Pleistocene |
| 1 | Int. . | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1921. . . . . . . . . . . . . . . . | Chace Coll. . . . . . . . . . | [1411] | Lower San Pedro. . | Pleistocene |

*Remarks:* Though so common at the present day, even if often somewhat local, along almost the entire coast of California, this very ornate little species is here recognized for the first time as a fossil. The specimens seen are intermediate valves and too characteristic in their well preserved sculpture to be readily mistaken.

The extraordinary extension of the recent range of the species as quoted by me above is based on a specimen [597] given me by Mr. Will F. Thompson, who collected it between tides in the Straits of Georgia.

The specific name is commonly written in the adjective form, *gemmea,* but as the originally published spelling is permissible as a substantive noun, it is here adopted.

Subfamily Ischnochitoninæ

Genus **Ischnochiton** Gray, 1847

Subgenus Stenoplax Carpenter 1879.

Section Stenoplax s. s.

### 21. Ischnochiton (Stenoplax) fallax Carpenter, 1892

(Plate VII, figs. 1-3)

1892. *Ischnochiton* (*Stenoplax*) *fallax* Carpenter, in Pilsbry, Man. Conch., (1), v. 14, p. 59, pl. 16, f. 17-18.

*Diagnosis:* Valves of moderate thickness, low, evenly arched, outline of all but the tail valve concave behind, not beaked; lateral areas strongly elevated, these and the terminal areas weakly sculptured by fine radial wrinkles and strongly terraced by the lines of growth; central areas very minutely, longitudinally ribbed and pitted, usually worn almost smooth; tail valve large, with central mucro; sutural laminæ sinuous, triangular, with steep inner slopes; sinus wide, with a small notch at each side; teeth sharp and moderately long, but covered by the strongly projecting, solid eaves; slits 8 to 9, 1-1, 10 to 11.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Nob Hill Cut, San Pedro, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Fort Bragg, California (!), to Santa Barbara Channel, California; shore to 15 fathoms.

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [650] | Lower San Pedro | Pleistocene |
| 1 | Post. | ? Deadman Id., San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [671] | ?"Upper San Pedro" | Pleistocene |
| ?1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Berry Coll. Cat. 3969. | [683] | ? | ? Pleistocene |

*Remarks:* The discovery of unmistakeable specimens of this little known Central California species in the southern fossil beds was a considerable surprise, but I feel reasonably confident of the identification. The peculiar features are the roundly arched outline and single slitting of the central valves, the terraced appearance of the lateral and terminal areas due to the very strong growth lines, the fine, wrinkly, radiating sculpture of these regions, and the very even and delicate ribbing and pitting of the central areas, though the ribs are hardly evident without a lens. All of these characteristics serve to separate *fallax* from *magdalenensis* and young *conspicuus,* with which it is alone likely to be confounded. Two of the fossils are beautifully preserved and check up well with the recent specimens, but the third is so badly worn there is perhaps some question regarding it.

Section Stenoradsia Carpenter, 1879

### 22. **Ischnochiton (Stenoplax) magdalenensis** (Hinds, 1844)

(Plate VII, figs. 4-10.)

1844. *Chiton magdalenensis* Hinds, Zool. Voy. "Sulphur", v. 2, p. 54, pl. 19, f. 1.
1864. *Ischnochiton Magdalensis* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, pp. 621, 649, 665.
1879. *Stenoradsia magdalenensis* Dall, Proc. U. S. Nat. Mus., v. 1, p. 296, 330, pl. 2, f. 12 (radula).
1888. *Ischnochiton magdalensis* Cooper, 7th Ann. Rep. Cal. State Miner., p. 244 (recorded from Quaternary of Santa Barbara, Cal.).
1892. *Ischnochiton (Stenoplax) magdalenensis* Pilsbry, Man. Conch., (1), v. 14, p. 62, pl. 15, f. 98-100.
1919. *Ischnochiton magdalenensis* Chace and Chace, Lorquinia, v. 2, p. 43 [3] (recorded from Pleistocene of Pt. Fermin, California).

*Diagnosis:* Valves of moderate thickness, depressed, subcarinate, all but the tail valve more or less concave behind, not beaked; lateral areas strongly elevated, these and the terminal areas ornamented by numerous fine ribs separated by rather sharp grooves, and interrupted to some extent by some of the lines of growth, yet not so conspicuously terraced as in *I. fallax;* central areas, where unworn, sculptured by numerous very fine anastomosing axial wrinkles, becoming more or less reticulated and pitted on the sides; slope of head valve straight or very weakly concave; tail valve large, with weakly projecting, central mucro; sutural laminæ long, triangular, slightly sinuous, with steep inner slopes; sinus wide, deep, notched at each side; teeth well developed, but surpassed by the projecting, solid eaves; slits 10 to 13, 2 to 4, 10 to 12.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Chiton Bed, Point Fermin, California (Chace and Chace, !); near lighthouse, Point Fermin, California (!).

Formation doubtful—Santa Barbara, California (Cooper); Deadman Island, San Pedro, California (!).

*Living:* Fort Bragg, California (!), to Magdalena Bay (and Cape San Lucas ?), Lower California.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4042 | [ 946] | Lower San Pedro | Pleistocene |
| 2 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4042 | [ 947] | Lower San Pedro | Pleistocene |
| 2 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4042 | [ 948] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Chace Coll. | [1031] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4105 | [1085] | Lower San Pedro | Pleistocene |
| 10 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Chace Coll. Berry Coll. Cat. 4076 | [1032] | Lower San Pedro | Pleistocene |
| 7 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4105 | [1086] | Lower San Pedro | Pleistocene |
| 4 | Post | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4105 | [1087] | Lower San Pedro | Pleistocene |
| 5 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Chace Coll. | [1033] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1365] | Lower San Pedro | Pleistocene |
| 7 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1365] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1365] | Lower San Pedro | Pleistocene |
| 4 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | | [1412] | Lower San Pedro | Pleistocene |
| 16 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Berry Coll. Cat. 4965 Cal. Acd. Sci. | [1413] | Lower San Pedro | Pleistocene |
| 5 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll | [1414] | Lower San Pedro | Pleistocene |
| 6 | Ant. | Near lighthouse, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4111 | [1102] | Lower San Pedro | Pleistocene |
| 16 | Int. | Near lighthouse, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4111 | [1103] | Lower San Pedro | Pleistocene |
| 1 | Post | Near lighthouse, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4111 | [1104] | Lower San Pedro | Pleistocene |
| 2 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll | Dept. Geology, Stanford Univ. | [ 684] | ? | Pleistocene |

*Remarks:* Although in the living state this is one of the most abundant California chitons, I have been able to identify as this species scarcely any fossil material except that from the Lower San Pedro beds at Point Fermin. Both fossil and recent specimens are usually easy to differentiate from small specimens of the related forms, *acrior* and *conspicuus,* by the narrower, more elongate outline; the convex, straight, or (when perfect) very weakly concave head valve; the finely plicate sculpturing (often eroded) of the central areas, which becomes prettily netted toward the sides; and the numerous, fine, relatively straight, radiating riblets of the lateral and terminal areas. There are also girdle characters of value which are of course unavailable to the paleontologist.

### 23. Ischnochiton (Stenoplax) conspicuus (Carpenter, 1879)

(Plate VIII, figs. 1-9.)

1879. *Maugerella conspicua* Carpenter, in Dall, Proc. U. S. Nat. Mus., v. 1, p. 296, pl. 2, f. 11 (radula).
1892. *Ischnochiton (Stenoplax) conspicuus* Pilsbry, Man. Conch., (1), v. 14, p. 63, pl. 15, f. 91-96.
1914. *Ischnochiton conspicuus* Oldroyd, Nautilus, v. 28, p. 81 (recorded from Pleistocene of Signal Hill, Long Beach, Cal.).
1916. *Ischnochiton conspicuus* Chace, Nautilus, v. 30, p. 71 (recorded from Pleistocene of Deadman Island, Cal.).
1917. *Ischnochiton conspicuus* Chace, Lorquinia, v. 2, p. 30 (recorded from Pleistocene of Santa Monica, Cal.).

*Diagnosis:* Valves moderately heavy, large, depressed or moderately elevated, all but the tail valve slightly concave behind, not beaked; lateral areas strongly elevated, bearing fine, rather wrinkly, radial striæ of varying length, those of the terminal areas similar, but finer and often nearly obsolete; central areas sometimes weakly, longitudinally ribbed, but usually nearly smooth; head valve slightly everted at apex, its anterior slope strongly concave; tail valve large and flat, with low, central mucro; sutural laminæ long, triangular, slightly sinuous; sinus abrupt, deep, of moderate width, with a small notch on each side; teeth strong and sharp, but surpassed by the massive, projecting, solid eaves; slit 9 to 12, 2 to 4, 8 to 10.

*Recorded Range:*

*Pliocene:* San Diego Formation, Pacific Beach, California (!).

*Pleistocene:* Upper San Pedro Series, Long Wharf Canyon, Santa Monica, California (Chace, !); Los Cerritos Hill, Long Beach, California (Oldroyd, !); "Coal Mine", west side of Point Loma, San Diego County, California (!); Spanish Bight, San Diego, California (!).

Formation doubtful, Deadman Island, San Pedro, California (Chace, !).

*Indian middens:* San Nicolas Island, California (Lowe); mouth of Topanga Canyon, near Santa Monica, California (!); Redondo, California (!); La Jolla, California (!).

*Living:* Santa Barbara, California, to Magdalena Bay, Lower California; between tides.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Ant. | Pacific Beach, Cal | Mrs. Kate Stephens | S. Diego Soc.Nat.Hist. | [501] | San Diego | Pliocene |
| 1 | Int. | Pacific Beach, Cal | Mrs. Kate Stephens | S. Diego Soc.Nat.Hist. | [347] | San Diego | Pliocene |
| 1 | Int. | Pacific Beach, Cal | Mrs. Kate Stephens | Berry Coll. Cat. 3924 | [502] | San Diego | Pliocene |
| 1 | Post. | Pacific Beach, Cal | Mrs. Kate Stephens | S. Diego Soc.Nat.Hist. | [347] | San Diego | Pliocene |
| 1 | Post. | Pacific Beach, Cal | Mrs. Kate Stephens | S. Diego Soc.Nat.Hist. | [501] | San Diego | Pliocene |
| 1 | Ant. | Long Wharf Canyon, Santa Monica, Cal | F. C. Clark | Berry Coll. Cat. 3963 | [350] | Upper San Pedro | Pleistocene |
| 1 | Post | Long Wharf Canyon, Santa Monica, Cal | F. C. Clark | Berry Coll. Cat. 3963 | [493] | Upper San Pedro | Pleistocene |
| 1 | Ant. | Long Wharf Canyon, Santa Monica, Cal | F. C. Clark | F. C. Clark Coll | [503] | Upper San Pedro | Pleistocene |
| ?1 | Post | Long Wharf Canyon, Santa Monica, Cal | F. C. Clark | F. C. Clark Coll | [504] | Upper San Pedro | Pleistocene |
| 1 | Ant. | Los Cerritos Hill, Long Beach, Cal | T. S. Oldroyd | Dept. Geology, Stanford Univ | [660] | Upper San Pedro | Pleistocene |
| 1 | Int. | Los Cerritos Hill, Long Beach, Cal | T. S. Oldroyd | Dept. Geology, Stanford Univ | [661] | Upper San Pedro | Pleistocene |
| 1 | Post. | Los Cerritos Hill, Long Beach, Cal | T. S. Oldroyd | Dept. Geology, Stanford Univ | [662] | Upper San Pedro | Pleistocene |
| 1 | Int. | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | S. Diego Soc.Nat.Hist. | [498] | Upper San Pedro | Pleistocene |
| 1 | Post | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | S. Diego Soc.Nat.Hist. | [498] | Upper San Pedro | Pleistocene |
| 1 | Int. | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | Berry Coll. Cat. 3923 | [499] | Upper San Pedro | Pleistocene |
| 1 | Post | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | Berry Coll. Cat. 3923 | [500] | Upper San Pedro | Pleistocene |
| 1 | Int | Spanish Bight, San Diego, Cal. | Mrs. Kate Stephens | S. Diego Soc.Nat.Hist. | [348] | Upper San Pedro | Pleistocene |
| 2 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll | Berry Coll. Cat. 3973 | [688] | ? | ? Pleistocene |
| 1 | Ant. | ? Deadman Id., San Pedro, Cal | Oldroyd Coll | Dept. Geology, Stanford Univ | [670] | ?"Upper San Pedro" | Pleistocene |
| 1 | Post | Deadman Id., San Pedro, Cal. | E. P. Chace | Berry Coll. Cat. 3934 | [346] | ? | Pleistocene |

*Remarks:* In life this fine species is well distinguished from all its described relatives by the peculiarly bristling dorsal girdle scales, but, with fossils, reliance must be had upon the shell characters, which are more variable and perhaps not always so decisive, especially in light of the fact that many specimens are apt to be badly worn. Well preserved material, however, is usually very characteristic. The species agrees with *I. acrior* in its large size and strongly concave head valve, features in which both these species differ from *I. magdalenensis*, but it differs from both *acrior* and *magdalenensis* in the very weak, or in adults usually obsolete, sculpture of the central areas. The radial sculpturing of the terminal areas is also less well developed than in either of the other species. In fact, it is difficult at times to make out its presence at all. The lateral areas are usually rather like a weak copy of those of *acrior.* The number of insertion teeth and slits seems to average rather less than in *acrior.* In the fossil specimens examined I find the number and arrangement of these to be generally as follows: i, 9-10 (one shell has 11; that figured from Santa Monica has 12); ii-vii, 2-2 (in one valve from Point Loma, 2-3); viii, 9 or sometimes 10 slits.

As a fossil *I. conspicuus* would appear to be much less abundant in most of the formations studied than its more tropical congener *I. acrior.*

Specimen 504, reported above with a query, may possibly be an *I. magdalenensis,* as on the central areas it shows distinct traces of a sculpture of the *magdalenensis* type, but other features point toward *conspicuus,* and in the absence of confirmatory material it seems best to leave it allocated as it is at present. It is a small specimen, with a diameter of only 9.2 mm.

### 24. **Ischnochiton (Stenoplax) acrior** Carpenter, 1892

(Plate IX; Plate X, figs. 1-3.)

1892. *Ischnochiton (Stenoplax) acrior* Carpenter, in Pilsbry, Man. Conch., (1), v. 14, p. 61, pl. 14, f. 86-89.

1917. *Ischnochiton acrior* Chace, Lorquinia, v. 2, p. 30 (recorded from Pleistocene of Santa Monica, Cal.).

*Diagnosis:* Valves quite heavy, large, depressed to moderately elevated, subcarinate, not beaked, all but the tail valve almost straight or weakly concave behind; lateral areas strongly elevated, these and the terminal areas sculptured by numerous strong, irregular, sharp, radiating riblets; central areas ornamented by numerous, acute, longitudinal, wrinkly, sometimes slightly anastomosing riblets; profile of head valve distinctly concave in front; tail valve large, flattened, with low mucro situated a little behind the center; sutural laminæ strong, deep, with a small notch at each side of the sinus; eaves wide, solid, massive, and strongly projecting past the stout, sharp teeth; slits 8, 2 to 4, 13.

*Recorded Range:*

*Pleistocene:* Upper San Pedro Series—Long Wharf Canyon, Santa Monica, California (Chace, !); "Coal Mine", west side of Point Loma, San Diego County, California (!).

Formation doubtful, Deadman Island, San Pedro, California (!).

*Living:* Cerros Island, Lower California, to Cape San Lucas, Lower California; between tides.

*Material Examined:*

| No. of Specimens | Valve | LOCALITY | COLLECTOR | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 2 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [351] | Upper San Pedro | Pleistocene |
| 8 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [351] | Upper San Pedro | Pleistocene |
| 2 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [351] | Upper San Pedro | Pleistocene |
| 1 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3916 | [344] | Upper San Pedro | Pleistocene |
| 1 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3916 | [352] | Upper San Pedro | Pleistocene |
| 1 | Ant. | Coal mine, W. side Pt. Loma, Cal. | C. L. Hubbs | Berry Coll. Cat. 3922 | [495] | Upper San Pedro | Pleistocene |
| 1 | Int. | Coal mine, W. side Pt. Loma, Cal. | Mrs. Kate Stephens | Berry Coll. Cat. 3917 | [343] | Upper San Pedro | Pleistocene |
| 1 | Int | Coal mine, W. side Pt. Loma, Cal. | F. Stephens | S. Diego Soc.Nat.Hist. | [941] | Upper San Pedro | Pleistocene |
| 2 | Int | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | S. Diego Soc.Nat.Hist. | [497] | Upper San Pedro | Pleistocene |
| 1 | Post | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | S. Diego Soc.Nat.Hist. | [497c] | Upper San Pedro | Pleistocene |
| ?1 | Post. | Coal mine, W. side Pt. Loma, Cal | C. L. Hubbs | S. Diego Soc.Nat.Hist. | [497d] | Upper San Pedro | Pleistocene |
| 1 | Post | Coal mine, W. side Pt. Loma, Cal. | Mrs. Kate Stephens | S. Diego Soc.Nat.Hist. | [342] | Upper San Pedro | Pleistocene |
| 1 | Post | Coal mine, W. side Pt. Loma, Cal. | C. L. Hubbs | Berry Coll. Cat. 3922 | [496] | Upper San Pedro | Pleistocene |
| 3 | Int. | Loc. 108, 2 mi. N. of Pt. Loma, Cal. | Cal. Acad. Sci. | Cal. Acad. Sci. | [518] | Upper San Pedro | Pleistocene |
| 1 | Int | Loc. 108, 2 mi. N. of Pt. Loma, Cal. | Cal. Acad. Sci. | Berry Coll. Cat. 3931 | [518] | Upper San Pedro | Pleistocene |
| 1 | Post | Loc. 108, 2 mi. N. of Pt. Loma, Cal. | Cal. Acad. Sci. | Cal. Acad. Sci. | [518] | Upper San Pedro | Pleistocene |
| 1 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [685] | ? | ? Pleistocene |
| 1 | Int | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [686] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [687] | ? | ? Pleistocene |

*Remarks:* So far as the shell characters go this species is extremely close to *I. conspicuus,* differing principally in its strong, coarse sculpturing. It naturally follows that poor or badly eroded specimens are exceedingly difficult to separate when the two species occur together. The best preserved of the fossil specimens display considerable variation even within the specific limits, those from Point Loma being much flatter and showing a distinctly sparser, cruder sculpturing than those collected at Santa Monica by Dr. Clark, but the material is not sufficient to justify one in recognizing separate races for the two localities. All the variations can be matched pretty well in a good series of recent specimens.

There is considerable variation in the number of insertion teeth. The Point Loma shells have slits as follows: valve i, 8; valves ii-vii, 4-3 and 3-3; valve viii, 10 to 13. Those from Santa Monica have: valve i, 10 to 11; valves ii-vii, 2-2 or 3-3; valve viii, 10. This variation is likewise paralleled in recent specimens.

The immense northern extension of the range of this species during late Pleistocene time through at least six degrees of latitude from its most northern living record is noteworthy. Rather oddly *I. acrior* appears almost always to accompany *I. conspicuus* in the fossil state, while, except for an unconfirmed note of the latter species from Magdalena Bay, among recent specimens such a coincidence has been recorded only at South Bay, Cedros Island, Lower California.[15] This leads one to wonder strongly whether a given species or genus may not be subject to change in its ability to adapt itself to specified climatic conditions through long periods of time, instead of such adaptation and consequent distribution in latitude being always the fixed criterion which some paleontologists seem to have assumed.

Pilsbry compares *acrior* more especially with *magdalenensis*, but if our northern *magdalenensis* are correctly so named, it seems to me that *I. conspicuus* is clearly the present species' nearest of kin.

Caliper measurements of the largest fossil valve seen [518a] are as follows: Maximum longitude 18.3, diameter 40, altitude 12 mm.

Subgenus Rhombochiton Berry, 1919

25. **Ischnochiton (Rhombochiton) regularis** (Carpenter, 1855)

1855. *Chiton regularis* Carpenter, Proc. Zool. Soc. London 1855, p. 232.

1864. *Lepidopleurus regularis* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 554, 649.

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[15] H. N. Lowe,—Nautilus, v. 27, p. 28.

1879. *Ischnochiton regularis* Dall, Proc. U. S. Nat. Mus., v. 1, p. 296, pl. 2, f. 14 (radula).
1893. *Ischnochiton regularis* Pilsbry, Man. Conch., (1), v. 14, p. 142, pl. 18, f. 41-46.
1895. *Ischnochiton regularis* Ashley, Proc. Cal. Acad. Sci. (2), v. 5, p. 343 (recorded from Pliocene of San Pedro).
1903. *Ischnochiton regularis* Arnold, Mem. Cal. Acad. Sci., v. 3, p. 28, 42, 85, 342 (recorded from Pleistocene of San Pedro, Cal.).
1906. *Ischnochiton regularis* Arnold, Pectens of Calif., p. 35 (recorded from Pleistocene of San Pedro, Cal.).
1910. *Callistochiton regularis* Thiele, Rev. Syst. Chit., II, p. 112, 113.
1919. *Ischnochiton* (*Rhombochiton*) *regularis* Berry, Proc. Cal. Acad. Sci., (4), v. 9, p. 2.

*Diagnosis*[16]*:* Valves thin, elevated, carinate, not beaked; side slopes nearly straight; lateral areas only slightly raised, these and the terminal areas very delicately radially threaded; central areas with numerous, very fine and regular, microscopically granose riblets; mucro in front of middle of tail valve; insertion plates low and wide, connected across the sinus by a delicately toothed plate; teeth sharp; eaves solid; slits 14 to 16, 2-3, 22.

*Recorded Range:*

*Pleistocene:* Upper San Pedro Series—Lumber yard, San Pedro, California (Arnold).

Formation Doubtful—San Pedro, California (Ashley).

*Living:* Fort Bragg, California (!), to San Diego, California (Kelsey); between tides.

*Remarks:* Besides the old record of Ashley, this species has been reported from the type locality of the Upper San Pedro Series at San Pedro by Arnold, but I have been unsuccessful

[16] Description drawn from recent specimens.

in all attempts to locate his specimens, and no fossil material of the species is in any of the collections seen by me. From its present range it is a species which one would expect to find in the Lower San Pedro horizons rather than the Upper. Its occurrence in the latter therefore needs confirmation. Arnold did not figure his specimens.

### Subgenus **Lepidozona** Pilsbry, 1892

### 26. **Ischnochiton (Lepidozona) pectinulatus** Carpenter, 1893*

(Plate X, figs. 4-6.)

1864. *Lepidopleurus pectinatus* Carpenter, Rep. Brit. Assoc. Adv. Sci., 1863, p. 649 (not *Chiton pectinatus* Sowerby, 1840).
1865. *Ischnochiton* (*Lepidopleurus*) *pectinatus* Carpenter, Proc. Cal. Acad. Nat. Sci., (1), v. 3, p. 211.
1892. *Ischnochiton* (*Ischnochiton*) *clathratus* Pilsbry, Man. Conch., (1), v. 14, p. 128 (pars), pl. 26, f. 31-34.
1893. *Lepidopleurus pectinulatus* Carpenter, in Pilsbry, Man. Conch., (1), v. 14, p. 129.

*Diagnosis*[17]: Valves thin, low, carinate; side slopes weakly arcuate; lateral areas elevated, bearing 5-7 closely granose, sometimes bifurcating, radial riblets, the posterior rib lower, but coarser, its tooth-like tubercles projected backward, strongly pectinating the suture; head valve similarly sculptured, the ribs 25-35 in number; sculpture of posterior area of tail valve likewise similar but a little weaker; central areas closely and sharply sculptured with 15-19 longitudinal ribs on each side, nearly straight everywhere except on the jugum of the second valve where they strongly diverge, intersected by numerous rather coarser but less sharp transverse bars, the intersections nodular, interstices deeply pitted; mucro of tail valve low, scarcely projecting, nearly median; sutural laminæ low, arcuate, connected by a dentate plate across the sinus; teeth short and stout; slits 11 to 12, 1-1, 14 to 16.

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*This is *Ischnochiton clathratus* of many writers on west American chitons, but not, I believe, of Reeve 1847, nor of Chace ( :17, p. 30, = *I. sanctæmonicæ* Berry).

[17] Description drawn in part from recent specimens.

*Recorded Range:*

*Pleistocene:* Upper San Pedro Series, Long Wharf Canyon, Santa Monica, California (?!); Spanish Bight, San Diego, California (!).

*Living:* Monterey, California (!), to Todos Santos Bay, Lower California (!).

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| ?2 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [508] | Upper San Pedro | Pleistocene |
| ?1 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll, Cat. 3979. | [508] | Upper San Pedro | Pleistocene |
| 1 | ii | Spanish Bight, San Diego, Cal. | Mrs. Kate Stephens | Berry Coll. Cat. 3925. | [507] | Upper San Pedro | Pleistocene |

*Remarks:* *I. pectinulatus* is a characteristic representative of a numerous and difficult group of *Ischnochitonidæ,* which, according to our present information, attains by far its most remarkable development on the northwest coast of America. Among this melange of species, but few of which have as yet been discovered in the fossil state, *I. pectinulatus* is recognizable chiefly by minor details of sculpturing, notably the divarication of the lateral and terminal areas into distinct, strongly irregularly multi-granose riblets (generally 5-6 in number on the lateral areas), while a series of especially strong backwardly directed tubercles (12-18 on a side) dentates the posterior margin of all the valves but the last. There are 15-19 longitudinal riblets on each side of the central region, overlying a transverse grating rather stronger than usual. The riblets of the jugal region diverge strongly on the second valve, but only weakly or not at all on the succeeding valves, very unlike the condition seen in the related *cooperi* and *mertensii.*

The above notes, as well as the identification of the fossil specimens, are based upon recent specimens from the San Diego region.

### 27. **Ischnochiton (Lepidozona) cooperi** Carpenter, 1879

(Plate XI.)

1879. *Ischnochiton cooperi* Carpenter, in Dall, Proc. U. S. Nat. Mus., v. 1, p. 296, pl. 2, f. 15 (radula).

1892. *Ischnochiton* (*Ischnochiton*) *cooperi* Pilsbry, Man. Conch., (1), v. 14, p. 127, pl. 26, f. 27-30.

1919. *Ischnochiton cooperi* Chace and Chace, Lorquinia, v. 2, p. 43 [3] (recorded from Pleistocene of Pt. Fermin, Cal.).

*Diagnosis:* Valves moderately thin, strongly elevated, sharply carinate; side slopes straight or but weakly arcuate; lateral areas elevated, with 5-6 low radial flutings, each bearing a series of usually elongate, often abraded pustules, the posteriormost coarser and projecting backward so as to pectinate the sutural margin; head valve similarly sculptured, the ribs 20-30 in number, their interspaces distinctly fluted out and concentrically decussated by the lines of growth; posterior area of tail valve similar but with the lines of pustules rather less definitely arranged; central areas sculptured by about 20 very sharply cut, longitudinal ribs, straight at the sides but distinctly diverging on the jugal tracts of all the valves, especially the second, their interspaces decussated by numerous, very closely placed, transverse riblets of much less prominence; mucro of tail valve low, scarcely projecting, nearly median; sutural laminæ low, wide, connected across the shallow sinus by a dentate plate; teeth short, not projecting; eaves solid; slits 8 to 11, 1-1, 9 to 11, with distinct pore lines leading into them.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Chiton Bed, Point Fermin, California (Chace and Chace, !); near lighthouse, Point Fermin, California (!); Nob Hill Cut, San Pedro, California (!); "Crawfish George's", San Pedro, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Coos Bay, Oregon (!), to Anacapa Islands, Santa Barbara Group, California (Yates).

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4043 | [ 949] | Lower San Pedro | Pleistocene |
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Chace Coll. | [1029] | Lower San Pedro | Pleistocene |
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1415] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Near lighthouse, Pt. Fermin, Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4112 | [1105] | Lower San Pedro | Pleistocene |
| 4 | Int. | Near lighthouse, Pt. Fermin Cal. | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4112 Cal. Acd. Sci. | [1106] | Lower San Pedro | Pleistocene |
| 3 | Int. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [ 651] | Lower San Pedro | Pleistocene |
| ?1 | Ant. | Crawfish George's, San Pedro, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4047 | [ 955] | Lower San Pedro | Pleistocene |
| 3 | Int. | Crawfish George's, San Pedro, Cal | E. P. & E. M. Chace, 1918 | Berry Coll. Cat. 4047 | [ 956] | Lower San Pedro | Pleistocene |
| 1 | Int. | ? Deadman Id., San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [ 669] | ?"Upper San Pedro" | Pleistocene |
| ?1 | Int. | ? Deadman Id., San Pedro, Cal | Oldroyd Coll. | Berry Coll. Cat. 5184 | [ 648] | ?"Upper San Pedro" | Pleistocene |
| 1 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [ 708] | ? | ? Pleistocene |
| 1 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept Geology, Stanford Univ. | [ 722] | ? | ? Pleistocene |
| 4 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [ 723] | ? | ? Pleistocene |
| 2 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [ 724] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [ 730] | ? | ? Pleistocene |

*Remarks:* This common central and northern California species appears to be of rather frequent occurrence in the Pleistocene around San Pedro, being probably characteristic of the Lower San Pedro Series. Whereas in the recent state it is much less common as a rule than its associate, *I. mertensii*, the reverse is true of the fossils.

*I. mertensii* is the only species with which it is likely to be confounded. In the case of valves ii-vii, however, even very fragmentary specimens are readily identifiable by the extremely numerous, crowded, transverse bars connecting the longitudinal riblets of the central areas, making their interspaces appear finely, but distinctly striate to the unaided eye. The lines of growth give a similar, but coarser effect of striation to the interspaces between the lines of more or less coalescent pustules on the head valve, so that this too has a certain individuality of aspect very helpful in distinguishing it from the corresponding valve in *mertensii*.

28. **Ischnochiton (Lepidozona) mertensii** (Middendorff, 1846)

(Plate X, figs. 7-12.)

1846. *Chiton Mertensii* Middendorff, Bull. Acad. Sci. St. Petersb., VI, p. 118 (fide Pilsbry).

1847. *Chiton (Phoenochiton, Hamachiton, Stenosemus) Mertensii* Middendorff, Malac. Ross., p. 34, 125, pl. 14, f. 1-3.

1879. *Lepidopleurus Mertensii* Dall, Proc. U. S. Nat. Mus., v. 1, pp. 297, 332, pl. 2, f. 18-18a (radula).

1892. *Ischnochiton (Ischnochiton) mertensii* Pilsbry, Man. Conch., (1), v. 14, p. 125, pl. 26, f. 20-26.

*Diagnosis*[18]: Valves moderately thin, fairly elevated, carinate; side slopes straight or but weakly arcuate; lateral areas elevated, divided by shallow, narrow grooves into 5 or 6 low, often obscure, flattened, radial ribs, each bearing a series (sometimes bifurcating) of rounded or pyriform pustules, the posteriormost series directed obliquely backward so as to dentate the suture; head valve similarly sculptured, the ribs and grooves perhaps 25 in number; posterior area of tail valve similar; central areas sculptured by 12-15 sharply cut longitudinal bars, subparallel on the pleural regions but usually distinctly divergent on the jugal tracts, especially on valve ii, their interspaces, except as a rule on the jugum, decussated by numerous radially arcuate, transverse riblets of much less prominence; mucro of tail valve low, median; sutural plates low, wide, connected across the sinus by a dentate plate; teeth short, not projecting; eaves solid; slits 10 to 11, 1-1, 10 to 12.

*Recorded Range:*

*Pleistocene* (?): Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Sitka, Alaska (Dall), to San Martin Island, Lower California (Baker); between tides to 50 fathoms.

[18] Description drawn in part from recent specimens.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| ?1 | Ant.. | Deadman Id., San Pedro, Cal. | Arnold Coll...... | Dept. Geology, Stanford Univ. | [ 707] | ? | ? Pleistocene |
| 4 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll...... | Dept. Geology, Stanford Univ. | [ 709] | ? | ? Pleistocene |
| 1 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll...... | Dept. Geology, Stanford Univ. | [ 725] | ? | ? Pleistocene |
| 2 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll...... | Dept. Geology, Stanford Univ. | [ 710] | ? | ? Pleistocene |

*Remarks:* It is not without a little hesitation that I refer all the specimens catalogued above to *I. mertensii,* as few of them are sufficiently well preserved to be characteristic in all particulars. Several of them, e. g. 725, I think are almost certainly this species, but the others are more doubtful. It may be that there is another species represented in the lot, but if so I do not think it can be one of the known recent species.

So far as shell characters go, the special features of *mertensii* are the numerous, usually distinctly separate, rounded or pear-shaped pustules of the terminal and lateral areas, the relative coarseness of the latticing between the longitudinal ribs of the central areas, and the fact that these ribs usually diverge strongly on the jugal tract of all the valves, except of course the head valve, their interspaces in this region being smooth as a rule, or with only weak traces of the interlatticing.

Although recorded from as far south as Lower California, this species cannot be said to be a common one much below Monterey County, and its presence in any numbers in any horizon to that extent would therefore indicate northern affinities. In southern California at the present time its place between tides is everywhere taken by *I. pectinulatus, mertensii* here being an off-shore species.

### 29. Ischnochiton (Lepidozona) cf. sinudentatus Carpenter, 1892

(Plate XII, figs. 10-17)

?1892. *Ischnochiton (Ischnochiton) sinudentatus* Carpenter, in Pilsbry, Man. Conch., (1), v. 14, p. 128.

*Recorded Range:*

*Pleistocene:* Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Monterey and Pacific Grove, California (!).

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | ? Deadman Id., San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [668] | ?"Upper San Pedro" | Pleistocene |
| 1 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [704] | ? | ? Pleistocene |
| 1 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [705] | ? | ? Pleistocene |
| 1 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Berry Coll. Cat. 4573. | [705] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [706] | ? | ? Pleistocene |

*Remarks:* Several valves in the Arnold and Oldroyd collections appear to represent a small species of *Lepidozona* which evidently belongs to the puzzling *sinudentatus*-group, several members of which have been described or named from the vicinity of Monterey. Perhaps the chief reason this group is more troublesome than most is that it is very insufficiently known. Neither *sinudentatus* itself, not the apparently allied *decipiens* Carpenter and *berryi* Dall have been any too adequately described, and no figures appear to be extant of any of these species. The fossil specimens show traces of a toothed plate across the sinus as described for *sinudentatus*, while they further agree very fairly with certain recent specimens from Pacific grove which I tentatively refer to Carpenter's species. The figures here given should serve to fix the identity of the present form, in case *sinudentatus* proves to be a different thing.

From other North American members of the *Lepidozona*-group, whether recent or fossil, this species is easily separable by reason of its small size, elevated outline, sharp dorsal ridge, distinctly convex slopes (though the height and convexity vary more or less in accordance with the serial position of the valves), numerous low, weakly granose, radial ribs of the terminal areas, 3 to 6 similarly granose ribs on the lateral areas, and the 12 to 15 strongly interlatticed, longitudinal ribs on each side of the central area, these last being considerably finer and closer in the jugal region.

### 30. **Ischnochiton (Lepidozona) sanctæmonicæ** Berry, new species

(Plate XII, figs. 1-9.)

1917. *Ischnochiton clathratus* Chace, Lorquinia, v. 2, p. 30, *not Chiton clathratus* Reeve 1847 (recorded from Pleistocene of Santa Monica, Cal.).

*Diagnosis:* Valves small, thin, elevated, carinate; side slopes nearly straight; lateral areas elevated, divided into 4-5 low, distinct, radial ribs, with narrower, coarsely granular interspaces, the sutural margin weakly dentate; head valve similarly sculptured, the ribs 32-47 in number; posterior area of tail valve similarly sculptured with about 25 ribs, obsolete toward the mucro; central areas on each side with 25-28, fine, more or less nodulose, longitudinal riblets, with abrupt, rather wider, deeply channeled interspaces, decussated by coarse, transverse threadings nearly as strong as the longitudinal ribs; mucro of tail valve low, median; sutural laminæ low, wide, connected across the shallow sinus by a short toothed plate; teeth stout, somewhat projecting; eaves rough but not truly spongy; slits 11, 1-1, 10, with conspicuous pore lines leading into them.

*Type:* An intermediate valve [883] entered as Cat. No. 3992 of the author's collection. A paratype is deposited in the collection of the California Academy of Sciences and there is one in the private collection of Dr. F. C. Clark.

*Type Locality:* Upper San Pedro Pleistocene of Long Wharf Canyon, Santa Monica, California; Dr. F. C. Clark; 3 head, 9 median, 1 tail valves.

*Range:* Unknown except type locality as given above.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Remarks | Formation | Period |
|---|---|---|---|---|---|---|---|---|
| 1 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3993 | [881] | Paratype | Upper San Pedro | Pleistocene |
| 2 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [882] | | Upper San Pedro | Pleistocene |
| 1 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3992 | [883] | Type | Upper San Pedro | Pleistocene |
| 1 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Cal. Acad. Sci. | [884] | Paratype | Upper San Pedro | Pleistocene |
| 7 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [885] | | Upper San Pedro | Pleistocene |
| 1 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3993 | [886] | Paratype | Upper San Pedro | Pleistocene |

*Description:* *Head valve* moderate in height, crescentic, ornamented above by about 32-47 strong, rounded or slightly flattened, radiating ribs, more numerous toward the margin, occasionally bifurcating, but for the most part simple and slightly wider than their finely, distinctly, closely granulated interspaces. Posterior margins further decorated by a series of about 10 short, strong, crescentic ridges, lying somewhat obliquely transverse of the radii. Interior with a low, irregular, transverse callus. Slits 11, each connected with the apex of the valve by a conspicuous series of transverse, slit-like pores. Teeth sharp, strongly beveled, scarcely longer than the solid, somewhat overhanging, crenulated eaves.

*Median valves* comparatively short and wide, strongly elevated, with a fairly sharp dorsal ridge and comparatively straight side slopes; not beaked. Lateral areas sharply defined, moderately elevated, sculptured much as above described for the head valve, the 4-5 radial ribs separated by rather narrower granular interspaces, and the posterior margin rendered weakly dentate by a series of perhaps a dozen crescentic tubercles placed obliquely transversely to the marginal radius. Jugal tract not well defined. Entire central area sculptured by numerous (in largest specimens about 25-28 on a side), fine, usually nearly straight, often nodulose, longitudinal riblets, appearing not quite so wide as their abrupt, deeply cut interspaces, and connected across the latter by rather coarse concentric threadings corresponding in their course somewhat to the lines of growth and on a lower level than the longitudinal riblets. Jugal region with the longitudinal bars still parallel, but with the transverse sculpture weaker than on the slopes. Interior with a strong, transverse, obtusely V-shaped callus. Sutural laminæ evenly arcuate, short and broad, connected across the shallow sinus by a short, toothed plate, which, when perfect, may project past the tegmentum; 5-6 more or less irregular, sometimes ill-defined, series of transverse, slit-like pores apparently corresponding in position to the slits in this plate. Insertion teeth scarcely beveled and more projecting than those of the head valve. Slits 1-1, a conspicuous radial series of the transverse, slit-like pores running to their apices. Eaves overhanging.

*Tail valve* with low, subcentral mucro. Posterior area elevated toward the sides in front, slightly concave behind the mucro; sculptured by about 25 low, radiating ribs, obsolete toward the mucro. Central area sculptured in similar fashion to the corresponding region on the median valves, the longitudinal riblets about 15 on a side. Interior with a triangular, strongly dendritic callus, its central portion showing about 4 irregular, longitudinal rows of the transverse pores leading into the short, weakly toothed plate connecting the sutural laminæ across the shallow sinus. Teeth similar to those of head valve, but much shorter, and fitting in under the eaves more closely. Slits 10, each the marginal terminus of the usual radiating series of transverse, slit-like pores.

Caliper measurements of the type and paratypes are as follows:

| | Head valve [881] | Med. valve Type [883] | Med. valve [884] | Tail valve [886] |
|---|---|---|---|---|
| Length | 3.5 mm. | 2.8 mm. | 2.6 mm. | 2.7 mm. |
| Diameter | 6.8 | 7.7 | 7.7 | 4.7 |
| Height | 2.0 | 3.4 | 3.5 | 1.5 |

*Remarks:* In the case of this species comparison is chiefly needed with *I. pectinulatus*, *I. sinudentatus*, and perhaps *I. decipiens*, although in the last instance the insufficiency of the original description, as well as the rarity of authentic specimens, precludes any positive opinion. From both the other species *I. sanctæmonicæ* differs in the much more numerous longitudinal riblets of the central areas. From *I. pectinulatus* it further differs in its much smaller size, the lack of prominent pustules on the ribs of the lateral and terminal areas, and the altogether more delicate scheme of sculpturing.

It is a very pretty little species occurring not rarely in the type horizon.

### 31. **Ischnochiton (Lepidozona)**, species

A nearly perfect anterior valve collected in the Upper San Pedro Pleistocene of Los Cerritos Hill, Long Beach, California, by T. S. Oldroyd [664], does not seem to be referable to any of the foregoing or other described species. It is apparently quite close to *I. sanctæmonicæ,* but differs from it in its greater elevation, steeper front slope, much narrower ribs, and peculiarly fluted-out interspaces between the latter. On the basis of such insufficient material, however, it is doubtfully advisable to erect a new species.

Subfamily Callistochitoninæ Berry, new subfamily

Genus **Callistochiton** Carpenter, 1882

32. **Callistochiton decoratus punctocostatus** Pilsbry, 1896

(Plate XIV, figs. 1-6)

1893. *Callistochiton decoratus* Pilsbry, Man. Conch., (1), v. 15, p. 87, p. 16, f. 54 (not of Carpenter, 1893).

1896. *Callistochiton decoratus* var. *punctocostatus* Pilsbry, Nautilus, v. 10, p. 50.

1919. *Callistochiton decoratus* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, Cal.).

*Diagnosis:* Valves of moderate thickness, rather depressed, but carinate; side slopes distinctly arcuate; lateral areas raised, strongly radially bicostate with the central sulcus decussated, the ribs at first tubercular and subcarinate, later smoother and often developing a secondary sulcus on the ridge or even bifurcating; head valve with 11, posterior area of tail valve with 9 similar ribs, their interspaces concentrically decussated; central areas in adult with perhaps 10-15 longitudinal ribs, nearly equal in width to the interspaces, across which they are connected by arcuately-transverse radial threading, the uppermost sculpture usually entirely lost on the jugum, which then shows a triangular smooth area of varying extent; mucro of tail valve low, distinctly postmedian, the posterior slope gradual at first, then suddenly steep; sutural plates low, arcuate, connected across the squarish sinus by a delicately toothed plate; teeth curved, sharp and distinct, not projecting; eaves thin, solid, overhanging; slits 9 to 11, 1-1, 9 to 12, with distinct pore lines leading into them.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Chiton Bed, Point Fermin, California (Chace and Chace, !).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Monterey, California (Williamson), to San Diego, California (!).

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4044 | [950] | Lower San Pedro | Pleistocene |
| 4 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [728] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [729] | ? | ? Pleistocene |
| 7 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [715] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Berry Coll. Cat. 4574 | [715] | ? | ? Pleistocene |

*Remarks:* I am not sure what value should be put upon the form here ranked as a subspecies of Carpenter's *decoratus*, but if it be valid at all, I believe practically all the *decoratus* now found living in the waters of California proper must be referred to it. Recent specimens show great variation in all details of shape and sculpture, particularly in the very feature upon which *punctocostatus* was principally founded in the first place, namely, the extent to which the typical smooth area on the jugum may be invaded by the sculpture of the pleural areas. The typical *decoratus* from Lower California is said to have a conspicuous, wide, rather sharply defined, triangular, smooth area on the jugum of valves ii to viii. This feature is wanting in typical *punctocostatus,* which is "somewhat irregularly pitted toward the beaks, and with rows of pits on each side of a small oblong smooth tract at the ridge; most valves pitted also on the ridge anteriorly"[19]. Even *punctocostatus* as thus described does not represent the extreme found in the form I here describe as *C. d. ferminicus,* where the sculpturing is developed clear across the valves. As a matter of fact one finds all transitions in the direction of typical *decoratus.* I have yet to see two specimens with sculpture exactly similar in this respect.

The Deadman Island specimens, curiously enough, include no median valves, but the tail valves show only a very narrow, rib-like, smooth area on the jugum, or the sculpture may extend clear across, though becoming more or less obsolete as the center is reached. The number of radial ribs in this series of valves is uniformly 9, of longitudinal riblets 10 to 15 on a side, and of slits, 9 to 11. The specimen illustrated (Pl. XIV, fig. 4) has the following caliper measurements: Length 3.7, diameter 6.5, height 2.3 mm.

---

[19]Pilsbry, H. A.—Nautilus, v. 10, p. 50, 1896.

One would expect the shell from Point Fermin to be an immature *ferminicus,* but it is so different from its associated specimens and so similar to recent shells that I refer it here.

From the associated members of the genus this species as a whole is remarkably distinct. The less highly modified insertion teeth, the 11 more or less carinated ribs of the head valve, the 9 similar ribs of the tail valve, and the delicate ribbing of the central areas are among the more easily available distinguishing features.

33. **Callistochiton decoratus ferminicus** Berry, new subspecies

(Plate XIV, figs. 7-8.)

*Diagnosis:* Similar to the preceding subspecies, but larger, much more elevated, with more strongly arcuate side slopes; sculpture of the central areas continuous over the jugum without the interposition of a smooth area, the longitudinal riblets very fine and numerous, 20-24 on a side.

*Type:* An intermediate valve [1040] entered as Cat. No. 4571 of the author's collection. A paratype is Cat. No. 4572 [1095].

*Type Locality:* Chiton Bed, Lower San Pedro Pleistocene, Point Fermin, California; E. P. and E. M. Chace, 1918; two median valves.

*Description:* (See diagnosis above.)

*Material Examined:* No specimens other than the type, paratype, and another specimen taken from the same exposure by Chace and Berry in 1920 have been seen.

*Remarks:* The *Callistochiton decoratus* complex is so extraordinarily variable for a chiton, it is only with diffidence that one adds a new name to the already overburdened list. Nevertheless the differences among three of the fossil valves from Point Fermin and all other fossil or recent specimens I have seen are too patent to go without recognition. None of a very extensive series of recent specimens before me approaches *ferminicus* either in fineness of sculpture of the central areas, in elevation, or in size.

Although otherwise in fair condition, the type is too worn within to show the characters of the articulamentum, and unfortunately the paratype is rather badly broken.

The dimensions of the type are: Length, 4.+; diameter, 9.8; height 4.6 mm.

### 34. **Callistochiton crassicostatus** Pilsbry, 1893

(Plate XIII.)

1893. *Callistochiton crassicostatus* Pilsbry, Man. Conch., (1), v. 14, p. 264, pl. 58, f. 1-6.

1917. *Callistochiton crassicostatus* Chace, Lorquinia, v. 2, p. 30 (recorded from Pleistocene of Santa Monica, Cal.).

1919. *Callistochiton crassicostatus* Chace and Chace, Lorquinia, v. 2, p. 42 [2] (recorded from Pleistocene of Pt. Fermin, Cal.).

(——. *Chiton fimbriatus* of various authors, but not of Sowerby, teste Pilsbry.)

*Diagnosis:* Valves small, thick, massive, well arched, scarcely angled; side slopes strongly arcuate; lateral areas raised into a strong, thickened rib, coarsely granulated and cut by one or more shallow radial sulci; head valve typically with 7 massive, radial ribs, each with a shallow median sulcus and sometimes others toward the base, the interspaces concentrically decussated; central areas strongly longitudinally ribbed, 7-12 ribs

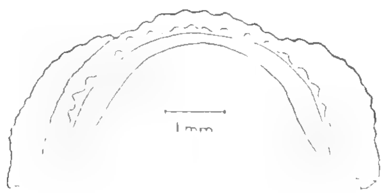


Fig. 10

Fig. 10. *Callistochiton crassicostatus* Pilsbry. Anterior elevation of valve illustrated in Plate XIII, figs. 6-7.

on a side, distinctly converging on the jugum, the interspaces finely latticed across; tail valve elevated, flattened above, the mucro increasingly posterior with growth, the slope behind it becoming almost vertical; sutural plates low, distinctly connected across the shallow sinus; teeth short, scarcely projecting in valves i-vii, very short and thick in valve viii; eaves solid; slits 9, 1-1, 14 to 18.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series — Chiton Bed, Point Fermin, California (Chace and Chace, !); Nob Hill Cut, San Pedro, California (!).

Upper San Pedro Series—Long Wharf Canyon, Santa Monica, California (Chace, !); "Coal mine", west side of Point Loma, California (!).

Formation doubtful—Deadman Island, San Pedro, California (!).

*Living:* Monterey, California (!), to Cedros Island, Lower California (Lowe); shore to 15 fathoms.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Chace Coll. | [951] | Lower San Pedro | Pleistocene |
| 2 | Ant. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4045 | [1091] | Lower San Pedro | Pleistocene |
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Berry Coll. Cat. 4045 | [1024] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Cal. Acd. Sci. | [1094] | Lower San Pedro | Pleistocene |
| 2 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1918 | Chace Coll. | [1093] | Lower San Pedro | Pleistocene |
| 1 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1919 | Berry Coll. Cat. 4045 | [1185] | Lower San Pedro | Pleistocene |
| 2 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace, 1920 | Chace Coll. | [1360] | Lower San Pedro | Pleistocene |
| 4 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Berry Coll. Cat. 4967 | [1417] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Berry Coll. Cat. 4967 | [1417] | Lower San Pedro | Pleistocene |
| 5 | Int. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1418] | Lower San Pedro | Pleistocene |
| 1 | Post. | Chiton Bed, Pt. Fermin, Cal. | E. P. Chace & S. S. Berry, 1920 | Chace Coll. | [1418] | Lower San Pedro | Pleistocene |
| 4 | Ant. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [645] | Lower San Pedro | Pleistocene |
| 5 | Int. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [646] | Lower San Pedro | Pleistocene |
| 3 | Post. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [647] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Berry Coll. Cat. 3970 | [645] | Lower San Pedro | Pleistocene |
| 1 | Int. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Berry Coll. Cat. 3970 | [646] | Lower San Pedro | Pleistocene |
| 1 | Post. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll. | Berry Coll. Cat. 3970 | [647] | Lower San Pedro | Pleistocene |
| 1 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3927 | [509] | Upper San Pedro | Pleistocene |
| 7 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3928 | [511] | Upper San Pedro | Pleistocene |
| 28 | Ant. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [510] | Upper San Pedro | Pleistocene |
| 19 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [514] | Upper San Pedro | Pleistocene |
| 1 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3927 | [512] | Upper San Pedro | Pleistocene |
| 3 | Int. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3928 | [513] | Upper San Pedro | Pleistocene |
| 3 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | Berry Coll. Cat. 3927 | [515] | Upper San Pedro | Pleistocene |
| 9 | Post. | Long Wharf Canyon, Santa Monica, Cal. | F. C. Clark | F. C. Clark Coll. | [516] | Upper San Pedro | Pleistocene |
| 1 | Ant. | Coal mine, W. side Pt. Loma, Cal. | Mrs. Kate Stephens | Berry Coll. Cat. 3926 | [349] | Upper San Pedro | Pleistocene |
| 1 | Ant. | Coal mine, W. side Pt. Loma, Cal. | C. L. Hubbs | S. Diego Soc. Nat. Hist. | [492] | Upper San Pedro | Pleistocene |
| 4 | Ant. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [712] | ? | ? Pleistocene |
| 1 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [713] | ? | ? Pleistocene |
| 7 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [679] | ? | ? Pleistocene |
| 1 | Int. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [682] | ? | ? Pleistocene |
| 7 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [714] | ? | ? Pleistocene |
| 1 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll. | Dept. Geology, Stanford Univ. | [680] | ? | ? Pleistocene |
| 1 | Post. | ? Deadman Id., San Pedro, Cal. | Oldroyd Coll. | Dept. Geology, Stanford Univ. | [666] | ?"Upper San Pedro" | Pleistocene |

*Remarks:* Occasional unmistakable specimens of this peculiar species have been discovered in the Pleistocene of many localities, and in the Long Wharf Canyon deposit it is one of the commonest forms to be found, being there exceeded in abundance only by the nearly related *C. palmulatus mirabilis* Pilsbry. This seems the more strange, since nowhere along our coast at the present time can it be said that *crassicostatus* is found in any very appreciable numbers. Usually but an occasional specimen or two is taken even at extreme low tides. Along the entire coast of southern California the commonest present-day *Callistochiton* is by all odds *C. decoratus punctocostatus*, a species for from common as a fossil.

Although very distinct in the living condition, poorly preserved fossils of *crassicostatus* are sometimes hard to identify on account of the possibility of their being mixed with *C. palmulatus mirabilis.* Well preserved valves, on the other hand, are as readily separable as recent specimens. This is quickly seen when the chief diagnostic characters of the two forms are placed in parallel columns:

HEAD VALVE

| *crassicostatus* | *mirabilis* |
|---|---|
| Primarily with *7* heavy, irregularly tubercular ribs, each divided almost at once by a median sulcus, and in old shells with a secondary sulcus on each side toward the base. | Primarily with *9* moderately heavy, strongly tubercular ribs, each sooner or later showing in the adult a median sulcus; the posterior rib on each side apparently duplex. |
| Slits typically 9 in number, *2 on each side of the central slit being adnate.* | Slits typically 9 in number, *regularly spaced.* |

MEDIAN VALVES

| | |
|---|---|
| Lateral areas elevated into a typically[20] *single, very heavy,* crudely nodulose rib, with usually about 4 rather weak, radiating furrows. | Lateral areas *divided by a strong median furrow* into two nodulose ribs, each of which may bear a weak secondary furrow. |
| Central areas with *7-12* quite strong, interlatticed ribs on a side, *showing a distinct tendency to converge anteriorly on the ridge,* even on valve ii. | Central areas with *14-18* (fewer in very small specimens) moderately strongly interlatticed ribs on a side, *not* showing any well-marked tendency to converge in front, and strongly divergent on valve ii. |

[20] One fossil specimen [682], which seems otherwise thoroughly referable to *crassicostatus,* shows sharply duplex lateral ribs recalling those of *palmulatus* and *mirabilis.*

TAIL VALVE

| | |
|---|---|
| *Flattened above.* *Mucro strongly posterior* (less so in juvenile specimens). Posterior area with 5-6 heavy ribs, at first simple, but developing from 1 to 4 grooves toward the base. | *Mucro strongly anterior,* the large posterior area usually *immensely thickened and elevated behind the mucro;* ribs 5-7, heavy, and though at first simple, soon developing a strong median furrow, with sometimes 1 or 2 secondary furrows toward the base. |
| Slits *14-18.* | Slits *18-25.* |
| Longitudinal ribs of central areas 5-8 on a side. | Longitudinal ribs of central areas 7-9 on a side. |

The marginal toothing in the anterior valve of this species is peculiar and apparently characteristic, the remarkable feature being that certain of the teeth are excessively minute due to the close approximation in pairs of the slits which bound them, a pair of slits in such cases being brought into coincidence with one of the external ribs instead of the usual single slit. The typical arrangement, where the duplication affects only the slits lying immediately on each side of the central one is clearly shown in Pilsbry's figure in the "Manual" (op. cit., pl. 58, fig. 4), but this has not become so fixed but that it is subject to some strangely irregular variation.[21] The gross number of slits is ordinarily 9, but even this is subject to modification. Reducing the number and arrangement of the slits with respect to the ribs to a formula, 17 Santa Monica specimens examined yield the following figures:

Arrangement symmetrical—

| | | |
|---|---|---|
| 11 show the formula | 1-1-2-1-2-1-1, | total 9 slits |
| 2 " " " | 1-1-2-2-2-1-1, | " 10 " |
| 1 shows " " | 1-1-1-1-1-1-1, | " 7 " |

Arrangement asymmetrical—

| | | |
|---|---|---|
| 2 show the formula | 1-1-2-1-2-2-1, | total 10 slits |
| 1 shows " " | 1-2-1-1-1-1-1, | " 8 " |
| 1 " " " | 1-2-2-2-2-1-1, | " 11 " |

With one single exception (which is 8-ribbed), all the above specimens have 7 strong primary ribs, simple at their origin, but soon developing a median sulcus and eventually in well grown specimens showing a very constant tendency to the formation of an accessory sulcus on each side of the primary one toward the base.

[21] Of course it is possible that if a sufficiently large series of specimens could be examined, the variations would not appear so irregular.

Of the intermediate valves examined from the same material, 2 show 12 longitudinal riblets on each side of the central areas, 3 show 11 (or 10-11), 3 show 10 (or 9-10), 3 show 9 (or 8-9), 2 show 8 (or 7-8), and 1 shows 7.

On the tail valves the riblets of the central areas are fewer: 6 on a side (or 5-1-5) in 6, 7-1-7 in 1, 8-1-8 in 1, 6-1-6 in 1, and 5 on a side in 1 specimen. 8 of these same valves show 5 strong radial ribs each, the other 3 shells having 6 each. 2 have 18 slits, 4 have 16, 3 have 15, and 1 has 14. No relation is evident between a maximum number of ribs and an increased quota of slits. Toward the base the ribs become double, and in larger shells triple, quadruple, or (in the case of the outermost pair) even quintuple at the base in similar fashion to the radial ribs of the other valves.

The specimens from the Lower San Pedro Formation at Nob Hill run rather larger than those from Santa Monica, and have unusually sharp, clear sculpture and teeth. Among these have been noted 7 head valves with the typical slit formula 1-1-2-1-2-1-1, none being certainly atypical. Of the median valves, 5 show longitudinal riblets on the central areas as follows: 11-11, 11-11, 11-10, 11-10, 5-5, the last a very small specimen. Three tail valves show 14 slits each, radial ribs respectively 7, 6, 5, and longitudinal riblets on central areas 8-9, 6-7, 4-4.

The teeth of *Callistochiton,* as evidenced by the present species, seem to be composed of a somewhat different substance from the more spongy deposit which fills in the slits, so even when quite worn down it is quite possible to distinguish their number and shape (in transection) with perfect accuracy, especially if the surfaces in question are slightly moistened, when the details are brought out with great clearness. This is fortunate as in most fossil specimens the teeth show as little more than a *pattern,* scarcely worthy of the name teeth at all.

Caliper measurements of some of the larger specimens are as follows:

| | | Length | Diameter | Height |
|---|---|---|---|---|
| Head valve | [349] | 3.5 mm. | 5.7 mm. | 3.4 mm. |
| Median valve | [512] | 3.2 | 6.7 | 3.2 |
| " " | [646] | 4.8 | 7.6 | 4.1 |
| " " | [679] | 4.3 | 8.3 | 4.7 |
| " " | [1024] | 4.2 | 7.8 | 3.8 |
| Tail valve | [515] | 4.0 | 5.2 | 2.4 |
| " " | [680] | 5.7 | 7.7 | 3.4 |

## 35. **Callistochiton palmulatus mirabilis** Pilsbry, 1893

(Plate XIV, figs. 9-16; Plate XV.)

1893. *Callistochiton palmulatus* var. *mirabilis* Pilsbry, Man. Conch., (1), v. 14, p. 263, pl. 58, f. 7-11.

1917. *Callistochiton palmulatus* and var. *mirabilis* Chace, Lorquinia, v. 2, p. 30 (recorded from Pleistocene of Santa Monica, Cal.).

*Diagnosis:* Valves small, thick, massive, elevated, carinated; side slopes slightly convex; lateral areas elevated, divided by a strong median sulcus into two nodulose ribs, each sometimes with a secondary furrow on the summit; head valve strongly elevated, primarily with 9 strongly tubercular, eventually sulcate, radial ribs; central areas with 14-18 moderately strongly

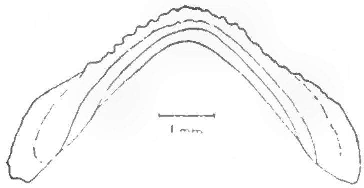


Fig. 11

Fig. 11. *Callistochiton palmulatus mirabilis* Pilsbry. Anterior elevation of valve illustrated in Plate XIV, figs. 15-16.

interlatticed ribs on each side, subparallel except on the jugum of valve ii, where they diverge; tail valve with mucro in front of middle, the abbreviated central area much lower than the swollen posterior region; sutural plates very short, connected across the shallow narrow sinus; teeth short, curved, slightly projecting in valves i-vii, extremely robust and thick in valve viii; eaves wide, solid; slits 9, 1-1, 18 to 25, with distinct pore lines leading into them.

*Recorded Range:*

*Pleistocene:* Lower San Pedro Series—Nob Hill Cut, San Pedro, California (!).

Upper San Pedro Series—Long Wharf Canyon, Santa Monica, California (Chace, !); Los Cerritos Hill, Long Beach, California (!).

Formation doubtful— Deadman Island, San Pedro, California (!).

*Living:* Monterey, California (!), to San Diego, California (!); between tides to 15 fathoms.

*Material Examined:*

| No. of Specimens | Valve | Locality | Collector | Where Deposited | Number in Author's Register | Formation | Period |
|---|---|---|---|---|---|---|---|
| 2 | Int.. | Nob Hill Cut, San Pedro, Cal. | Oldroyd Coll........... | Dept. Geology, Stanford Univ..... | [ 649] | Lower San Pedro... | Pleistocene |
| 2 | Ant.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | Berry Coll. Cat. 3929. | [ 522] | Upper San Pedro... | Pleistocene |
| 13 | Ant.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | Berry Coll. Cat. 3930. | [ 523] | Upper San Pedro... | Pleistocene |
| 90 | Ant.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | F. C. Clark Coll...... | [ 524] | Upper San Pedro... | Pleistocene |
| 1 | Int.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | Berry Coll. Cat. 3929. | [ 525] | Upper San Pedro... | Pleistocene |
| 4 | Int.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | Berry Coll. Cat. 3930. | [ 526] | Upper San Pedro... | Pleistocene |
| 12 | Int.. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | F. C. Clark Coll...... | [ 527] | Upper San Pedro... | Pleistocene |
| 6 | Post. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | Berry Coll. Cat. 3929. | [ 528] | Upper San Pedro... | Pleistocene |
| 12 | Post. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | Berry Coll. Cat. 3930. | [ 529] | Upper San Pedro... | Pleistocene |
| 57 | Post. | Long Wharf Canyon, Santa Monica, Cal............. | F. C. Clark............ | F. C. Clark Coll...... | [ 530] | Upper San Pedro... | Pleistocene |
| 1 | Post. | Los Cerritos Hill, Long Beach, Cal..................... | T. S. Oldroyd......... | Dept. Geology, Stanford Univ..... | [ 663] | Upper San Pedro... | Pleistocene |
| 1 | Int.. | Deadman Id., San Pedro, Cal. | Arnold Coll............ | Dept. Geology, Stanford Univ..... | [ 681] | ? | ? Pleistocene |
| ?2 | Post. | Deadman Id., San Pedro, Cal. | Arnold Coll............ | Dept. Geology, Stanford Univ..... | [ 716] | ? | ? Pleistocene |

*Remarks:* This species or subspecies has already received some attention in the course of the discussion of the last species, but a few more notes deserve to be recorded.

For one thing I am not yet altogether sure that *mirabilis* is entirely worthy of subspecific separation from *palmulatus* Carpenter. On the other hand I am no more positive but that it may eventually prove specifically distinct. This seems paradoxical but is a situation which logically follows from the conflicting evidence afforded by our scanty data. While it is true that the majority of the fossil specimens fall without debate under Pilsbry's diagnosis, and it further appears that none of the specimens, unless very doubtfully some of the juvenals, accord entirely with his description of typical *palmulatus*, still the number of specimens which in one or more particulars are intermediate between the two is legion. My experience with recent specimens is that they are often even more troublesome to separate. Without exception all the characters depended upon to distinguish the two forms are subject to much variation. On the other hand the features separating the *palmulatus* complex from *crassicostatus* seem dependable enough. These two facts are brought out rather forcefully in the following summary of observations made on Dr. Clark's numerous Santa Monica specimens.

Sixty-six head valves of the Long Wharf Canyon *mirabilis* have 9 ribs and 9 slits to correspond, though the two outermost ribs are in each case apparently duplex, and counting each of these as 2 would raise the number of ribs to 11. Fifteen others have 9 ribs each, but the number of slits could not be accurately determined. Two have 9 ribs, 9 slits to correspond, and a supernumerary slit between two of the ribs. Four have the usual 9 ribs, but 10 slits, due to a double slit opposite one of the ribs, the position of the rib so favored being variable. A single valve has 10 ribs and 10 corresponding slits.

Ten median valves show variations in the number of longitudinal ribs on each side as follows: 18-18, 17-16, 16-16, 16-15, 15-15, 15-15, 14-14, 14-14, 14-14, 10-10. The number apparently depends in considerable degree upon the size of the specimen.

One tail valve shows 12 longitudinal riblets to a side on the central area, 2 show 11, 2 show 10, 8 show 9, 8 show 8, 5 show 7, and 2 show 6, none showing less than 6. Here again there seems to be a certain degree of correlation, not entirely absolute, between the number of these riblets and the size of the specimen. Twenty-five tail valves show 5 radial ribs, all at first simple, but soon divided by a strong median furrow, secondary furrows being sometimes developed later on each side of the primary one. In the outermost pair of ribs on one or two of these specimens the central furrows commence so early that the total number of ribs could easily be stated as 7. Two valves clearly have 7 ribs. Fifteen specimens have 6 ribs, the 2 central ribs in such cases being usually very evidently homologous with the single median rib of the 5-ribbed specimens. This is shown by the pair in question being very close together, while neither develops its median furrow as early as the remaining ribs do. Turning to the insertion plates, 7 valves have 25 slits each, 9 have 24, 9 have 25, 4 have 22, 1 has 21, 4 have 20, 4 have 19, 2 have 18, and 1 has 16. The mode seems to lie in remarkable proximity to the maximum in a curve plotted on this basis.

The position of the mucro is very constant, but the degree of elevation of the posterior area is extremely variable. The accompanying series of figures (Plate XV, figs. 1-12) is designed to illustrate this.

When eroded to the proper degree, the radiating tubercles of this species show each a distinct central pore or lumen.

This is by all odds our most abundant fossil chiton, even though this is entirely due to its enormous frequency in the Upper San Pedro of Long Wharf Canyon, Santa Monica. An amazing circumstance in this connection is the great preponderance of head and tail valves among the specimens collected (see foregoing table). Why only 17 out 197 specimens quarried should be median valves, when the latter must originally have been exactly three times as numerous as the terminal ones, is not easy to understand. It is true that they are much less heavy and solid, but as broken fragments are not more common in the one case than the other, this does not seem an entirely sufficient explanation. To a less degree the same phenomenon is likewise true of *C. crassicostatus* in these beds.

The largest specimens taken have the following caliper measurements:

| | | Length | Diameter | Height |
|---|---|---|---|---|
| Head valve | [522] | 3.4 mm. | 5.2 mm. | 3.4 mm. |
| Median valve | [526] | 2.7 | 6.8 | 3.6 |
| Tail valve | [529] | 4.2 | 4.7 | 3.3 |
| " " | [528] | 3.5 | 5.0 | 2.6 |

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## EXPLANATION OF PLATES

### Plate I.

Fig. 1. *Oligochiton lioplax* Berry, n. sp. Exterior view of head valve from Loc. N. P. 129 [606], in situ.

Fig. 2. *Oligochiton lioplax* Berry, n. sp. Same valve after delamination and removal of tegmentum; same scale as preceding.

Fig. 3. *Oligochiton lioplax* Berry, n. sp. Exterior view of median valve from Loc. N. P. 129 [607], in situ; same scale as preceding.

Fig. 4. *Oligochiton lioplax* Berry, n. sp. Interior view of right side of same valve, showing radial lines; same scale as preceding.

Fig. 5. *Oligochiton lioplax* Berry, n. sp. Exterior view of tail valve from Loc. N. P. 129, type specimen [608], after removal from matrix; same scale as preceding.

Fig. 6. *Oligochiton lioplax* Berry, n. sp. Interior view of same valve; same scale as preceding.

Fig. 7. *Lepidochitona dentiens* (Gould). Exterior view of median valve from Nob Hill Cut, San Pedro, California (Lower San Pedro Pleistocene) [659].

Fig. 8. *Lepidochitona dentiens* (Gould). Interior view of same valve; same scale as preceding.

Fig. 9. *Lepidochitona dentiens* (Gould). Anterior elevation of same valve; camera outline.

Fig. 10. *Leptochiton clarki* Berry, n. sp. Enlarged view of sculpture detail from right side of intermediate valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene); type specimen [605].

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PLATE II.

Fig. 1. *Tonicella lineata* (Wood). Exterior view of median valve from near lighthouse, Point Fermin, California (Lower San Pedro Pleistocene) [1096].

Fig. 2. *Tonicella lineata* (Wood). Interior view of same valve; same scale as preceding.

Fig. 3. *Tonicella lineata* (Wood). Anterior elevation of same valve; camera outline.

Fig. 4. *Tonicella lineata* (Wood). Exterior view of tail valve from near lighthouse, Point Fermin, California (Lower San Pedro Pleistocene) [1097]; same scale as Fig. 1.

Fig. 5. *Tonicella lineata* (Wood). Profile of same valve; camera outline.

Fig. 6. *Cyanoplax hartwegii* (Carpenter). Exterior view of median valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [943]; same scale as Fig. 1.

Fig. 7. *Cyanoplax hartwegii* (Carpenter). Interior view of same valve; camera outline.

Fig. 8. *Cyanoplax hartwegii* (Carpenter). Anterior elevation of same valve; camera outline.

Fig. 9. *Cyanoplax fackenthallæ* Berry. Oblique anterior view of head valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1082].

Fig. 10. *Cyanoplax fackenthallæ* Berry. Profile of same valve; camera outline.

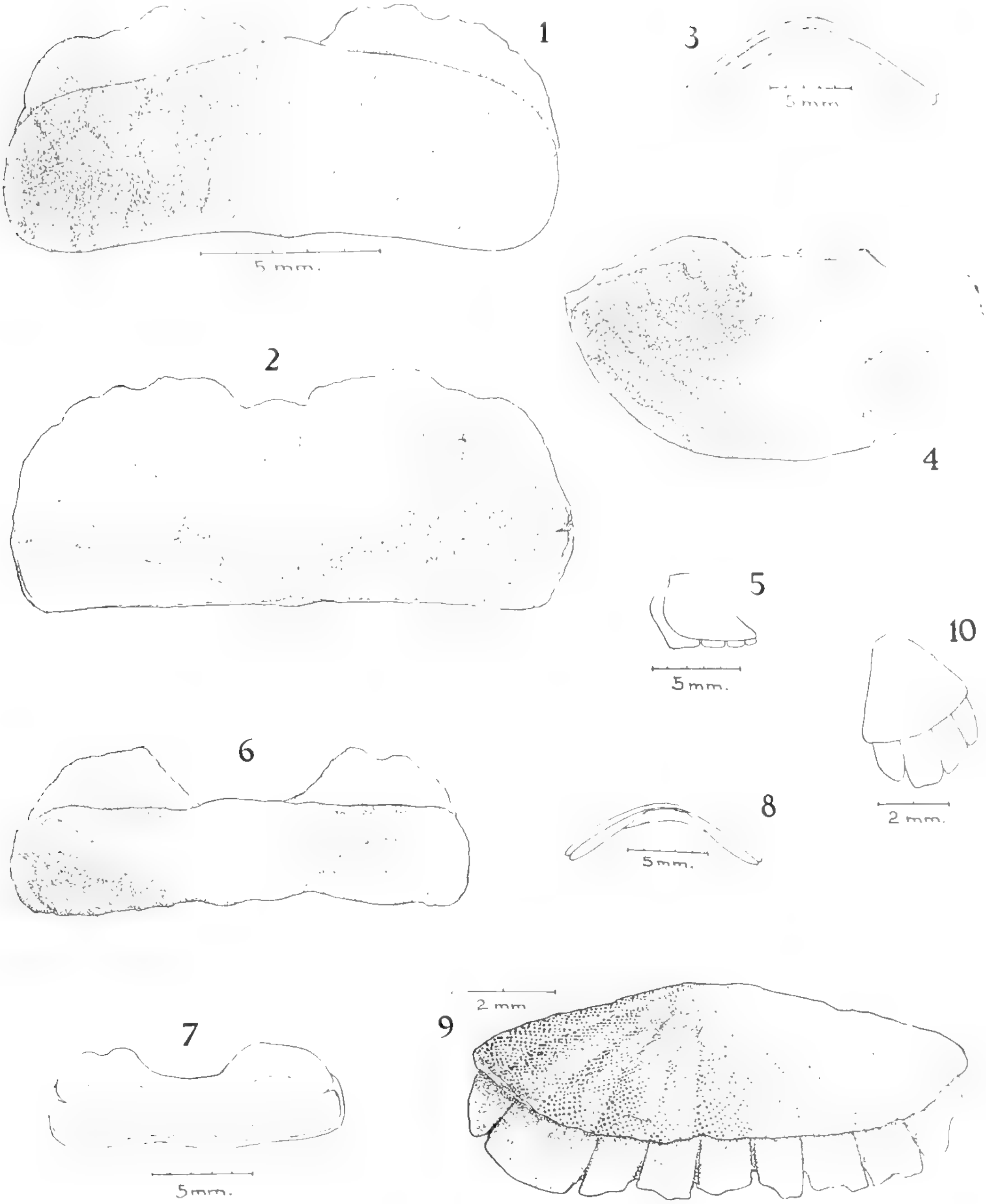
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PLATE III.

Fig. 1. *Nuttallina californica* (Nuttall). Exterior view of head valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1026].

Fig. 2. *Nuttallina californica* (Nuttall). Interior view of same valve; same scale as preceding.

Fig. 3. *Nuttallina californica* (Nuttall). Profile of same valve; camera outline.

Fig. 4. *Nuttallina californica* (Nuttall). Exterior view of median valve from Nob Hill Cut, San Pedro, California (Lower San Pedro Pleistocene) [653]; same scale as Fig. 1.

Fig. 5. *Nuttallina californica* (Nuttall). Interior view of same valve; same scale as preceding.

Fig. 6. *Nuttallina californica* (Nuttall). Anterior elevation of same valve; camera outline.

Fig. 7. *Nuttallina californica* (Nuttall). Exterior view of tail valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1028]; same scale as Fig. 1.

Fig. 8. *Nuttallina californica* (Nuttall). Interior view of same valve; same scale as preceding.

Fig. 9. *Nuttallina californica* (Nuttall). Profile of same valve; camera outline.

Fig. 10. *Nuttallina californica* (Nuttall). Exterior view of median valve of a less mature individual from Deadman Island, San Pedro, California (probably Pleistocene) [678]; camera outline showing shape of uneroded valve.

Fig. 11. *Nuttallina californica* (Nuttall). Interior view of same; camera outline; same scale as preceding.

Fig. 12. *Nuttallina californica* (Nuttall). Anterior elevation of same valve; camera outline; same scale as preceding.

Fig. 13. *Placiphorella velata* Carpenter. Exterior view of median valve from Deadman Island, San Pedro, California (probably Pleistocene) [677].

Fig. 14. *Placiphorella velata* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 15. *Placiphorella velata* Carpenter. Anterior elevation of same valve; camera outline.

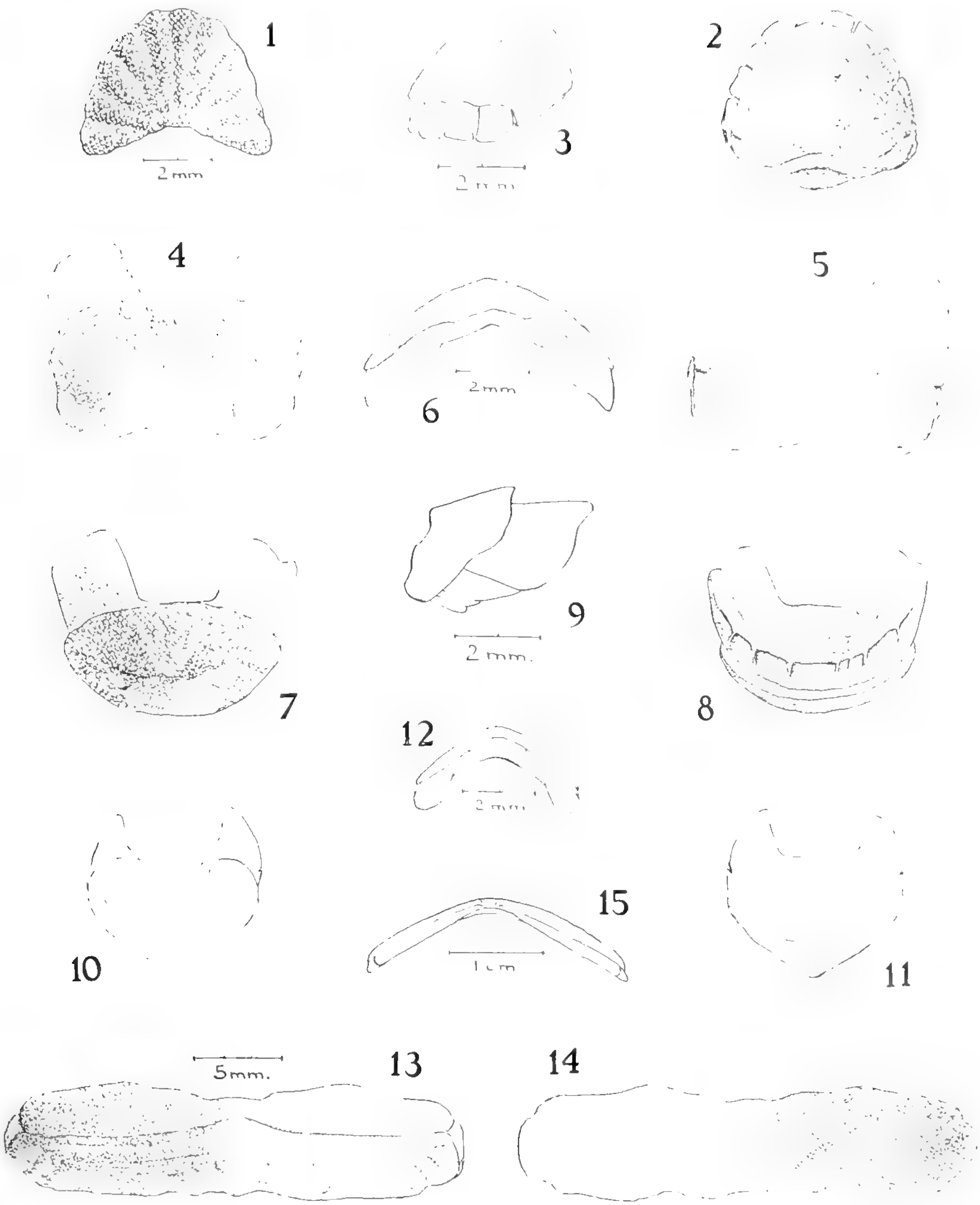
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PLATE IV.

Fig. 1. *Mopalia muscosa* (Gould). Exterior view of head valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1034]; viewed from somewhat obliquely toward the front.

Fig. 2. *Mopalia muscosa* (Gould). Interior view of same valve; same scale as preceding.

Fig. 3. *Mopalia muscosa* (Gould). Profile of same valve; camera outline.

Fig. 4. *Mopalia muscosa* (Gould). Exterior view of median valve from "coal mine", west side of Point Loma, California (Upper San Pedro Pleistocene) [550].

Fig. 5. *Mopalia muscosa* (Gould). Interior view of same valve; same scale as preceding.

Fig. 6. *Mopalia muscosa* (Gould). Anterior elevation of same valve; camera outline.

Fig. 7. *Mopalia muscosa* (Gould). Exterior view of tail valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1090].

Fig. 8. *Mopalia muscosa* (Gould). Interior view of same valve; same scale as preceding.

Fig. 9. *Mopalia muscosa* (Gould). Profile of same valve; camera outline.

Fig. 10. *Mopalia hindsii* (Sowerby). Exterior view of second valve from Deadman Island, San Pedro, California (Pleistocene) [578]; same scale as Fig. 4.

Fig. 11. *Mopalia hindsii* (Sowerby). Interior view of same valve; same scale as preceding.

Fig. 12. *Mopalia hindsii* (Sowerby). Anterior elevation of same valve; camera outline.

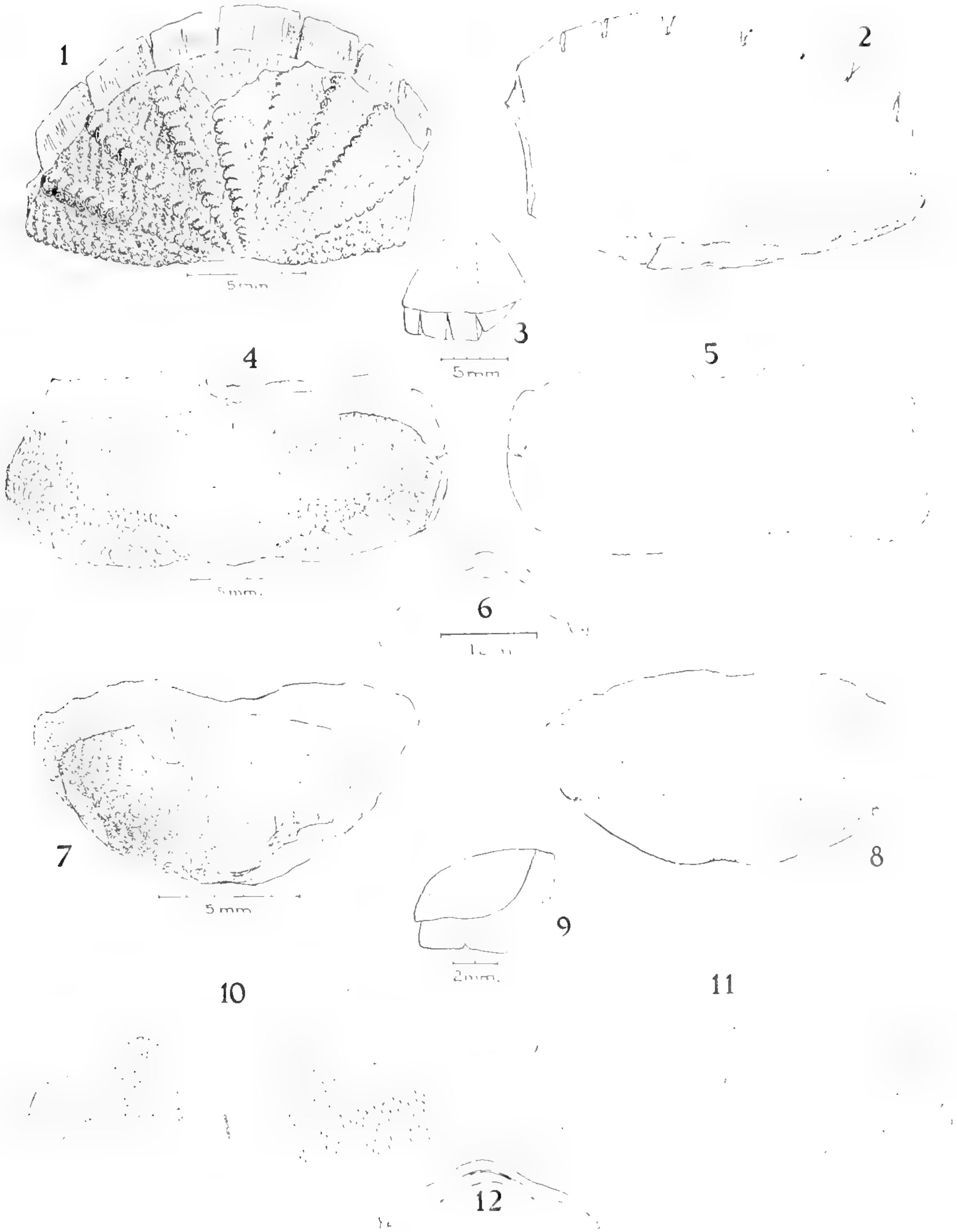
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PLATE V.

Fig. 1. *Mopalia ciliata* (Sowerby). Exterior view of head valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1036].

Fig. 2. *Mopalia ciliata* (Sowerby). Interior view of same valve; same scale as preceding.

Fig. 3. *Mopalia ciliata* (Sowerby). Profile of same valve; camera outline.

Fig. 4. *Mopalia ciliata* (Sowerby). Exterior view of median valve, probably from Deadman Island, San Pedro, California (Pleistocene) [676].

Fig. 5. *Mopalia ciliata* (Sowerby). Interior view of same valve; same scale as preceding.

Fig. 6. *Mopalia ciliata* (Sowerby). Anterior elevation of same valve; camera outline.

Fig. 7. *Mopalia ciliata* (Sowerby). Exterior view of tail valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1038]; same scale as Fig. 1.

Fig. 8. *Mopalia ciliata* (Sowerby). Interior view of same valve; same scale as preceding.

Fig. 9. *Mopalia ciliata* (Sowerby). Profile of same valve; camera outline.

Fig. 10. *Mopalia acuta* (Carpenter). Exterior view of median valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [762].

Fig. 11. *Mopalia acuta* (Carpenter). Interior view of same valve; same scale as preceding.

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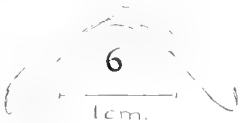


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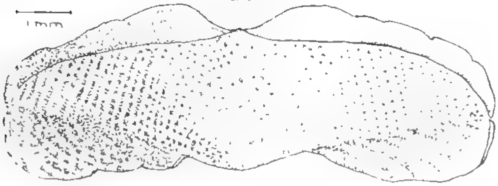


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## Plate VI.

Fig. 1. *Katharina tunicata* (Wood). Exterior view of head valve from Deadman Island, San Pedro, California (Pleistocene) [345]; tegmentum lost from this specimen.

Fig. 2. *Katharina tunicata* (Wood). Interior view of same valve; same scale as preceding.

Fig. 3. *Katharina tunicata* (Wood). Profile of same valve; camera outline.

Fig. 4. *Katharina tunicata* (Wood). Exterior of median valve from Deadman Island, San Pedro, California (Santa Barbara Pliocene) [726].

Fig. 5. *Katharina tunicata* (Wood). Interior of same valve; same scale as preceding.

Fig. 6. *Katharina tunicata* (Wood). Anterior elevation of same valve; camera outline.

Fig. 7. *Mopalia* cf. *sinuata* (Carpenter). Lateral view of head valve from Deadman Island, San Pedro, California (probably Pleistocene) [717].

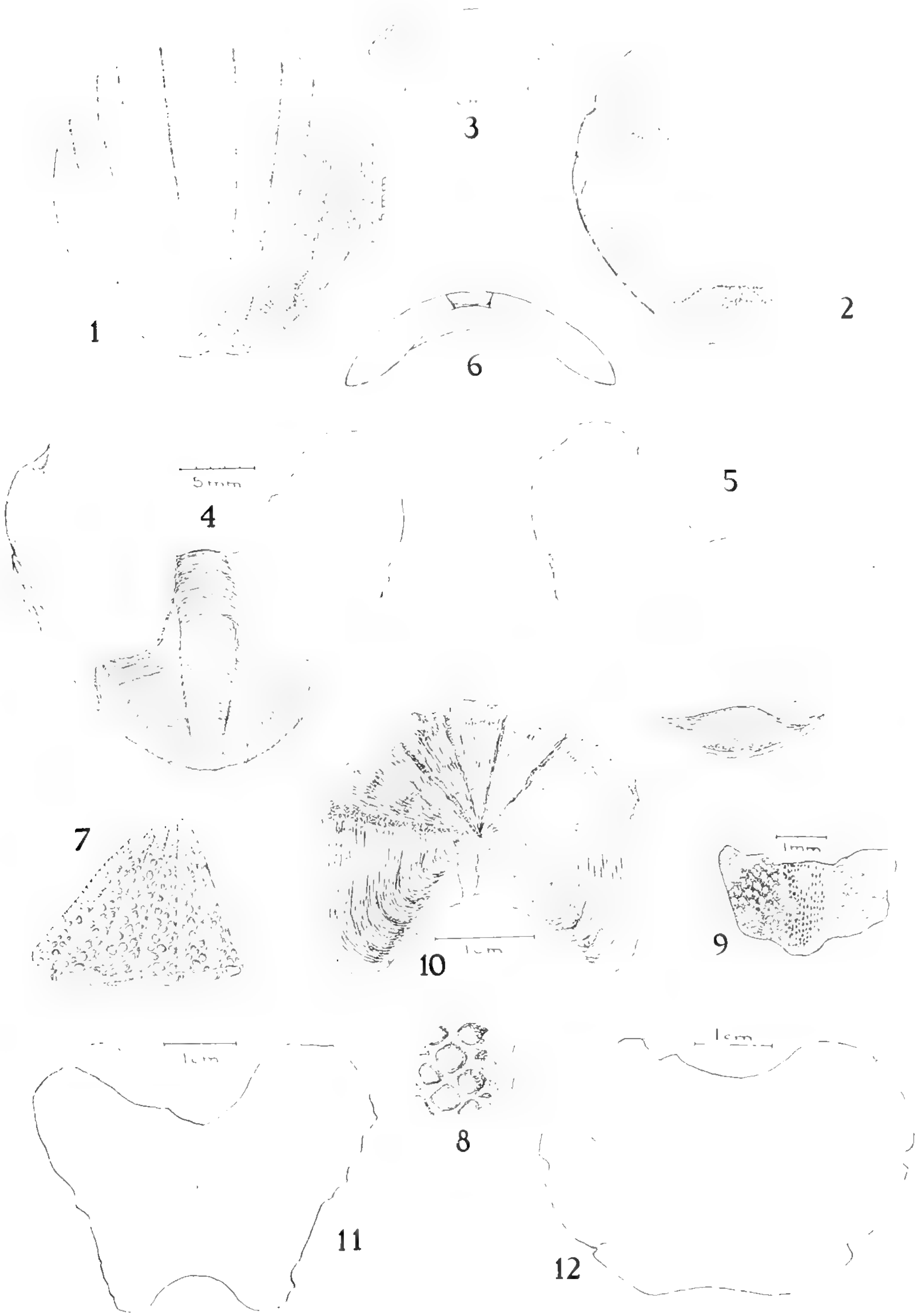
Fig. 8. *Mopalia* cf. *sinuata* (Carpenter). Sculptural detail of same specimen, greatly magnified.

Fig. 9. *Acanthochitona avicula* (Carpenter). Exterior of imperfect median valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [940].

Fig. 10. *Cryptochiton stelleri* (Middendorff). Interior view of head valve from C. A. S. Loc. 108, 2 miles north of Point Loma, California (Upper San Pedro Pleistocene) [517]; showing radial lines made visible by delamination of inner layer of articulamentum.

Fig. 11. *Cryptochiton stelleri* (Middendorff). Exterior of median valve from Pacific Beach, San Diego County, California (San Diego Pliocene) [505]; camera outline.

Fig. 12. *Cryptochiton stelleri* (Middendorff). Exterior view of tail valve from Nob Hill Cut, San Pedro, California (Lower San Pedro Pleistocene) [644]; camera outline.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## Plate VII.

Fig. 1. *Ischnochiton fallax* Carpenter. Exterior view of median valve from Nob Hill Cut, San Pedro, California (Lower San Pedro Pleistocene) [650].

Fig. 2. *Ischnochiton fallax* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 3. *Ischnochiton fallax* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 4. *Ischnochiton magdalenensis* (Hinds). Exterior view of head valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [946]; same scale as Fig. 1.

Fig. 5. *Ischnochiton magdalenensis* (Hinds). Profile of same valve; camera outline.

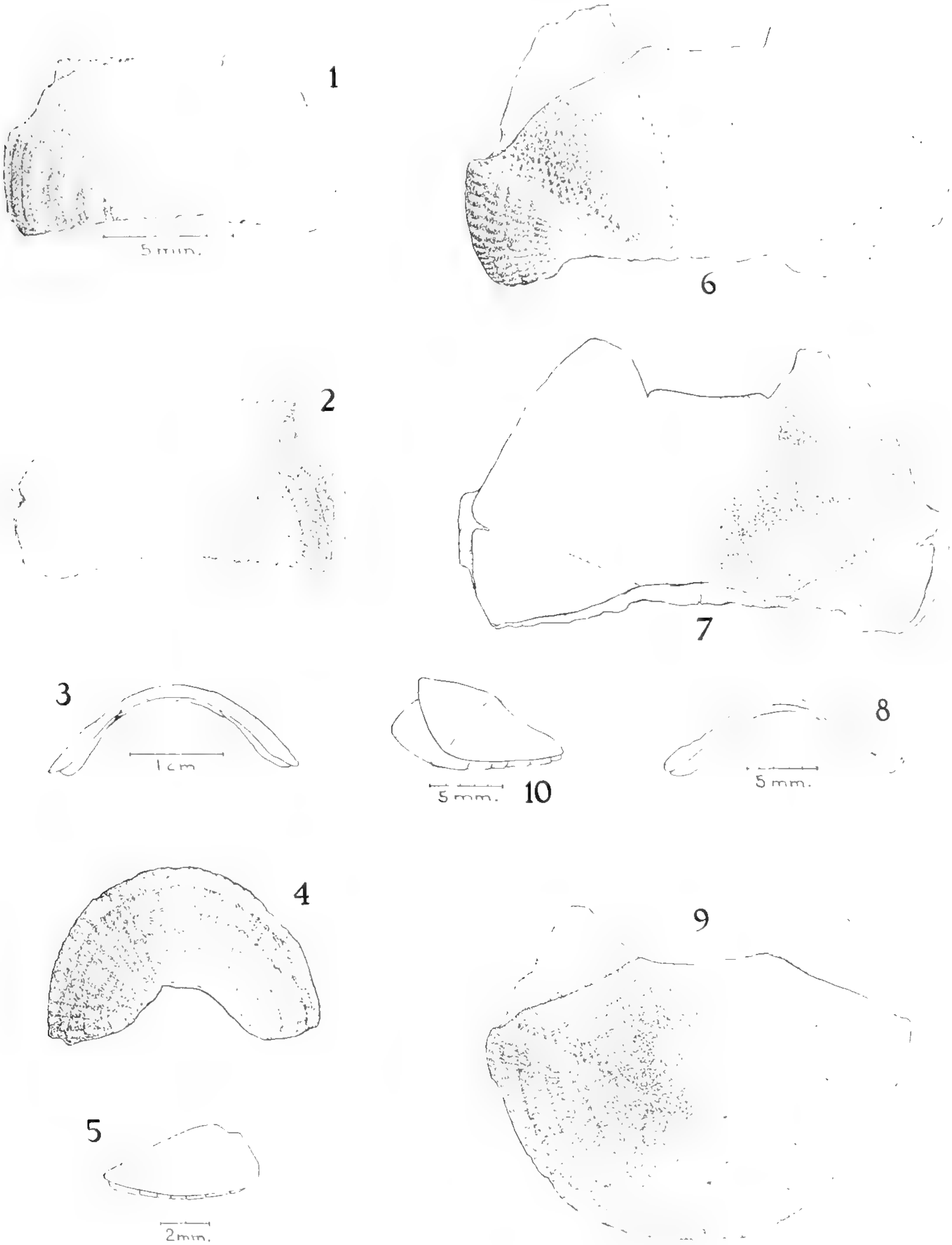
Fig. 6. *Ischnochiton magdalenensis* (Hinds). Exterior view of median valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1086]; same scale as Fig. 1.

Fig. 7. *Ischnochiton magdalenensis* (Hinds). Interior view of same valve; same scale as preceding.

Fig. 8. *Ischnochiton magdalenensis* (Hinds). Anterior elevation of same valve; camera outline.

Fig. 9. *Ischnochiton magdalenensis* (Hinds). Exterior view of tail valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1087]; same scale as Fig. 1.

Fig. 10. *Ischnochiton magdalenensis* (Hinds). Profile of same valve; camera outline.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## Plate VIII.

Fig. 1. *Ischnochiton conspicuus* Carpenter. Exterior view of head valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [350].

Fig. 2. *Ischnochiton conspicuus* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 3. *Ischnochiton conspicuus* Carpenter. Profile of same view; camera outline.

Fig. 4. *Ischnochiton conspicuus* Carpenter. Exterior view of median valve from "coal mine", west side of Point Loma, California (Upper San Pedro Pleistocene) [499].

Fig. 5. *Ischnochiton conspicuus* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 6. *Ischnochiton conspicuus* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 7. *Ischnochiton conspicuus* Carpenter. Exterior view of tail valve from Deadman Island, San Pedro, California (Pleistocene) [346]; same scale as Fig. 1.

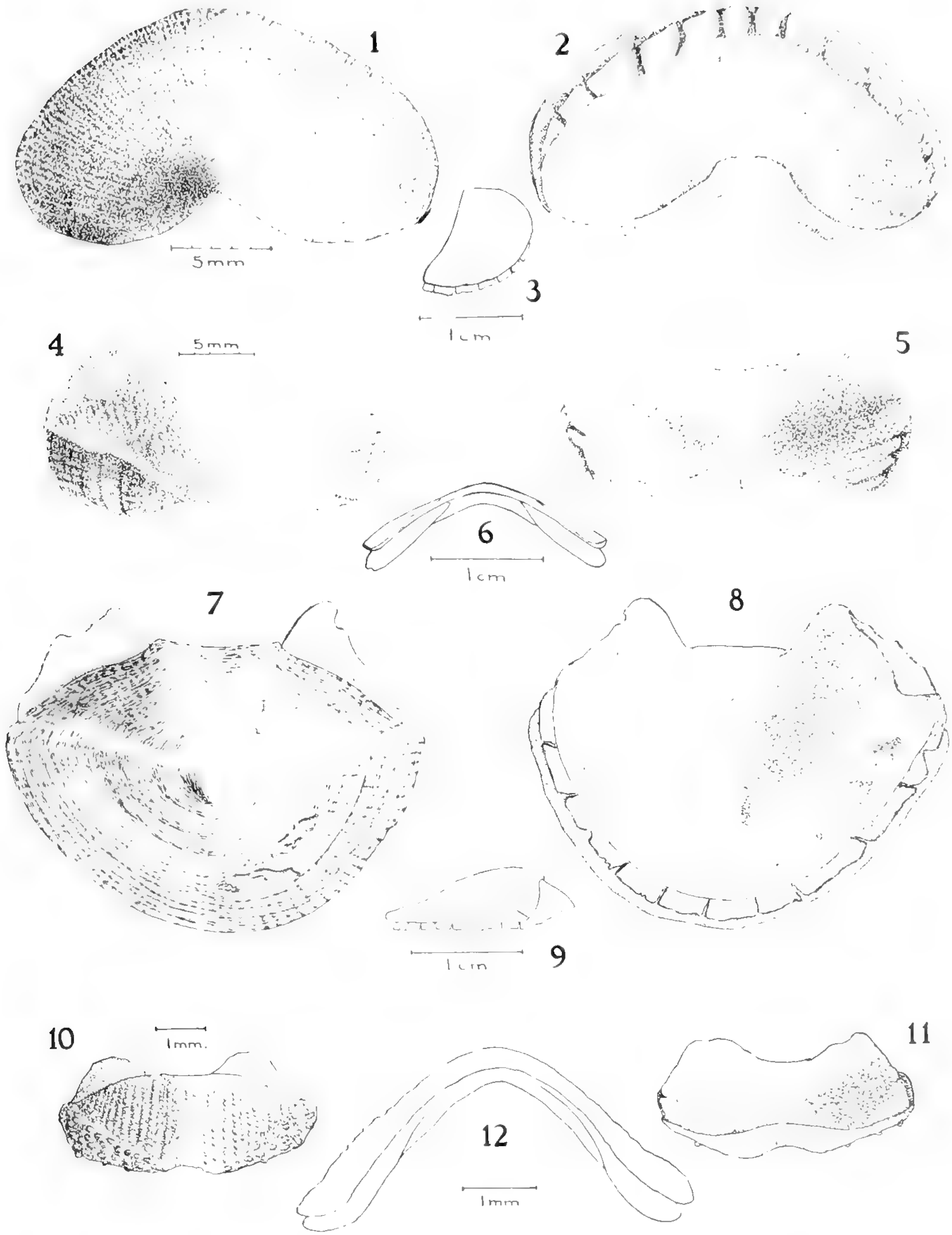
Fig. 8. *Ischnochiton conspicuus* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 9. *Ischnochiton conspicuus* Carpenter. Profile of same valve; camera outline.

Fig. 10. *Chaetopleura gemma* Carpenter. Exterior view of median valve from Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1025].

Fig. 11. *Chaetopleura gemma* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 12. *Chaetopleura gemma* Carpenter. Anterior elevation of same valve; camera outline.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### Plate IX.

Fig. 1. *Ischnochiton acrior* Carpenter. Exterior view of head valve from Deadman Island, San Pedro, California (probably Pleistocene) [685].

Fig. 2. *Ischnochiton acrior* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 3. *Ischnochiton acrior* Carpenter. Profile of same valve; camera outline.

Fig. 4. *Ischnochiton acrior* Carpenter. Exterior view of median valve from "coal mine", west side of Point Loma, California (Upper San Pedro Pleistocene) [343].

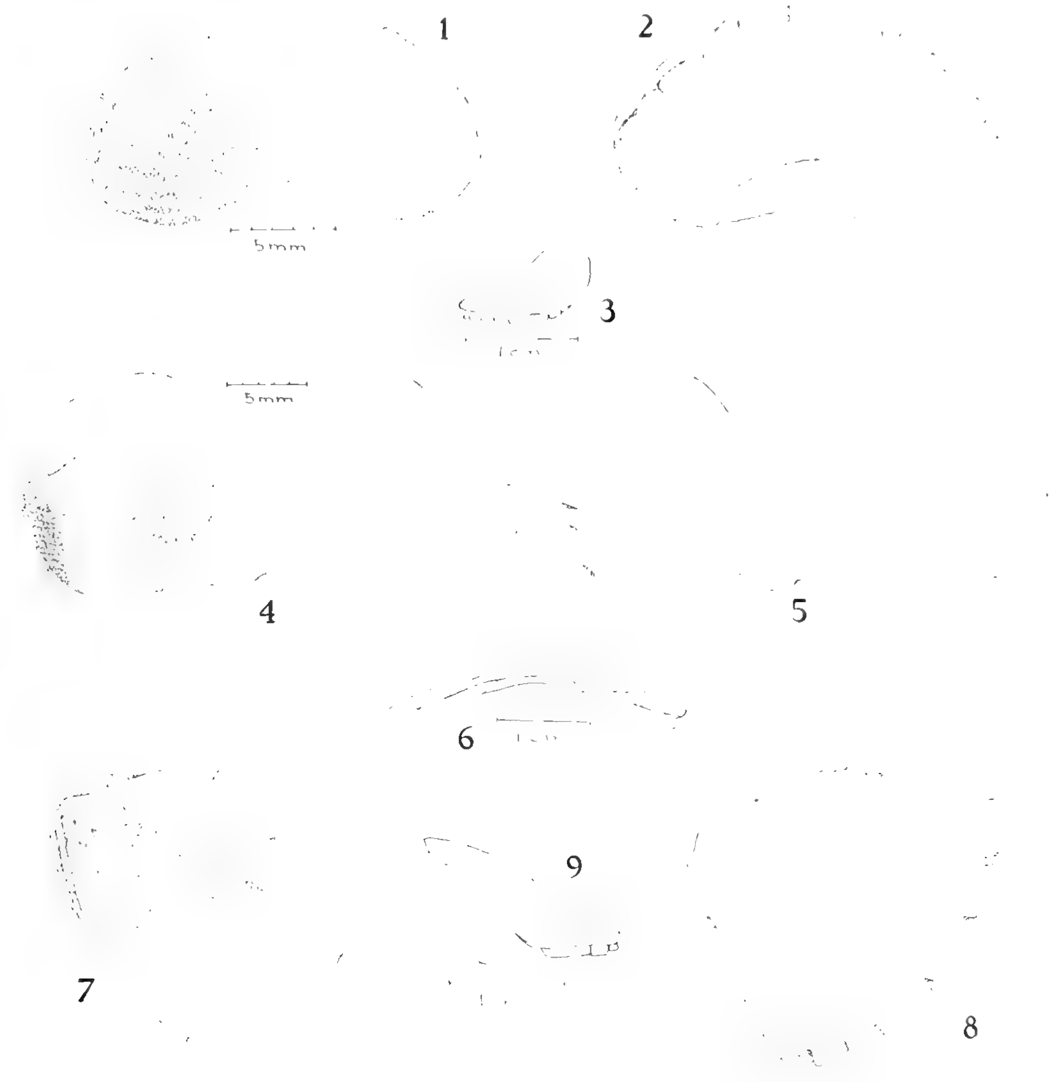
Fig. 5. *Ischnochiton acrior* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 6. *Ischnochiton acrior* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 7. *Ischnochiton acrior* Carpenter. Exterior view of fragmentary tail valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [352]; same scale as Fig. 1.

Fig. 8. *Ischnochiton acrior* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 9. *Ischnochiton acrior* Carpenter. Profile of same valve; camera outline.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## PLATE X.

Fig. 1. *Ischnochiton acrior* Carpenter. Exterior view of median valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [344].

Fig. 2. *Ischnochiton acrior* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 3. *Ischnochiton acrior* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 4. *Ischnochiton pectinulatus* (Carpenter). Exterior view of second valve from Spanish Bight, San Diego, California (Upper San Pedro Pleistocene) [507].

Fig. 5. *Ischnochiton pectinulatus* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 6. *Ischnochiton pectinulatus* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 7. *Ischnochiton mertensii* (Middendorff). Exterior view of median valve from Deadman Island, San Pedro, California (probably Pleistocene) [709]; same scale as Fig. 4.

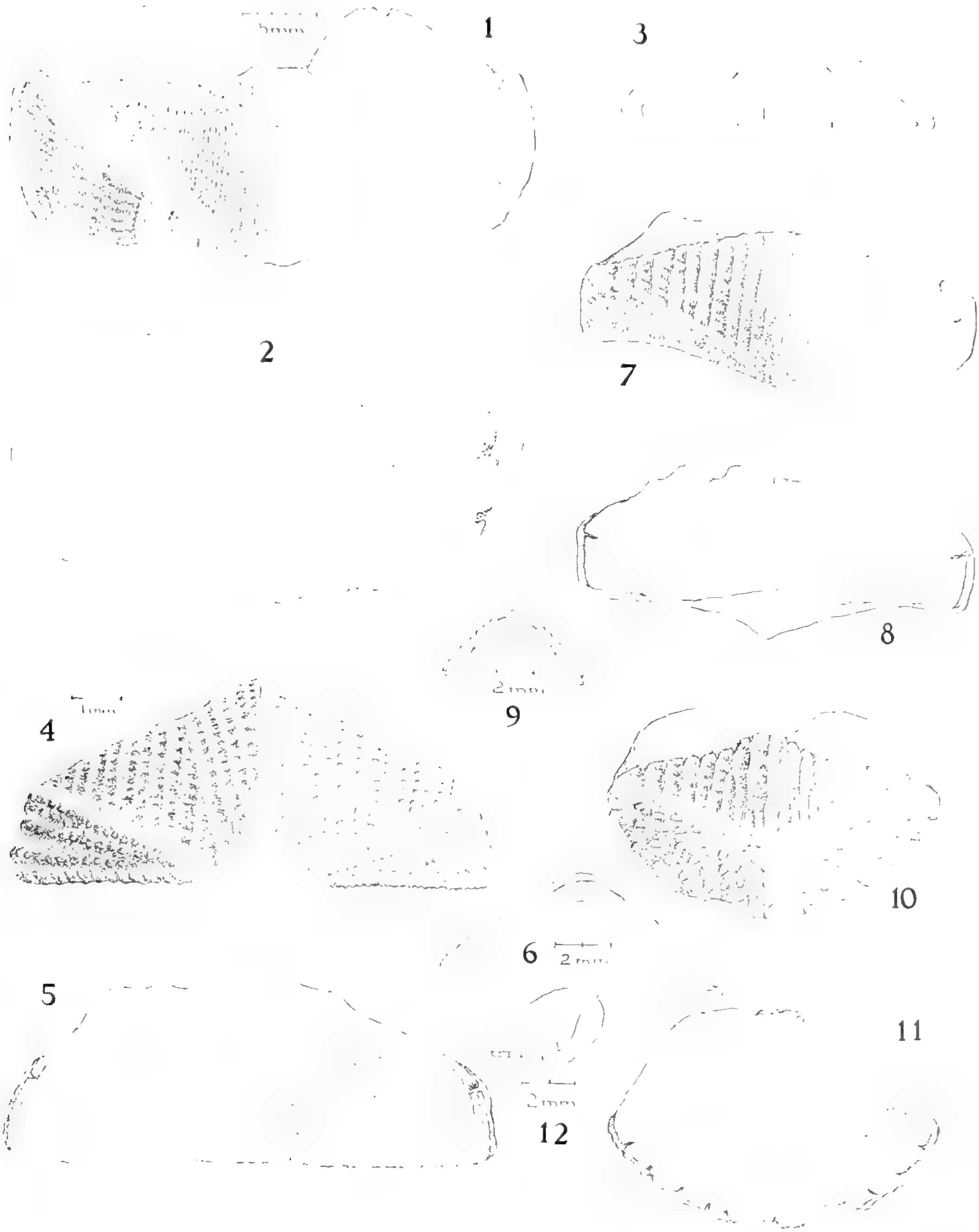
Fig. 8. *Ischnochiton mertensii* (Middendorff). Interior view of same valve; same scale as preceding.

Fig. 9. *Ischnochiton mertensii* (Middendorff). Anterior elevation of same valve; camera outline.

Fig. 10. *Ischnochiton mertensii* (Middendorff). Exterior view of tail valve from Deadman Island, San Pedro, California (probably Pleistocene) [710]; same scale as Fig. 4.

Fig. 11. *Ischnochiton mertensii* (Middendorff). Interior view of same valve; same scale as preceding.

Fig. 12. *Ischnochiton mertensii* (Middendorff). Profile of same valve; camera outline.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## Plate XI.

Fig. 1. *Ischnochiton cooperi* Carpenter. Exterior view of head valve from Deadman Island, San Pedro, California (probably Pleistocene) [722].

Fig. 2. *Ischnochiton cooperi* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 3. *Ischnochiton cooperi* Carpenter. Profile of same valve: camera outline.

Fig. 4. *Ischnochiton cooperi* Carpenter. Exterior view of median valve from Deadman Island, San Pedro, California (probably Pleistocene) [723].

Fig. 5. *Ischnochiton cooperi* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 6. *Ischnochiton cooperi* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 7. *Ischnochiton cooperi* Carpenter. Exterior view of median valve, probably from Deadman Island, San Pedro, California (Pleistocene) [648].

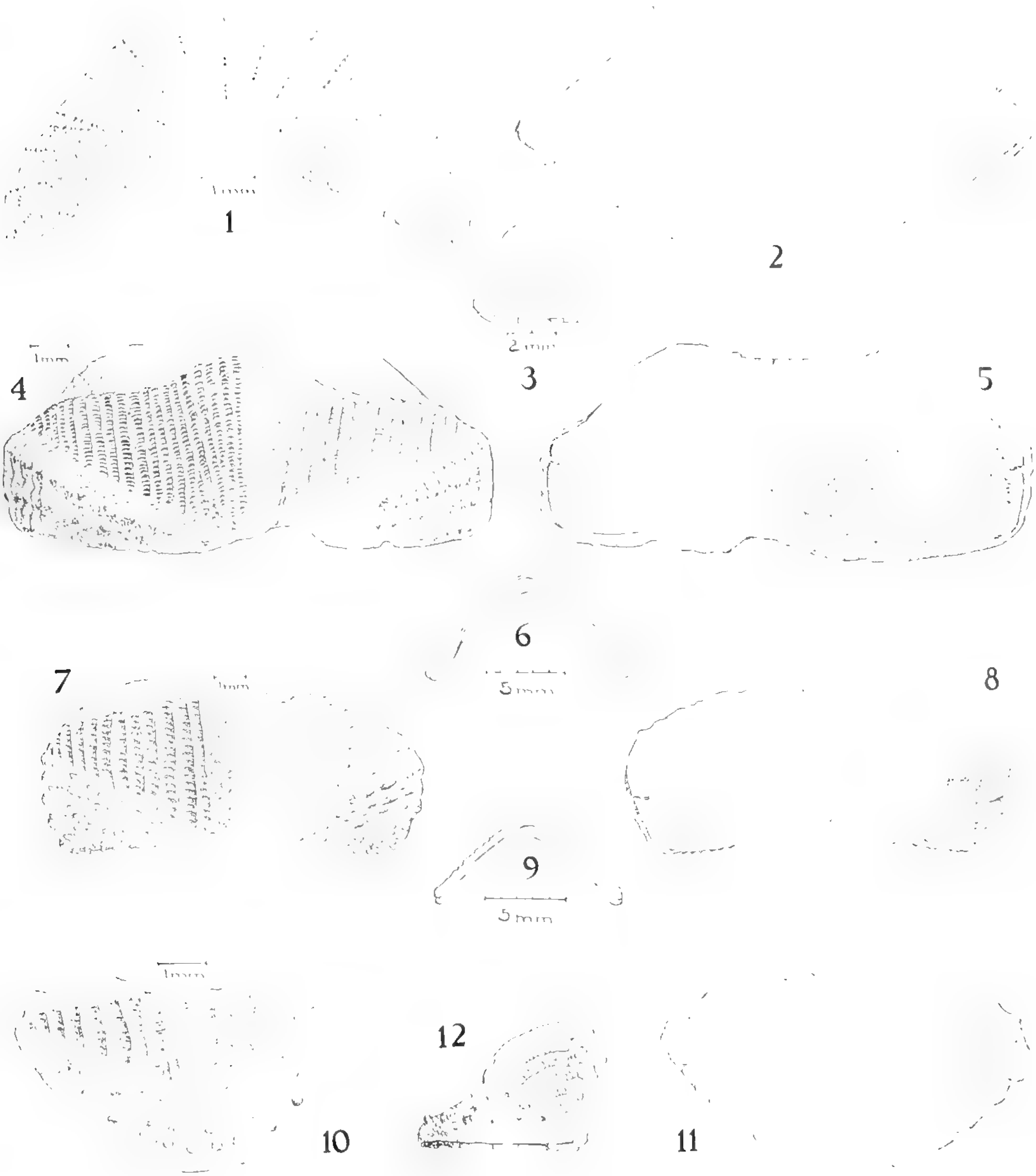
Fig. 8. *Ischnochiton cooperi* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 9. *Ischnochiton cooperi* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 10. *Ischnochiton cooperi* Carpenter. Exterior view of tail valve from Deadman Island, San Pedro, California (probably Pleistocene) [730].

Fig. 11. *Ischnochiton cooperi* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 12. *Ischnochiton cooperi* Carpenter. Profile of same valve; same scale as preceding.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## PLATE XII.

Fig. 1. *Ischnochiton sanctaemonicae* Berry, n. sp. Exterior view of head valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene); paratype [881].

Fig. 2. *Ischnochiton sanctaemonicae* Berry, n. sp. Interior view of same valve; same scale as preceding.

Fig. 3. *Ischnochiton sanctaemonicae* Berry, n. sp. Profile of same valve; camera outline.

Fig. 4. *Ischnochiton sanctaemonicae* Berry, n. sp. Exterior view of type specimen, a median valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [883]; same scale as Fig. 1.

Fig. 5. *Ischnochiton sanctaemonicae* Berry, n. sp. Interior view of same valve; same scale as preceding.

Fig. 6. *Ischnochiton sanctaemonicae* Berry, n. sp. Anterior elevation of same valve; camera outline.

Fig. 7. *Ischnochiton sanctaemonicae* Berry, n. sp. Exterior view of tail valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene); paratype [886]; same scale as Fig. 1.

Fig. 8. *Ischnochiton sanctaemonicae* Berry, n. sp. Interior view of same valve; same scale as preceding.

Fig. 9. *Ischnochiton sanctaemonicae* Berry, n. sp. Profile of same valve; camera outline.

Fig. 10. *Ischnochiton* cf. *sinudentatus* Carpenter. Exterior view of head valve from Deadman Island, San Pedro, California (probably Pleistocene) [704]; same scale as Fig. 1.

Fig. 11. *Ischnochiton* cf. *sinudentatus* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 12. *Ischnochiton* cf. *sinudentatus* Carpenter. Profile of same valve; camera outline.

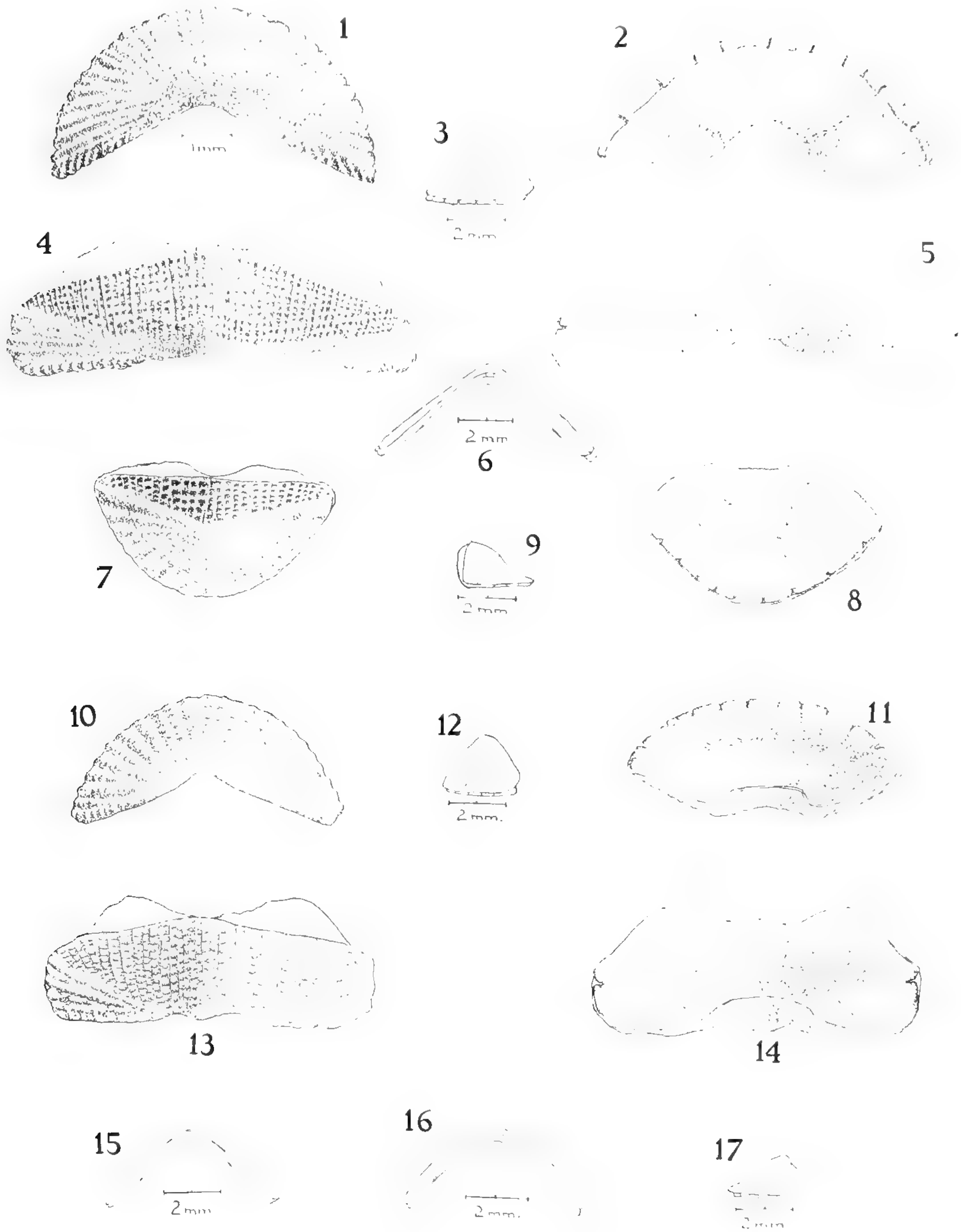
Fig. 13. *Ischnochiton* cf. *sinudentatus* Carpenter. Exterior view of median valve from Deadman Island, San Pedro, California (probably Pleistocene) [705]; same scale as Fig. 1.

Fig. 14. *Ischnochiton* cf. *sinudentatus* Carpenter. Interior view of same valve; same scale as preceding.

Fig. 15. *Ischnochiton* cf. *sinudentatus* Carpenter. Anterior elevation of same valve; camera outline.

Fig. 16. *Ischnochiton* cf. *sinudentatus* Carpenter. Anterior elevation of another valve from same lot [705]; camera outline.

Fig. 17. *Ischnochiton* cf. *sinudentatus* Carpenter. Profile of tail valve from Deadman Island, San Pedro, California (probably Pleistocene) [706]; camera outline.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## Plate XIII.

Fig. 1. *Callistochiton crassicostatus* Pilsbry. Dorsal view of head valve from "coal mine", west side of Point Loma, California (Upper San Pedro Pleistocene) [349].

Fig. 2. *Callistochiton crassicostatus* Pilsbry. Profile of same valve; same scale as preceding.

Fig. 3. *Callistochiton crassicostatus* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 4. *Callistochiton crassicostatus* Pilsbry. Dorsal view of less mature head valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [509]; same scale as preceding.

Fig. 5. *Callistochiton crassicostatus* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 6. *Callistochiton crassicostatus* Pilsbry. Exterior view of median valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [512].

Fig. 7. *Callistochiton crassicostatus* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 8. *Callistochiton crassicostatus* Pilsbry. Exterior view of tail valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [515a]; same scale as Fig. 1.

Fig. 9. *Callistochiton crassicostatus* Pilsbry. Right lateral view of same valve; same scale as preceding.

Fig. 10. *Callistochiton crassicostatus* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 11. *Callistochiton crassicostatus* Pilsbry. Exterior view of less mature tail valve from same lot [515b]; same scale as preceding.

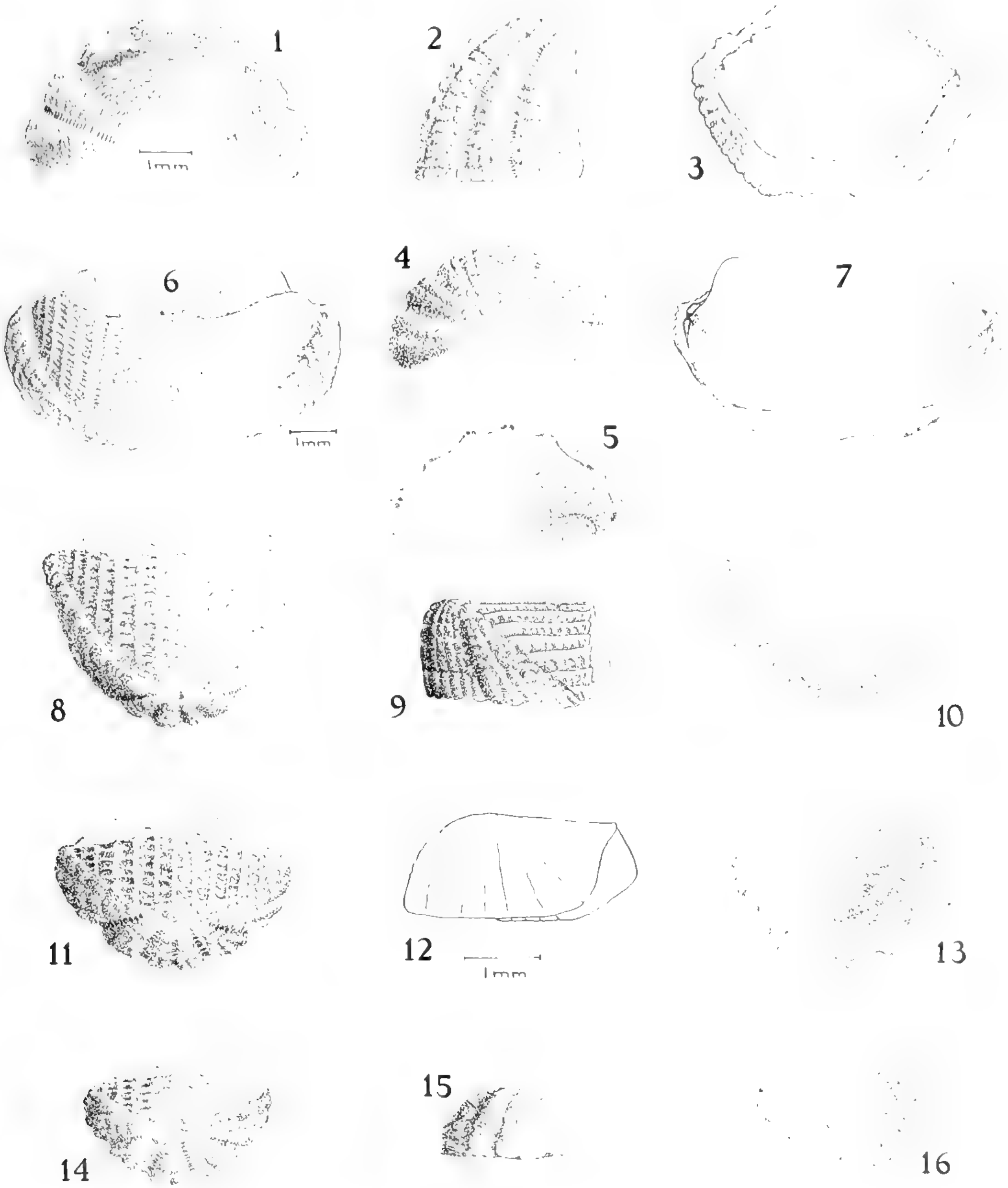
Fig. 12. *Callistochiton crassicostatus* Pilsbry. Profile of same valve; camera outline.

Fig. 13. *Callistochiton crassicostatus* Pilsbry. Interior view of same valve; same scale as Fig. 11.

Fig. 14. *Callistochiton crassicostatus* Pilsbry. Exterior view of juvenile tail valve from same lot [515c]; same scale as preceding.

Fig. 15. *Callistochiton crassicostatus* Pilsbry. Right lateral view of same valve; same scale as preceding.

Fig. 16. *Callistochiton crassicostatus* Pilsbry. Interior view of same specimen; same scale as preceding.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## Plate XIV.

Fig. 1. *Callistochiton decoratus punctocostatus* Pilsbry. Exterior view of head valve from Deadman Island, San Pedro, California (probably Pleistocene) [728].

Fig. 2. *Callistochiton decoratus punctocostatus* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 3. *Callistochiton decoratus punctocostatus* Pilsbry. Right lateral view of same valve; same scale as preceding.

Fig. 4. *Callistochiton decoratus punctocostatus* Pilsbry. Exterior view of tail valve from Deadman Island, San Pedro, California (probably Pleistocene) [715]; same scale as preceding.

Fig. 5. *Callistochiton decoratus punctocostatus* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 6. *Callistochiton decoratus punctocostatus* Pilsbry. Right lateral view of same valve; same scale as preceding.

Fig. 7. *Callistochiton decoratus ferminicus* Berry, n. subsp. Exterior view of type specimen, a median valve from the Chiton Bed, Point Fermin, California (Lower San Pedro Pleistocene) [1040]; same scale as preceding.

Fig. 8. *Callistochiton decoratus ferminicus* Berry, n. subsp. Anterior elevation of same valve; camera outline.

Fig. 9. *Callistochiton palmulatus mirabilis* Pilsbry. Dorsal view of head valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [522a]; same scale as Figs. 1-7.

Fig. 10. *Callistochiton palmulatus mirabilis* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 11. *Callistochiton palmulatus mirabilis* Pilsbry. Left lateral view of same valve; same scale as preceding.

Fig. 12. *Callistochiton palmulatus mirabilis* Pilsbry. Dorsal view of less mature head valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [522b]; same scale as preceding.

Fig. 13. *Callistochiton palmulatus mirabilis* Pilsbry. Interior view of same valve; same scale as preceding.

Fig. 14. *Callistochiton palmulatus mirabilis* Pilsbry. Left lateral view of same valve; same scale as preceding.

Fig. 15. *Callistochiton palmulatus mirabilis* Pilsbry. Exterior view of median valve from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [525]; same scale as preceding.

Fig. 16. *Callistochiton palmulatus mirabilis* Pilsbry. Interior view of same valve; same scale as preceding.

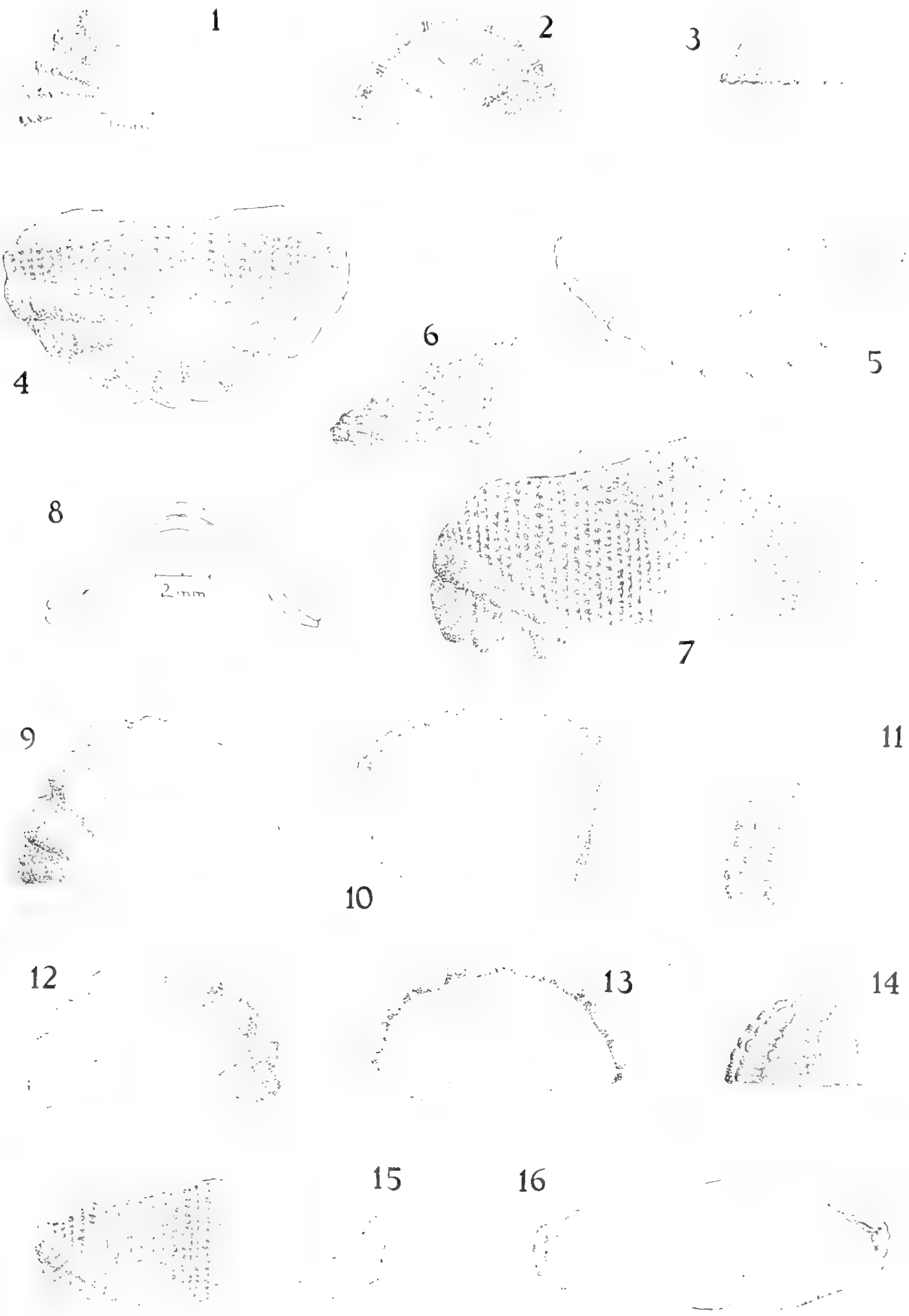
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PLATE XV.

Figs. 1-6. *Callistochiton palmulatus mirabilis* Pilsbry. Dorsal aspect of six tail valves from Long Wharf Canyon, Santa Monica, California (Upper San Pedro Pleistocene) [528], showing variation at corresponding stages of growth.

Figs. 7-12. *Callistochiton palmulatus mirabilis* Pilsbry. Right lateral view of same six valves; same scale as preceding.

Fig. 13. *Callistochiton palmulatus mirabilis* Pilsbry. Interior view of valve shown in Figs. 1 and 7; same scale as preceding.

Fig. 14. *Callistochiton palmulatus mirabilis* Pilsbry. Interior view of valve shown in Figs. 4 and 10; same scale as preceding.

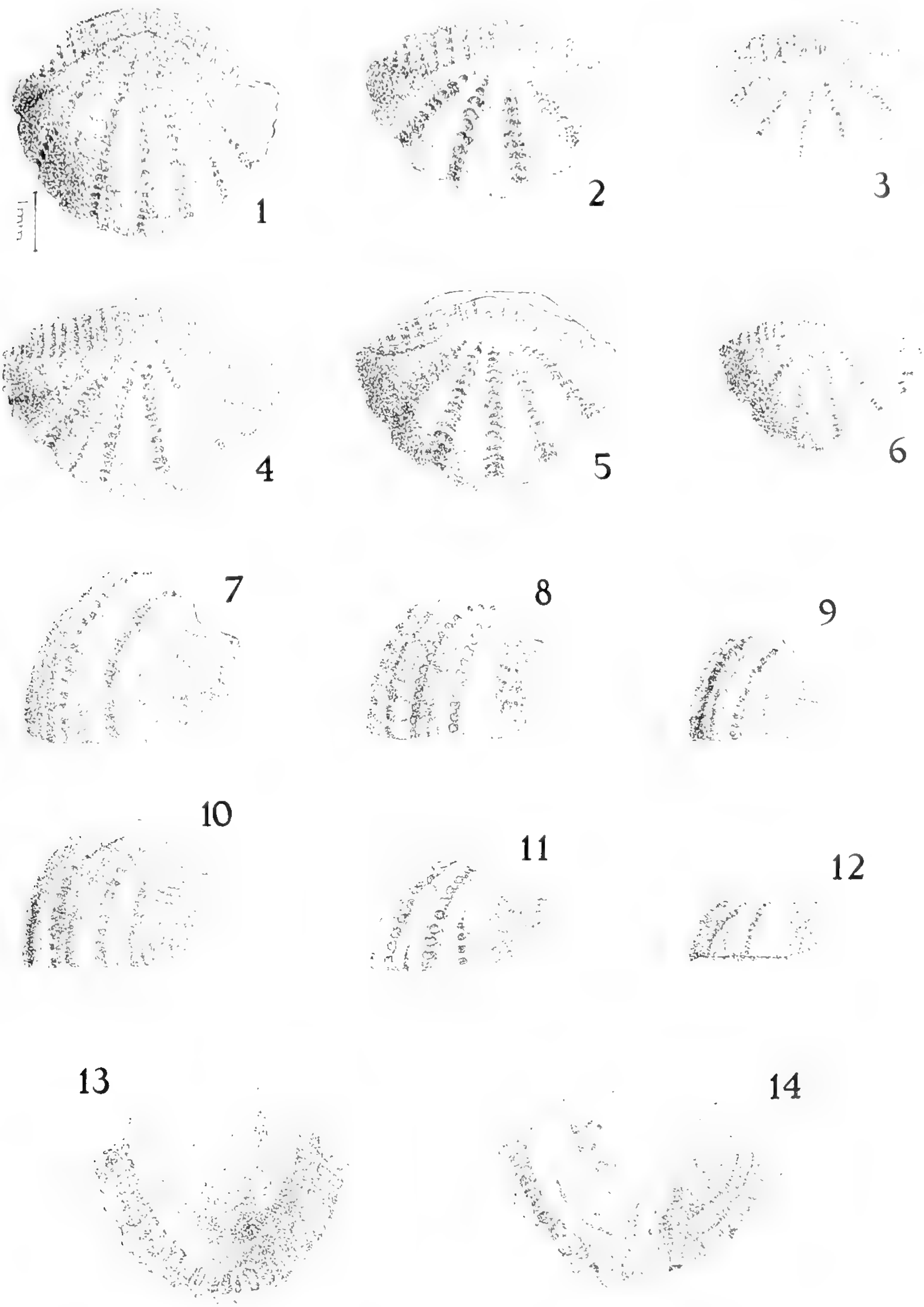
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Plate XVI.

Fig. 1. Point Fermin, Los Angeles County, California, from the northwest. The "Chiton Bed" exposure is near the upper center of the picture just below the dip to the left of the pavilion. Photographed by the author, October 3, 1920.

Fig. 2. The "Chiton Bed" exposure at Point Fermin, looking northwest. Photographed by the author, October 3, 1920.

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XIX

# TERTIARY AND QUATERNARY HISTORY OF THE PETALUMA, POINT REYES AND SANTA ROSA QUADRANGLES

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CONTENTS

## Introduction and Acknowledgments

The geology of the southern half of California and that of the Sierra Nevada has been largely elucidated because the occurrence of those great sources of California's mineral wealth, Oil and Gold. Owing to the lack of such an economic inducement, geological research and mapping in the northern half of the Coast Ranges has been largely neglected. The writer became interested through work in the southern half of the state in certain problems whose solution required detailed mapping in the northern half. Some interesting and unexpected results were obtained through an extension of the work of Professor Lawson in the San Francisco Quadrangle, and that of Dr. Weaver in the Napa Quadrangle, east of the area studied. The excellent topographic maps of the Petaluma and Santa Rosa quadrangles were available during most of the time the writer was engaged in this research. The Point Reyes Quadrangle was not available during the field work. It is hoped that the rapid publication of suitable topographic maps will lead to more work in this much neglected field.

The writer is aware of the incompleteness and many deficiencies of this work, but it was thought best to present the results obtained at this time so that they may be available for use by others.

For helpful criticism, the writer is greatly indebted to Professors Andrew C. Lawson, John C. Merriam, Ruliff S. Holway, Bruce Clark, and Chester Stock of the University of California; Professor James Perrin Smith of Stanford University; Professor Earl L. Packard of the University of Oregon; Dr. W. S. W. Kew of the U. S. Geological Survey; and to Mr. John B. Kerr, Geologist, General Petroleum Company, who assisted in the field work during the summer of 1916. The writer is also under great obligations to Mr. H. C. Bundy, who prepared the geological sections, and to Mr. L. L. Stewart who drew the manuscript copy of the geological maps. The California Academy of Sciences provided the facilities for this work and the paleontological collections upon which it is based are deposited in that institution.

The mapping of the Petaluma Quadrangle and the southern half of the Santa Rosa Quadrangle is detailed as respects the Tertiary formations, but no attempt was made to differentiate the formations within the Franciscan group. The northern quarter of the Point Reyes Quadrangle is reconnaissance mapping only, as the topographic sheet was not available in the field. A small amount of detailed mapping was done upon the Pleistocene formations in Tomales Bay. The writer is indebted to Mr. F. M. Anderson[1] for the excellent mapping of the rest of this quadrangle. Owing to different scales, some of the contact lines are not exact; nevertheless, the map shows the approximate distribution of the formations correctly.

## Outline of Results

The area under discussion is immediately north of the San Francisco Bay Region, or it may be regarded as a northern part of this terrain. It is cut on the west by Tomales Bay which was determined by that notable feature, the San Andreas Rift. Long continued faulting in this zone has caused a separation of the Point Reyes Triangle, a northern extension of Professor Lawson's[2] Montara Block from the eastern shore of Tomales Bay, the mainland. One of the conclusions of this paper is that this condition is an old one and that the Triangle and the mainland have been subjected to different sets of movements during the geologic past as well as the present. The exact nature of these motions is not entirely understood, but some progress has been made in discovering their character. The Pleistocene formations which are exposed in the headlands on the eastern side of Tomales Bay prove, both by their lithology and fauna, that this long inlet existed during their deposition and that earthquake movements were prevalent then. The absence of these sediments from the western shores of the bay and the presence of fine terraces in the shales and sandstones of the Point Reyes Peninsula, indicate that the Triangle moved independently of the mainland, as successive titan steps (marine terraces) were cut during periods of standstill. These steps do not correspond to those of the mainland nor to the slotted-

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[1] Anderson, F. M., The Geology of Point Reyes Peninsula, Univ. Calif. Publ., Bull. Dept. Geol., vol. 2, No. 5, 1903.
[2] Lawson, A. C., San Francisco Folio, No. 193, U. S. Geological Survey, p. 16, 1914.

in blocks of Pleistocene in the Tomales Bay trench of the San Andreas Rift. The mainland, the San Francisco-Marin and Berkeley Hills, blocks of Lawson, as will be shown later, has been subjected to a peculiar hinge-like movement by rotation along an axis situated somewhere in the area east of Santa Rosa and Petaluma valleys. This mainland-block's uptilted edge is exposed along the shores of Tomales Bay and the Pacific Ocean. Apparently warping or differential tilting has also affected it. The peculiar type of stream drainage within the area affected by these fault blocks, so well described by Holway,[3] is a result of this type of movement. The northern extension of the Hayward Rift Zone was recognized on the western flanks of Sonoma Mountain and proofs of recent activity were established through the recognition of fault sag ponds, fault shelves, minor drainage modifications, and similar features. The occurrence of estuarine fossils of upper Miocene age in the clays and sands of the Petaluma formation fixes the age of a freshwater fauna which is also found in these beds. A study of the Petaluma formation adds an interesting chapter to the history of this region during upper San Pablo time and indicates that the San Pablo sea did not extend to the northward in this region. A revision of the stratigraphy of the beds in Sonoma Mountain which yielded the remains of the Pliocene horse, *Neohipparion gidleyi* Merriam, indicates that this horizon is in the Sonoma group. The Sonoma group is correlated with the marine Merced group by excellent stratigraphy in this region. Neohipparion is a form which occurs in the Orinda formation of the Berkeley Hills and the Etchegoin of the San Joaquin Valley. Upon this basis and stratigraphic studies, the Merced group is broadly correlated with the Sonoma group, Pinole tuff, Orinda of the Berkeley Hills and Etchegoin formation of the Great Valley.

The investigation of the Pleistocene deposits of Tomales Bay led to the recognition of two distinct formations of this period. Small estuarine faunas were obtained from the upper beds of the Tomales formation, while the lower beds of the Millerton formation yielded several species which are now found only in the latitude of San Diego. In other words,

[3] Holway, R. S., Physiographically unfinished entrances to San Francisco Bay, Univ. Calif. Publ., Geog., vol. 1, No. 3, pp. 90-95, 1914.

the faunas in both formations are sub-tropical and indicate warm interglacial epochs. Just what time interval is represented by the unconformity which separates these two formations is very difficult to evaluate as these beds are in the immediate line of faulting along the San Andreas Rift where great changes are possible within a very limited space of geologic time, but the writer believes that this was an important break. In both beds, well preserved cones of the Monterey pine *(Pinus radiata)* were found. This species does not at present range north of San Mateo County, it being replaced in the present day flora of this region by *Pinus muricata.* Thus it is evident that both the faunas and the floras of these beds indicate warmer climates during the Pleistocene interglacial epochs than at the present time in these latitudes.

## Review of the Literature

This region was cursorily examined by Whitney[4] who noted that marine sandstones rested upon the metamorphics (Franciscan) and he referred these sandstones to the Miocene. We now know that they are Pliocene, the Merced formation. Gabb[5] described *Metula remondii* from the sandstones of this Pliocene formation at San Antonio Estero near the town of Tomales, and several other fossils from the vicinity of Mark West Creek from beds of the same age. Lawson,[6] in the Geomorphogeny of the Coast of California, gives the first detailed information about this area. He recognized that the terraces of Point Reyes Peninsula were due to wave erosion, described briefly the great fault which conditions Tomales and Bolinas bays, and perceived that the last movement, recognized in this vicinity, the subsidence which gave rise to San Francisco Bay, had also affected Point Reyes Peninsula. "Even more significant of the recency of the depression are the flooded streams which end at the sand beach of Drakes Bay. These are called Drakes Estero on the Coast Survey Chart. They are finger-like inlets which are very clearly flooded stream canyons, representing a drainage convergent towards the south.

[4] Whitney, J. D., Geology of California, vol. 1, pp. 81-85, 1865.
[5] Gabb, Wm., Geological Survey of California; Palæontology, vol. 2, pp. 3, 72, pl. I, fig. 5, 1869.
[6] Lawson, A. C., Univ. of Calif., Publ. Dept. Geol., vol. 1, No. 8, pp. 245-246, 264-265, and 268-269, 1894.

These canyons have effected the dissection of a plateau which is a marine wave-cut terrace, representing one of the later stages of the epeirogenic uplift of the coast." Concerning the possibility of a Pliocene peneplain Professor Lawson says: "It may, perhaps, be well to state here that in those portions of the coast which once served as areas of Pliocene sedimentation, as in the vicinity of the Bay of San Francisco, much of the geomorphic character was evolved in pre-Pliocene time, and had simply been revealed and modified by the stripping off of the Pliocene accumulations." The accuracy of this conclusion will be better appreciated after the evidence for this surface has been described around Petaluma and Freestone. At these places the conditions are essentially in accord with Lawson's statement. Lawson suggested that Petaluma Valley was once occupied by the Russian River. His statement is as follows: "Associated with the subsidence which flooded the Bay of San Francisco, there were probably other deformations of the crust which seem to have had an important influence on the drainage. The most notable instance of this kind is the shifting of the divides of the hydrographic basin of the Russian River. This stream once clearly flowed through Petaluma Valley to the main drainage outlet at the Golden Gate. A low divide in the middle of the old valley now causes the drainage to flow westward at right angles to its former southerly course, and seek the coast by the present transverse route. The change in the drainage may be due to stream capture or to crustal warping. The latter is most probably the cause; but the problem has not yet been studied sufficiently." The writer is not in agreement with this statement in its entirety, but warping, as Lawson points out, is one of the controlling influences in the development of the physiography of this country. Lawson also discusses this region in the San Francisco Folio. Mr. F. M. Anderson[7] mapped and described the Point Reyes Quadrangle and his excellent mapping is used in this publication with but slight alteration. These changes are the addition of the Pleistocene formations in Tomales Bay region and reconnaissance mapping of Merced strata around To-

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[7] Anderson, F. M., Geology of Point Reyes Peninsula, Univ. Calif. Publ., Bull. Dept. Geol., vol. 2, No. 5, 1903.

males. Osmont[8] constructed a reconnaissance cross-section across this general region. This paper was found very suggestive, although the writer is in disagreement with several portions of the text. The San Pablo (?) of Osmont which was described as being in the vicinity of Freestone is beyond doubt Merced, as fossils found at Freestone prove. The area east of Petaluma which he regards as Orinda (?) is the Petaluma formation of upper Miocene age described in this paper. The teeth of the Pliocene horse, *Neohipparion gidleyi* Merriam, were reported by Osmont as coming from the San Pablo (?) formation beneath the lavas of Sonoma Mountain, whereas they were found in strata which are interbedded with these lavas of the Sonoma group. The synclinal structure of Petaluma Valley as interpreted by Osmont does not appear to be the explanation of this topographic feature. The Sonoma tuff of Osmont does not prove to be as accurate a horizon marker as he thought since there are several strata of tuff in Sonoma Mountain which are separated from one another by lava flows. The writer is indebted to Osmont for his careful study of the igneous rocks of the region. Professor J. C. Merriam[9] described the teeth of *Neohipparion gidleyi* to which reference was made in a brief paper concerning the occurrence of these interesting remains. He states "that they probably came from a stratum just below the coal seam at a mine on the Lawler Ranch, six miles east of Petaluma, California. The formation has been doubtfully referred to the San Pablo Miocene, but may represent a later period." Dr. G. K. Gilbert[10] in the California Earthquake Commission's Report gives an excellent description of the fault features shown along the San Andreas Rift in the vicinity of Olema and Tomales Bay. He also discusses the modifications in the drainage caused or controlled by rifting. A trace of the fault of 1906 is given in the atlas of this report. This same publication contains collateral biologic articles by Dr. C. A. Kofoid[11] and Dr. Wm. E.

[8] Osmont, Vance, A Geological Section of the Coast Ranges North of the Bay of San Francisco, Univ. Calif. Publ., Bull. Dept. Geol., vol. 4, No. 3, pp. 39-87, 1904.

[9] Merriam, J. C., New Species of the Hipparion Group from the Pacific Coast and Great Basin Provinces of North America, Univ. Calif., Publ. Dept. Geol., vol. 9, No. 1, pp. 1-8, 1915.

[10] Gilbert, G. K., Report of the State Earthquake Investigation Commission, vol. 1, part 1, p. 66, Publ. Carnegie Institution of Washington, 1908.

[11] Kofoid, C. A., Idem, p. 89.

Ritter[12]. Professor R. S. Holway[13] of the University of California has published two papers upon the physiography of this region and its environs, "The Russian River, a Characteristic Stream of the California Coast Ranges," and "Physiographically unfinished Entrances to San Francisco Bay." What little the writer has to add to these problems is but slight modification of Professor Holway's principal thesis.

Concluding the paper upon the Russian River, Professor Holway makes the following statement: "In attempting to summarize the history of the Russian River in its various parts the limitations noted in the introduction, namely, the lack of maps showing the topography and the areal geology, necessarily limits definiteness of statement in any conclusions stated. In briefly recapitulating the conclusions already offered in the discussion of the various sections, some comment will be made concerning their probability or concerning possible alternative hypotheses.

The lower river is termed antecedent and is considered the remnant of a former consequent coast stream which has held its position despite the slow uplift. It is possible that much of it flowed over the soft recent deposits and by the removal of that series has been let down upon older rocks in which it now flows. Technically such a history may justify the use of the term "superimposed", but in no place is the present river out of harmony with the minor topography in the way that the Middle River is in various places. The antecedent condition of the Lower River fully accounts for leaving the open Santa Rosa Valley and crossing the western highland in a canyon. The Lower River is termed antecedent, as a sufficient explanation. If superposition of the river upon the Merced series ever existed, it has not resulted in any relations that are not explained by its more antecedent character. The Middle River in its peculiar cutting off of the point of a ridge in Alexander Valley, in its course through Fitch Mountain, and in incising its channel on the slope of Santa Rosa Valley, exhibits the characteristics of a superimposed river,—a conclusion justified by the existence within

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[12] Ritter, Wm. E., Idem, p. 88.

[13] Holway, R. S., Univ. Calif. Publ., Geog. Dept., vol. 1, No. 1, p. 38, 1913; Univ. Calif. Publ., Geog. Dept., vol. 1, No. 3, 1914.

the area of patches of the softer and later series through which the Middle River has cut down to its present position."

The occurrence of Merced fossils at Plantation a few miles north of the mouth of the Russian River, also at Freestone, a short distance south of the Lower River, indicates to the writer that the intervening area was once covered by Merced sandstones and shales and probably a thin veneer of marine Pleistocene terrace material as well. Subsequent erosion has removed these incoherent materials along the present course of Russian River and has left for present topography the old Miocene or early Pliocene peneplain cut in Franciscan rocks upon which the sands and gravels of the Merced sea were deposited. In brief, the Lower River as well as the Middle River is superimposed. Holway described accurately the peculiar relations of Walker and San Antonio creeks in the monograph, "The Physiographically Unfinished Entrances of San Francisco Bay" and his hypothesis that they were once one stream which drained to Tomales Bay is confirmed by these studies. The writer thinks that the tilting of the mainland block is the cause of this "broken-backed" stream and that the waters of the middle and upper portions of the Pleistocene Walker Creek were spilled out by way of one of the headwater tributaries when the tilting was sufficient to overcome the grade of the stream. This will be discussed further in the latter portion of this paper.

## Geology

The oldest rocks in this general region are limestone, quartzite, and schists of possible Paleozoic age which occur only in Point Reyes Peninsula. These rocks are remnants of the roof of a great granitic batholith of probable Mesozoic age and they occur as inclusions in the granite of the Point Reyes Peninsula. Rocks of the Franciscan group of possible Jurassic age are restricted to the east side of the San Andreas Rift and Tomales Bay. For many miles east of Tomales Bay, the Franciscan is either the surficial rock or it forms a base upon which the later rocks rest. Another interesting group from a distributional point of view is the Monterey of Middle or Lower Miocene age. This, like the granites and limestones, is restricted to the Point Reyes Triangle and no indications of its presence in any other portion of the area occur on the surface, but one of the characteristic products from the shale phase of this group—petroleum—may have been supplied to the overlying sands in the Sonoma group. Eastward in Carneros Creek, beyond the area under discussion, rocks of this age are again found. It seems probable that this formation was once continuous over the area between Sonoma Mountain and Tomales Bay, but was eroded during Upper Miocene and the interval between Miocene and Pliocene time. A formation of Upper Miocene age, here described as the Petaluma formation consists chiefly of lacustrine deposits, and indicates that the upper Miocene Sea which occupied the present site of San Pablo Bay Region did not extend in this region to the northwest. The Merced group of Pliocene age and its correlative, the Sonoma group, are well exemplified in this region and their stratigraphic and faunal relations are clearly demonstrated. Two interesting formations of marine Pleistocene were differentiated on the eastern shores of Tomales Bay. Such, in brief are the formations recognized within this field.

### Limestone of Mesozoic or Paleozoic Age

An area of coarse-grained marble occurs in connection with the granitic rocks of the Point Reyes Peninsula on the eastern slope of Inverness Ridge. This marble which was carefully studied by F. M. Anderson is very similar to the "Santa Cruz limestone" of the Santa Cruz Mountains and that of Montara Mountain. The geologic relations are the same in all three cases. The limestone mass was intruded by the granitic magma and those portions of the batholithic roof which dropped into the melting pot were preserved for our inspection. Granitic rocks largely surround the Inverness Ridge limestone area.

### Granitic Rocks of Probable Mesozoic Age

The granitic rocks of this region are restricted to the Point Reyes Triangle and are not found on the eastern side of Tomales Bay, as Anderson pointed out in his paper describing this area. Anderson's[14] description in part is as

[14] Anderson, F. M., The Geology of Point Reyes Peninsula, Univ. Calif. Publ., Bull. Dept. Geol., vol. 2, No. 5, p. 124, 1903.

follows: "In the field the granites of Point Reyes appear as moderately coarse-grained, light gray rocks showing rough and rounded surfaces where they are firm, though usually they are much decomposed. Where erosion is not rapid the rocks are decayed, often to a depth of a dozen feet or more, but on the summits where harder phases protrude, and in the deep ravines where the erosion is greatest, and along the shore the rocks are firmer and often more angular. All of them, where favorably exposed, are seen to be greatly shattered and broken, and testify to the large amount of disturbances they have undergone. The rock is mostly unfit for quarrying purposes on this account, since it is not easy to find many blocks of any considerable size. These granites are to be classified as normal biotite granites. Quartz is in only moderate proportions, and both orthoclase and plagioclase feldspars are present. As to the quantity of biotite present, there is considerable variation. Basic segregations are common, in which there is no quartz and little feldspar, while on the other hand there are phases containing but little biotite. Hornblende is not abundant."

### Franciscan Group, Jurassic (?)

Rocks of this group are restricted to the mainland in contrast with the granitic rocks of the Triangle. The San Andreas Rift Zone sharply separates these terrains, but unfortunately at no place are they in close contact. There can be no doubt that they were separated by ancient movements along the San Andreas Rift. This ancient fault line seems to lie on the western side of Tomales Bay, as the Franciscan occurs beneath the Pleistocene deposits on Hog Island and Tom's Point, both of which are located about two-thirds of the way across Tomales Bay from its eastern shore. The eastern face of Inverness Ridge must of necessity be interpreted as a much eroded fault scarp. The Franciscan group occupies the greatest area of any in this field and it underlies most of the region now covered by the Merced formation. Island-like masses such as Meachims Hill, appear through the veneer of Pliocene sediments in many places. In other words, the peneplain upon which the Merced was deposited was cut in Franciscan rocks, and many monadnocks were left standing above the general surface of this notable feature. In and around Petaluma this same relationship is seen in several places. No attempt was made to separate this group in the mapping, but nearly all its characteristic rocks occur within this area. Since this terrain is merely an extension of the Franciscan which Lawson[15] mapped in detail in the Tamalpais Quadrangle, of the San Francisco Folio, the reader is referred to this work for details. Chert, glaucophane schist, garnet schist, actinolite schist, sandstone and igneous rocks associated with this group,—serpentine and basalt—were recognized in this region. A conglomeratic limestone was also noted a few miles south of Petaluma. This limestone seemed to be a beach deposit and although it appeared as if it might be fossiliferous, no samples were found which contain unmistakable organic remains. This deposit will be described in detail under Economic Notes.

No attempt was made to work out the structure within the Franciscan, but only the nature of the contacts between this group and the Tertiary rocks of the region was studied. In general, as noted above, the Franciscan forms the basement upon which the marine sediments of the Merced group were laid down and upon which the lavas, volcanic ashes and breccias of the Sonoma group were outpoured. The Franciscan is, however, in fault contact with the Petaluma formation of upper Miocene age in the vicinity of Lakeville. This fault, whose trace is indicated upon the geologic map of the Petaluma Quadrangle, is apparently an ancient one, as the lavas of the Sonoma group rest upon the Franciscan south of Tolay Creek as well as upon the Petaluma formation immediately north of that stream at about the same elevation. Evidently, no pronounced movements have taken place along this line of weakness since the close of the Miocene. For convenience this line of weakness will be referred to as the Tolay Fault.

### Monterey Group, Middle Miocene

This group is excellently exposed in the Point Reyes Peninsula where it is the most important formation from an areal viewpoint. Anderson's mapping and description of this terrain have been borrowed from his excellent paper in order that the reader may grasp certain problems which are only

[15] Lawson, A. C., U. S. Geological Folio, No. 193.

solved by considering the distribution of the groups in the general field. Mr. Anderson's description is as follows:

Miocene Sediments.—The Miocene series consists of three members, the upper two of which are not distinctly separated. The lower member is a dark heavy, conglomerate, in which the pebbles and stones range from one-half inch to more than one foot in diameter. The second member is a thin-bedded, cream-colored sandstone that passes quite gradually into the upper member, the special features of which will be described later. It is the white Miocene shale of the Monterey series, well known in the Coast Ranges. This series is essentially similar at all the points at which a complete section is to be seen. At the summit of Whittenberg Hill a series of the Miocene sediments, some hundreds of feet in thickness, have conglomeratic beds at their base, with a thickness of eight or ten feet, containing pebbles of granitic and crystalline limestone.

Concerning the shales of Whittenberg Hill, Anderson remarks that

. . . Nothing of great importance has been discovered on the peninsula, not already known from other regions, and their petrography would be merely a repetition of what has been said before. In texture they vary from a tolerably granular, sandy phase to what might be called flinty. In Bear Valley and west of Whittenberg Hill, the compact, somewhat vitreous and banded phase is more frequent, though this appears to be an areal rather than a stratigraphical variation. Such portions of the shale are both less porous and less bituminous than the more granular portions. West of Drake's Estero the shales are sandy and the amount of bituminous matter is very much greater than in the more compact portions. This is commonly seen in the fetid character of the water rising from them.

Rocks of this group are not found in the mainland portion of this area. In the region west of Petaluma it is probable that these rocks were totally removed during the erosion interval at the close of the Miocene or early Pliocene as the marine Merced rests directly upon the Franciscan in this vicinity.

It seems entirely probable that rocks of this group once extended over this area as its characteristic shales and sandstones are well exposed in the headwaters of Carneros Creek in the Napa Quadrangle about 20 miles east of Petaluma. At this place a fair fauna representing the Arca montereyana zone has been obtained. This group may underlie a portion of Sonoma Mountain as a product which is yielded by its shales—petroleum—is found in a sandstone which is a member of the Sonoma group. A fault of moderate throw has exposed this sandstone and underlying and overlying basalt in a creek bed about 5 miles northeast of Petaluma, one-quarter mile north 20° W. of Mountain School in the Santa Rosa Quadrangle. The sandstone in places is thoroughly impregnated with oil and droplets of oil were found in the vesicular cavities of the overlying basalt. There are no other indications of the Monterey group beneath Sonoma Mountain that were found but it seems very probable that the basalts and tuffs of the Sonoma group are underlain by the shales of the Monterey group. The clays and sandstones of the Petaluma formation probably intervene in many localities. The Monterey group may underlie the Petaluma formation in the region southeast of the Mountain School. What would preserve this group from erosion here while it was entirely removed from the whole area only 4 miles west across Petaluma Valley? As has been pointed out above, the Tolay fault has not been active since late Miocene or early Pliocene but during this time the eastern or downthrown block may have been so lowered beneath the general base level of that time that it was in this manner preserved from the general destruction which the western block suffered. Whether this area around the Mountain School has any economic oil possibilities is problematic, although the writer is not prepared to condemn the area absolutely, yet the uncertainty of a source of oil is very liable to make this region a pecarious one for experimenting.

### Petaluma Formation, Upper Miocene

This formation is confined to the northeast corner of the Petaluma Quadrangle and the adjoining southeast corner of the Santa Rosa Quadrangle. Stratigraphically, it is unconformably overlain by the Sonoma group of volcanics and their associated members on its eastern boundary while its western limit in the Petaluma Quadrangle is marked by the Tolay fault which separates it from the Franciscan in this vicinity. On the northwest, the incoherent sands of the Merced formation mantle it in the vicinity of Penn Grove. Lithologically this formation is characterized by the great abundance of clays, but only in certain stream canyons does one obtain opportunity to observe them. Elsewhere they have readily weathered into a thick, heavy soil. The different lithologic facies are typically exposed along the Lakeville-Sonoma road between Lakeville School and Eureka School and vicinity. In this area, while no continuous section occurs, we find several fair exposures sufficient to enable us to distinguish this formation from the Merced group which occurs in the near vicinity. A fine-grained, light-brown sandstone occurs at Eureka School at the cross roads. The bedding in this massive sandstone makes the structure obscure, but the approximate strike is N. 60° W., and dip 25° N. A coarser brown sandstone and its associated conglomerates which are free from basaltic or andesitic pebbles or other fragments of the Sonoma group are found along the road at intervals of about a mile southwest of Eureka School. The absence of these rocks from the Petaluma formation, and their general presence in the sandstone of the Merced group, enable one to discriminate these formations in the field. The pebbles in these conglomerates consist of chert, quartz, schist and sandstone fragments and most of them have been derived from the Franciscan group. Along the road which runs northwesterly from Eureka School in the bottom of the stream just west of the road, green clay with thin strata of interbedded limestone occurs. This clay is well stratified but does not exhibit characteristic shale structure in most exposures. Limestone is frequently present in the form of small nodular masses and is very argillaceous. Resting upon this green clay is a tan sandstone containing green grains. These beds have a strike of N. 55° W., and dip of 20° S., while just a short distance on the north side of the road reverse dips were found in the same material in the small gulches entering the major stream. The green and light gray clays are well exposed in a tributary of Tolay Creek about 2 miles southeast of Eureka School. These deposits are characteristically lacustrine. That this is true, is amply proved by the presence of brackish and freshwater fossils in them in the extension of this formation to the northwest. Certain other lithologic variations are best observed here as well. A sandstone which occurs one-quarter mile east of Waugh School, Santa Rosa Quadrangle, is interbedded with clays which yield a stiff adobe soil. This sandstone contains obscure fossils—plant remains—and it is lighter in color than the prevailing sandstone of the Merced group. Small chunks of light colored clay ranging from a quarter inch to an inch in diameter are embedded in the clayey sandstone matrix. In the stream canyons east of Waugh School many excellent sections of this formation may be seen. The great abundance of petrified wood which is found in the sandstones of this formation is very noteworthy. In one place this material formed a stratum from 8 inches to a foot in thickness.

### FAUNA

Two interesting faunas occur in the Petaluma formation: the one, a brackish water and the other, a freshwater fauna. The estuarine facies was recognized on upper Lichau Creek where *Corbicula californica* (Gabb) was collected and at California Academy of Sciences Locality No. 415. About 2.1 miles N. 26° E. from Elmore School in canyon and two-fifths mile southeast of Mountain School road, clay shale and soft, fossiliferous sandstone are found interbedded. The overlying igneous rock near the contact is basalt and agglomerate.

The best preserved specimens occur at California Academy of Sciences Locality No. 415, but only two species, *Corbicula californica* (Gabb) and *Bittium rodeoensis* (Clark), were found here. These two forms, however, are also found associated in the uppermost portion of the San Pablo formation, in the Pinole syncline, on the shores of Carquinez Strait and San Pablo Bay, showing that the identity of these two horizons is highly probable. In other words, the Petaluma formation is a freshwater and brackish water phase of the marine San Pablo formation of upper Miocene age. The stratigraphic relations also reinforce this correlation as both the San Pablo and the Petaluma formations are unconformably below the Sonoma group and its equivalent, the Pinole tuff. Probably stratigraphically above this horizon containing the brackish-water fauna is another set of beds whose clays have yielded a very finely preserved collection of freshwater shells. California Academy of Sciences Locality 417, where these shells were obtained, is in Haggin Creek, about 200 feet below the bridge on clay beds which are overlain by conglomerate one mile southeast of Penn Grove, Santa Rosa Quadrangle. The strata dip 12° S. W. and have a strike of

N. 60° W. The fossils belong to the genera *Sphærium, Pisidium, Planorbis, Lymnæa* and *Physa,* and form an assembly of species very similar to that found in the Tulare formation of the Coalinga field, but the forms are all specifically distinct. They are likewise separable from similar species in the Orinda lake beds of the Berkeley Hills. It is believed wild ducks distribute the eggs of the species belonging to these genera at the present time, and as such means of distribution probably existed during the Miocene time, it would seem that such forms should prove useful in correlation with other upper Miocene lacustrine beds.

The Petaluma formation in the field northeast of Petaluma is thrown into a series of narrow anticlines and synclines which are not very persistent. Anticlines which are clearly seen in one creek canyon will not be present in the next canyon a half mile east of the first one. These shallow foldings do not extend to Tolay Valley. In the hills west of Eureka School, a well developed syncline was recognized and its corresponding anticline parallels the northwesterly flowing stream which heads at the Eureka School. As was stated above, the Tolay fault limits this formation in a westerly direction. Here the various members of the Petaluma formation are in contact with the Franciscan group and along the fault these lake beds are displaced greatly, steeply dipping beds being the rule. The plane of this fault is almost vertical, in one place measuring 75° to 80°. This fault is an old one as the rocks of the Sonoma group cross it indifferently in its southeastern extension. However, it may have been an important line of movement during late Miocene or early Pliocene.

### Merced Group, Pliocene

This group was recognized in Santa Rosa Valley early in the work of the Geological Survey of California, and Gabb, in the volume on the Paleontology of California, described several species of fossils collected from exposures on Mark West Creek. The thickness of these beds is not great nor are they greatly folded in most places in the region of Mark West Creek and Freestone. Osmont represents these beds as having a very decided dip toward the center of Santa Rosa Valley, but observations made at Wilson's Ranch show that the Easterly dip of these beds is but one or two degrees. In and around Freestone low dips were prevalent and apparently the Merced strata are but slightly undulatory, as the Franciscan base is seen in the bottom of Salmon Creek near Freestone and again as a noteworthy mass of serpentine about 3 miles east of Freestone. As the Merced sediments are traced southward on the west side of Santa Rosa and Petaluma valleys, similar conditions were found as respects their general attitude. Locally, however, dips as high as 10° to 15° were recorded around Tomales, Bodega village, and near the Cinnabar School, two miles north of Petaluma, where a westerly dip is recorded. Apparently some minor folding or faulting has occurred in a few places, but the writer questions the synclinal character of Santa Rosa Valley. The hills bordering the Santa Rosa Valley on the east, two to four miles north of Santa Rosa, are composed of tuff and interbedded sandstones with dips at certain localities as high as 40° to the east. The Hayward fault is probably expressed by the sharp separation of the main valley and the eastern bordering hills, and is approximately parallel to the state highway. No other fault characters were recognized in this vicinity, however. Santa Rosa Valley seems to be due chiefly to erosion in soft, nearly horizontal, Merced strata, but complicated by minor folding and faulting. The best known Merced locality is at Wilson's Ranch, a half mile east of Russian River, where a very characteristic, well-preserved fauna occurs. At this place the Merced is composed of hard, gray, conglomeratic sandstone which has an easterly dip of 1° to 2°, and a soft, tuffaceous, yellow sandstone with minor strata of tuff, interbedded. This yellow sandstone with minor tuff members, is the commonest lithologic character of the group throughout this field.

The following fauna was obtained at Wilson's Ranch:

Bathytoma carpenteriana fernandoana Arnold.
Crepidula adunca Sowerby
Drillia mercedensis Martin
Nassa californiana Conrad
Nassa moraniana Sowerby
Natica consors Dall
Olivella biplicata Sowerby

Thais papillus (Linnæus)
Trophon (?), sp.
Arca trilineata Conrad
Cardium, sp.
Glycimeris cf. gabbi Dall
Cryptomya californica Conrad
Macoma cf. edentula Broderip & Sowerby
Paphia staleyi Gabb
Schizothærus pajaroensis Conrad
Solen sicarius Gould
Spisula albaria (Conrad)
Spisula cf. falcata (Gould)
Spisula voyi (Gabb)
Spisula cf. voyi (Gabb)
Spisula (?) sp.

The same general characters mark this group in the region to the west around Freestone. At a locality in the bed of Salmon Creek, one-eighth of a mile from the railroad station at Freestone, in blue gray argillaceous sandstone associated with a yellow tuffaceous sandstone, a Merced fauna was obtained, at a stratigraphic horizon which cannot be over 50 feet above the base of this group, as Franciscan cherts occur only a half mile further up stream and three-quarters of a mile down stream. The Merced beds at this point have an east-west strike and dip of 5° S.

A prominent 4-foot bed of tuff containing casts of marine shells is found 150 feet stratigraphically above this last locality on the road between Freestone and Sebastopol and about one-quarter of a mile east of Freestone. The bed, which is nearly horizontal, is underlain and overlain by yellow tuffaceous sandstone. The material on the crest of the plateau is a light gray sand which is probably of Pleistocene age, though no sharp division line was found which separates these sands from the underlying Merced. The even sky-line as seen here can scarcely be interpreted any other way except that it represents a marine plain of Pleistocene age. (See plates XX and XXVI.)

On Bodega-Valley Ford Road, one-eighth of a mile south of Bodega Postoffice and church, *Crepidula grandis* and *Saxidomus nuttalli* were collected from hard, coarse, gray sandstone with dip of 15° W. and strike of N. 20° E. The sandstone forms the limb of a small syncline which is apparently truncated by a Pleistocene marine plain. Here, as around Freestone, several of the canyon bottoms expose Franciscan rocks. Most of the hills between Bodega and Valley Ford are capped or composed of Merced sandstones. At Valley Ford the rocks of this group are horizontal and the lowermost member consists of a coarse-grained, conglomeratic sandstone or finely-grained conglomerate whose pebbles are nearly all red chert. This resistant sandstone has given rise to the picturesque little buttes seen about the village of Valley Ford. Similar conditions occur around Tomales where the hills are capped by Merced sandstone laid down upon an old erosion surface cut in Franciscan rocks. About two miles west of Tomales, on the Tomales-Dillon's Beach Road, the Merced outcrops boldly as a massive coarse-grained conglomeratic sandstone which has a local dip to the east of 15° with strike of N. 35° W. The sandstone is truncated near this point by a marine plain at an elevation of about 400 feet. (See plates XXI and XXII.) In the sea cliff at Dillon's Beach, Franciscan sandstone with lignite is well exposed so that it is evident the Merced in this vicinity rests upon a Franciscan base at no very great depth. Large casts and one or two good specimens of *Pecten turneri* Arnold, were collected from the roadside about one and one-half miles west of Tomales. The Merced formation was not recognized on the south side of Walker Creek along the coast. Eastward from Tomales toward Petaluma, the road leads through the village of Two Rock where the Franciscan outcrops boldly. In most of the wells dug in the low, flat plain, marine shells were encountered at a small depth. Near the church in this town, on a slight elevation of about 30 feet above the plain around Two Rock, a yellow sandstone entirely surrounded by Franciscan cherts yielded casts of *Leda*, sp., and a few other indeterminate marine shells. Thus we have evidence that the Merced was here laid down upon a decidedly irregular surface. For two or three miles only, Franciscan rocks outcrop along the road. As Petaluma is approached the hills are capped by yellow and tan-colored tuffaceous sandstones. In and around Petaluma good proof of the intimate relations of the marine Merced to the lavas and tuff of the Sonoma volcanic series is seen.

On top of Spring Hill, three miles west and 10 south of Petaluma, the Merced sandstone is found resting upon a basalt flow which is about 50 to 100 feet thick. This basalt flow in turn rests upon the Franciscan, but Merced strata occur at an elevation of 100 feet above sea level, one mile northeast of this hill in what is clearly a sag in the old Franciscan surface. The lower edge of the basalt flow on Spring Hill has an average altitude of about 300 to 400 feet above sea level. In other words, an inequality in the erosion surface of about 300 to 400 feet, is here recognized as a small outcrop of Franciscan occurs at an elevation of about 50 feet in the town of Petaluma, one block west of the corner of Stanley and High streets. At other places in the vicinity, like peculiarities are seen in the distribution of Merced and basalt. One of considerable local interest is found on the corner of Stanley and Howard streets. (See Plate XXVIII.) Loosely consolidated tan sandstones containing what are to all appearances mud balls of volcanic tuff, which are from six inches to a foot in diameter, rest upon an erosional surface of basalt. These beds have a low dip of about one degree to the east. Workers in making the excavations at this place reported marine shells, but the writer was unable to verify this conclusion. These tuffaceous sandstones, however, are areally connected with tan sandstones and gravels of Reservoir Hill, elevation 270 feet, where casts of several pelecypods of Merced age were obtained. The basalt occurring at Stanley Street is relatively thin at this point, as Franciscan schists and cherts occur on Stanley Street one block west of High Street, at a point only 15 or 20 feet lower than the corner of Howard and Stanley streets. One-half mile west of this locality, however, occurs a hill 100 feet high, consisting almost wholly of basalt. This same basaltic area extends southward and rises to an elevation of 200 or 300 feet. From this distributional study it is evident that the basalt was laid down upon an irregular surface cut in the Franciscan. The local unconformity between the Merced and basalt at the corner of Stanley and Howard streets indicates that a part of the flows actually entered the Merced Sea of that time, were partly eroded, and Merced sands were in turn deposited upon them.

This general relation is further demonstrated by the occurrence of Merced fossils beneath the basalts of Burdell Mountain. This hill rises to an elevation of 1560 feet and as the map shows, its main mass consists of basaltic flows and tuff beds of the Sonoma group. On the northwest end of Burdell Mountain basalt, about a mile and a half south of Olompali at an elevation of 300 feet, blocks of conglomerate containing Merced fossils, *Tivela crassatelloides* (Conrad), were found. These blocks, while not in place, were evidently derived from a sandstone member which is exposed in a narrow creek canyon in the vicinity. The Merced at this place rests upon Franciscan rocks. Owing to slides, exposures in most places are meagre, but only 50 to 100 feet occur here, as Dr. M. E. Blanchard, who accompanied the writer to this locality, explored the higher elevation immediately above the sandstones and shales of the Merced, and found nothing but tuffs and lavas. From the evidence we conclude that the lavas and ash deposits of the Sonoma group were laid down close to the shore line of the Merced sea.

The Merced formation occurs in and around Penn Grove and at one locality about one-half mile north of the village, on the state highway, some casts of Merced fossils were collected. The Merced outcrops in the village of Penn Grove consist essentially of tuff and tuff-breccia, thus showing the intimate relationships between the tuffs of the Sonoma group and the marine Merced. Tan-colored sands and gravels entirely surround Meachim Hill, whose top, however, is composed of one of the Franciscan volcanics which is apparently an olivine basalt. A mile and one-half southeast of Penn Grove, Merced strata are in contact with the Petaluma formation of Upper Miocene age. The contact unfortunately is obscure but the inclination of the beds in the Petaluma formation as exposed in Haggin Creek indicates that an angular unconformity probably exists here. The general attitude of the Merced beds is nearly horizontal, while those of the Petaluma formation exhibit dips as high as 12° to the southwest in Haggin Creek.

A series of tan-colored and tuffaceous sandstones is found east and south of Lakeville. No fossils were obtained from the beds, but they are assigned to the Merced upon lithologic grounds. The basaltic conglomerates near Grand View may be of the same age, but they have been somewhat arbitrarily assigned to the Sonoma group because basaltic flows of considerable extent are associated with them.

This general distributional study of the Merced indicates that the Merced was laid down upon a decidedly irregular basement cut in Franciscan rocks, whose relief, judging from the present elevation of Meachim Hill and the Franciscan area at Cherry Station, Santa Rosa Quadrangle, must have been 400 to 500 feet. The surface does not appear to have been wave-cut, but is apparently the result of sub-aerial erosion. In other words, we are dealing with a peneplain which was developed during Ep-Miocene time or Lower Pliocene time, or both. The faunas of the Merced and its lithology indicate that the shore-line of the Merced sea was near the present northeast side of Petaluma Valley.

### FAUNA

As was stated above in connection with the general description, the best collecting locality in the Merced group in the region under discussion is at Wilson's Ranch, about one-half mile east of Russian River. The fauna as listed below is typically Merced, and beyond this the writer did not discover any essentially new features. A study of this list readily demonstrates that the locality from near the base of the Merced in this region near Freestone is typically Merced.

### DESCRIPTIONS OF LOCALITIES FROM MERCED (PLIOCENE) GROUP

Locality 411. Interbedded fossiliferous s.s. with tuff on ridge 3 miles SE of Freestone. Elevation 600′. Same white sandstone overlying tuff. Dip 10° N Strike E & W. Fossiliferous s.s. in Hall's ranch or Burn's ranch. Schoolhouse in Burnside Dist. Sec. 17, T. 6, R. 9. Coll., J. B. Kerr, July 19, 1916.

Locality 413. One-half mile north of Freestone and 200′ east of trestle in stream. Shaly s.s. and soft s.s. Dip 5° S. Strike E. and W.
Coll., J. B. Kerr, July 22, 1916.

Locality 414. On Bodega—Valley Ford Road one-eighth mile south of Bodega Post-office and Church. Dip 15° W. Strike N. 20° E.
Coll., R. E. Dickerson, July 21, 1916.

Locality 426. One and one-half miles west of Tomales on county road. Merced formation.
Colls., J. B. Kerr and R. E. Dickerson, July 22, 1916.

Locality 545A. One-quarter mile SE. of 546.

Locality 546. Merced fossils from Wilson Ranch, Sonoma Co. Pliocene. Coll., R. E. Dickerson.

Locality 572. Petaluma Quadrangle, 122° 37′ West Longitude, 38° 10′ 5″ North latitude, beneath the basalt of Burdell Mountain.
Coll., R. E. Dickerson, June 21, 1918.

LIST OF SPECIES FROM THE MERCED (PLIOCENE) GROUP

| PELECYPODA | 411 | 413 | 414 | 426 | 545A | 546 | 572 |
|---|---|---|---|---|---|---|---|
| Arca trilineata Conrad | .. | .. | .. | .. | + | + | .. |
| Cardium cf. meekianum Gabb | .. | + | .. | .. | .. | .. | .. |
| Cardium, sp. | .. | .. | .. | .. | .. | + | .. |
| Glycimeris cf. gabbi Dall | .. | .. | .. | .. | + | .. | .. |
| Cryptomya californica Conrad | .. | + | .. | .. | .. | .. | .. |
| Cryptomya ovalis Conrad | .. | .. | .. | .. | .. | + | .. |
| Macoma edentula (?) Broderip & Sowerby | .. | .. | .. | .. | + | + | .. |
| Macoma nasuta Conrad | .. | + | .. | .. | .. | .. | .. |
| Mya, sp. | .. | + | .. | .. | .. | .. | .. |
| Panope generosum (Conrad) | .. | + | .. | .. | .. | .. | .. |
| Paphia staleyi Gabb | .. | + | .. | .. | + | + | .. |
| Pecten turneri Arnold | .. | .. | .. | + | .. | .. | .. |
| Pecten cf. turneri Arnold | .. | + | .. | .. | .. | .. | .. |
| Saxidomus (?), sp. | + | .. | .. | .. | .. | .. | .. |
| Schizothærus cf. pajaroensis Conrad | .. | + | .. | .. | .. | .. | .. |
| Solen sicarius Conrad | .. | + | .. | .. | .. | + | .. |
| Spisula albaria (Conrad) | .. | + | .. | .. | .. | + | + |
| Spisula cf. falcata (Gould) | .. | .. | .. | .. | + | .. | .. |
| Spisula voyi (Gabb) | .. | + | .. | .. | .. | + | .. |
| Spisula cf. voyi (Gabb) | .. | .. | .. | .. | + | .. | .. |
| Spisula (?), sp. | .. | .. | .. | .. | .. | + | .. |
| Tivela crassatelloides (Conrad) | .. | .. | .. | .. | .. | .. | + |
| GASTROPODA | | | | | | | |
| Astralium sp. | .. | + | .. | .. | .. | .. | .. |
| Bathytoma carpenteriana fernandoana Arnold | .. | .. | .. | .. | .. | + | .. |
| Calyptræa inornata Gabb | .. | + | .. | .. | .. | .. | .. |
| Chrysodomus imperialis Dall | .. | + | .. | .. | .. | .. | .. |
| Chrysodomus portolænsis Arnold | .. | + | .. | .. | .. | .. | .. |
| Crepidula adunca Sowerby | .. | .. | .. | .. | .. | + | .. |
| Crepidula grandis Gabb | + | .. | .. | .. | .. | .. | .. |
| Crepidula princeps Conrad | .. | + | + | .. | .. | .. | .. |
| Drillia mercedensis Martin | .. | .. | .. | .. | + | + | .. |
| Nassa californiana Conrad | .. | .. | .. | .. | + | + | .. |
| Nassa moraniana Martin | .. | .. | .. | .. | + | + | .. |
| Natica consors Dall | .. | .. | .. | .. | .. | + | .. |
| Natica cf. consors Dall | .. | + | .. | .. | .. | .. | .. |
| Olivella biplicata Sowerby | .. | .. | .. | .. | .. | + | .. |
| Thais papillus (Linnæus) | .. | .. | .. | .. | + | + | .. |
| Trophon (?), sp. | .. | .. | .. | .. | .. | + | .. |
| CRUSTACEA | | | | | | | |
| Balanus, sp. | .. | + | .. | .. | .. | .. | .. |

### Sonoma Group

Basalts, andesites, rhyolites, tuff breccia, fine-grained tuff, and other agglomerates, comprise the Sonoma group of volcanic rocks which are typically exposed on the western flanks of Sonoma Mountain in the area. Osmont first used the name, Sonoma, in connection with the tuff phase of this great group, and he thought there was only one horizon of tuff beds. His Mark West Andesite and St. Helena Rhyolite were shown to be merely members of this great volcanic mass by Dr. C. E. Weaver,[16] while working upon the Napa Quadrangle.

Dr. Weaver found that andesites or rather basalts, like the "Mark West Andesite" occur at various horizons. He also found that rhyolites and tuffs were variously distributed. Detail studies of the western slope of Sonoma Mountain show the correctness of Dr. Weaver's views.

The Sonoma group covers a large area of country east of the region under discussion, extending over most of the Napa Quadrangle and southward across Carquinez Straits where it is known in the Pinole syncline as the Pinole tuff. The areal mapping in the Petaluma and Santa Rosa quadrangles shows that the lavas of this group probably did not extend much further west than Spring Hill, two miles west of Petaluma, and that these lavas in part were actually interfingered with Merced. The tuffaceous facies of the Sonoma group are represented as interbedded tuff members of the marine Merced, as was described in detail above. In the road cuts a half-mile east of Freestone, a prominent tuff member occurs, and, since numerous casts of marine fossils of Merced age occur here, its origin as a sediment in the waters of the Merced sea is clearly demonstrated.

Osmont[17] made a careful microscopic study of the rocks composing the Sonoma group. His descriptions are in part as follows:

> A specimen of this rock from beneath the Sonoma tuff near the contact on the west limb of the anticline near Mark West Springs showed itself to be microscopically a dark, heavy rock, varying from dark greenish black to brown in color, according to degree of weathering, and

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[16] Weaver, C. E., Unpublished manuscript of Napa Folio, U. S. Geological Survey.

[17] Osmont, Vance, A Geological section of the Coast Ranges north of the Bay of San Francisco, Univ. Calif. Publ., Bull. Dept. Geol., Vol. 4, No. 3, p. 60-61, p. 64, p. 69-70.

sufficiently coarse-grained to enable the lath-shaped feldspars of the ground mass to be readily seen with the naked eye. Scattering phenocrysts of feldspar and of olivine occur up to 4 mm. in length.

Microscopically, this rock is coarse in texture, consisting of a few large phenocrysts of labradorite and olivine scattered through a rather coarsely crystalline ground mass, made up chiefly of labradorite feldspar in well-shaped laths almost universally twined on the albite law, and rounded grains of augite, the structure being the common one called by Rosenbusch "Intersertal". The feldspar phenocrysts, measured by the common method of symmetrical extinctions on the albite twining plane (101), gave a maximum extinction angle of 37.5°. According to Michel Levy, this angle corresponds to a labradorite of about the composition $Ab_3An_4$. One crystal, rhombic in section, with good cleavages parallel to (001) and (100), and showing no twining lamellae, was evidently cut parallel to the albite twining-plane (010). It gave an extinction angle measured against the trace of (001), of 22°. The extinction fell in the acute angle of the rhomb, making the sign negative. This corresponds to labradorite of a composition between $Ab_3An_4$ and $Ab_8An_5$.

Small crystals and grains of magnetite occur, in some cases formed around the ends of the feldspar laths, never included in them. Hematite in flakes and irregular patches, and as a mere stain discoloring the feldspar, is very abundant. It seems to have come from some exterior source as an infiltration. Flow structure is very noticeable, the feldspar laths of the ground mass being drawn out in more or less parallel lines, and wrapped around the ends of the phenocrysts. A little glass is present.

A specimen from beneath the Sonoma tuff on the east limb of the anticline near the contact at Mark West Springs is very similar in appearance to the rock above described from the west contact. It is a dark greenish-black, heavy rock, rather too coarsely crystalline for a basalt, with scattering phenocrysts of feldspar.

Microscopically, also, it is similar. It is somewhat fresher, and contains much less hematite. By Michel Levy's statistical method, the feldspars gave a maximum angle of 43.5°. This indicates a basic labradorite of a composition somewhat more basic than $Ab_3An_4$, or nearly $Ab_1An_2$. Augite occurs sparingly as phenocrysts up to .38 mm. in length. These crystals are rounded and corroded as though acted upon by the magma prior to consolidation. The abundant augite in the ground mass occurs in rounded grains lying between the laths of feldspar in the "Intersertal" structure of Rosenbusch. The feldspar laths are short and stout, and invariably twined on the albite law. The augite is of the usual lavender-gray color. It appears to be altering to chlorite of a dark green shade, which stains the rock freely. No olivine was observed in this slide. A slight flow structure was observed. No glass was recognized. A careful determination of the silica contents of this rock gave 65.13%.

This tuff (Sonoma) is a fragmental rock made up wholly of the volcanic material, and characterized by containing numerous fragments of pumice, in size from very small grains up to an inch or more in length. Two silica determinations made on the pumice, from two localities in Santa Rosa Valley, gave respectively 61% and 63% $SiO_2$. Hence it is andesitic in character.

The rock is usually very light in color and in weight, and, where well exposed, forms a conspicuous feature of the landscape. Certain fine grained varieties of it are easily worked into blocks, which make very good building stone where great strength is not required.

A specimen (St. Helena Rhyolite) from the top of Mount Saint Helena showed the following characteristics:

Microscopically, it is a very light colored, almost white, rock, occasionally slightly reddish from iron stains, notably lacking in ferromagnesian minerals. It has a rough, trachytic-like surface. Numerous large, glassy feldspar phenocrysts can be seen, but no quartz. The ground mass appears to be noncrystalline. Microscopically, this rock is seen to consist of numerous rather poorly formed phenocrysts of potash and soda-lime feldspars enclosed in a fine grained ground mass, composed mostly of glass. No ferromagnesian mineral is present, the only iron-bearing mineral being occasional cubes of magnetite and flakes of hematite, the feldspars frequently being stained with the latter. The most abundant phenocryst is sanidine. Its frequent straight extinction and absence of repeated twining served to distinguish it from the plagioclase present. It is very abundant, and sometimes occurs in well terminated crystals, but usually in broken fragments, frequently badly kaolinized. A relatively small amount of plagioclase occurs, of which the highest extinction angle observed on (010) was 10.5°. This would indicate either albite or oligoclase. The ground mass is very fine grained, and under the high power is seen to be composed of minute fragments of feldspar, apparently sanidine, intimately mixed with unindividualized glass.

Determined solely by its optical properties, this rock would be called a trachyte, since no quartz phenocrysts were observed. A silica determination, however, showed it to contain 72.13% $SiO_2$. Hence is classed as a *Rhyolite*. A similar rock from above the Sonoma Tuff on the west side of Wooden Valley, Napa County, yielded 72.36% $SiO_2$.

Detailed studies on the west side of Sonoma Mountain show that the history represented by the different horizons of the Sonoma group is highly complex. Along the Mountain School road in the Santa Rosa Quadrangle, four different beds of tuff separated by basaltic flows were recognized. That erosion intervals occurred between the basalt flows and ash deposits was evidenced by irregular contacts and streaks of basaltic gravels and sandstones between the major tuff strata and the basaltic flows. The Neohipparion gidleyi beds at Lawlor's Ranch indicate that some of these intervals were of considerable duration. These beds are fairly well exposed on Lawlor's Ranch just below the ranch house, between the 600 and 700 foot contours, one mile S. 30° E. from the Mountain School, about 6 miles N. E. of Petaluma at an old coal prospect. About 60 feet of sandstone, lignite, and carbonaceous shale, and freshwater chert is found in a small canyon. Considerable sliding has taken place and it is difficult to tell where the freshwater chert fits in the section. Beneath a lava flow, a stratum of sandstone occurs, then apparently a three- or four-foot seam of coal resting upon carbonaceous shale, and possibly the freshwater chert next; and finally a coarse sandstone is found resting upon compact tuff. The thickness of these members was not observable. The coal as reported by Mrs. Thompson, a daughter of Mr. Lawlor, was of good quality when mined and she also stated when interviewed in Petaluma, that the horse remains, *Neohipparion gidleyi* Merriam,[18] were taken out of the beds associated with the coal. The coal and freshwater chert indicate that a considerable time would be required for their formation.

These beds outcrop in a few other places southeast of Lawlor's Ranch and, since they are less resistant than the underlying tuff of the Sonoma group, are worn away easier than the tuff, leaving a plateau underlain by tuff with the Neohipparion beds in the scarp-like hillside. A generalized N-S section running north from Adobe fort to the Petaluma Reservoir, shows the following sequence:

Basalt
Tuff
Basalt
Conglomerate
Basalt
Neohipparion beds
Tuff
Unconformity, base of Sonoma Group
Petaluma formation

From the end of this road to the top of Sonoma Mountain, basalt predominates. These lavas on the Hayward Rift have not been much disturbed and the vertical displacements may be measured probably only in tens of feet. The top of Sonoma Mountain is to all appearances a plateau due to a nearly horizontal sheet of the basaltic lava. The distribution of the lavas and tuffs is not uniform, since at some places lavas rest directly upon the Petaluma formation while at other localities tuff intervenes. Such is the case at the locality where bituminous sands occur in upper Lynch Creek, about half a mile northwest of Mountain School, Santa Rosa Quadrangle. At this place a fault whose exact position was not determined has disturbed the Neohipparion gidleyi beds and given them a pronounced dip of 25° W. These bituminous sands and carbonaceous shales rest upon basalt and

[18] Merriam, J. C., New species of the Hipparion Group from the Pacific Coast and Great Basin Provinces of North America; Univ. Calif. Publ., Bull. Dep't. Geol., Vol. 9, No. 1, pp. 1-8, 1915.

in turn are overlain by basalt. Plate XXXVIII shows the approximate sequence in Lynch Creek. The cavities in the overlying basalt are in some places filled with a thick petroleum residue and some of the dark brown, medium-grained sandstones are impregnated with petroleum. These sands yield a very good petroleum test when shaken out with chloroform. The Petaluma formation is not a probable source of the oil but it apparently has come up from below, along a fault. The Monterey shale is probably its original source and this group apparently underlies the Petaluma formation in the region. Another indication of petroleum, a seep, is reported about one mile southwest of Ducker's ranch house. Two wells of 100 feet and 400 feet in depth were drilled on the Ducker ranch. A heavy gas pressure was reported.

### SONOMA PETRIFIED FOREST

It is always a difficult question to decide the relative importance of unconformities and the time intervals between successive outbursts of lava, volcanic ash, or tuff-breccia. A very rough measure of time is found at the Sonoma Petrified Forest, which is located about eleven miles northwest of Santa Rosa and five miles west of Calistoga, a town at the head of Napa Valley. Most of the trees in this "forest" were covered, or nearly covered, by tuff and tuff-breccia, belonging to the Sonoma group of volcanics, when discovered by Mr. Chas. Evans in 1871. Mr. Evans excavated the trees and exposed several large redwoods and firs to view. This excellent work has been continued by the present owners, Mr. and Mrs. D. G. Bockee, and there are now about eight fine trees which have been laid bare for inspection. (See Figures 1 and 2, Plate XXXI.) The "Queen of the Forest" is a large redwood about twelve feet in diameter at its base. About eighty feet of this tree is preserved in stone. As the picture indicates, it is broken somewhat, but its fragments were so arranged when it was excavated that the position of the tree as it was toppled over and buried by a great flow of volcanic mud and ash, has been maintained to this day. A smaller but more nearly perfect specimen is shown in Figure 2, Plate XXXI. This tree was almost completely buried in tuff-breccia when discovered. Its natural taper is readily apparent and like the "Queen of the Forest" its top is toward the southwest and base toward the northeast. The "Monarch" is a large fir whose exposed, preserved length is ninety feet and whose diameter at the base is about ten feet. It also has the orientation of the trees described above. In all of these trees the gradual replacement of the woody material by silica carried by waters which percolated through the covering of tuff-breccia has been so complete that the fibers and peculiar texture of the various species have been retained. The direction of all of the trees in the "forest" was measured and in all cases was found to lie between N. 30° E. and N. 45° E., with tops toward the southwest. It is evident from these facts that the volcanic mud and pumice came in a great volume from the northeast. A study of the vicinity shows that a lava lies beneath the tuff-breccia and light gray pumice. A section in a small creek, a hundred yards south of the petrified trees proves that the forest grew upon a soil formed from this lava. The lava was probably a basalt, but the rock is so badly weathered that it is impossible to classify it with certainty. How long it takes to form from such a lava a soil sufficient to maintain a great forest is an unknown factor, but it must be estimated at least in terms of hundreds of years. The "Queen of the Forest" was probably at least a thousand years old when the great catastrophe occurred which wiped out this Pliocene forest. From such data, we may assume that the time interval between the lava flow and the deposition of tuff and tuff-breccia must be estimated in terms of a few thousand years as a minimum. The time interval represented by the Neohipparion gidleyi beds of Sonoma Mountain is probably of about the same order as the above described case. We must be generous in the use of time when we are concerned with geologic estimates and such an interval as indicated above is probably not sufficiently long to justify minute sub-division of the geologic scale. In broad correlations it is not possible to consider many of these cases.

### CORRELATION

As was shown above, the marine Merced is distinctly interfingered with the basalts and tuffs of the Sonoma group. Around Freestone, tuffs containing Merced fossils were found interbedded with sandstones and sandy shales of Merced age. At Spring Hill, west of Petaluma, Merced strata rest upon a basalt flow, but at the northwest end of the Burdell Mountain mass (Petaluma Quadrangle), conglomerate containing Merced fossils occurs, resting upon Franciscan with several hundred feet of basalt and tuff-breccia above the Merced strata. In the vicinity of Penn Grove the intimate relations between Merced sandstones containing marine fossils and tuff-breccia is quite clear. In this vicinity the nearly horizontally bedded Merced rests unconformably upon the Petaluma lake beds of Upper Miocene age, and a like relation exists between the basalts and tuffs and the Petaluma formation on the west side of Sonoma Mountain. The stratigraphic relations are entirely clear and in this way the Merced group is thus shown to be the correlative of the Sonoma group. As was shown above, the Neohipparion gidleyi beds belong with the Sonoma group and are not associated with the Petaluma.

Neohipparion and Hipparion, which are typical horses of the Pliocene, occur also in beds of the Orinda formation of the Berkeley Hills and in the Etchegoin and Jacalitos of the western border of the San Joaquin Valley. Merriam[19] describes the Orinda and Siesta formations and their faunas as follows:

The Orindan and Siestan formations occurring in the hills immediately to the east of Berkeley form the larger part of a thick accumulation of freshwater and alluvial beds resting unconformably upon the marine Miocene. The Orindan formation is the lower portion of these beds, and comprises a great thickness of clays, shales, sands, conglomerates, and tuffs, with occasional beds of limestone. The Orindan is followed by a series of igneous rocks consisting mainly of andesite and basalt. The Siestan rests upon the lavas covering the Orindan, and is in turn covered by a volcanic series made up largely of basalt.

The section, from the base of the Orindan to the top of the lavas above the Siestan, contains no marine fossils. It shows scattered through it a few remains of freshwater Mollusca and Crustacea, land Mollusca, land plants, and land or freshwater vertebrates. The accumulation as a whole is evidently the result of deposition in a basin which was at some time occupied, at least in part, by freshwater, and at other times may have received purely alluvial deposits.

Remains of early horses have been found at two localities in the Orindan beds. No specimens representing this group are certainly known from the Siestan. It is stated that bones of a horse were found in a shaft sunk in Siestan beds on Frowning Ridge near the upper end of Telegraph Canyon.

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[19] Merriam, J. C., Vertebrate Fauna of the Orindan and Siestan beds in Middle California, Univ. Calif. Publ., Bull. Dept. Geol., Vol. 7, pp. 373-374; pp. 376-377, and pp. 384-385.

New Species of the Hipparion Group from the Pacific Coast and Great Basin, Univ. Calif. Publ., Bull. Dept. Geol., Vol. 9, p. 3, 1915.

Tertiary Vertebrate Faunas of the North Coalinga Region, Trans. Am. Philos. Soc., Vol. 22, part 3, Philadelphia, 1915.

A single tooth was obtained by Mr. J. P. Buwalda from Mr. Williams, who discovered it in extensive Orindan exposures about two and one-half miles from the mouth of Tassajara Canyon, on the southwest side of Mount Diablo. The specimen from Tassajara Canyon and the better preserved tooth from Bolinger Canyon seem to represent different species. The second specimen from near Bolinger Canyon is imperfectly preserved, but is possibly different from the other two teeth.

Nomland[20] describes the occurrence of vertebrates in the (Jacalitos) lower Etchegoin as follows:

As has already been mentioned, a large quantity of fossil leaves and petrified wood is found in the highly colored, perhaps land-laid beds mapped as basal Jacalitos. This collection may, when carefully studied, assist in determining the age of this formation. In these beds fossil remains of the three-toed horse, *Neohipparion molle* Merriam, were found.
The finding of *Pliohippus*? in the gravels two hundred feet above the basal Jacalitos, or in the bed mapped by Arnold and Anderson as their lowest Jacalitos member, has already been mentioned in this paper.
Above this no invertebrate or vertebrate fossils have thus far been found until reaching the Glycymeris coalingensis zone, or lowest Etchegoin. The Pliohippus stage of the development of the horse is represented here in the basal beds and a few hundred feet upwards. This zone has therefore been called the Pliohippus coalingensis zone by Professor Merriam.

Merriam in the "Tertiary Vertebrate Faunas of the North Coalinga Region," describes the relations of Neohipparion as follows:

The species represented by specimen 21370 is evidently distinct from the Ricardo forms, and from all other described Hipparion species of the Pacific Coast and Basin provinces. Whether it is a more or a less advanced species than the Mohave form is not entirely clear. The slightly greater length of crown, and the large, much-flattened protocone may indicate a more advanced stage in the Coalinga species. The Neohipparion species represented by no. 21370 is described as *Neohipparion molle*. This species is characterized by length and narrowness of upper molar crown, simplicity of enamel borders of the narrow fossettes, and unusually large anteroposterior diameter of the laterally compressed protocone. . .
The Jacalitos fauna as now known is characterized by the presence of Neohipparion occurring only in the lowest beds, and by Pliohippus or Protohippus apparently occurring a little higher than the Neohipparion specimens in the basal portion of the section.

Although *Neohipparion gidleyi* from the Sonoma group, *Neohipparion molle* from the basal beds of the (Jacalitos) Etchegoin formation north of Coalinga, and *Hipparion platystyle* from Orinda beds two and a half miles southwest of Tassajara Post Office, are specifically different, yet all three

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[20] Nomland, J. O., Relation of the Invertebrate to the Vertebrate Faunal Zones of the Jacalitos and Etchegoin Formations in the North Coalinga Region, California. Univ. Calif. Publ., Bull. Dept. Geol., Vol. 9, No. 6, 1916.

belong to the Hipparion group and probably represent closely related forms. Recently, Dr. Chester Stock secured a vertebrate fauna from sandstone beds just above the upper tuff member of the Pinole formation and conformable with this tuff, and the assemblage of mammalian types is apparently an Orinda fauna. The Pinole Tuff-Orinda strata in the Pinole syncline are very closely connected areally with tuff beds of the Sonoma group north of Carquinez Straits. Since the volume of tuff diminishes gradually as one travels from Napa toward the south it is suggested strongly that the volcanic ash and pumice came from a northerly direction. The thickness of the Pinole tuff is much less than the tuff beds around Napa. While this is not conclusive evidence, as Carquinez Strait intervenes, it fits in with evidence derived from the study of the vertebrate faunas.

In brief then, the Merced has been shown to be the equivalent of the Sonoma group through stratigraphic and areal relations. The Sonoma group in turn is areally connected with the Pinole tuff and the Orinda formation of the Berkeley Hills and by means of *Neohipparion gidleyi,* its close faunal relationship is shown. The fauna of the (Jacalitos) Lower Etchegoin is related to that obtained from the Neohipparion gidleyi beds of the Sonoma group.

## Millerton and Tomales Formations

One of the interesting results of the work in the region of Tomales Bay was the discovery of a Pleistocene fauna in the Millerton formation which indicated a climatic condition similar to that of San Diego today. Two or three excellent collecting localities were found in the headlands on the northeast side of Tomales Bay. A small but distinctive Pleistocene fauna of the same type was found in terrace deposits overlying the Millerton formation of Lower or Middle Pleistocene age. The beds containing this fauna will be referred to as the Tomales formation, owing to their occurrence also on the northeastern side of Tomales Bay.

The type locality of the Millerton formation is in the headland near Millerton Station, northeast of Inverness on Tomales Bay. On the west side of this headland, the beds here exposed have a strike of north and south and a dip of

10° to the east. The lowermost member as exposed in this cliff-section is an oyster bed made up almost wholly of the remains of *Ostrea lurida*. Resting upon these oyster beds is a bed of flesh-colored clay containing numerous specimens of *Corbula fragilis* Hinds. These Corbula beds (Cal. Acad. Sci. Loc. 563) are in turn overlain by sandstone and a prominent conglomerate member whose pebbles are composed of schist, chert, sandstone and granite. Two hundred yards northeast of the headland, lignitic sands containing wood and pine cones, oyster shells and *Chione undatella,* rest upon a conglomerate which dips 1° to 2° to the west. These horizontal lignitic beds exhibit a striking relation to the underlying conglomerate in that roots of pine trees have penetrated the contact between the two formations, thus indicating in quite conclusive manner, a notable Pleistocene unconformity. These lignitic beds and the overlying tan-colored sandstone conglomerates are assigned to the Tomales formation. The pine cones are not badly damaged and do not show wear by running water or by waves. They have been identified by Miss Alice Eastwood, Curator of Botany, California Academy of Sciences, as *Pinus radiata*. These cones, as well as *Chione undatella,* indicate a climatic condition during the upper Pleistocene considerably warmer than that of today. *Chione undatella* does not range further north at the present time than San Pedro, California, and *Pinus radiata* has its present northern limit in San Mateo County.

California Academy of Sciences Localities 561 and 563 are on Millerton headland, so that both characteristic Pleistocene faunas are present in the one vicinity. The base of the Millerton formation is not exposed at the type locality, the block making Millerton headland being lodged between two fault lines of the San Andreas Rift. On the north side of Tom's Point near the entrance to Tomales Bay, basal beds of the Millerton formation rest unconformably upon Franciscan chert and glaucophane schist. The basal member is a conglomerate composed of fragments of chert, schist, tuff and tuff-breccia, and its matrix is a dark gray andesitic mud. Pieces of bark, a sixteen-inch tree trunk and cones of *Pinus radiata* are imbedded in it. California Academy of Sciences Locality 412 is in sandy shales overlying the basal conglomerate. These shales contain essentially the same fauna as that of the type locality of the Millerton formation. Tom's Point, as will be seen from a study of Figure 1, Plate XXXII, and Figures 1 and 2, Plate XXXIV, has been much disturbed by faulting along the San Andreas Rift. Typical fault-sag ponds occur on the top of Tom's Point along two marked lines of faulting. The fault-sag pond shown in Figure 1, Plate XXXII, is on the western end of the point. Another fault-sag pond occurs about a hundred yards east of this locality, marking a fault which is apparent in the picture of the cliff-section shown in Figure 1, Plate XXXIV. The two pictures shown in Plate XXXIV indicate considerable disturbance of the Millerton formation, as dips as high as 20° to 25° are common at this point. The best stratigraphic section of the Millerton formation was found in the headland a mile and a half northwest of Millerton Station, on the northwest side of this point. Enough fossils were obtained from these beds to prove that the fauna was the same as that of the Millerton at its type locality. In the west end of the cliff-section, 50 feet of conglomerate is exposed and it exhibits a pronounced dip of 23° E. with strike of N. 20° W. This strike and dip is quite uniform for several hundred feet until a point is reached about sixty feet west of the railroad, where one of the faults of the San Andreas Rift Zone has shattered the section. The conglomerate strata at the west end of the point are 65 feet in thickness and are overlain by 85 feet of carbonaceous tan-colored sandstone and dark gray shale containing marine shells in its middle portion. A prominent conglomerate member two feet in thickness is next observed. The latter deposit is overlain by more carbonaceous tan-colored sandstone and dark gray shale, 23 feet in thickness. A fault apparently intervenes at this point and the underlying strata are not exposed east of it. Near the railroad an erosional unconformity appears to be present between the Millerton formation of Lower or Middle Pleistocene age and the Tomales formation of Upper Pleistocene age. The Tomales formation at this point is composed of a tan-colored sandstone and conglomerates—perhaps fanglomerates would be a better designation—lighter in color than the tan-colored sandstones of the Millerton formation. The outcrops of the Tomales formation in this vicinity were carefully searched for fossils but no shells were found which were unmistakably in place. The Tomales formation is apparently largely composed of land-laid deposits and it appears probable that much of the loosely consolidated sandstone represents material composing Pleistocene alluvial fans. Most of the headlands on the northeast side of Tomales Bay are thinly coated with these loosely consolidated sandstones and conglomerates of the Tomales formation. The even-topped terraces one-quarter of a mile northwest of Point Reyes Station are composed of tan-colored sands and gravels whose pebbles are schist, chert, sandstone, basalt and granite. The occurrence of granite pebbles in these gravels is noteworthy, as it shows that a part of the gravels is due to contributions from the southwestern side of Tomales Bay, thus apparently indicating that the bay was not so extensive during the Tomales-Pleistocene time as today or during the period of deposition of the Millerton formation.

### FAUNA OF THE MILLERTON FORMATION

A list of species obtained from the Millerton formation is shown in the accompanying table.

### DESCRIPTIONS OF CALIFORNIA ACADEMY OF SCIENCES PLEISTOCENE LOCALITIES OF THE MILLERTON FORMATION

Locality 412. Cliffs along northeast shore of Tomales Bay, about one-half mile from Ocean. Fossiliferous conglomerate reef in Pleistocene. This reef is a hard conglomerate made up of schist pebbles on shore line in Pleistocene. Above it is clay shale and soft yellow sandstone.
Coll., J. B. Kerr, July 24, 1916.

Locality 561. Pleistocene fossils occur on east side of Tomales Bay, east of Inverness Yacht Club.
Coll., R. E. Dickerson, April 4, 1918.

Locality 563. Pleistocene fossils on point on east side Tomales Bay, east of Inverness Yacht Club.
Coll., R. E. Dickerson, April 4, 1918.

LIST OF SPECIES FROM MILLERTON FORMATION, LOWER OR MIDDLE PLEISTOCENE OF TOMALES BAY

| PELECYPODA | 412 | 561 | 563 | PRESENT GEOGRAPHIC RANGE OF SPECIES | GEOLOGIC RANGE OF SPECIES |
|---|---|---|---|---|---|
| Cardium substriatum Conrad | × | .. | .. | Catalina Island to Acapulco (Dall) | Pleistocene to Recent (Arnold) |
| Cardium quadrigenarium Conrad | × | × | × | Santa Barbara, Calif., to Todos Santos Bay, Lower Calif. (Dall) | Miocene to Recent (J. P. Smith) |
| Cardium corbis Martyn | × | .. | .. | Bering Sea to San Diego (Dall) | San Pedro Pleistocene to Recent (Arnold) |
| Chama cf. pellucida Broderip | × | .. | .. | Oregon to Chile and Galapagos Islands (Dall) | Etchegoin Pliocene to Recent |
| Cryptomya californica Conrad | × | .. | × | Chichagof Island, Alaska, to Topolobampo, Mexico (Dall) | Pliocene to Recent |
| Corbula fragilis Hinds | × | × | × | Monterey, Calif., to Salina Cruz, West Coast of Mexico (Dall) | Pleistocene to Recent |
| Chione undatella Sowerby | × | × | × | San Pedro, Calif., south to Guayaquil (Dall) | Pleistocene to Recent |
| Glycimeris septentrionalis Middendorff | .. | .. | × | Aleutian Islands to Puget Sound (Dall) | Miocene to Recent |
| Hinnites giganteus Gray | × | .. | .. | Aleutian Islands to Magdalena Bay, Lower California (Cooper) | Miocene to Recent |
| Leda taphria Dall | × | .. | × | Bodega Bay, Calif., to Lower California (Dall) | Miocene to Recent |
| Metis alta Conrad | .. | .. | × | Santa Barbara, Calif., to San Diego, Calif (Dall) | Miocene to Recent |
| Macoma nasuta Conrad | × | .. | × | Kodiak Island and Cook Inlet south to Scammon Lagoon, Lower California (Dall) | Miocene to Recent |
| Monia macroschisma Deshayes | × | .. | .. | Japan; Unalaska to San Diego, Calif (Cooper) | San Pablo Miocene to Recent (J. P. Smith) |
| Ostrea lurida Carpenter | × | × | × | Sitka to Cape St. Lucas (Dall) | Etchegoin Pliocene to Recent (J. P. Smith) |
| Paphia tenerrima Carpenter | × | .. | .. | Puget Sound to San Quentin Bay, Lower California (Dall) | San Pablo Miocene to Recent (J. P. Smith) |
| Paphia staminea Conrad | .. | .. | × | Commander and Aleutian Islands to Kamchatka and North Japan and to Puget Sound and Socorro Islands (Dall) | San Pablo Miocene to Recent (J. P. Smith) |
| Phacoides nuttalli Conrad | × | .. | .. | Monterey to San Diego (Cooper) | San Diego Pliocene to Recent (Arnold) |

List of Species continued on the following page.

List of Species from Millerton Formation, Lower or Middle Pleistocene of Tomales Bay—Continued.

| PELECYPODA | 412 | 561 | 563 | PRESENT GEOGRAPHIC RANGE OF SPECIES | GEOLOGIC RANGE OF SPECIES |
|---|---|---|---|---|---|
| Pecten latiauritus Conrad | × | × | × | Monterey, Calif. to Lower California (Dall) | Pleistocene to Recent (Arnold) |
| Semele decisa Conrad | × | .. | × | San Pedro to San Diego, California (Dall) | Pleistocene to Recent (Arnold) |
| Schizothærus nuttalli (Conrad) | × | .. | .. | Wrangell, Alaska, to San Diego (Dall) | Pliocene to Recent (Arnold) |
| Tagelus californianus (Conrad) | .. | .. | × | Santa Barbara, Calif., to Gulf of Tehuantepec (Dall) | Pliocene to Recent (Dall) |
| GASTROPODA | | | | | |
| Astyris gausapata (Gould) | .. | .. | × | Alaska to San Diego (Hanna) | Pleistocene to Recent (J. P. Smith) |
| Calliostoma tricolor Gabb | × | .. | .. | New Year Point to San Diego (Cooper) | San Pedro Pliocene to Recent (Arnold) |
| Nassa perpinquis Hinds | .. | .. | × | San Francisco to Lower California | Pliocene to Recent |
| Nassa californiana Conrad | × | .. | .. | Drake's Bay to Cerros Island, Lower California (Arnold) | San Pablo Miocene to Recent (J. P. Smith) |
| Olivella biplicata Sowerby | × | .. | .. | Straits of Fuca to San Diego (Cooper) | Etchegoin Pliocene to Recent (J. P. Smith) |
| Tornatina cerealis (Gould) | .. | .. | × | Monterey to San Diego | Pleistocene to Recent (Arnold) |
| Thalotia caffea (Gabb) | .. | .. | × | Monterey to San Pedro (Cooper-Raymond) | Pliocene to Recent (Arnold) |
| Astyris tuberosa (Carpenter) | .. | .. | × | Neah Bay to San Diego (Cooper) | Pliocene to Recent (J. P. Smith) |
| Crepidula onyx Sowerby | × | .. | × | Panama, Central America (Carpenter) | Upper Miocene to Recent (J. P. Smith) |
| Fissuridea murina (Carpenter) | .. | .. | × | San Pedro to Catalina (Williamson) | Pleistocene to Recent. |
| Lunatia lewisii (Gould) | × | .. | × | Straits of Fuca to San Diego (Cooper) Japan (Tryon) | Monterey Miocene to Recent (J. P. Smith) |
| Monoceras engonatum Conrad | × | .. | .. | Bolinas to San Diego (Cooper) | San Pablo Miocene to Recent (J. P. Smith) |
| Murex festivus Hinds | × | × | × | San Pedro to Lower Calif. (Cooper) | Pleistocene to Recent (Arnold) |
| Nassa mendica Gould | .. | .. | × | Sitka to San Diego (Cooper) | Pliocene to Recent |
| SCAPHOPODA | | | | | |
| Dentalium neohexagonum S. & P. | × | × | .. | Monterey to Mexico (Hanna) | Pliocene to Recent (Arnold) |
| CRUSTACEA | | | | | |
| Balanus concavus Bronn | × | .. | .. | Panama to San Pedro, Calif., Philippine Archipelago, Australia (Darwin) | Miocene to Recent |

## Interpretation of Fauna of the Millerton Formation

Professor J. Perrin Smith, who examined the fauna collected from the beds of the Millerton formation and Tom's Point, recognized that the types in this assemblage were of species considered characteristic of a warm period of the Pleistocene, and he stated that the fauna was equivalent to that obtained from the upper San Pedro beds by Dr. Ralph Arnold. The careful work of Mr. Thomas Oldroyd has indicated, according to Professor Smith, that such forms as *Chione undatella* were restricted to the Upper San Pedro deposits and did not range downward into the beds of the Lower San Pedro Pleistocene. The writer has prepared a list of the forms obtained from the Millerton beds and has given the present known ranges of these forms in the Recent fauna. None of these species is extinct, but many of the forms, such as *Cardium substriatum* Conrad, *Cardium quadrigenarium* Conrad, *Corbula fragilis* Hinds, *Chione undatella* Sowerby, *Metis alta* Conrad, *Semele decisa* Conrad, *Tagelus californianus* (Conrad), *Pecten latiauritus* Con., *Dentalium neohexagonum* S. & P., *Crepidula onyx* Sowerby, and *Murex festivus* Hinds, are now restricted in range to regions south of Santa Barbara or Monterey. Ranges are given according to available literature. The other forms in this fauna are species which at present have a great range along the Pacific Coast. From the study of this fauna the writer is led to complete agreement with Professor Smith's correlation. With one exception, this is the first time that a fauna of a warm period of the Pleistocene has been reported from San Francisco Bay vicinity. Faunas collected from the Pleistocene terraces around Santa Cruz contain species which are characteristic of that region today. Pleistocene faunas collected by Mr. Bruce Martin from marine terraces on the Oregon Coast also yield Recent species which occur commonly in waters of the ocean at that locality. The Pleistocene fauna of Merced Beach, San Francisco Peninsula, likewise does not suggest any conditions different from those of today.

Dr. Ralph Arnold[21] in his notable memoir on the marine Pleistocene and Pliocene of San Pedro, California, correlated

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[21] Arnold, Ralph, Memoirs of the Calif. Acad. of Sciences, Vol. 3, The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California, p. 49, 29-30, 1903.

certain Pleistocene beds which are exposed along the Straits of Carquinez at Rodeo with his warm water facies of the Pleistocene, the Upper San Pedro. Concerning this Arnold states:

> The Pleistocene deposits on the shore of San Pablo Bay between the Union Oil Refinery and Point Pinole have been visited by Dr. Merriam and the writer. The deposits, which rest on the upturned edges of the San Pablo strata, consist of horizontally bedded layers of sand, gravel, and clay. Teeth of the mammoth, and bones of the giant sloth and extinct bison have been found in these Pleistocene layers by Dr. Merriam. In certain places the Pleistocene layers consist almost entirely of oyster and mussel shells. Fossils from the Pleistocene deposits on San Pablo Bay between the Union Oil Refinery and Point Pinole are, *Ostrea lurida*, *Ostrea conchaphila*, *Mytilus edulis*, and *Tagelus californianus*. The character of these Pleistocene strata and of the fauna leads the writer to correlate them with the upper San Pedro series.

Arnold further states concerning his upper San Pedro as follows:

> The upper San Pedro beds do not represent the top of the Pleistocene. The fauna of these upper beds, although having many species in common with the living fauna of the same locality, is still quite distinct. This would suggest a period of considerable length since the deposition of the strata. The number of distinctly southern forms living at San Pedro during the period of deposition of the upper beds also shows that there has probably been a change in climatic conditions since that time. A raised beach unconformable with the upper San Pedro strata at Deadman Island shows that there have been orographic movements since the upper San Pedro beds were deposited. All of this evidence, then, leads to the conclusion that there has been a sufficient lapse of time since the deposition of the upper San Pedro strata, to admit of marked faunal and orographic changes.

Lawson[22] in his "Geomorphogeny of the Coast of Northern California," states in the concluding paragraph concerning the Rodeo beds that, "Seemingly the last event is a slight uplift in the vicinity of the Straits of Carquinez."

Arnold's tentative correlation was probably based upon the occurrence of *Tagelus californianus* (Conrad) whose present range is from Santa Barbara to the Gulf of Tehuantepec, and indicates that it is restricted to warmer waters than those of the San Francisco Bay of today. As noted above, Arnold clearly recognizes that the Upper San Pedro fauna is not

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[22] Lawson, A. C., Univ. of Calif. Publ., Bull. Dept. Geol., Vol. 1, p. 271, 1894.

the latest Pleistocene, but he did not consider the possibility that more than one warm epoch might be represented in the marine sequence of the Pacific Coast. A small fauna from California Academy of Sciences Location 571, situated 200 feet northeast of California Academy of Sciences Location 562, on the northeast end of the headland opposite Inverness Yacht Club, on the east side of Tomales Bay, three-quarters of a mile northeast of Millerton Station, demonstrates that a second warm epoch was probably present in the Tomales Bay region. This fauna consisting of *Chione undatella* Carpenter and *Ostrea lurida* Carpenter, is closely associated with cones of *Pinus radiata*. The two localities just mentioned are separated by an unconformity between the Tomales and Millerton formations.

Later work by Professor J. C. Merriam[23] and others upon the vertebrate and invertebrate faunas obtained from the Rodeo beds gives evidence that the vertebrates from this locality do not apparently represent the same stage of evolution as those from the Rancho la Brea beds. To quote from this guidebook:

On the borders of a swamp near the oil refinery of the Union Oil Company are exposed vertical strata of Pinole tuff, composed of light yellowish or white pumice. These strata dip at a relatively low angle on the southwest side of the syncline. The axis of the asymmetric Pinole syncline passes through the swamp. The Pinole tuff, having a thickness of about 1000 feet, was laid down in part, at least, in a lake basin. Freshwater shells belonging to the genus Physa have been found in the strata on the eastern side of the swamp. Rodeo-Pleistocene beds rest upon the Pinole tuff at this point. Further west the Pinole tuff is exposed in the railroad cuts near Rodeo Station. Just west of this station easterly dipping beds of the upper San Pablo are exposed. At Hercules Station the shattered Monterey strata which form the lower portion of the western limb of the Pinole syncline are seen. West of Pinole Station the Pinole tuff is in contact with the Monterey.

The Pleistocene deposits of San Pablo Bay have been referred to frequently as the Rodeo beds. They are well exposed in the sea cliffs near Rodeo and Pinole. Near Rodeo Station the horizontal Pleistocene strata rest upon sharply tilted beds of San Pablo-Miocene and Pinole Tuff-Pliocene. At a number of localities the basal layers of the Rodeo are made up almost entirely of marine shells, comprising mainly oysters and mussels. Above the shell layer the deposits grade into beds of estuarine or alluvial origin. The thickness of the Pleistocene in this region is commonly not over 40 feet.

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[23] Merriam, J. C., and others, Preliminary Program and Outline for Excursions for Meeting of the Paleontological Society, pp. 8-10, 1915.

Not more than seven marine types are known from the Rodeo. The complete list of species is as follows:

| | |
|---|---|
| Ostrea lurida Conrad | Tagelus californianus (Conrad) |
| Mytilus edulis Linnæus | Epitonium hindsii (Carpenter) |
| Cryptomya californica (Conrad) | Balanus, sp. |
| Cardium corbis (Martyn) | |

All the marine species of the Rodeo-Pleistocene are still living on the Pacific Coast, and with the exception of *Tagelus californianus* all are found in the vicinity of San Francisco Bay. This species is now limited to the relatively warm waters south of Santa Barbara. All of the Rodeo species are now typical marine forms, but may also appear in estuaries. These Pleistocene beds were presumably deposited during a period of relatively warm climate, and may therefore be approximatly contemporaneous with the upper San Pedro Pleistocene of Arnold.

Fossil bones of mammals and birds have been found at several horizons in the Rodeo formation. Remains of Elephas are known from the shell layers at the base of the section. The vertebrate fauna includes the following forms:

| | |
|---|---|
| Equus, sp. (possibly new) | Felis, near atrox Leidy |
| Bison, near antiquus Leidy | Smilodon?, sp. |
| Elephas columbi Falconer | Æcmophorus occidentalis (Lawrence) |
| Camelid (possibly new) | |
| Mylodon, sp. | |

The mammal fauna of Rodeo is not closely comparable with that of any well-known stage on this coast. The camel and the horse do not correspond to the species of Rancho La Brea, but later collections may show that the fauna is not widely different in stage from that of Rancho La Brea.

As is pointed out above, the contrast in the lithology of the Millerton and Tomales formations is striking and the unconformity between the two deposits is likewise well marked. As was stated in the introduction, the evaluation of an unconformity in a Rift Zone area is a difficult one, as events happen here with startling suddenness. Although the writer has considered this carefully, several facts cause him to believe that this unconformity may represent a long period of Pleistocene time, and that the Millerton formation was deposited during one warm epoch — possibly an interglacial stage—and the Tomales formation during a later warm epoch. When the fauna of the Millerton is studied, the absence of such genera as Haliotis Echinarachnius, and other forms characteristic of an open coast, is a noteworthy feature. The forms composing the fauna are, on the other hand, such as can live in land-locked bays. The character of the lithology and the sudden changes in the lithology of the Millerton formation, such as the mixture of conglomerates and clays are strikingly similar to the deposition going on in Tomales Bay at the present time.

Dr. J. C. Merriam[24] in a paper entitled "Ground Sloths in the California Quaternary" has described the humerus of a large ground sloth from the northeast shore of Tomales Bay, and gives the following note upon the occurrence of this interesting form:

> The place pointed out to Mr. Calkins as that from which the humerus was obtained is in a small run about three-quarters of a mile southeast of Hamlet and about 100 feet above the level of the bay. The stream in the run has cut down quite sharply for about 12 feet into a loose, sandy clay at the spot where the specimen was obtained. Above this point it flows through or over deposits similar to those just mentioned, and over rocks of the Franciscan series, so that the specimen must be derived from one or the other of these formations. As the Franciscan rocks are of middle Mesozoic age and have suffered much disturbance, the only possible source of such a specimen as that which we have under consideration is the more recent deposit.
>
> Incoherent, yellowish, sandy clays, similar to those just mentioned form the most prominent feature of the geology along the east side of Tomales Bay between Point Reyes Station and Hamlet. In many places they form prominent seacliffs up to 40 feet in height. They are everywhere unsolidified and frequently show horizontal stratification. Mr. Calkins considers the beds in the stream cutting in which the humerus was found as an extension of this deposit up the slope of the hill. Judging from their incoherent nature and horizontal stratification, these beds are certainly much younger than the latest Pliocene in the region. Excepting the humerus, the only fossil obtained from them is a badly worn Elephas tooth, which was picked up on the shores of Tomales Bay near Point Reyes. This formation resembles the deposits along the shores of San Pablo and Suisun bays, in which a Quaternary fauna, both molluscan and mammalian, has been obtained by the writer. In this connection the preservation of the specimen is a noteworthy character, as the bone is absolutely intact and the original material unchanged. One might almost suppose it a product of the last half century.

Dr. Chester Stock has identified the specimen from Tomales Bay as belonging to *Mylodon harlani,* a species commonly represented in the Pleistocene of Rancho La Brea.

This form probably occurred in the Tomales formation as the Millerton formation is missing from this portion of Tomales Bay, and the lithological description corresponds to that of the Tomales formation.

The Millerton formation was deposited in a graben along the San Andreas Rift, very similar to the Tomales Bay of the present day. Both the flora and fauna obtained from these beds indicate a climate considerably warmer than that

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[24] Merriam, J. C., Bull. Geol. Soc. America, Vol. II, pp. 612-614, 1899.

which prevails in this region today, an interglacial epoch. The Tomales formation is largely land or stream-laid deposits. During a portion of Tomales-Pleistocene time, however, the region was occupied by a shallow bay. Both its fauna and flora testify conclusively a milder climate for the Tomales epoch.

### Undifferentiated Pleistocene

It has been indicated incidentally in the description of the Merced group that marine and stream terraces occur both in the Point Reyes Triangle and the uplifted mainland block. Unfortunately, but little fossil material has been obtained from these terraces of the Point Reyes Triangle. The general profile of the western face indicates unmistakably that the sea was the agent which cut these gigantic steps. Likewise, the even surface which truncates the Merced around Freestone is so broad and level that any other erosion agency except the sea could not have done this planing. Osmont reports some boring mollusks in and around Occidental but the writer was unable to find the locality.

Pleistocene stream gravels were noticed in the Petaluma Quadrangle, three-quarters of a mile southwest of Waugh School, in a road-cut. At this locality a very evident erosional unconformity is present between the Pleistocene gravels and the underlying yellow tuffaceous sandstone of the Merced.

Another interesting stream channel is found in the State Highway a quarter of a mile northwest of Penn Grove. This old stream channel is full of gravel in which large fragments of petrified wood are found. The direction in which the stream flowed in Pleistocene time is apparently at right angles to the drainage of the present day. A similar suggestion of an east-west drainage during upper Pleistocene time was obtained from a study of the stream gravels at Waugh School. From other evidence it appears probable that during a portion of Pleistocene time the streams of this vicinity did actually drain into the streams entering Tomales Bay.

Dr. Chester Stock found interesting mammalian remains in Pleistocene beds one-half mile northwest of the Iowa School. This locality is in the Santa Rosa Quadrangle near its southwest corner, in an area which is largely covered by Merced strata. Dr. Stock has supplied the note given below:

Remains of the ground sloth *Mylodon harlani* were found in the Santa Rosa Quadrangle approximately seven miles northwest of Petaluma and three-quarters of a mile southeast of William McGrew's Ranch house, in bluish clay overlain by gravels of Pleistocene age. These deposits rest unconformably upon greenish-colored sandstones presumably of Franciscan age. The bones were exposed in a gully about 100 yards north of the road leading to the McGrew house and one-half mile west of main road connecting Stony Point with Cherry. The fossil material consists of parts of a pelvis sacrum, and lumbar and caudal vertebræ.

A narrow Pleistocene marine terrace was observed at Dillon's Beach, on the Pacific Ocean between Tomales and Bodega bays, about 50 feet in elevation at its old cliff. This shelf, which is now being rapidly eroded, was cut in micaceous gray Franciscan sandstone, interbedded with thin strata of lignite and carbonaceous shale. The deposits which cover a portion of this wave-cut shelf consist of incoherent tan-colored sandstone, 10 to 30 feet in thickness. The Franciscan rocks in Hog Island are covered by a similar deposit. These last two are probably referable to the Tomales formation.

General impressions obtained very largely from physiographic studies on the tilted mainland block indicate that the time interval required to strip the Merced strata from a considerable area was a long one. This data will be presented again in connection with a discussion of the physiography.

## Structure and Stratigraphy

The dominant features of the area under discussion are, as previously pointed out, the Point Reyes Triangle, the San Andreas Rift Zone, the San Francisco-Marin Block, and the Berkeley Hills Block. The Point Reyes Triangle and the orogenic block on the northeast side of Tomales Bay are respectively recognized by Lawson[25] as extensions of the Montara and San Francisco-Marin blocks.

The Berkeley Hills Block which Lawson recognizes in the San Francisco Bay Region, appears in the vicinity of Petaluma and Sonoma Mountain as a dominant orographic feature. Concerning the relationship of the blocks in this area, Lawson, after pointing out the geological differences between

[25] Lawson, A. C., San Francisco Folio, U. S. Geological Survey, p. 15, 1914.

the rocks of the Point Reyes Triangle and those of the San Francisco-Marin Block, states that: "It would therefore seem probable that the earlier movements on this fault zone were pre-Miocene and that they caused a relative upthrow on the southwest side of the fault, in consequence of which the Franciscan rocks were lifted into the zone of erosion and stripped off the underlying granitic rocks. This erosion may have taken place in any part or during the whole of Cretaceous and Eocene time." It must be remembered in this connection that our mapping does not show any Eocene or Cretaceous rocks in this vicinity. Eocene rocks are not found until the vicinity of Carneros Creek in the Napa Quadrangle is reached. Rocks of the Knoxville Cretaceous also occur in this vicinity, so our mapping gives added data in support of Lawson's views.

The occurrence of great thicknesses of Monterey shale in the Point Reyes Triangle and its absence from the San Francisco-Marin Block was recognized as a significant thing by Lawson,* who states: "The shore line of the sea in which these shales were deposited must have lain far east of Bolinas Ridge, for we can not regard the beds at the base of the ridge as in any sense littoral. It follows that the Monterey beds were laid down not only over the area of Point Reyes Peninsula but also over a large part of the territory farther northeast, and that they were therefore spread over the trace of the old fault. In post-Miocene time there was probably a recurrence of movement at the time of the deformation of the Monterey strata, but the effect of this movement can not be satisfactorily differentiated from that of the later post-Pliocene displacement." The indications of the presence of the bituminous shales beneath the Petaluma formation on the west flank of Sonoma Mountain suggest that Lawson's view concerning the distribution of the Monterey is correct. The work in this area under discussion shows that in pre-Pliocene time the San Francisco-Marin Block was uplifted into the zone of active erosion and the northwestern extension of the Berkeley Hills Block which is bounded on the southeast by the Tolay fault was depressed below the base-level of erosion at that time, thus preserving the diatomaceous Monterey shale which in all probability lies beneath the Petaluma lake

*Idem. p. 16.

beds and the tuffs and lavas of Sonoma Mountain. It would appear quite probable that the Point Reyes Triangle was likewise depressed at the end of the Miocene, as it is difficult to account for the preservation of such a great thickness of the Monterey group within such a limited area in any other way.

### Movements within the Dominant Blocks

As Anderson indicated in the Geology of the Point Reyes Peninsula, the Monterey strata have been folded in a broad, shallow syncline. The general relations of this structure are shown in the Section E-F which accompanies this report. This folding took place in pre-Merced time, as the Merced probably rests with unconformity upon the Monterey shale at Bolinas Head, near the town of Bolinas, Tamalpais Quadrangle.

The writer did not attempt to work out the structure in the Franciscan rocks but it is probable that the dominant folds which Lawson recognizes in the Tamalpais Quadrangle extend in a northwesterly direction. A fault between the Sonoma group at Grand View and the Franciscan rocks is apparently a movement which did not extend to the northwest as no trace of it was found in Burdell Mountain. This fault, however, may be a dominant structure in its southeasterly extension, but unfortunately a great mass of alluvium prevents us from determining this point. From the general nature of the structure in this part of the Coast Ranges it seems quite probable that movement along this fault at the end of Pliocene time or during the early Pleistocene may have determined the form of Petaluma Valley. The northeastern side of this fault is apparently the downthrown side. However, there are complications within the block, as the basaltic conglomerate near Grand View shows. This basaltic conglomerate extends beneath the alluvium of Petaluma Valley. The State Highway Engineers in charge of building the Grand View bridge, Mr. Gerlach and Mr. Brown, presented the writer with a section which indicates that these gravels are found at a depth of 105 feet at the east pier of the bridge, which is about 400 feet from the Grand View shore line. Minor faulting or folding may have affected the Merced in the vicinity of the Cinnabar School, near the southern edge of the Santa Rosa Quadrangle, as the anomalous dip of 10° S. was recorded here. This, however, is local, as the beds north and south of this locality exhibit little, if any, inclination.

Within the northern extension of the Berkeley Hills block, faulting, with possibly some folding incidental to it, has been very vigorous in the northeastern portion of the Santa Rosa Quadrangle during post-Pliocene time. The writer did not have sufficient time to work out these structures in detail, but certain broad features were recognized. Sonoma Mountain for the major part has not been greatly disturbed by faulting or folding except its northwestern extensions, Taylor Mountain and Bennett Mountain.

Kenwood Valley, a name which the writer proposes for a northwest-southeast valley whose principal town is Kenwood, appears to be a well marked graben, as the Mayacamas Mountains rise abruptly from its northeastern border. These mountains exhibit in some places exceedingly steep dips, as high as 40° to 45° to the southwest. (See Fig. 2, Plate XXV.) The peculiar courses of the streams draining this valley are results of complicated fault movements in this vicinity. Rincon Valley probably has a similar origin. The hills north of Santa Rosa are in detail quite complicated by folding and faulting. The Hayward fault, whose northern extension is recognized on the northwest side of Sonoma Mountain, is in this area as in its type locality, a very recent feature, and it has not greatly modified the structure within the Berkeley Hills block.

During Epi-Miocene time the San Francisco-Marin Block was upthrust, for an erosional surface was developed, upon which the Merced was laid down. Possibly during the upper-Miocene time this block was elevated also, since the Petaluma lake beds lying on the northeast side of Tolay fault indicate that a land mass cut this region from the sea. Since the Petaluma lake beds lie within the northern extension of the Berkeley Hills Block, it appears probable that this block was relatively depressed in upper-Miocene time. During Merced-Pliocene time, the Point Reyes Triangle, an extension of the Montara Block, and the San Francisco-Marin Block were both depressed to receive marine Pliocene sediments and apparently the waters of the Merced sea covered completely, all the region west of the northeastern border of Petaluma and Santa Rosa valleys. Little or no Merced strata occur east of the projection of the Tolay fault in the Petaluma Quadrangle, and it seems probable that the Berkeley Hills Block was somewhat upthrust into the zone of erosion during this time, as much of the lava and volcanic ash deposits of Sonoma Mountain was laid down upon an erosion surface cut across the rocks of the Petaluma formation of upper-Miocene age. During a portion of Pliocene time, a distinct divide cut off Sonoma Mountain and the Berkeley Hills from the ocean, as the Orinda and Siesta formations of the Berkeley Hills are in a large part composed of lacustrine deposits. The Merced-Pliocene was shown to be the equivalent of the Sonoma group and in turn of the Orinda beds of the Berkeley Hills. Within the San Francisco-Marin Block, the uplift during post-Pliocene time was not apparently uniform, as Merced strata are now lacking in the vicinity of Tamalpais. Further north of Tamalpais, in and around Petaluma, residuals of Merced strata occur, and as one goes further northward towards Freestone the thickness increases. Of course it is barely possible that the Tamalpais mass may have been an extension of a Pliocene San Francisco Peninsula, and therefore may not have been the site of Merced deposition. An alternative explanation, that Merced strata once covered Tamalpais but have been removed completely owing to a greater uplift of this portion of the block, is probably correct, as Merced strata once covered its northern flanks. This is clearly shown by the occurrence of Merced beneath the capping of the basalt on Burdell Mountain, which has preserved this small remnant to the present day.

During the Pleistocene the Point Reyes Triangle underwent movements which are not recognized in the San Francisco-Marin Block. This block was apparently successively elevated during this time, with periods of standstill long enough for the sea to chop out a fine series of marine terraces on its western side. These terraces do not have their correlatives on the northeast side of Tomales Bay, showing these orogenic blocks moved independently.

At the beginning of the Pleistocene, the San Francisco-Marin Block was thickly covered by nearly horizontal Merced strata, and at least in the northern portion of this block, excellent evidence that the Pleistocene sea truncated Merced strata, may be seen. As was pointed out above, fine terraces occur around Freestone and to the northwest of this village. After this marine plain (or plains) was formed, the San Francisco-Marin Block was lifted above sea level, consequent Pleistocene streams began their downward and sidewise cutting, and quickly worked through the soft Merced strata to the old erosion surface cut across Franciscan rocks. At this time the drainage was across the block from east to west. Pleistocene Russian River[28] was probably the most vigorous of these streams, as it cut the longest and deepest canyon in the Franciscan. Later in the Pleistocene, the San Francisco-Marin Block was uptilted on its western edge and the lower portions of the consequent streams, with an increased gradient, were enabled to cut canyons in the underlying Franciscan rocks. All the streams on this block which now flow into the Pacific Ocean or Tomales Bay from the Russian River to Elk Creek, have canyons of greater or less length cut into the Franciscan. The tilting variously affected the middle and upper courses of the streams, producing in some cases ponding and in others spilling them out by way of their headwater tributaries, reversing the stream direction.

## Topography and Physiography

The principal topographic units of this region, as well as orogenic divisions, are the Point Reyes Peninsula, the Rift Valley of Tomales Bay, the San Francisco-Marin Block which extends from Tomales Bay and the Pacific Ocean, to Petaluma Valley and the northwestern extension of the Berkeley Hills Block, Point Reyes Triangle.

The Point Reyes Triangle, as will be seen by consulting the topographic map of the Geological Survey, has its northeastern base sharply determined by the San Andreas Rift Zone. Point Reyes is the apex opposite this base, and Tomales Point and Bolinas headland are the other apices of

[28] Holway, R. S., The Russian River, a Characteristic Stream of the California Coast Ranges, Univ. Calif. Publ., Geog. Dept., Vol. 1, No. 1, 1913.

the triangle. The comparatively straight Inverness Ridge parallels the San Andreas Rift. Short, rapid streams descend from the high northeastern scarp of this ridge to Tomales Bay or the Rift Zone in the vicinity of Olema. The southwestern slopes of this ridge are cut by many deeply intrenched streams, which very evidently at one time had far longer courses than is at present indicated, as Drakes Estero is clearly a drowned stream valley, due to the last general subsidence in this region. This southwestern slope of Inverness Ridge has been further chiseled into fine, wave-cut terraces of several different elevations. According to F. M. Anderson the most distinct terraces occur between 600 and 700 feet elevation and at 200 feet elevation. In addition, there are other less distinct shelves, which can be clearly seen from certain points of view. Whether or not these shelves are correlatives with the small plateau near Inverness is exceedingly difficult to decide, since this plateau is so eroded that its exact character was not evident to the writer. Other indistinct plateaus occur in the western shores of Tomales Bay in the vicinity of Tomales Point, but much detailed work would be necessary to decide their origin. Likewise these titan steps in the southwestern side of Inverness Ridge do not have correlatives in the northeastern shores of Tomales Bay in the mainland mass. The Pleistocene beds of the Millerton or Tomales formations which are found in the headlands on the eastern shores of Tomales Bay, are apparently unrelated either to these wave-cut terraces of Point Reyes Peninsula or to the indefinite 400 foot terrace of the mainland mass. This lack of synchrony very clearly indicates that the Point Reyes Triangle has moved upward or downward at times quite independently of the movements of the mainland. The Point Reyes Triangle is then clearly recognized as a definite orographic block whose history is quite different from that of the mainland.

Other differences between these two regions also occur. According to Lawson[27] in the San Francisco Folio:

> The vegetation on the west side of the San Andreas Rift valley is radically different from that on the east side. From Bolinas Lagoon northward, the eastern slope of the main ridge of the Point Reyes Peninsula is covered with a forest which though not continuous, is fairly

[27] Lawson, A. C., San Francisco Folio, U. S. G. S., No. 193, p. 3, 1914.

dense in the areas where it is best developed. This forest is composed almost exclusively of *Pinus muricata,* which is accompanied by a little *Pisania densiflora* and *Quercus agrifolia* and by considerable *Umbellularia californica* on very steep slopes. The densest part of the forest is, however, pure *Pinus muricata.* The shrubs of the Point Reyes Peninsula are northern types, which have here their southernmost or nearly their southernmost representation. These shrubs include *Rubus spectabilis menziesii, Ledum glandulosum* and *Rhododendron californicum.*

The differences in the floras of these two regions are in part due to different soils produced by the contrasting formations, but since the plants on the triangle are northern types it seems probable that actual geographic separation may likewise be a potent cause. The triangle may have been an island during late Pleistocene time and this relict flora may be due to the protection secured by this separation from the mainland mass.

A comparison of the present faunas of these two regions might lead to some interesting results.

### THE RIFT VALLEY OF TOMALES BAY

As the geologic map shows, Tomales Bay and the valley of Olema Creek form a very distinct zone separating the mainland mass from that of the Point Reyes Triangle. Tomales Bay is essentially a graben between these two blocks. This graben is not a simple one as the Pleistocene deposits in the northeastern side of the bay show. (See Plate XX; Plate XXXIV, Figures 1 and 2.) The Millerton formation of lower or middle Pleistocene age as is indicated upon the map of this region has been broken into several different wedge-like blocks. Since this region has been carefully studied in relationship to the San Andreas Fault in the Report of the California Earthquake Commission,[28] the reader is referred to this report for further detail.

### BERKELEY HILLS BLOCK

The Block described under this heading comprises the northeastern portion of region discussed in this paper. The writer believes that this is a definite orographic block which during the Tertiary has moved as one mass at times, but at other times has been broken into subordinate blocks of notable size.

[28] State Earthquake Commission upon the California Earthquake of April 18, 1906, Carnegie Institution of Washington, Vol. 1, pt. 1, pp. 65-91; pp. 30-35, 1908.

### Kenwood Valley

One of the highest points in this Kenwood valley region is Sonoma Mountain, elevation 2465 feet. This mountain mass is separated from the Mayacamas Mountains by a long narrow valley which we will refer to as Kenwood valley. The highest point in this area is Mt. Hood, one of the peaks of the Mayacamas Range with an elevation of 2715 feet. Sonoma Mountain is separated from the northern extension of the Mt. Tamalpais Mountain mass by Petaluma and Santa Rosa valleys. These physiographic units are, in part due to geologic structure, and in part, due to erosion. Only reconnaissance work was done in the Mayacamas Mountains, but the anomalous drainage of this mass is at once apparent from a brief study of the Santa Rosa Quadrangle. A part of the drainage on the southwest side of this range goes into Santa Rosa Creek, a tributary of the Russian River, while the other half reaches the ocean indirectly by way of Sonoma Creek, which empties into San Pablo Bay. The course of Sonoma Creek is particularly anomalous. Sonoma Canyon and its tributary stream, Bear Creek, drain the rugged eastern side of Mt. Hood Ridge, and a northwestern tributary which drains the northwestern side of Mt. Hood Ridge meets the main Sonoma Creek one-half mile northwest of Kenwood village. The main stream, which has been crowded to the southwestern side of Kenwood valley by the alluvial fans of the short, sharp streams descending from the southwestern slope of the Mayacamas Mountain scarp, suddenly abandons what appears to be a perfectly direct course out of the valley, to cut across the hills on the southwest side of Kenwood valley. After flowing in a canyon for two miles due south, the stream then turns and maintains a general southeastern course for two miles until it is joined at the village of Glen Ellen by Calabazas Creek and then proceeds through a narrow valley for a mile to Eldridge. A brief study of the topographic map near Los Guilicos quickly shows that the unnamed western tributary of Sonoma Creek has sometimes swung upon its fan so that the drainage from this slope has been out by way of the small stream draining through Annadel, which for the lack of a better name will be used to designate this odd but significant wet-weather stream. Annadel Creek, flowing in a northwesterly direction, cuts deeply into a low basaltic ridge two miles southeast of Melitta. It is very possible that this stream has followed the course of a fault line as being the easier way, although a comparatively wide, undrained valley one-half mile to the north would seem the logical way. The writer was not able to spend sufficient time upon this interesting problem to work out the details, but it is quite apparent that the canyon course of Sonoma Creek south of Kenwood is clearly antecedent to the fault movements which gave rise to Kenwood valley. Since a northern branch of this stream was well developed before the faulting, this northern branch was able to maintain its course against the upthrust on the southwestern side of Kenwood valley. Likewise Kenwood valley did not drop rapidly enough to divert the drainage out by way of Santa Rosa Creek or north by way of Beltaine Pass, which the Southern Pacific Railroad uses. The northern block, the Mayacamas Mountains, was uplifted with considerable rapidity. The streams draining that block were greatly accelerated and hence could carry a great load of debris which aided in filling Kenwood valley graben. Rincon valley is apparently also due to faulting.

### Sonoma Mountain

The main mass of Sonoma Mountain is essentially a lava plateau composed of nearly horizontally bedded basalts and tuffs of the Sonoma group. (See Plate XXX, Figures 1 and 2.) Its northern flanks, Bennett Mountain and Taylor Mountain, have evidently been subjected to considerable faulting at the end of, or during, Pliocene time. Faulting along the Hayward Rift has not affected the main mass of Sonoma Mountain or its principal streams essentially, but minor modifications in the drainage in the southwest flanks in the vicinity of the Petaluma Reservoir and Roger's Creek are results of this recently developed line of weakness. (See Plate XXIX, Figure 1; Plate XXXVI, Figures 1 and 2; Plate XXXVII, Figures 1 and 2.) The drainage of Sonoma Mountain is distributed in three directions: Matanzas Creek and its South Fork, and the south tributaries of Santa Rosa Creek drain the vicinity of Taylor and Bennett mountains. Graham

Creek, Carriger Creek and other small streams are tributary to the master stream, Sonoma Creek, which drains into San Pablo Bay. Roger's Creek is another one of these streams, but through the aid of the Hayward Rift it has succeeded in capturing a portion of the drainage of the southwest side of Sonoma Mountain. The southwest side of Sonoma Mountain is drained in part by Tolay Creek and Petaluma Creek into San Pablo Bay, while the northwestern half of this drainage has an indefinite water parting on the fan of Copeland Creek at Cotati divide. The waters of Copeland Creek and Crane Creek now find their way into Laguna de Santa Rosa, a stream on the western side of Santa Rosa Valley.

### Hayward Rift

The northwestern extension of the Hayward Rift is easily recognized on the southwestern slope of Sonoma Mountain, where many characteristic features are seen. The general direction of the rift is, through most of this area, about N. 40° W. in the Santa Rosa Quadrangle, but its general trend as it crosses the northeastern corner of the Petaluma Quadrangle is about N. 20° W. Like the Hayward rift in the Berkeley Hills, this rift is not a simple fault line, but a series of parallel fault lines in a zone which varies from a quarter to a half mile in width. Lawson[29] has shown that the Hayward Rift in the Berkeley Hills is a very recent feature which has only modified the original consequent drainage of the southwestern slope of the Berkeley Hills in a minor way. The same condition is essentially true along the extension of this line in the Petaluma and Santa Rosa Quadrangles. One mile east of the Eureka School on the Sonoma-Petaluma Road three beautiful fault sag ponds were first recognized along a half mile strip in a direction N. 20° W., and the corresponding small blocks which were separated from one another by interspaces, which, like the fault sag ponds, are due to a series of minor differentially dropped blocks. The hills and their interspaces are bounded on their northeast and southwest sides by faults of the Hayward Rift Zone. Such a series of differentially dropped blocks are termed by Law-

[29] Lawson, A. C., San Francisco Folio, No. 193, U. S. Geological Survey, p. 17, 1914.

son, Kernbuts. These peculiar topographic forms were defined by Lawson[30] in his paper upon the Geomorphogeny of the Upper Kern Basin. Lawson's Kern cols, the low passes which the Kernbuts connect with the main mountain mass, are characteristically separated from one another in this region by elongate depressions, the fault sags of Dr. G. K. Gilbert.[31] "Considering the Rift as a physiographic type, I find it convenient to have a specific name for one of its elements, the small valley; and in some of the descriptions which follow I shall speak of it as a fault-sag.

The general relation of the Rift to the greater valley is illustrated by the cross profile in Fig. 7. Along the northeastern side it lies everywhere lower than the adjacent slope of the greater valley, the produced profile of the valley slope passing the fault-ridges (kernbuts of Lawson) as well as the fault-sags. Along the southwestern side some of the fault-ridges appear to project above the restored profile of the greater valley, while the fault-sags lie below. If I interpret the structure correctly, the great compound fault concerned in making the valley includes a certain amount of step faulting which is responsible for some of the western ridges of the rift belt; but with that exception, the ridge and sags of the rift are occasioned by the unequal settling of small crust blocks along a magnified shear zone."

The conditions along the Hayward Rift are essentially the same as Dr. Gilbert has outlined but since this feature is a recent one the topographic forms which are present are on a small scale but were apparently developed "by the unequal settling of small crust blocks along a magnified shear zone." Many of the small hills are elongate-oval in form with major axis parallel to the Rift and the writer is inclined to regard some of them as small "sliver" fault blocks due to minor "scissors" faults along the Rift. The Hayward Rift in this region traverses the long southwestern slope of Sonoma Mountain into which it has cut a shallow trench in basalt. A view from a point a mile southeast of the Petaluma reservoir looking along the rift toward the northwest shows a slightly notched skyline at the end of the Mountain School

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[30] Lawson, A. C., Univ. Calif. Publ., Bull. Dept. Geol., Vol. 3, No. 15, p. 332, 336, 337, 1904.

[31] Report of the State Earthquake Investigation Commission, p. 33, 1908.

road. Three faults occupy the notches and the low ridges are lowered but little if at all, below the former slope of the mountain. (See Fig. 1, Plate XXXVII and Fig. 1, Plate XXXVI and Fig. 1, Plate XXIX.) From these photographs one might gain the impression that the drainage was toward the observer along the Rift, but such is not the case entirely. Only the lower portion of the valley is drained by the headwaters of Rodgers Creek. In the upper portion of the rift valley, the consequent streams still maintain courses across the Rift. Rifting has affected some of their acute-angled tributaries slightly by causing them to join their master streams at right angles and made other minor deflections in their courses. Rodgers Creek, however, drains the lower portion of this rift valley and it has captured the upper portions of the consequent streams which once drained across the rift. This is evidenced by much interesting physiographic detail on the southwest side of the rift in the region one to three miles southeast of Petaluma reservoir. At a point a mile and a quarter southeast of Petaluma reservoir, a wind gap of pronounced character occurs and it is very evident that it was once occupied by a consequent stream to the northeast which is now tributary to the piratical Rodgers Creek. A mile further on, another wind gap was found and in this case a small, youthful tributary of Rodgers Creek is rapidly reversing the drainage to the southwest. A considerable stream once occupied this gap as its relatively wide valley in late maturity is traceable a half mile west. In upper Rodgers Creek typical fault sags are common and in the rift valley a mile and a half southeast of Petaluma two or three elongate hills illustrate the recent fault feature, the kernbut. Near the top of the bordering southwest ridge, on the northeast side, a narrow fault shelf was noted. Fault-sag ponds and kernbuts are seen as one looks to the northwest from the north end of Mountain School road toward Santa Rosa, and the rift evidently extends in this direction along the southwestern face of Bennett Mountain. This feature was not recognized northwest of Santa Rosa unless the sharp line which separates Santa Rosa Valley from the hills north of Santa Rosa town represents a different expression of this line, similar to that of the Hayward Fault, south of Hayward town. The presence of undrained fault-sag ponds, low side-hill fault shelves, wind gaps of small order and minor stream modifications all indicate movements along this line within the last 200 years as many such transient topographic features would have been obliterated within a longer time. No fault furrows or recent fault scars which might be the surface results of movements along this line on April 18, 1906, were found, but the great destruction in the town of Santa Rosa on that fateful day may have been due to subterranean movements along this northern extension of the Hayward Rift.

The physiography of the San Francisco-Marin Block is intimately tied, both to the geologic history of this region previous to the Pleistocene and that very changeful period of the Pleistocene itself. A study of the peculiar type of stream drainage within this block has given the essential clews to the history of this region. Professor Holway's[32] paper upon the Russian River described the Russian River and its tributaries on this block, and his paper upon the Physiographically unfinished Entrances to San Francisco Bay[33] describes the peculiar drainage of Walker Creek and San Antonio Creek, and that of Elk Creek in Sausalito and Tiburon peninsulas. Professor Holway brings out some interesting topographic facts concerning Liberty Gap, which is a few miles northwest of Petaluma, and shows that a general coast depression of 250 feet would cause the sea to invade the Santa Rosa Valley from the west. In this paper he describes the valley of Walker-San Antonio Creek under the name of Lagoon Pass, and indicates that it would be flooded with a similar depression.

The writer will not describe the details of the drainage in this block, as much would be merely a repetition of Professor Holway's excellent work, but will confine his discussion to such additional bits of information derived from a study of this region from a slightly different point of view. The streams draining into Tomales Bay and the Pacific Ocean have certain characteristics in common. From Russian River these streams are, in order, Salmon Creek, Estero Americano, Estero San Antonio, Lagunitas Creek, and one of the small, but interesting streams of the Tamalpais region, Elk Creek. All these streams were flooded a greater or lesser distance

[32] Univ. Calif. Publ. Geog., Vol. 1, No. 1, 1913.
[33] Univ. Calif. Publ., Geog., Vol. 1, No. 3, 1914.

from their mouths as a result of the general subsidence of this region. In most of the streams in the middle portion of the block, wide valley stages are characteristic of their middle courses. Owing to initial differences the streams in the block have been differently affected by the same general movement within the San Francisco-Marin Block during Pleistocene time. Professor Holway concluded that the Lower Russian River was a part of an old stream which existed when the whole region was near sea level, and that Mark West Creek was the direct upstream extension of the Lower River. A glance at the general index map in this publication (See Plate XX) indicates a peculiar condition of Lower Russian River. This portion of the stream is intrenched in Franciscan rocks, but a study of the distribution of the Merced strata in this region and the Pleistocene plain which truncates them near Freestone, indicates that the Pleistocene Russian River attained the essentials of its present course as a consequent East-West stream upon a low coastal plain which was developed upon Merced strata. Merced strata occur at the town of Plantation, a few miles north of Russian River Canyon and at Freestone, only a few miles south of Russian River. The immediate region bordering the Lower Russian River is wholly composed of Franciscan rocks and when one stands upon hills bordering the canyon of Russian River, an old plateau surface is clearly apparent, but this surface is not a perfectly even one and considerable elevations rise above it. The distribution of Merced strata as stated above shows that this old surface was once covered by the muds and sands of a Merced sea. The Pleistocene surface, which is very evident two miles south of the main stream around Freestone (See Plate XXVI) can be traced a few miles north of Freestone to the vicinity of Occidental, where Osmont reports the presence of boring mollusks. To summarize briefly the evidence, a consequent Mark West Russian River of Pleistocene age developed upon a wide low coastal plain. After a slight uplift this stream became intrenched in this plain and since the Merced strata were soft, cut rapidly downward until the old pre-Merced erosion surface which truncated Franciscan rocks was reached. This surface acted as a temporary base level for a time and the stream no longer cut downward but swung from side to side, making a wide valley in the sandstones of the Merced. Later in the Pleistocene, the San Francisco-Marin and the Berkeley Hills blocks were uplifted together and tilted from the west to the east. Since the Mark West Russian River had developed a strong system of tributaries in the mountains northeast of Santa Rosa, its drainage area was the largest of any of the consequent streams within these two blocks. Owing to its greater volume this stream succeeded in maintaining its course against the uptilting of this block during Pleistocene time. Owing to the tilting of this block Santa Rosa Valley became a basin of accumulation and it is the writer's opinion that Laguna de Santa Rosa is ponded as a specific result of the West-East tilt. In other words, there is a neutral zone within this tilted block in which we have a balanced condition as respects drainage.

A part of the story was derived from the study of some of the smaller streams south of Russian River. Salmon Creek has a lower course intrenched in Franciscan rocks, and a middle and upper course which is in a notably wide valley whose surrounding hills are composed of Merced strata and whose valley bottom is underlain at no great depth by rocks of the Franciscan group. A connecting link between the mouth of this stream and its upper and middle course was found about two miles down stream from Bodega town. As one looks across Salmon Creek from this place to the north, well developed stream terraces, a couple of hundred feet above the bottom of the gorge of Salmon Creek are seen. The gorge of Salmon Creek is cut in Franciscan rocks and this stream terrace is likewise composed of Franciscan rocks until its northern boundary is reached, where Merced rocks are encountered at once. This terrace then, is a remnant of a temporary base level, the pre-Merced erosion surface, which was developed upon Franciscan rocks and has been exhumed by Salmon Creek during Pleistocene and Recent times. Salmon Creek was not sufficiently powerful to maintain its course across the entire block. During early Pleistocene time Salmon Creek may have drained the area directly east of Freestone in the vicinity of Sebastopol and Santa Rosa, but the tilting in later Pleistocene time probably diverted the drainage of its eastern headwaters to the east, ponded them somewhat, and they fell an easy prey to the more powerful stream, the Russian River, which succeeded in maintaining a strong course completely across the Berkeley Hills and San Francisco-Marin blocks.

Estero Americano apparently had a similar history. Like Salmon Creek it cut a gorge at its mouth in Franciscan rock. The wide valley stage is seen in the region just east of Valley Ford and in and around Valley Ford the Merced strata rest upon Franciscan rocks exposed in the bottom of the valley. The stream further south, Estero San Antonio and its main tributary, Tomales Creek, exhibit the same characters.

Estero San Antonio and Tomales Creek probably had a drainage that originated in Sonoma Mountain and it is possible that the two old stream channels described under the heading "Undifferentiated Pleistocene" near Waugh School are remnants of this East-West drainage.

When the gorge of Walker Creek is compared to that of Estero San Antonio, one finds that it is far better developed, but its present drainage basin is far less than that of Estero San Antonio. Professor Holway has described the relationship between Walker Creek and San Antonio Creek and has pointed out the ponded area at their present headwaters (See Plate XXIV, Figure 2), and that the present tributaries of San Antonio Creek enter the main stream in certain cases at acute angles whose vertices point toward the source of the stream and not toward its mouth. These anomalous features indicated to Professor Holway that the former course of this drainage was entirely toward the Pacific and that San Antonio Creek of today was in reality the headwaters of a more powerful, ancient Walker Creek. When the Point Reyes and Petaluma quadrangle sheets are placed together Professor Holway's evidence is clearly shown, and if you place a stream line across Chileno Valley and ink the tributaries of San Antonio Creek, the evidence will be even clearer. The writer thinks that the broken backed condition of Pleistocene Walker Creek was, like the changes in other streams previously discussed, due to tilting in late Pleistocene time. That Pleistocene Walker Creek was developed upon a Pleistocene marine plain which graded into a low upland appears probable. That Merced strata once covered the entire valley of the Pleistocene Walker Creek is shown by the small remnant of Merced on the northwest end of Burdell Mountain mass on the south side of San Antonio Creek and the Merced of Spring Hill on the north side of the same stream near its present headwaters. Most of the area south of the Walker-San Antonio Creek valley is now composed of Franciscan rocks and the only suggestion of Merced obtained in this region is the presence of an old erosion surface which appears to rise as one travels from Petaluma southward. This old erosion surface is also seen as one looks eastward from Bolinas Ridge, a mile west from Tocaloma. The physiography of the southern half of the Petaluma Quadrangle was not given detailed study by the writer, but he thinks that this old surface across these ridges indicates that the San Francisco-Marin Block was uplifted higher and given even a greater eastern tilt than the area further north.

A reconnaissance trip southwest on the Point Reyes-Petaluma road which passes through Hick's Valley in the Petaluma Quadrangle and Pomponio Creek yielded some interesting observations. Salmon creek and its tributary, Arroyo Sausal, are cut in solid Franciscan rock, and the tortuous course of these streams when studied upon the combined charts, particularly in the vicinity of Hick's Valley, clearly indicates that they are superimposed streams. Hick's Valley when its bottom is examined is found composed of alluvium which completely surrounds some hills of Franciscan rocks, and this recent material appears peaty in places, thus evidencing a ponding of the upper tributaries of Arroyo Sausal. A low divide separates Hick's Valley drainage from that of Arroyo Nicasio. In the vicinity of the Pacheco School and around Nicasio a similar ponding was observed. At Pacheco School, on a small tributary the ponded condition is still present and marshy ground in a relatively broad valley which is evidently due to recent filling was seen. This tributary and its neighboring tributary as one goes southeast from the schoolhouse are separated by a very low divide and a ponded condition is evident here as well as on the main stream around Nicasio village. As one ascends Nicasio Creek, following up Lucas Valley this ponding disappears and at Big Rock ranch, the stream canyon is in early maturity, as well as Bolinas Creek which heads in this same vicinity. Gallinas and Novata valleys on the bayward slope exhibit the same general characters. Ponding is lacking in both streams and their sidewalls are very steep and meet an alluviated valley due to the last general subsidence in the San Francisco Bay Region very abruptly. It appears probable from these contrasts that Arroyo Sausal and Arroyo Nicasio never had drainage across the entire block during the Pleistocene, but in both cases their upper courses were ponded as an incident of tilting in upper-Pleistocene time.

Looking southeastward from the hilltop about one mile west of Tocaloma, an old plateau surface is visible in the direction of Barnaby Mountain. From the same viewpoint the canyon of Papermill Creek (Lagunitas Creek) appears to be cut in this old plateau and since Middle and Upper Lagunitas Creek (called Papermill Creek in the Petaluma Quadrangle) have a greater drainage area than Arroyo Nicasio, ponding is not so evident along its course. Only a slight suggestion of this effect was noted on its tributary, the San Geronimo Creek, near Mailliard Station.

Elk Creek in Elk Valley of the Sausalito Peninsula has been shown by Professor Holway to exhibit on a small scale essentially the same history of Walker-San Antonio Creek, that is, a Pleistocene stream which once drained the region north and west of Mill Valley Junction in Tiburon Peninsula had its back broken as a result of tilting, and a portion of its waters were spilled out by one of its headwater tributaries.

There is much that the writer has not discovered in the stream drainage of this block, but it appears evident that the tilting of the San Francisco-Marin Block in upper-Pleistocene time, caused similar results in many of the streams of this block, and that these results are not equal because of unequal development of the respective streams.

Petaluma and Santa Rosa valleys were not studied intensively, but the geological mapping of these areas and the physiography of their bounding blocks show that they are not simple synclinal valleys. Faulting may have played a part in their development, at least in a minor way, but another cause may have been effective as well. The marine terrace which was developed during Pleistocene time possibly extended to near the present eastern border of Santa Rosa Valley. When the San Francisco-Marin and Berkeley Hills blocks were given an eastward tilt this eastern border began to receive some drainage from the west. That is, when the backs of Pleistocene Salmon and Tomales creeks were broken, deposition from the west as well as the east began in the ponded area along the former border of an earlier Pleistocene plain.

The velocity of the swift upper portion of Pleistocene Salmon Creek (Santa Rosa Creek) was checked, with the consequent rapid building of great alluvial fans and a southeast tributary of the Pleistocene Russian River, which was strong enough to maintain a course across the uplifted block captured this drainage. The writer is not satisfied that this is a complete explanation, but it is partially correct at least.

Lower Petaluma Valley may have been aided by movements along the fault just southeast of Burdell Mountain, but this valley may have had a history somewhat similar to Santa Rosa Valley as outlined above. A tributary of the Pleistocene Sacramento River captured this drainage and gradually robbed the headwaters of Pleistocene Tomales and Walker creeks. These two valleys are apparently comparatively young, geologically speaking, and developed after the tilting of the mainland block, but before the last event in the Pleistocene, the subsidence which gave rise to San Francisco Bay and the narrow flooded stream valleys of Russian River and its associated streams.

## Tertiary Geologic History

Since no Eocene rocks were recognized in this area the events of this period are not well known. Both Martinez, Lower Eocene, and Tejon, Upper Eocene, rocks occur on Carquinez Straits, a few miles southeast, and Tejon rocks are known in the vicinity of Carneros Creek in the Napa Quadrangle east of Petaluma. The nature of some of the sediments in the Martinez indicates that they were deposited upon the outer edge of the continental shelf. The faunas obtained from these beds developed in such a habitat. It appears probable a large portion of the sites of the Petaluma and

Point Reyes quadrangles was once covered by the sediments of the Martinez and Tejon seas, but these were subsequently eroded. Lawson holds that Point Reyes Peninsula may have been under erosion during the Cretaceous and Eocene, as a long time interval would be required to remove the Franciscan rocks from their granite basement. Cretaceous time is quite sufficient for erosion to have accomplished this result.

No Oligocene rocks were discovered in the environs of Petaluma, but rocks of this age are present a few miles east, in a limited area on Carneros Creek, and in the Contra Costa hills. These rocks could have been deposited over the Point Reyes Triangle and the San Francisco-Marin Block and then eroded during Epi-Oligocene time.

As the areal mapping shows, rocks of Monterey Miocene were deposited upon the Point Reyes Triangle, but they are absent from the San Francisco-Marin Block. However, indications of their presence in the Berkeley Hills Block were found. It appears probable that they were removed during Epi-Miocene time from the San Francisco-Marin Block. During this period the Point Reyes Triangle and the Berkeley Hills Block were relatively lower than the San Francisco-Marin Block, faulting being active along the San Andreas Rift and Tolay Fault.

Records of Upper-Miocene time in the Point Reyes Triangle and the San Francisco-Marin Block are completely obliterated, but it appears probable from a study of the Petaluma formation (Upper Miocene) that the San Francisco-Marin Block was uplifted sufficiently high to form a barrier between the ocean and Petaluma Lake, which probably drained out southward into an arm of the San Pablo sea. During Epi-Miocene time both the Berkeley Hills and the San Francisco-Marin blocks were upthrust into the zone of active erosion and an extensive peneplain was developed.

After this long period of vigorous erosion, the two outer blocks were lowered beneath the sea. Sands and muds were deposited unconformably across the older rocks. During this time great lava floods swept downward from the northeast and actually entered the Merced sea. Volcanoes in the same region also threw forth great volumes of ashes which were deposited in the sea and upon the shore, which was located about the present site of Sonoma Mountain. Between these successive eruptions there were time intervals sufficiently long for soils to form from the lavas and for the growth of great forests of pine and redwood. In other portions of the shore during these time intervals, lakes were formed as attested by freshwater cherts, in the Neohipparion beds. In this lake vegetation accumulated in sufficient amount to form a three foot vein of coal. Whether this lake was directly connected with Lake Orinda of the Berkeley Hills region was not determined, but they were, beyond much doubt, synchronous. This is the period during which *Neohipparion gidleyi* and other Pliocene horses flourished in this region.

Great changes took place at the close of the Pliocene. The two outer blocks were lowered and at least the major portions of these blocks were swept at times by the Pleistocene sea. It is very possible that the Point Reyes Triangle was never completely submerged as a Pleistocene Tomales Bay is evidenced by the deposits of the Millerton formation. The immediate environs of Tamalpais were under active wave erosion or sub-aerial erosion during a portion of Pleistocene time as no Merced is now found within this area. Further north, however, the planation effects of the Pleistocene sea across the soft sandstones and shales of the Merced formation are preserved to this day in the vicinity of Freestone. After a marine plain was developed across the San Francisco-Marin Block, the mainland was slightly uplifted. Short, rapid East-West consequent streams developed across this plain. Later, the mainland blocks were tilted and the velocities of the streams in lower courses were sufficiently accelerated, so that practically all cut gorges of greater or lesser lengths at their mouths. Some of the larger consequent streams, such as the Mark West Russian River and, for a time, Pleistocene Walker Creek, maintained courses across the two mainland blocks. Some of the smaller streams, however, were quickly ponded in their middle courses as a result of this tilting and were early spilled out to the east by way of their head-water tributaries.

That marked climatic changes took place in the San Francisco Bay Region as well as in the Sierra Nevada is shown by two distinct faunas and floras of Pleistocene age. Both the Millerton and Tomales faunas and floras indicate a climate like that of San Diego at the present day. Elsewhere in the Bay Region, as on the Santa Cruz coast, the fauna obtained from one of the marine terraces flourished under conditions similar to that of today. In brief, glacial and interglacial epochs appear to be registered by the marine sequence on the Pacific Coast.

The entire region under discussion was affected by a last general subsidence which gave rise to San Francisco Bay. Drake's Estero and other drowned valleys of all of the streams, as well as the graben of Tomales Bay, evidence this clearly.

## Appendix: Economic Notes

### Manganese and Chrome Deposits

From time to time various reports of the State Mining Bureau have mentioned the occurrence of Manganese ores and Chrome-iron within this area. One of the Manganese localities is on what was formerly known as the Mailliard Ranch. The Manganese ore occurs five-eights to six-eights of a mile south, 45° west, of Mailliard Ranch-house, near Mailliard Station, on the east side of a small stream which is tributary to San Geronimo Creek, in connection with an outcrop of radiolarian chert. Analyses of samples from this locality indicate that the deposit is too siliceous to work economically under present conditions. Chrome-iron ore was also reported from this same vicinity, but no deposit has ever been located. The samples obtained were float specimens found within the serpentine areas of this region.

### Limestones

No workable deposits of limestone suitable for the making of quick-lime were discovered, but a limestone within the Franciscan rocks, which may be suitable as a fertilizer for sour soils, was examined. Mr. Donald G. Martin, assistant farm advisor of Sonoma County, accompanied the writer to this locality, which is three miles south, 20° west, of Petaluma town, in the northwest quarter of Section 16, Township 4 north, 7 west, Mt. Diablo Baseline and Meridian. This locality is on the western spur of a hill, whose elevation is 296 feet. The limestone outcrop occurs at an elevation of 400 feet, which point is near the west line of the section, about 150 feet above the wagon road which cuts the northwestern corner of Section 16. The exposure is about a hundred yards long and 35 to 40 feet in width. There is a three-foot stratum of limy conglomerate in the middle of the section. A small amount of development work had been done on the exposure when the writer visited it on May 18, 1918, and it seems entirely probable that the deposit will yield a tonnage sufficiently large to warrant exploitation. The hills to the north across the valley were carefully examined, but the outcrop does not extend in that direction. The hill to the east was also examined, but no outcrop was discovered. The northern end of the deposit stops quite abruptly and the writer is inclined to think that a cross-fault may terminate the deposition to north. The southerly extension of this deposit disappears gradually as one descends the hill slope. A cross-cut should be made at the southern end to determine whether this gradual disappearance is due to a lense structure or merely to a thickening of the soil cover at that place.

Another deposit occurs on the Jacobsen ranch, near the southeast corner of the northwest quarter of Section 9. An old limekiln at this place, long abandoned, shows that this deposit was opened years ago. The limestone at this place is too gravelly to be of value even as a source of ground limestone. Another small deposit occurs in Section 17 on the west side of the Point Reyes-Petaluma-Red Hill road, but the deposit is cut off by serpentine and schist and has apparently been intruded by the serpentine. The deposit is too small to be economic. All of these occurrences of limestone are closely associated with typical cherts and schists of the Franciscan group, and the writer has assigned them to it on this account. The limestone deposit in Section 16 is an unusual type of rock in that it is associated with conglomerate and appears to be a beach deposit. Certain obscure markings in this limestone suggest that it is composed of comminuted shell fragments. The deposit should be carefully searched for fossils.

### Clays and Coal

Workable deposits of clays suitable for brick-making or tile are common in the outcrops of the Petaluma formation, near Eureka School. Excellent exposures of these clays occur in an eastern branch of Tolay Creek, a mile and a half south, 30° east, of Eureka School, and in the creek a mile and a half east of Adobe Fort. Other exposures within this same formation occur in the lower slopes of Sonoma Mountain. These deposits are located sufficiently close to roads and railroads to receive economic consideration. As the Santa Rosa Quadrangle shows, this region is the type locality of the "basalt block," as abandoned quarries occur in large numbers throughout the Santa Rosa and Petaluma quadrangles. These quarries were abandoned owing to the increasing use of concrete and asphaltic concrete roads. Many excellent basaltic outcrops have been exposed through these abandoned workings. Some coal seams occur in the Neohipparion gidleyi beds of the Sonoma group on its western face, but these deposits have not proved economic, although Mrs. Thompson reports that the coal obtained from the prospect at Lawlor's ranch was of excellent quality. Samples of coals and clays were collected from the western side of Bennett Mountain by Mr. W. W. Watts of the California State Mining Bureau, several years ago. These old workings are now closed, but the writer doubts their economic value.

### Oil

The bituminous sandstones as reported in the Sonoma group indicates the probable occurrence of Monterey shale beneath the basalts and tuffs of the Sonoma group and the sands and clays of the Petaluma formation. Whether oil might be obtained in this region is problematical. The writer however, is not inclined to condemn this area entirely, and it may warrant exploitation in the future. The possible area which might be exploited is essentially the region in which the shales and sandstones of the Petaluma formation are mapped. This possible oil region might be widened slightly on the northeast, but the Tolay fault definitely limits the possibilities of this region on the southwest side. This is nicely shown in the geological cross-section along the line C-D, Petaluma and Santa Rosa quadrangles. As explained above, it is the writer's opinion that the Monterey formation, which is probably beneath the Petaluma formation in this region, was preserved from erosion by being dropped below base-level along the Tolay fault at the end of the Miocene or during Epi-Miocene time. As will be seen from the geological map, the structures within the Petaluma formation are, as a rule, small, and exploitation for oil in this region would be attended with considerable expense. The best location is the anticline north of the Eureka School along the road between the Eureka School and Adobe Fort.

## Water Resources

### artesian

The synclinal structure at the head of Tolay Creek is a fold in the Petaluma formation and it appears quite possible that moderately deep wells sunk in this syncline might obtain water, since this formation has abundant coarse sandstones to act as water reservoirs, and good stiff impervious clays overlying these sandstones, acting as a cap rock. It is possible that water might be obtained from the same synclines about two miles northwest of Adobe Fort in the Santa Rosa Quadrangle. The possibilities for artesian water in the Petaluma Quadrangle are very slight, as most of this region is underlain at no great depth by the non-water-bearing rocks of the Franciscan group. This group has been tested in many places within the Santa Rosa Quadrangle and practically all the wells sunk are failures. The same statement applies to the southwestern corner of the Santa Rosa Quadrangle and most of the Point Reyes Quadrangle as well. Suitable structures in Sonoma and the Mayacamas Mountains were not recognized. Time did not permit a thorough exploration of the artesian possibilities of Santa Rosa Valley.

### ground

One of the interesting results of the investigation of the Merced deposits around Petaluma was the recognition of the intimate relations between ground-water and the unconsolidated sandstone of this Merced group. The Merced sandstones in and around Petaluma vary from 50 to 200 feet in thickness and rest upon the relatively impervious rocks of the Franciscan group. The pore space in these sandstones is large and hence much water can be reservoired within them. If it were not for this fact the numerous small chicken ranches around Petaluma on the north and west, as well as around Penn Grove, would be failures, owing to the lack of water. Nearly all these places have shallow wells sunk in the Merced sandstone and can obtain a moderate but independent supply of water. The light sandy soil yielded by the Merced is warmed readily by the spring sun and, with aid of fertilizer, produces fair yields of green crops necessary for the fowls. A third factor in making Petaluma a poultry center is due to cheap transportation provided by small river steamers which navigate Petaluma Creek, a stream drowned by the subsidence of the Bay Region.

The ground-water relations of the Merced are splendidly exemplified in Spring Hill, a half mile west of Marin School, about three miles west of Petaluma town. (See Geological Cross-section along the line A-B, Petaluma and Santa Rosa Quadrangles.) As will be seen from this section the deposits of Merced rest upon basalt, which in turn rests upon Franciscan rocks. This relationship is nicely shown in Plate XXVIII, Figure 1. The Merced sandstone resting upon this basaltic flow is from 50 to 100 feet in thickness, and all around Spring Hill at the contact between the Merced and the basalt numerous springs occur. The dwellers on Spring Hill are thus favored by Nature, who, not satisfied with the impervious Franciscan beds, laid down upon them an excellent grouting of hard basalt, 50 to 100 feet in thickness, and then the waves of the Pliocene sea deposited coarse grained Merced sands, thus providing a sponge-like mass for the favored residents of this beautiful hill country. The dwellers within Franciscan areas in this region must be content with obtaining a small water supply from the shallow alluvium of small valleys, or pipe it from Sonoma Mountain.

The city of Petaluma has its water reservoir on the southwestern slope of Sonoma Mountain in the Santa Rosa Quadrangle, directly within the Hayward Rift. Although the writer did not verify this condition, it seems probable they have enlarged and modified one of the fault-sag ponds along this rift by damming its southeast side. This rift, like the San Andreas Rift, lends itself particularly well for reservoir sites, as it crosses the normal courses of the streams on the mountain slopes and makes their diversion an easy and natural one along its trend. At the same time the city of Petaluma should provide an adequate secondary reservoir as insurance against earthquake movement along this zone of recent seismic activities.

## Explanation of Plates

### PLATE XIX

The sketch model of the Central Coast Ranges of California represented upon this plate is thought to be correct to the extent of giving a reasonably accurate impression of the general features of the central coast region of California. No reliable topographic maps exist for the major portion of the area shown. The exact elevation of the mountains of the extreme northern portion is known in relatively few instances; elevations south of the Golden Gate are fairly accurate. From photograph by Professor R. S. Holway, Geography Department, Univ. of Calif.

### PLATE XX

Photograph of sketch model and index map of San Francisco Bay Region and the Russian River, prepared under the direction of Professor R. S. Holway, Geography Department, Univ. of California. This picture was kindly loaned by Professor Holway.

### PLATE XXI

Figure 1. View from Tomales-Dillon's Beach road about two miles west of Tomales, looking northwest, showing Merced sandstone in the foreground and marine plain on the sky-line. Elevation about 500 feet.

Figure 2. View from Tomales-Dillon's Beach road about two miles west of Tomales looking west, showing Tomales Point and the entrance to Tomales Bay. The small hill, Tom's Point, surrounded by water near the extreme left of the picture is composed of Pleistocene beds which dip to the east about ten degrees.

### PLATE XXII

Figure 1. View from a hill about two miles west of Tomales showing east end of tilted marine plain, looking northeast toward Santa Rosa. This plain is cut in Merced Pliocene rocks. Franciscan rocks are exposed in deeper stream canyons which are incised in this plain.

Figure 2. View from Tomales-Dillon's Beach road looking west, about one and three-quarter miles west of Tomales showing coarse conglomeratic Merced sandstone dipping about 10°-15° to the northeast.

## PLATE XXIII

Figure 1. View of Pleistocene terrace opposite Inverness Yacht Club. The Tomales formation rests with marked unconformity upon the Millerton formation in this headland.

Figure 2. View of Tomales Bay looking northwest. Tom's Point in the distance, Tomales Point beyond. On the right is a small terrace covered by the Tomales formation.

## PLATE XXIV

Figure 1. View from the west flanks of Sonoma Mountain, Lawler Ranch: Tuffs and basalt (?) in foreground; Petaluma lake beds which yielded Corbicula californica in the middle ground; Petaluma and Petaluma Valley in the background. The even sky line in part represents a marine terrace on right of picture.

Figure 2. View of Walker and San Antonio Creek divides, about five miles southwest of Petaluma showing the present divide between these two streams. The Merced formation covers the divide one mile northeast of the viewpoint of the picture. The rocks composing the hills shown in this view are all Franciscan, but the valley of the Pleistocene San Antonio Creek, which once drained to Tomales Bay was determined upon a Pleistocene marine terrace in the incoherent sandstone of the Merced formation.

## PLATE XXV

Figure 1. View looking north from divide fan about three miles west of Kenwood. Mt. Hood, which is not shown, is to the right of this view.

Figure 2. General view from divide fan three miles northwest of Kenwood, showing Mt. Hood and a sharp peak on the south flanks of this mountain. This peak is due to steeply dipping tuff-breccia beds.

## PLATE XXVI

Figure 1. Looking across Salmon Creek, three-fourths of a mile southwest of Freestone. Note horizontal Merced strata. Franciscan rocks occur in creek bed and by barn a quarter of a mile up stream.

Figure 2. Looking northeast from Freestone across Salmon Creek. Fair fossil collecting in creek bed on left of picture. Sonoma tuff stratum is exposed near the top of the hill in the middle of the picture.

## PLATE XXVII

Figure 1. View looking northwest across the mouth of Walker Creek. Merced strata caps the hills on the sky-line, but Walker Creek Canyon is cut chiefly in Franciscan rocks.

Figure 2. View of Tomales Town, which is located upon a small tributary of Walker Creek, Keys Creek, which has not yet succeeded in cutting into the hard Franciscan rocks and its relatively wide, shallow, valley is determined by the old erosion surface of pre-Merced age. The hills behind Tomales Church are composed of Merced strata.

## PLATE XXVIII

Figure 1. Basalt in foreground; Merced cap on top of Spring Hill, three-quarters of a mile west of Marin School, Petaluma Quadrangle. The basalt in turn rests upon Franciscan rocks.

Figure 2. Tuffaceous Merced resting on basalt, corner Stanley and Howard Sts., Petaluma.

## PLATE XXIX

Figure 1. View looking southeast along the Hayward fault line from highest point in road about one and one-half miles northwest of Petaluma reservoir. Fault sag pond in the middle ground. Petaluma reservoir in distance.

Figure 2. Flanks of Sonoma Mountain. Plateau determined by hard, resistant tuff-breccia and lava flows overlain by softer shales and sandstones of the Neohipparion beds of Lawler Ranch, a quarter of a mile away.

## PLATE XXX

Figure 1. Sonoma mountain top; a lava plateau.

Figure 2. Looking southwest across the top of Sonoma Mountain.

## PLATE XXXI

Figure 1. Petrified forest, five miles from Calistoga. View showing "queen of the forest," a petrified redwood tree, which was once almost entirely covered by volcanic tuff.

Figure 2. A smaller, but more nearly perfect specimen, showing the nature of occurrence in this interesting fossil forest. The tree in figure 1, the tree here figured, and the other trees which have been excavated all lie in the same general direction, tops toward the southwest, and roots of the trees upturned toward the northeast, thus indicating the direction from which the tuff-breccia mud flow which engulfed these trees came.

## PLATE XXXII

Figure 1. A view looking southwest toward the head of Tomales Bay, Hog Island, center. A fault sag pond occurs in the middle ground about twenty-five feet above sea level.

Figure 2. View looking north from Dillon's Beach, showing a small remnant of Pleistocene Terrace.

## PLATE XXXIII

Figure 1. Unconformity between Tomales and Millerton formations, one and three-quarters miles northwest of Millerton.

Figure 2. View showing unconformity between Millerton and Tomales Pleistocene formations, one and three-quarters miles northwest of Millerton. Upper clays are horizontal.

## PLATE XXXIV

Figure 1. Rifted Pleistocene shale, northwest side of Tom's Point.

Figure 2. Pleistocene shale on northwest side of Tom's Point, east of figure 1. The beds which are dipping away from the observer to the northeast are also cut by another fault along the San Andreas Rift.

## PLATE XXXV

Figure 1. Pleistocene shale resting on conglomerate, one and three-quarters miles northwest of Millerton.

Figure 2. Pleistocene shale and conglomerate at west end of headland, one and three-quarters miles northwest of Millerton.

## PLATE XXXVI

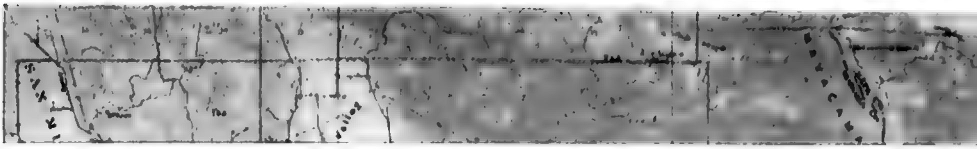
Figure 1. Triplicate Rift Lines. View from one and one-half miles southeast of Petaluma Reservoir looking northwest. A fault shelf is seen in lower right, a kernbut in center and a notched sky-line marking the three lines of rifting in the background.

Figure 2. Looking southeast along the Haywood Fault line two miles from Petaluma Reservoir; rift zone is marked by three lines, two of which are indicated by a kernbut, a wooded hill in the right center of the picture.

## PLATE XXXVII

Figure 1. Sonoma Mountain, Hayward Fault. Looking northwest from a point one mile southeast of the Petaluma reservoir. Note the kernbut in the sky-line. The Petaluma reservoir is located in the distance just above the heavy woods. A fault scarp appears in the middle ground and a long narrow kernbut is seen west of this scarp. Faulting in this region is marked by two and sometimes three rift lines.

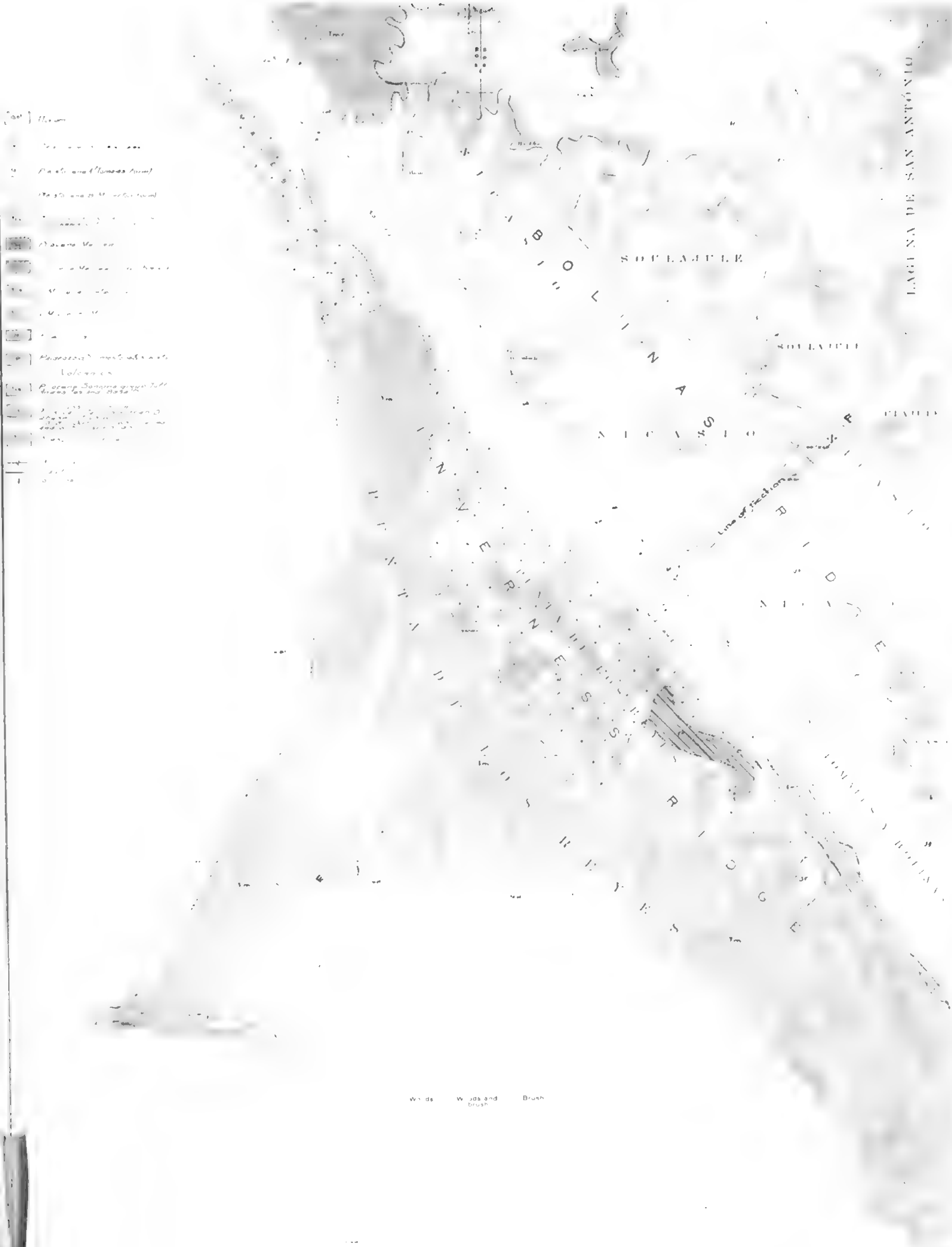
Figure 2. Looking southeast along the Hayward Fault line two eighth of a mile southeast of Petaluma Reservoir. The Hayward rift beheaded the stream once draining across the surface, and its drainage is now southwest by way of Rodger's Creek.



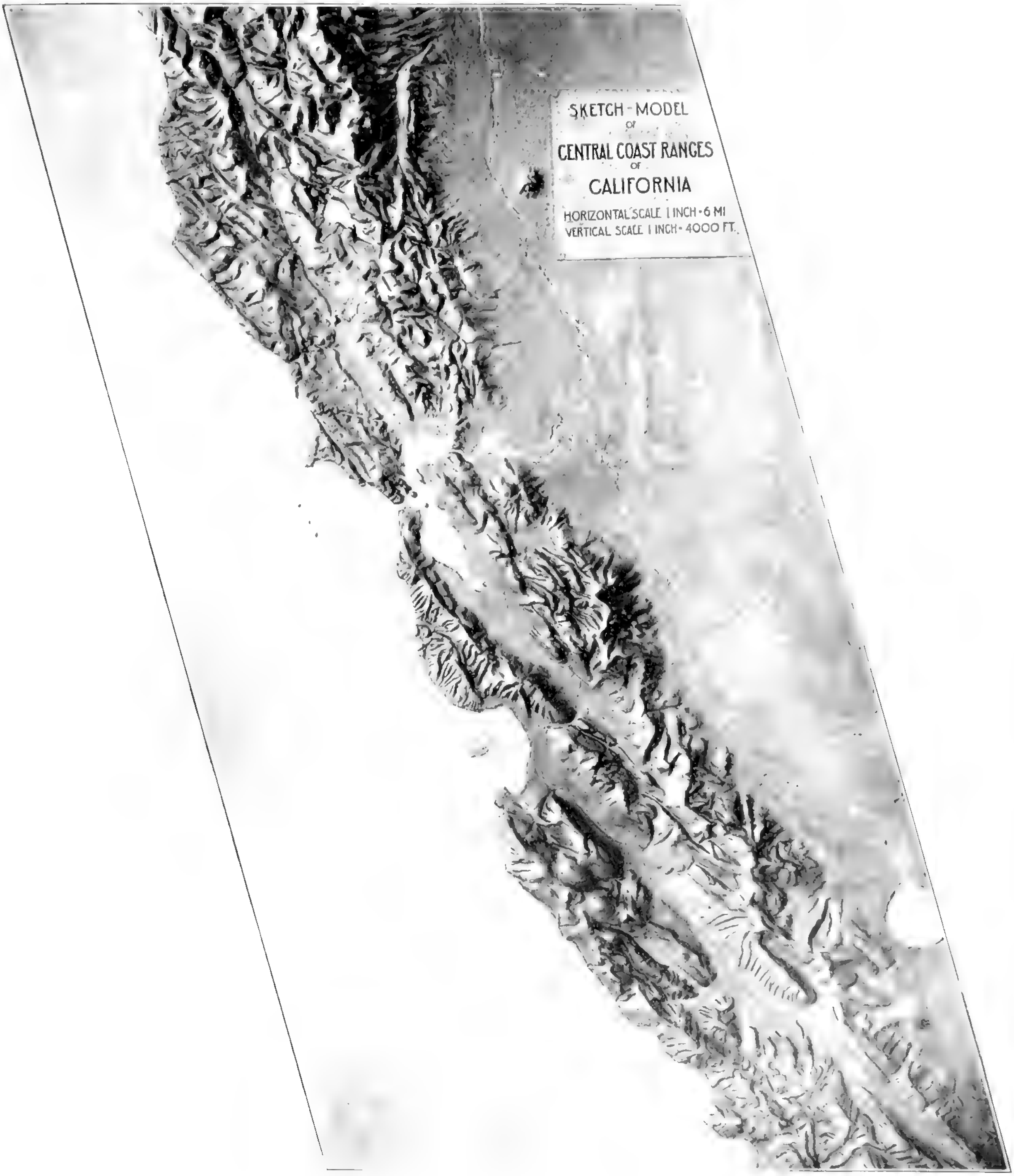
Geology after F M Anderson, with additions by R E Dickerson.


GEOLOGICAL MAP SHOWING THE DISTRIBUTION OF THE TERTIARY FORMATIONS IN THE SANTA ROSA AND PETALUMA QUADRANGLES.

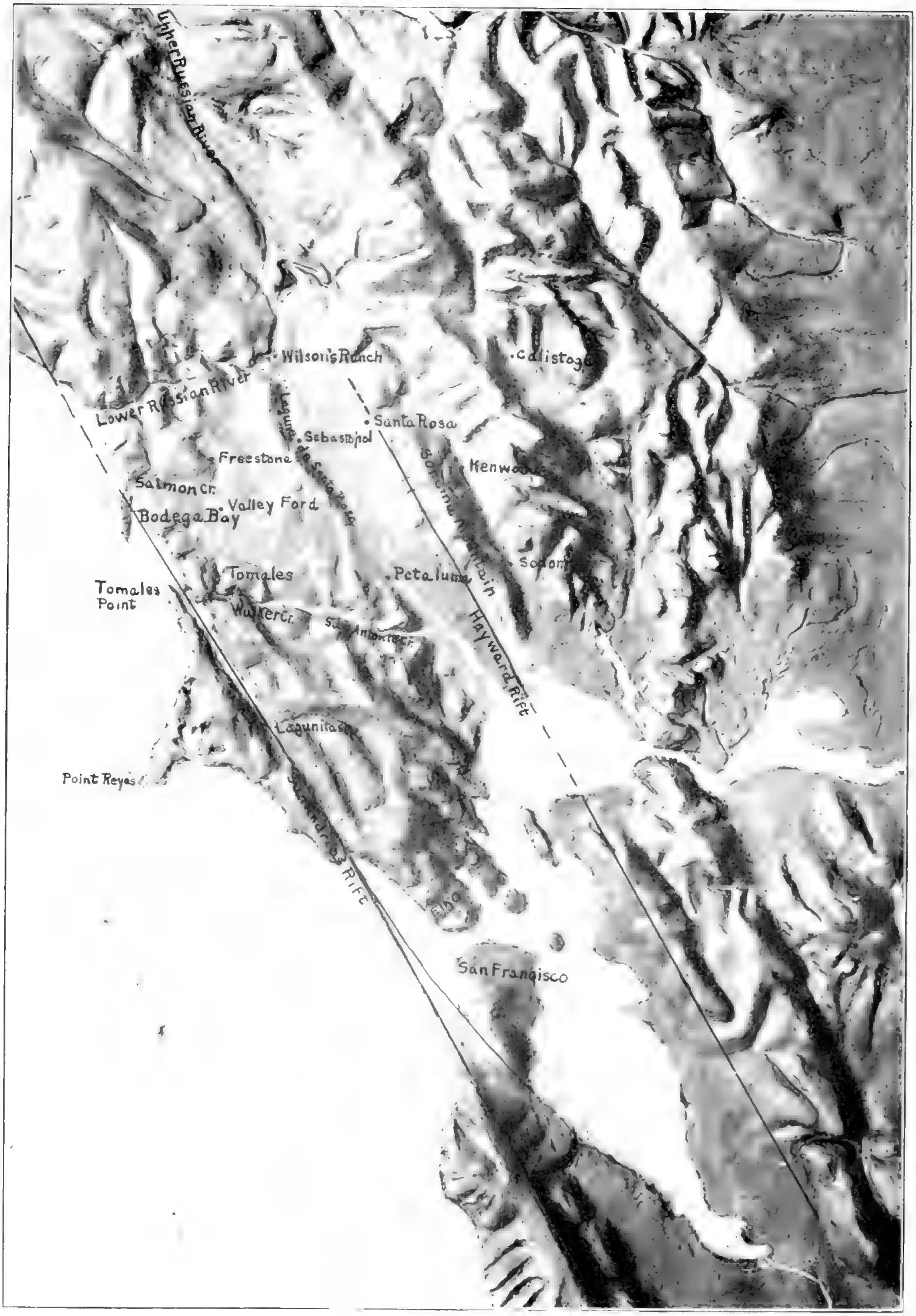
Geology by R.E. Dickerson




RECONNAISSANCE GEOLOGICAL MAP OF THE [illegible] TRIANGLE
*Geology after F. M. Anderson, with additions by R. E. Dickerson.*




Sketch model of the Central Coast Ranges of California




Photograph of sketch model and index map of San Francisco Bay Region and the Russian River.

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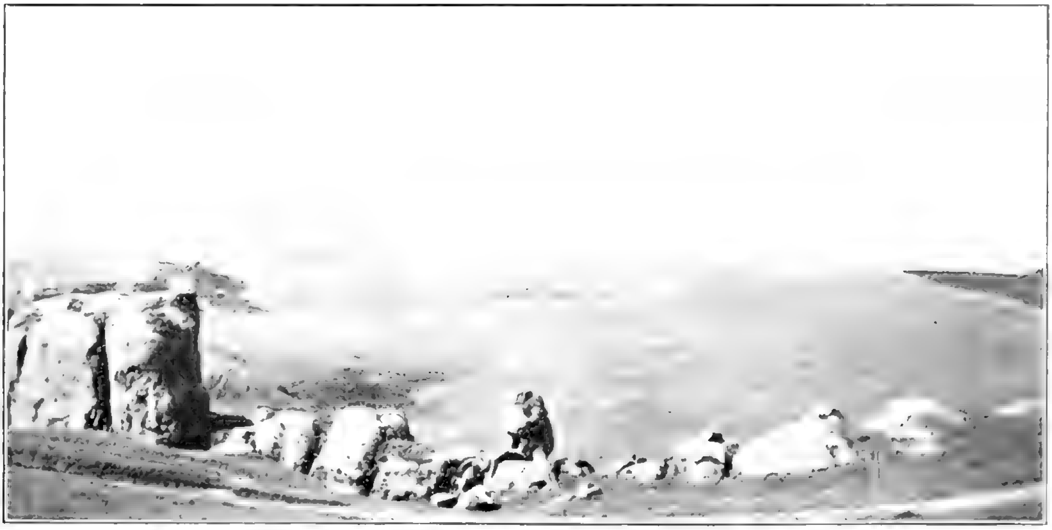

Fig. 2. View from Tomales-Dillon's Beach road about two miles west of Tomales looking west, showing Tomales Point and the entrance to Tomales Bay.

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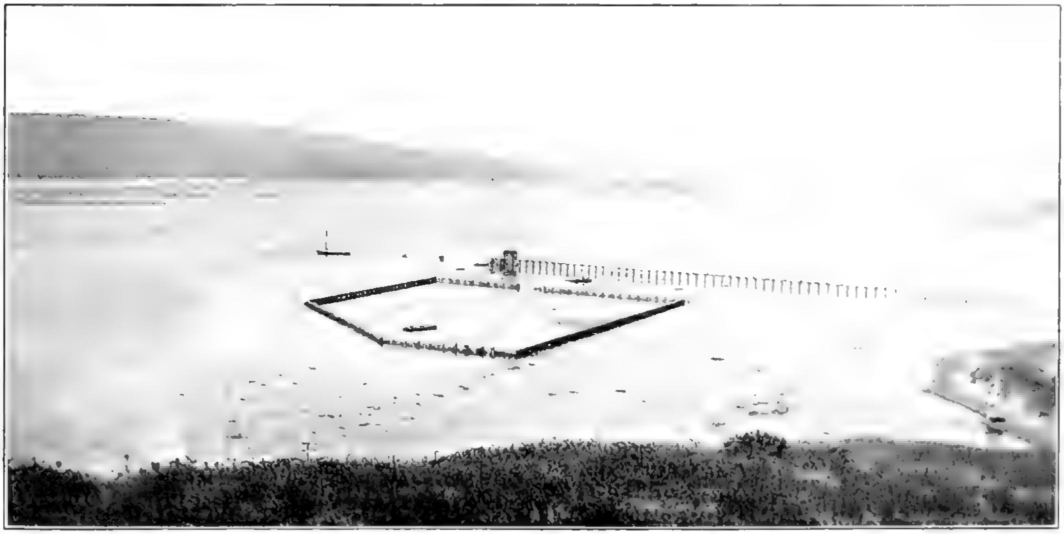


Fig. 2. View of Tomales Bay looking northwest. Tom's Point in the distance, Tomales Point beyond. On the right is a small terrace covered by the Tomales formation.

Fig. 1. View from the west flanks of Sonoma Mountain, Lawler Ranch.

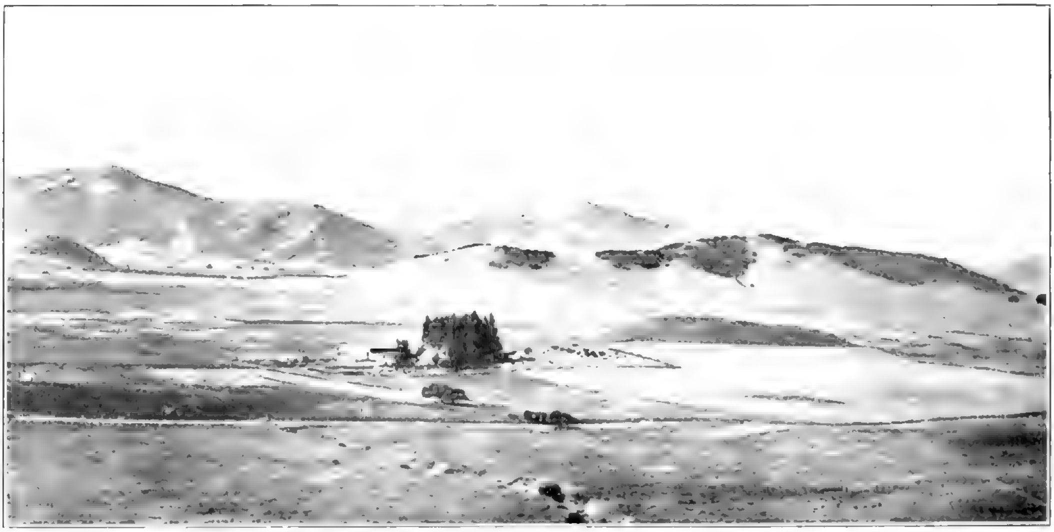
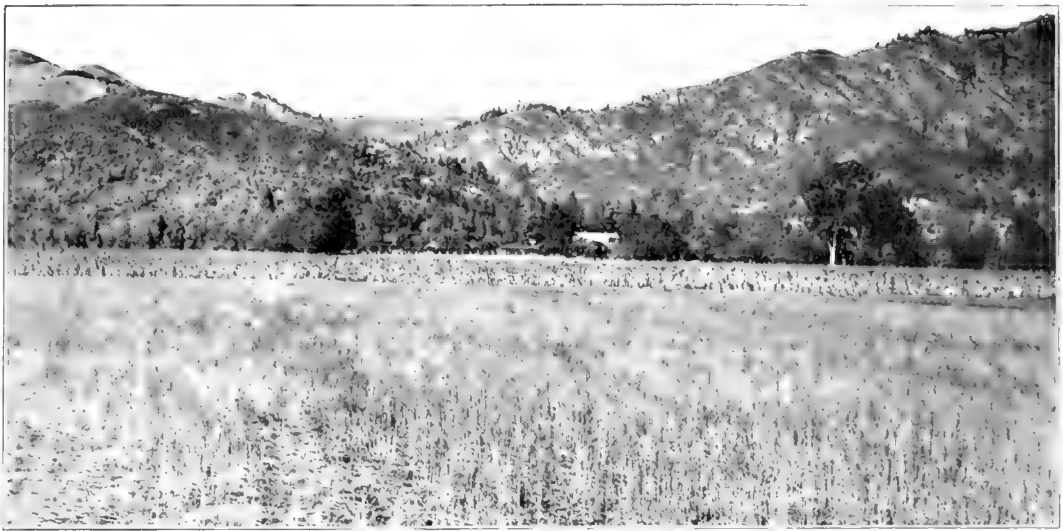


Fig. 2. View of Walker and San Antonio Creek divides, about five miles southwest of Petaluma showing the present divide between these two streams.



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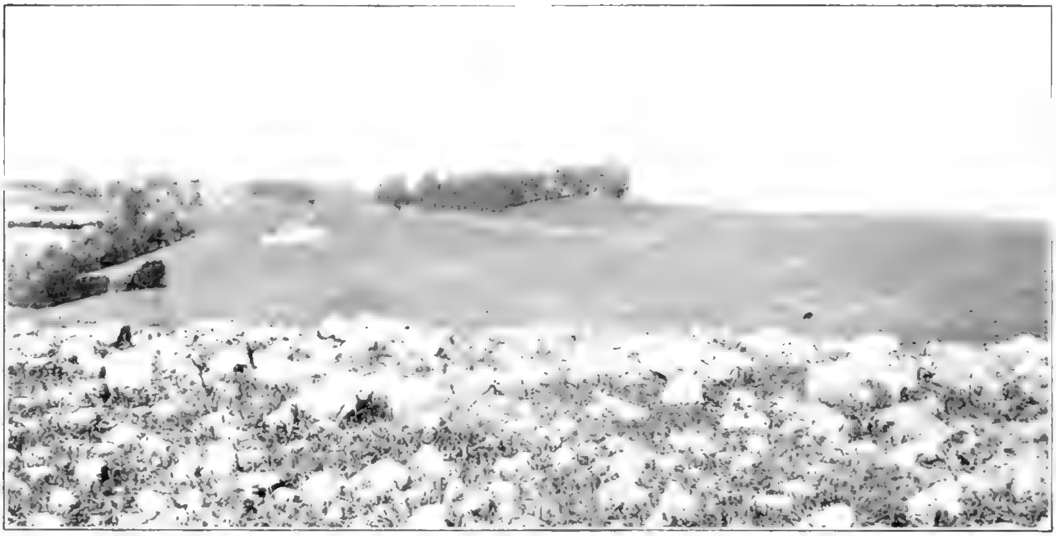

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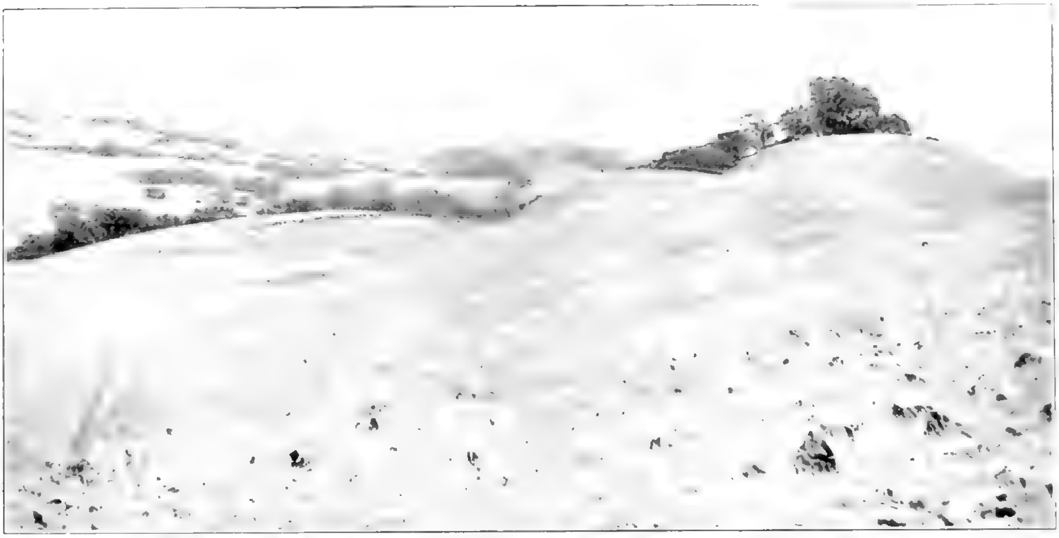

Fig. 1. View looking southeast along the Hayward fault line from highest point in road about one and one-half miles northwest of Petaluma reservoir. Fault sag pond in the middle ground. Petaluma reservoir in distance.

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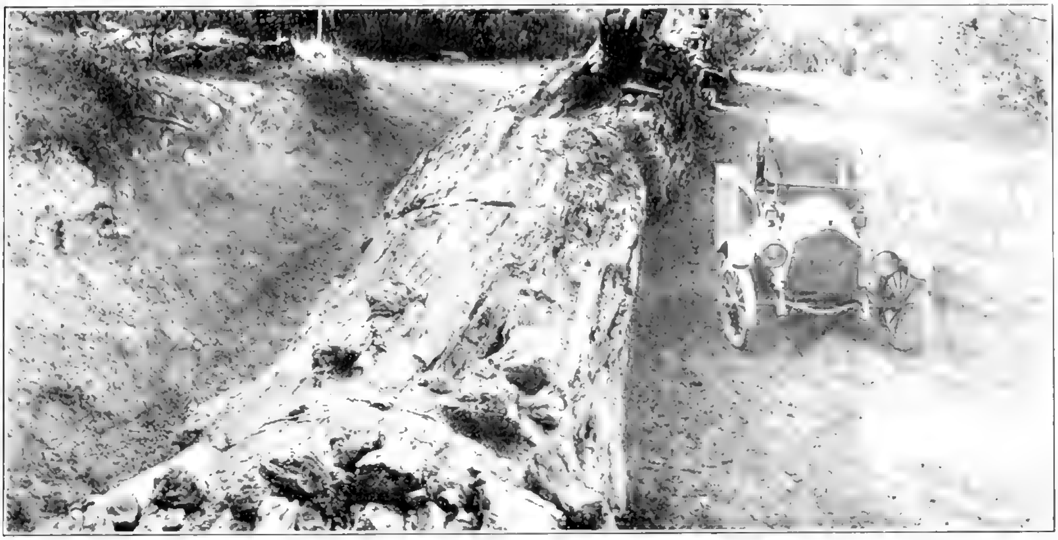

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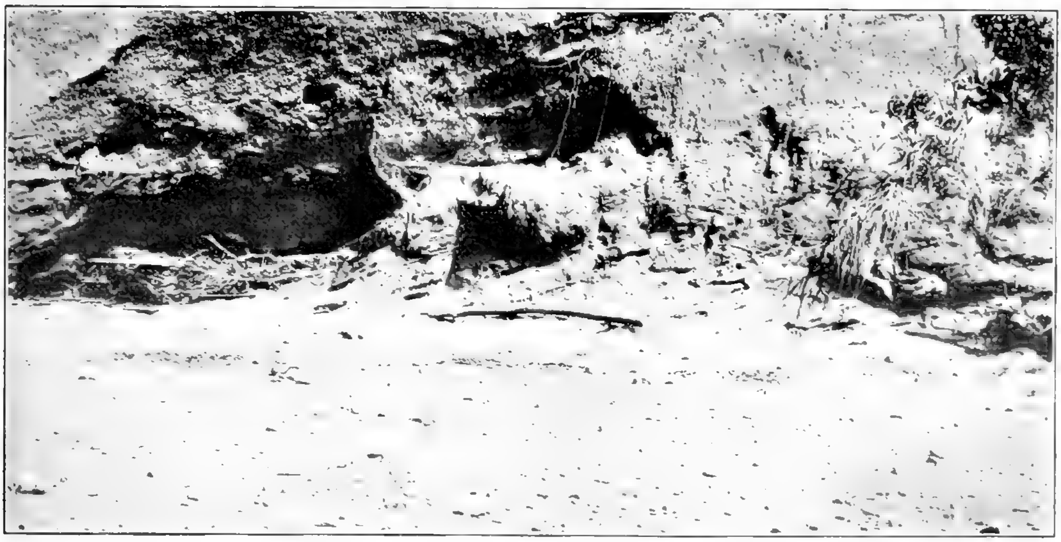

Fig. 2. View showing unconformity between Millerton and Tomales Pleistocene formations, one and three-quarters miles northwest of Millerton. Upper clays are horizontal.

Fig. 1. Rifted Pleistocene shale, northwest side of Tom's Point.

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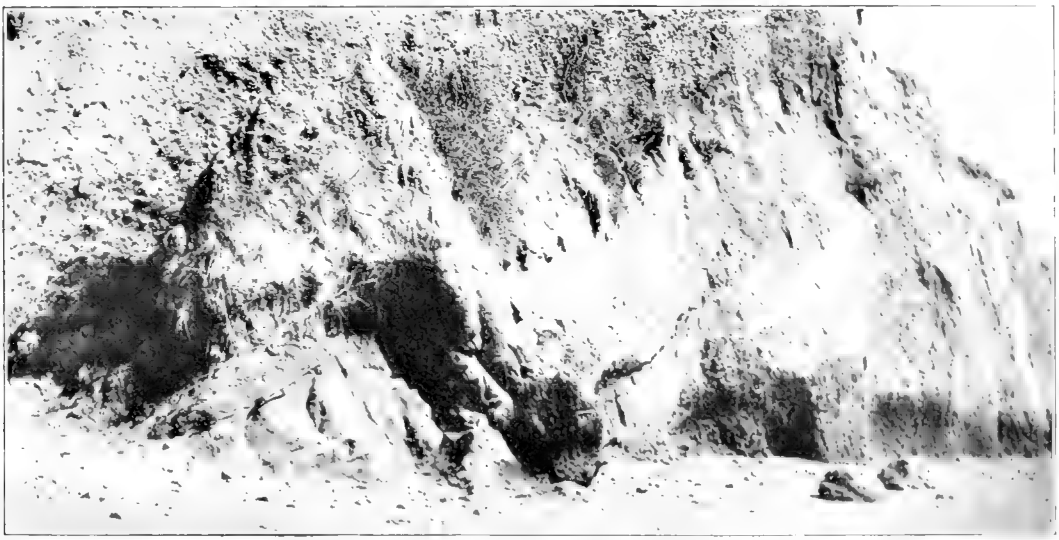

Fig. 2. Pleistocene shale on northwest side of Tom's Point, east of figure 1. The beds which are dipping away from the observer to the northeast are also cut by another fault along the San Andreas Rift.

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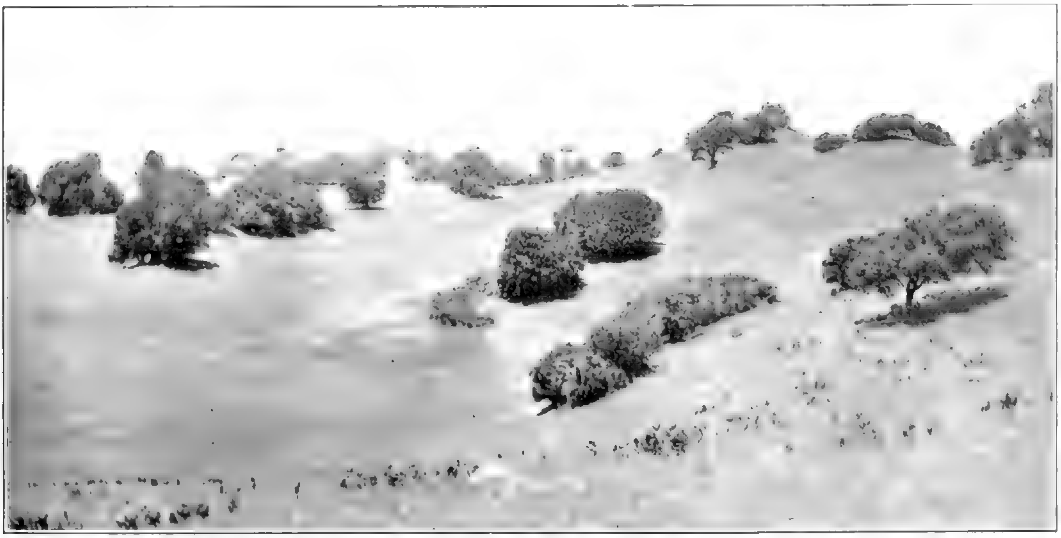
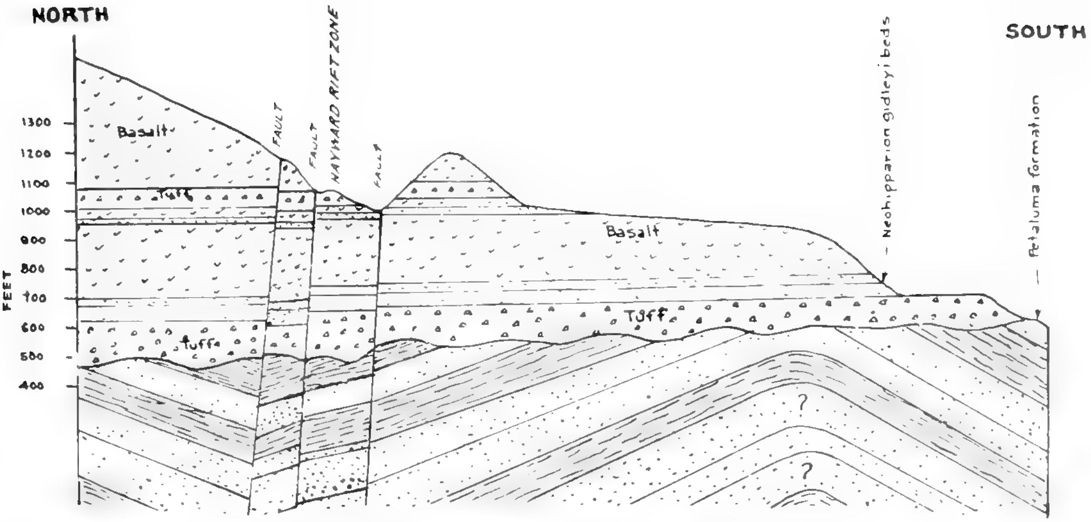
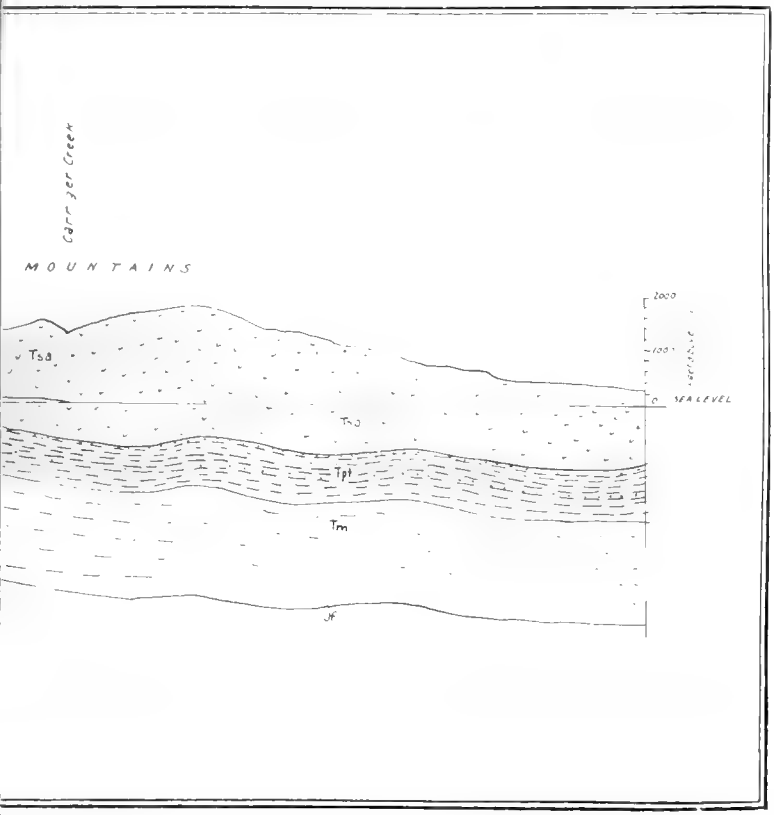
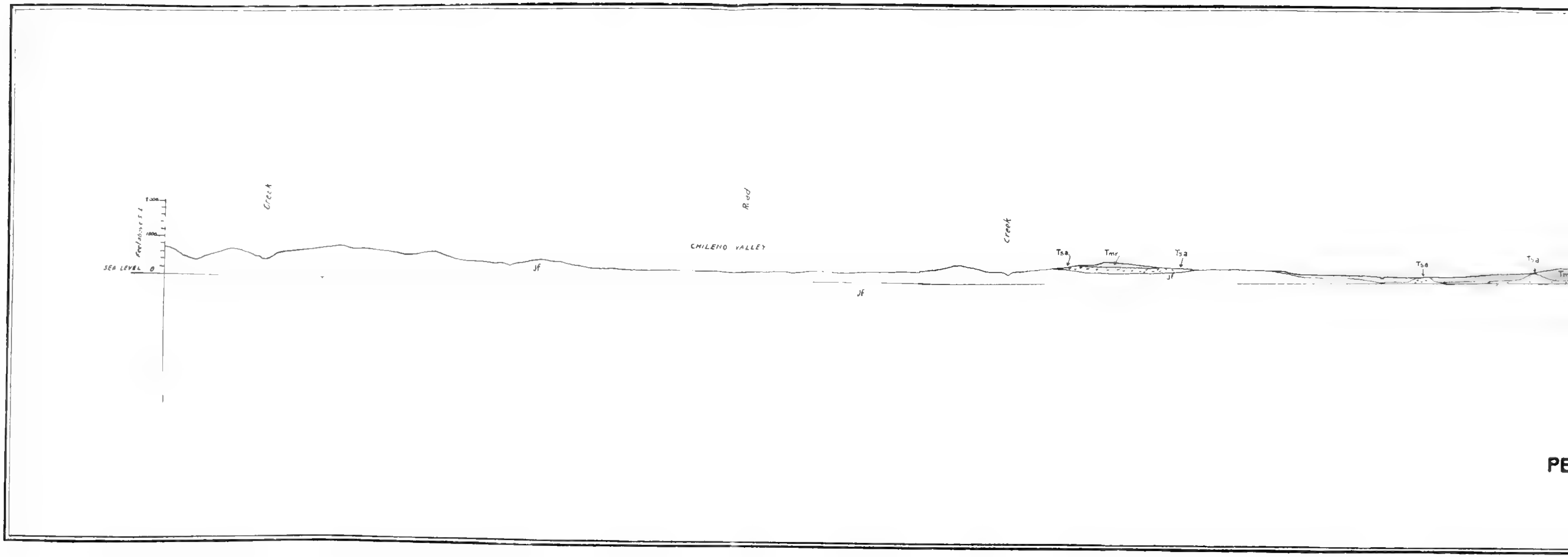


Fig. 2. A surface in late maturity. Sonoma Mountain one-eighth of a mile southeast of Petaluma Reservoir. The Hayward rift beheaded the stream once draining across the surface and its drainage is now southwest by way of Rodger's Creek.

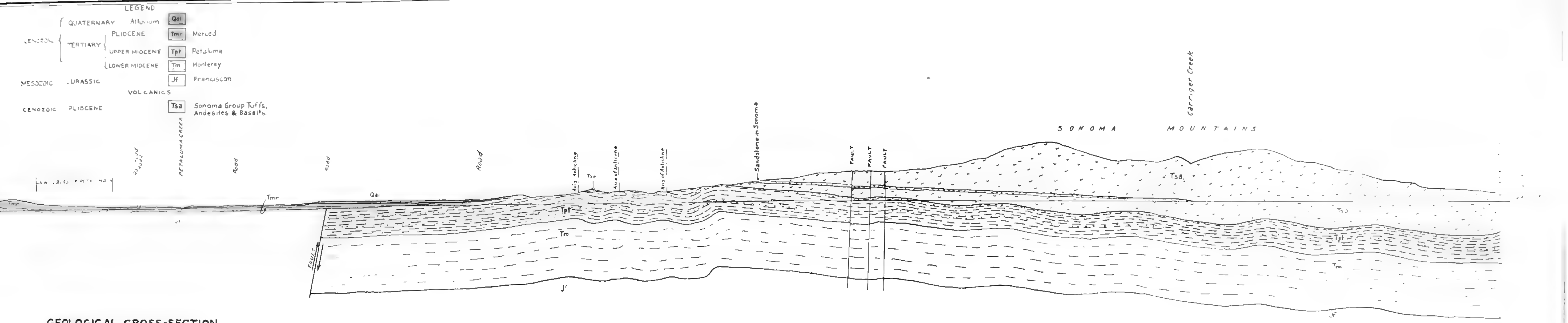



N.-S. HYPOTHETICAL SKETCH SECTION
THROUGH
NEOHIPPARION GIDLEYI BEDS
LAWLER'S R'CH., SANTA ROSA QUADRANGLE
SONOMA Co., CAL.
GEOLOGY BY R.E. DICKERSON

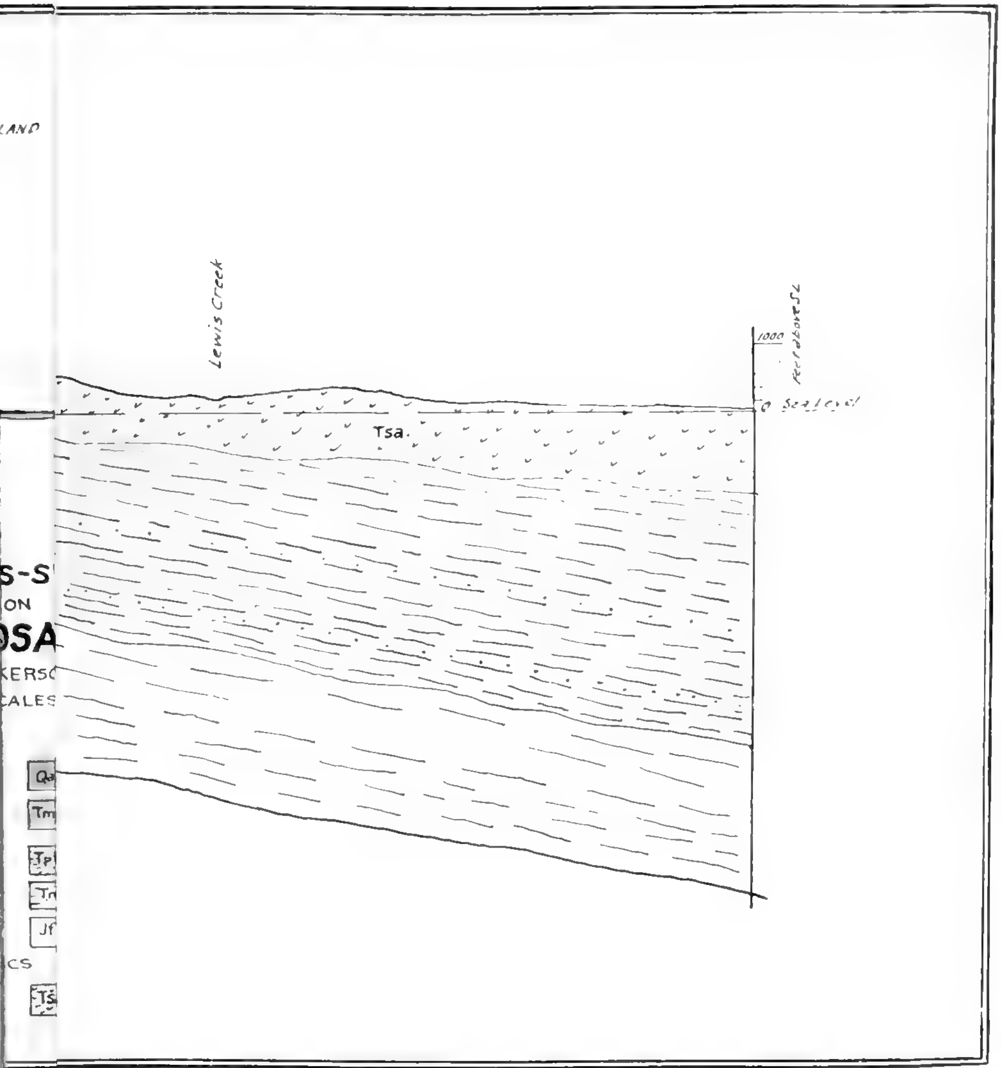

MOUNTAINS
2000
SEA LEVEL
Tpt
Tm

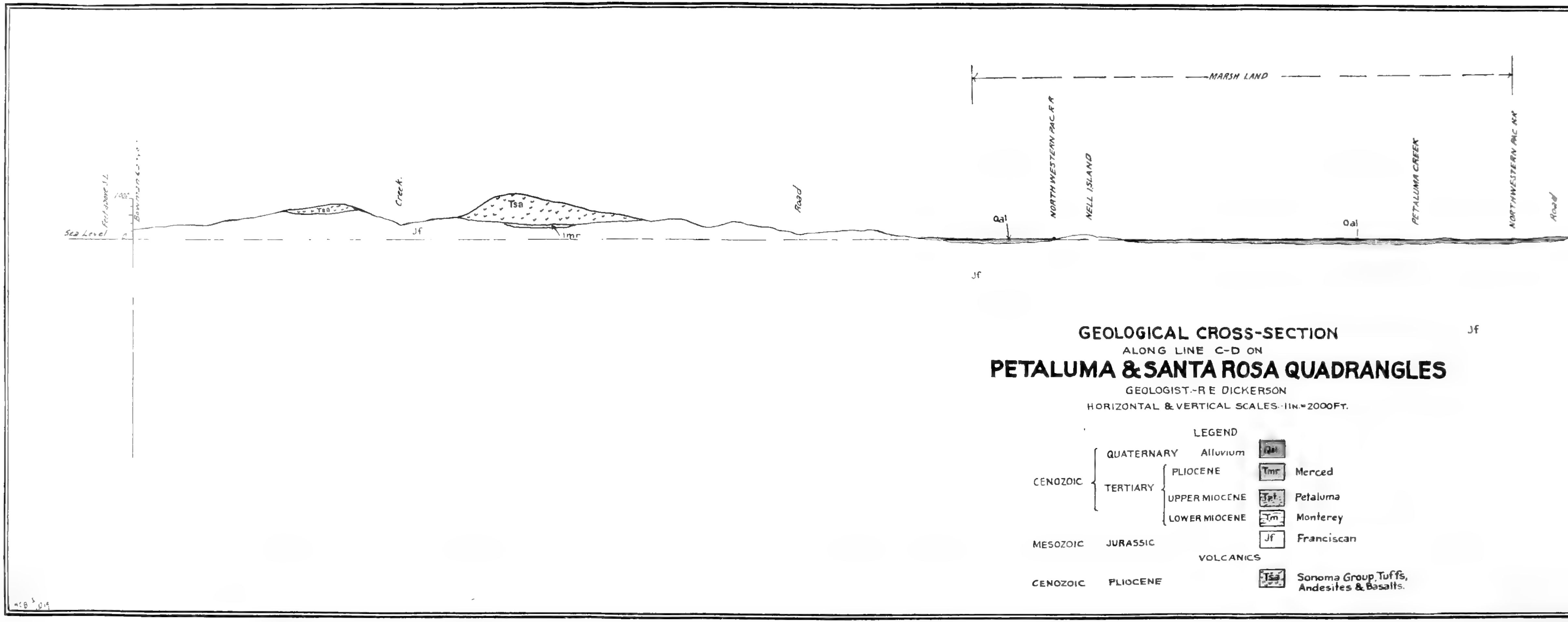

Creek
Road
Creek
CHILENO VALLEY
SEA LEVEL
Tsa
Tmr
Tsa
Tsa
Tsa
Jf
Jf
Jf

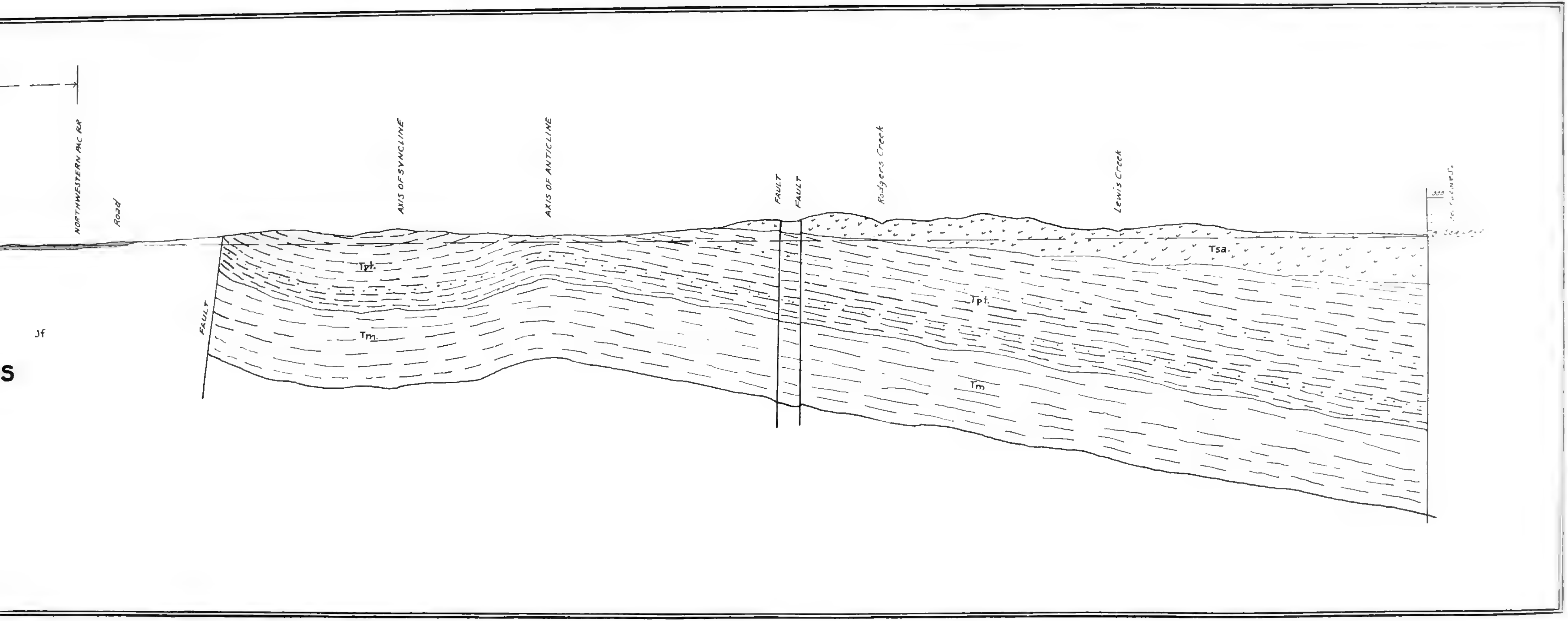
PE




GEOLOGICAL CROSS-SECTION
ALONG LINE A-B ON
PETALUMA & SANTA ROSA QUADRANGLES
GEOLOGIST · R E DICKERSON
HORIZONTAL & VERTICAL SCALES · 1 IN = 2000 FT

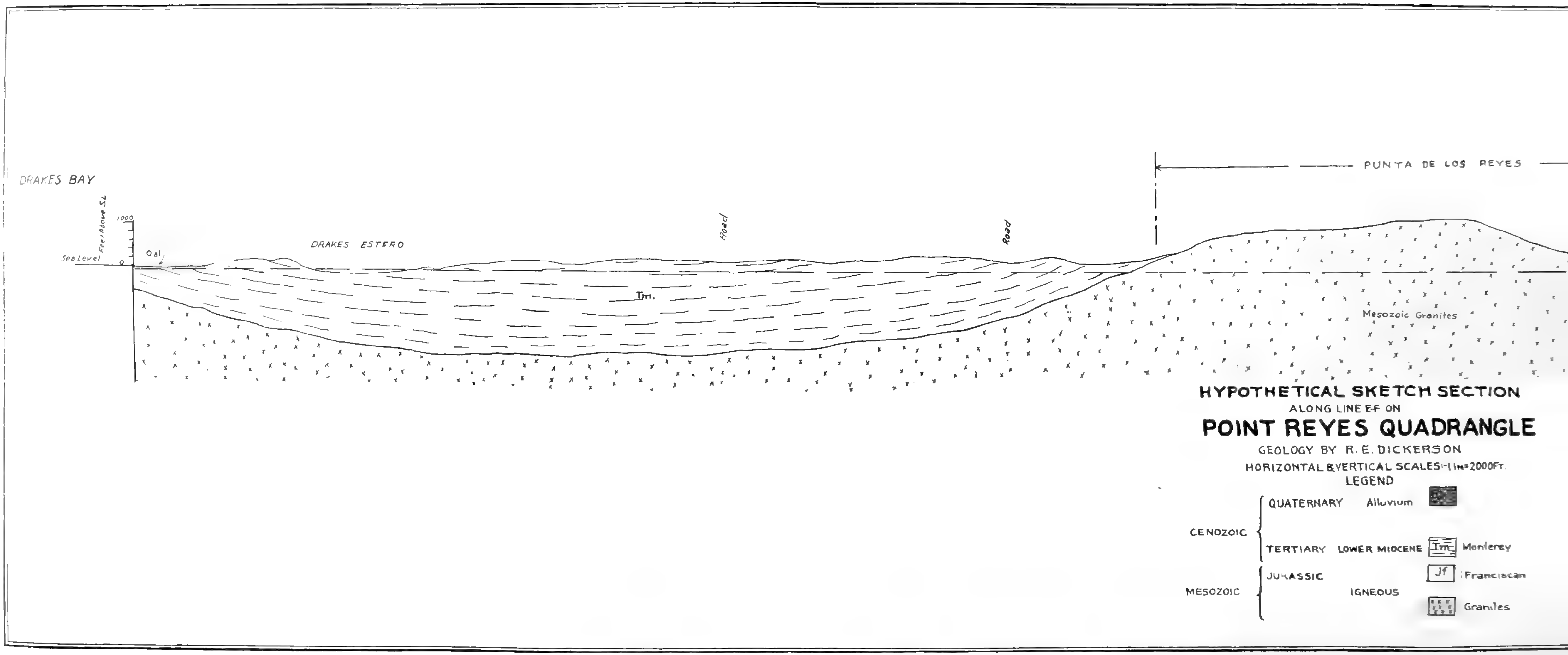

Lewis Creek
1000
Tsa
0 Sea level

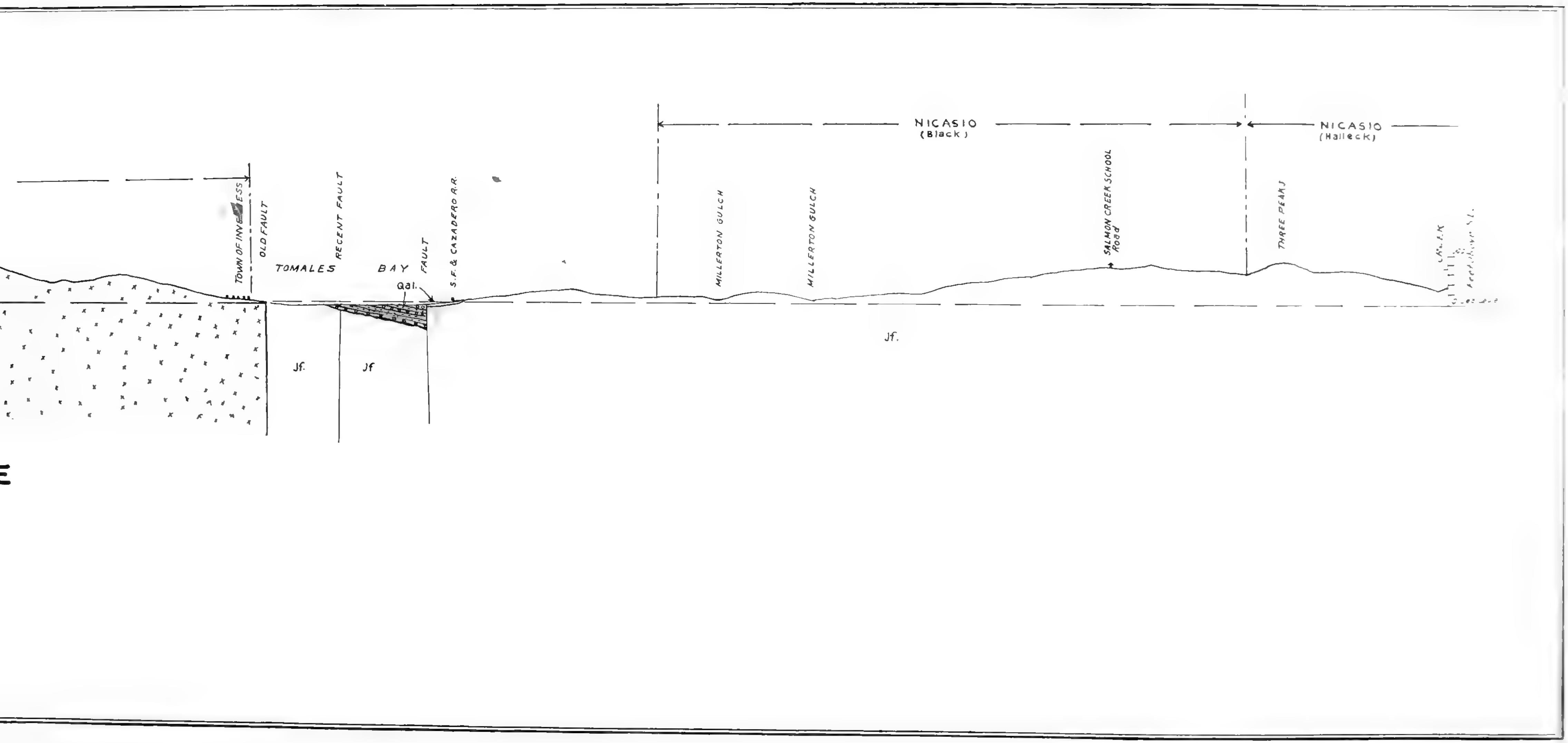

MARSH LAND
NORTHWESTERN PAC. R.R.
NELL ISLAND
PETALUMA CREEK
NORTHWESTERN PAC. R.R.
Road
Creek
Road
Sea Level
Feet above S.L.
1400
Tsa
Tsa
Tmr
Jf
Qal
Qal
Jf
Jf
GEOLOGICAL CROSS-SECTION
ALONG LINE C-D ON
PETALUMA & SANTA ROSA QUADRANGLES
GEOLOGIST.-R E DICKERSON
HORIZONTAL & VERTICAL SCALES.-1IN.=2000FT.
LEGEND
CENOZOIC
QUATERNARY
Alluvium
Qal
TERTIARY
PLIOCENE
Tmr
Merced
UPPER MIOCENE
Tpt
Petaluma
LOWER MIOCENE
Tm
Monterey
MESOZOIC
JURASSIC
Jf
Franciscan
VOLCANICS
CENOZOIC
PLIOCENE
Tsa
Sonoma Group, Tuffs, Andesites & Basalts.



NORTHWESTERN PAC RR
Road
AXIS OF SYNCLINE
AXIS OF ANTICLINE
FAULT
FAULT
Rodgers Creek
Lewis Creek
FAULT
Jf
Tpt.
Tm.
Tsa.
Tpt.
Tm
S


MILLERTON GULCH
THETICA
ALONG
T REY
GEOLOGY B
ORIZONTAL &
QUATERNA
TERTIARY
JURASSIC


DRAKES BAY
Feet Above S.L.
1000
Sea Level
0
Qal
DRAKES ESTERO
Road
Road
PUNTA DE LOS REYES
Tm.
Mesozoic Granites
HYPOTHETICAL SKETCH SECTION
ALONG LINE E-F ON
POINT REYES QUADRANGLE
GEOLOGY BY R. E. DICKERSON
HORIZONTAL & VERTICAL SCALES: 1 IN = 2000 FT.
LEGEND
CENOZOIC
QUATERNARY
Alluvium
TERTIARY
LOWER MIOCENE
Tm
Monterey
MESOZOIC
JURASSIC
Jf
Franciscan
IGNEOUS
Granites


NICASIO
(Black)
NICASIO
(Halleck)
TOWN OF INVERNESS
OLD FAULT
RECENT FAULT
TOMALES BAY
FAULT
S.F. & CAZADERO R.R.
Qal.
MILLERTON GULCH
MILLERTON GULCH
SALMON CREEK SCHOOL Road
THREE PEAKS
Jf.
Jf
Jf.

**PROCEEDINGS**

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XI, NOS. 20 AND 21, pp. 603–653 AUGUST 21, 1922

# XX

# REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1921

By C. E. GRUNSKY
*President of the Academy*

The activities of the California Academy of Sciences during the year 1921 have resulted in some notable achievements, as will appear from the reports of your officers about to be presented.

There has been an increase of 65 in membership which is now close to the 1000 mark. New members to the number of 110 were admitted. The loss by death was 28; by resignation, 14; and dropped for arrearages, 3. At the beginning of the year the members numbered 927; on January first, 1922, they numbered 992.

The present membership is made up of:

| | |
|---|---|
| Patrons | 12 |
| Honorary Members | 25 |
| Life Members | 83 |
| Fellows | 24 |
| Members | 848 |
| Total | 992 |

The Academy carries on its list of Patrons the following names:

*Living*

William B. Bourn
William H. Crocker
Peter F. Dunne
Barton Warren Evermann
Herbert Fleishhacker
Joseph D. Grant
A. Kingsley Macomber
John W. Mailliard
Joseph Mailliard
M. Hall McAllister
Ogden Mills
William C. Van Antwerp

*Deceased*

| | |
|---|---|
| William Alvord | James Lick |
| Charles Crocker | Alexander F. Morrison |
| John W. Hendrie | Amariah Pierce |
| Mrs. Charlotte Hosmer | Ignatz Steinhart |

Those who were called by death during 1921 are as follows:

| | | |
|---|---|---|
| Dr. J. A. Allen | Honorary | August 29, 1921 |
| Mr. James Baumberger | Member | November 21, 1921 |
| Prof. Charles B. Cory | Honorary | July 29, 1921 |
| Mrs. Nelly Waterhouse Dorne | Member | March 25, 1921 |
| Mr. Alex. Goldstein | Member | April 5, 1921 |
| Mr. Howard C. Holmes | Member | October 31, 1921 |
| Mr. C. Frederick Kohl | Life Member | November 23, 1921 |
| Mr. John Lederer | Member | November 24, 1921 |
| Mr. A. F. Morrison | Patron | November 13, 1921 |
| Mr. Henry Payot | Life Member | November 21, 1921 |
| Mr. Harry L. Roff | Member | February 3, 1921 |
| Mrs. Sidney Smith | Member | November 3, 1921 |
| Mr. Donald F. Tillinghast | Member | December 11, 1921 |
| Mr. George D. Toy | Member | January, 1921 |
| Mr. Louis Weimann | Member | April 25, 1921 |
| Mr. Vinoy Westfall | Member | March 8, 1921 |
| Mr. John E. Williams | Member | 1921 |
| Mr. Thomas S. Wilson | Member | December 26, 1921 |

The Academy has published during 1921 the following papers in continuation of the Fourth Series of the Proceedings:

Vol. X, No. 11, pp. 119-127—Report of the President of the Academy for the Year 1920, by C. E. Grunsky.

Vol. X, No. 12, pp. 128-163—Report of the Director of the Museum for the Year 1920, by Barton Warren Evermann.

Vol. XI, No. 1, pp. 1-26—Notes on a Fauna of the Vigo Group and its bearing on the Evolution of Marine Molluscan Faunas, by Roy E. Dickerson.

Vol. XI, No. 2, pp. 27-38—A List of the Amphibians and Reptiles of Nevada, with Notes on the Species in the Collection of the Academy, by John Van Denburgh and Joseph R. Slevin.

Vol. XI, No. 3, pp. 39-47—A List of the Amphibians and Reptiles of Idaho, with Notes on the Species in the Collection of the Academy, by John Van Denburgh and Joseph R. Slevin.

Vol. XI, No. 4, pp. 49-72—A List of the Amphibians and Reptiles of the Peninsula of Lower California, with Notes on the Species in the Collection of the Academy, by John Van Denburgh and Joseph R. Slevin.

Vol. XI, No. 5, pp. 73-94—Notes on the Birds and Mammals of Siskiyou Co., California, by Joseph Mailliard.

Vol. XI, No. 6, pp. 95-98—Preliminary Diagnoses of New Species of Reptiles from Islands in the Gulf of California, Mexico, by John Van Denburgh and Joseph R. Slevin.

Vol. XI, No. 7, pp. 99-102—New Californian Spiders, by Nathan Banks.

Vol. XI, No. 8, pp. 103-107—Undescribed Tipulidæ (Diptera) from Western North America, Part ii, by Charles P. Alexander.

Vol. XI, No. 9, pp. 109-110—Description of a New Species of Pero from California, by W. S. Wright.

Vol. XI, No. 10, pp. 111-134—CHARACTERS OF SOME NEW SPECIES OF NORTH AMERICAN HEMIPTEROUS INSECTS, WITH ONE NEW GENUS, by Edward P. Van Duzee.

Vol. XI, No. 11, pp. 135-136—OUR NORTH AMERICAN SPECIES OF STRONGYLOCORIS (HEMIPTERA), by Edward P. Van Duzee.

Vol. XI, No. 12, pp. 137-144—CHARACTERS OF EIGHT NEW SPECIES OF NORTH AMERICAN ANTHOCORIDÆ OR FLOWER BUGS, by Edward P. Van Duzee.

Vol. XI, No. 13, pp. 145-152—A STUDY OF NORTH AMERICAN GRASS BUGS OF THE GENUS IRBISIA, by Edward P. Van Duzee.

Vol. XI, No. 14, pp. 153-195—INSECTS OF THE PRIBILOF ISLANDS, ALASKA: INTRODUCTION, by G. Dallas Hanna; COLEOPTERA, by Edwin C. Van Dyke; HYDROPHORUS FUMIPENNIS, by M. C. Van Duzee; DIPTERA (GENERAL REPORT), by F. R. Cole; ANTHOMYIIDÆ, by J. R. Malloch; TIPULIDÆ, by C. P. Alexander; HYMENOPTERA (BREMIDÆ), by Theodore H. Frison; HYMENOPTERA (SAW-FLIES), by Alexander D. MacGillivray; and ORTHOPTERA, NEUROPTERA, HEMIPTERA AND LEPIDOPTERA, by E. P. Van Duzee.

Vol. XI, No. 15, pp. 197-344—AN ANNOTATED LIST OF THE DIPTERA (FLIES) OF OREGON, by F. R. Cole and A. L. Lovett.

Vol. XI, No. 16, pp. 345-393—REVISION OF THE PIPIZA GROUP OF THE FAMILY SYRPHIDÆ (FLOWER-FLIES) FROM NORTH OF MEXICO, by C. Howard Curran.

Vol. XI, No. 17, pp. 395-398—PRELIMINARY DIAGNOSES OF MORE NEW SPECIES OF REPTILES FROM ISLANDS IN THE GULF OF CALIFORNIA, MEXICO, by John Van Denburgh and Joseph R. Slevin.

During the year 1921 eleven free lectures were delivered at the stated meetings of the Academy, as follows:

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|---|---|
| JANUARY 5. | Vanishing Wild Life in California—Cause and Remedy, by Mr. E. R. Zion, Efficiency Expert, Civil Service Commission, San Francisco, Calif. |
| MARCH 2. | Experiences in the Gulf of California, by Mr. Rufus A. Coleman, United States Bureau of Fisheries, San Francisco, Calif. |
| APRIL 6. | Erosion in California in Relation to Forestry, by Mr. E. N. Munns, Forest Examiner, United States Forest Service, San Francisco, Calif. |
| MAY 4. | The Relation of Pacific Coast Rainfall to the World System of Rain Belts, by Dr. Marsden Manson, San Francisco, Calif. |
| JUNE 1. | Historical Sketch of the Scripps Institution and Illustrative Examples of certain researches that it has undertaken, by Dr. George F. McEwen, Oceanographer, Scripps Institution for Biological Research, La Jolla, Calif. |
| JULY 6. | Field Work in Del Norte County during the spring of 1921, by Mr. Jos. Mailliard, Curator of Ornithology and Mammalogy, California Academy of Sciences, San Francisco, Calif. |
| AUGUST 3. | Diatoms, the Jewels of the Plant World, by Dr. Albert Mann of the Carnegie Institution of Washington, Washington, D. C. |
| SEPTEMBER 7. | The 1921 California Academy of Sciences Expedition to the Gulf of California, by Mr. E. P. Van Duzee, Curator, Department of Entomology, California Academy of Sciences. |

October 5. Observations on the Geology of Colombia, by Mr. F. M. Anderson, Berkeley, California.

November 2. Bacterial Food Poisoning, by Dr. Ivan C. Hall, Associate Professor of Bacteriology, University of California.

December 7. Field Work of the Department of Ornithology and Mammalogy during 1921, by Mr. Joseph Mailliard, Curator, Department of Ornithology and Mammalogy, California Academy of Sciences, San Francisco.

The Sunday Afternoon lectures delivered in the Museum Building during 1921 have been well attended; they have included the following:

January 2. Atoms and Ions, by Dr. E. P. Lewis, Professor of Physics, University of California, Berkeley.

January 9. Electrons and Positive Rays, by Dr. E. P. Lewis, Professor of Physics, University of California, Berkeley.

January 16. Radioactive Transformations, by Dr. E. P. Lewis, Professor of Physics, University of California, Berkeley.

January 23. General Properties of X and Gamma Rays, by D. L. Webster, Professor of Physics, Stanford University, California.

January 30. Photography of the Planets, with Special Reference to Mars, by Dr. E. C. Slipher, Lowell Observatory, Flagstaff, Ariz.

February 6. X-Ray Spectra, by Dr. D. L. Webster, Professor of Physics, Stanford University, California.

February 13. The Structure of Atoms, by Dr. D. L. Webster, Professor of Physics, Stanford University, California.

February 20. How Uncle Sam's Money is Wasted, by Mr. Edward Berwick, Member of the Institute of International Law, Pacific Grove, Calif.

February 27. The Dimensions of the Stellar Universe, by Dr. Harlow Shapely, Mount Wilson Observatory, Pasadena, Calif.

March 6. Eighteen Thousand Miles in Search of Mosquitoes in California—How and Why, by Major W. B. Herms, Associate Professor of Parasitology, University of California, Berkeley.

March 13. Parasitism among Insects, by Mr. Harry S. Smith, Entomologist, State Department of Agriculture, Sacramento, Calif.

March 20. Some Injurious Forest Insects of California, by Dr. E. C. Van Dyke, Assistant Professor of Entomology, University of California, Berkeley.

March 27. Evolution of the Ancient Orders of Insects, by Professor C. W. Woodworth, Professor of Entomology, University of California, Berkeley.

April 3. The Evolution of California Scenery, by Dr. R. S. Holway, Associate Professor of Physical Geography, University of California, Berkeley.

April 10. Ancient Seas and their Faunas, by Dr. B. L. Clark, Assistant Professor of Paleontology, University of California, Berkeley.

April 24. The Former Mammalian Life of California, by Dr. Chester Stock, Research Assistant, Department of Paleontology, University of California, Berkeley.

| | |
|---|---|
| May 1. | The Relation of Pacific Coast Rainfall to the World System of Rain Belts, by Dr. Marsden Manson, San Francisco. |
| May 8. | Weather Forecasts, Ancient and Modern, by Mr. E. A. Beals, Meteorologist, United States Weather Bureau, San Francisco. |
| May 15. | Some Popular Misconceptions about California Climate, by Mr. B. M. Varney, Instructor in Geography, University of California, Berkeley. |
| May 22. | Aviation and Meteorology, by Mr. Thomas R. Reed, Meteorologist, United States Weather Bureau, San Francisco. |
| May 29. | The Science of the Sea and Applications to our Pacific Coast Waters, by Dr. George F. McEwen, Oceanographer, Scripps Institution for Biological Research, La Jolla, Calif. |
| June 5. | Researches on the Figure of the Earth, including a definite Determination of the Oblateness, by Captain T. J. J. See, Professor of Mathematics, United States Navy, Mare Island, Calif. |
| September 25. | Birds and Mammals of the Mount Rainier National Park, by Dr. Walter P. Taylor, Biologist, Bureau of Biological Survey, La Jolla, Calif. |
| October 2. | The Flora of Mount Rainier National Park, by Miss Alice Eastwood, Curator, Department of Botany, California Academy of Sciences, San Francisco. |
| October 9. | Mammals of the Yosemite National Park, by Dr. Joseph Grinnell, Director, Museum of Vertebrate Zoology, University of California, Berkeley. |
| October 16. | Questions concerning distribution of life in the open Sea, by Mr. W. E. Allen, Biologist and Publicity Secretary, Scripps Institution for Biological Research, La Jolla, Calif. |
| October 23. | The Next War and our Chemical Warfare Service, by Mr. Edward Berwick, Pacific Grove, Calif. |
| October 30. | National Forests as Recreation Grounds, by Mr. Paul J. Fair, Constructor of Educational Material, United States Forest Service, San Francisco. |
| November 6. | The Yosemite National Park—Its History, Geology and Scenic Features, by Mr. Ansel F. Hall, Park Naturalist, Yosemite National Park, Calif. |
| November 13. | Birds of the Yosemite National Park, by Prof. Tracy I. Storer, Museum of Vertebrate Zoology, University of California, Berkeley. |
| November 20. | Nature Guiding in a National Park, by Dr. Harold C. Bryant, Economic Ornithologist, University of California, Berkeley. |
| November 27. | The Birds of the High Sierra and their Homes, by Dr. William F. Badè, President of the Sierra Club, Berkeley, Calif. |
| December 4. | Yellowstone Park—Last Stand of the Old West, by Mr. Horace M. Albright, Superintendent of the Yellowstone National Park, Wyoming. |
| December 11. | Some Activities in California of the Bureau of Plant Industry, United States Department of Agriculture, by Mr. G. P. Rixford, Physiologist, Bureau of Plant Industry, United States Department of Agriculture, San Francisco. |
| December 18. | The Hawaii National Park, by Mr. Will J. Cooper, Agent, Hawaii Tourist Bureau, San Francisco. |

The Academy during this year curtailed its general activities to some extent in order to make possible an expedition into the Gulf of California where collections were made for the various departments. The results of this expedition are fully covered in the report of the Director of the Museum and in the reports of the Academy's curators, and nothing remains to be said about it except that it was eminently successful and has added materially to our knowledge of the fauna and flora of a region that has long waited for thorough scientific exploration. The Academy sincerely appreciates the sacrifices of those who went on the expedition and is thankful for the sustained effort of each, which was essential for its success.

It can now be announced that plans for the Steinhart Aquarium have been approved by the City and Park authorities as also by the executors of the estate of the late Ignatz Steinhart, and that bids for the construction thereof have been called for. It is hoped that contracts for its construction can be entered into soon after March first. The apparent delay in entering upon construction will prove of benefit to the enterprise in two ways: first, because interest has been accumulating and more money is therefore available than named in the bequest; and second, because the cost of building is now considerably less than it was several years ago. A year from now the Academy will be asking the City to make provision for operation.

The financial standing of the Academy is set forth in the Treasurer's report. There have been no unusual sources of income. Our regular income from rents and dues and sales of publications and the like has been about $77,000.

Among the receipts and expenditures of special note attention may be called to the following:

The Gulf of California Expedition sailed from San Francisco on April 2, 1921, chartered the schooner "Silver Gate" at Guaymas, and spent three months in exploring the islands and shores of the Gulf. The total expense of this expedition was $8,515.22.

The purchase of the Albert Prager Herbarium which has been added to the collection of the Botanical Department during the year at a total expense of $1,266.53, was made possible by the following donations:

| | | | |
|---|---|---|---|
| Wm. C. Van Antwerp | $120 | A. F. Morrison | $200 |
| Wm. M. Fitzhugh | 200 | Wm. F. Herrin | 200 |
| J. D. Grant | 100 | Wm. H. Crocker | 200 |
| John C. Augsbury | 100 | | |

The following have been added to the list of Life Members of the Academy:

| | | | |
|---|---|---|---|
| Adolph B. Spreckels | $100 | Albert Meyer | $250 |
| Mrs. Anna J. Kaseberg | 100 | Edward Jesurum | 100 |
| Irving Miller | 100 | | |

The mortgage indebtedness of the Academy which was originally $300,000, has been again reduced during the year by a payment of $10,000. This leaves an unpaid balance of $280,000.

Further contributions during the year toward the cost of the game paddocks in the Yosemite Valley have been received to the amount of $250. A balance of $286.11 remains yet to be collected for which Mr. M. Hall McAllister has kindly undertaken to be responsible.

The Grizzly Bear habitat group, which, as noted heretofore, has been made possible by a donation of $5,000 by Mr. Ogden Mills is nearing completion. This fills the last of the large alcoves available for such exhibits. Special attention will now be given to completing the installation of the habitat groups of small mammals and fully utilizing the remaining exhibition space.

The Academy is rapidly outgrowing the accommodations which its museum building affords. Another structure as large as the one now occupied is needed; but if dependence must be placed on the Academy resources alone it will be long before its erection can be undertaken. Here would be an excellent opportunity for some one materially to assist the Academy's educational and research work by donating funds for the building.

Aside from the work done by the Academy in its regular departments, the Academy has assisted during the year in the conservation of wild animal life. There was appointed a "Committee on the Conservation of Wild Animal Life" and this committee has had in charge the distribution of California Valley Elk; the protection of the Antelope herds, of Mountain Sheep, and Roosevelt Elk; also the building of the game paddocks stocked with elk in the Yosemite Valley and the providing of an antelope refuge at Mount Dome in Siskiyou County. This last named undertaking has attracted the attention of the American Bison Society and the New York Zoological Society both of which have subscribed to the necessary fund. The committee has arranged with the United States Forest Service for the care of this herd of antelope numbering now about 100. They are now regularly fed by a paid keeper or guardian, Mr. Ash Carsley, who sends in semi-monthly reports. Outside of Yellowstone Park this, according to the committee report, is the finest, most compact, tamest, and most accessible herd of wild antelope in the West. The committee is issuing a "Distribution Map of California" which shows the location of the antelope, the elk and bighorn or mountain sheep in California. It is expected that forest rangers, game wardens, and others who have opportunity to observe will advise the committee where and when any of these animals are seen.

Death, during the year, has deprived the Academy of its legal advisor, Mr. A. F. Morrison, and since the close of the year death has taken one member from the official staff of the Academy, Mr. Rudolph J. Taussig, who has served for a number of years as Treasurer. To both of these late members the Academy is deeply indebted for valuable aid in the conduct of its affairs, and their associates keenly feel the loss which they and the Academy have sustained.

To all of those who have in any way contributed to, or assisted in, the Academy's activities, or who have helped to increase its service to the public, the officers of the Academy extend thanks. They commend, too, the good work done by the several departments which, however, will show for itself in the various reports which are about to be presented.

# XXI

# REPORT OF THE DIRECTOR OF THE MUSEUM FOR THE YEAR 1921

By BARTON WARREN EVERMANN
*Director of the Museum*

The annual report of the Director for the year 1920 was presented to the Academy at the annual meeting February 16, 1921. At that time the taxidermists were at work upon the Grizzly Bear Group. Shortly afterward the artist began upon the background for that group. The work of both taxidermists and artist has been progressing very slowly, but it is hoped that the group will be completed in a few days.

Owing to lack of funds necessary to secure competent preparators, very little has been done during the year upon small panel groups. It is hoped that during the coming year funds may be available to enable the Museum to prepare a considerable number of groups of this class. It is also hoped that we may be able to complete the Golden Gate Park Bird exhibit and that the exhibit of fur-bearing animals of California which we have long had in mind may be commenced.

## PERSONNEL

The personnel of the Museum remains about the same as it was one year ago. Mr. William Heim, taxidermist, who was absent on account of ill health in the early fall of 1920, returned but soon found it necessary to take still further leave.

The employes of the Academy at this date are as follows: Dr. Barton Warren Evermann, Director and Executive Curator of the Museum, Editor, and Director of the Steinhart Aquarium; W. W. Sargeant, Secretary to the Board of Trustees; Miss Susie Peers, Secretary to the Director; Joseph W. Hobson, Recording Secretary; Miss Alice Eastwood, Curator and Mrs. Kate E. Phelps, assistant, Department of Botany; Edward P. Van Duzee, Curator, F. R. Cole, Curator in Dipterology, and J. O. Martin, assistant, Department of Entomology; Dr. John Van Denburgh, Curator, and Joseph R. Slevin, assistant curator, Department of Herpetology; Dr. G.

Dallas Hanna, Curator, Dr. Roy E. Dickerson and Mr. F. M. Anderson, honorary curators, and William Barbat, temporary assistant, Department of Invertebrate Paleontology; Joseph Mailliard, Curator, Chase Littlejohn, assistant curator, and Mary E. McLellan, assistant, Department of Ornithology and Mammalogy; Dr. Walter K. Fisher, Curator, Department of Invertebrate Zoology; Edward P. Van Duzee, assistant librarian, and Mrs. Helen Van Duzee, library assistant; John I. Carlson, general assistant; Pauline Kusche, temporary general assistant; William C. Lewis, janitor; Fred Maag, carpenter and assistant janitor; George W. Edwards, assistant janitor; Frank W. Yale, assistant janitor; J. H. Kavanaugh, daywatch; Archie McCarte, nightwatch; Mrs. Johanna E. Wilkens, janitress.

## ACCESSIONS TO THE MUSEUM AND LIBRARY

Accessions to the Museum and to the Library have been numerous and unusually valuable. A few of the more notable are mentioned in the President's report and a detailed list will be found in the appendix to this report (pp. 638-647).

## COOPERATION WITH SCHOOLS

During the year 6,589 school children of various grades, representing 221 schools in San Francisco, accompanied by 214 teachers in charge, visited the Museum. From places outside of San Francisco there were 597 pupils representing 29 schools and accompanied by 26 teachers. Among the towns and cities outside of San Francisco that sent one or more schools to visit the Museum are Alameda, Berkeley, Hayward, Kentfield, Oakland, Piedmont, Richmond, San Mateo, and San Leandro.

The visits by schools in the year have been as follows:

*Schools of San Francisco:*

| | |
|---|---|
| Total number of classes visiting | 221 |
| Total number of teachers in charge | 214 |
| Total number of students visiting | 6589 |

*Schools outside of San Francisco:*

| | |
|---|---|
| Total number of classes visiting | 29 |
| Total number of teachers in charge | 26 |
| Total number of students visiting | 597 |

*Grand Totals:*

| | |
|---|---|
| Total number of classes | 250 |
| Total number of teachers in charge | 240 |
| Total number of students visiting | 7186 |

The Museum is glad to be of service to the public in this way and it hopes that this service may grow from year to year.

## VISITORS TO THE MUSEUM

As heretofore and in accordance with established policy, the Museum was open to the public every day in the year. The attendance by months for each year since the Museum was first opened to the public is shown in the following table:

| Month— | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|---|---|
| January | ..... | 23170 | 25260 | 17241 | 27013 | 25755 |
| February | ..... | 22058 | 23698 | 17586 | 23450 | 25679 |
| March | ..... | 31606 | 26810 | 27397 | 25419 | 28279 |
| April | ..... | 32175 | 23274 | 25994 | 32208 | 24939 |
| May | ..... | 26154 | 26391 | 28369 | 37107 | 25517 |
| June | ..... | 32123 | 29843 | 32248 | 36207 | 29406 |
| July | ..... | 37193 | 31420 | 48028 | 52492 | 43186 |
| August | ..... | 24619 | 31137 | 43730 | 53470 | 39422 |
| September | 16448[1] | 27866 | 29847 | 34007 | 42013 | 31458 |
| October | 36933 | 20629 | 14743[2] | 30463 | 33500 | 24861 |
| November | 27718 | 21810 | 8531[2] | 25246 | 19347 | 18593 |
| December | 15002 | 21693 | 19588 | 21188 | 21340 | 15062 |
| | 96101 | 321096 | 290542 | 351497 | 403566 | 332157 |

## FIELD WORK OF THE MUSEUM STAFF

Within the past year the Museum carried on a number of field investigations, the most important being the

## EXPEDITION TO THE GULF OF CALIFORNIA

Realizing that the fauna and flora of the numerous islands in the Gulf of California were little known, it was decided to send an expedition to the Gulf early in the spring of 1921.

The "Silver Gate," a gasoline schooner, 22 tons net, 65 feet over all, capable of eight knots, with cruising radius of 2,000 miles, crew of five men, was chartered for the purpose.

[1] Attendance from September 22 to 30.
[2] Museum closed 29 days on account of the "flu."

Owing to the fact that the vessel was already in the Gulf, very satisfactory charter-terms were arranged.

The departments of the Museum represented on the expedition were: Herpetology, by Joseph R. Slevin, who was put in charge of the expedition; Entomology, by Edwin P. Van Duzee and Joseph C. Chamberlin; Botany, by Ivan M. Johnston; Ornithology and Mammalogy, by Virgil W. Owen; Paleontology, by Dr. Fred Baker.

The Mexican government sent two representatives to accompany the expedition. They were Señor Francisco Contreras, Jefe Del Museo Nacional de Historia Natural de Mexico, and Señor Carlos Lopez, of the Estudio Geologico. These gentlemen proved very agreeable additions to the personnel of the party and were very helpful in many ways, particularly in our relations with the officials of the various towns visited. The Academy feels that cooperation in scientific work by scientific men and institutions of the two countries will prove of mutual value and interest.

The expedition spent 87 days in the field (April 14 to July 9). The length of the cruise was 1,811 miles, number of localities visited, 56; number of islands visited, 36; number of collection stations, 96.

The expedition was in every way very successful, and large collections were made in most departments. In herpetology 3,200 specimens were obtained. All previously recorded species save two, were secured and at least 20 new species were discovered.

Of insects, spiders, scorpions and pseudoscorpions, about 19,275 specimens were collected. Although the specialists working up the various groups have barely begun they have already found nearly a hundred new species.

The collections in botany were very large and contain a surprisingly large number of new species. In paleontology and conchology large and important collections were secured. In birds and mammals the collections were small; very fine series of eggs of several species of birds were obtained, however, several of the species previously represented only poorly or not at all in museums. On the whole, the expedition is regarded as having been a very satisfactory one and its successful accomplishment reflects much credit not only upon

Mr. Slevin, chief of party, but upon all the representatives of the Academy and of the Mexican government.

Within the year several other parties were in the field. Dr. Hanna carried on work in Ventura County; Mr. Mailliard in Del Norte County and elsewhere in the north part of the state. These investigations are fully reported on by the respective curators in their department reports.

## MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ITS AFFILIATED SOCIETIES

The 1921 meeting of the Pacific Division of the American Association for the Advancement of Science and Affiliated Societies was held at the University of California, Berkeley, August 4 to 6. The Academy was well represented in the attendance and on the programs. Not fewer than 68 members of the Academy were in attendance. Among those appearing on the programs were the following:

R. G. Aitken
L. L. Burlingame
W. W. Campbell
John N. Cobb
Alice Eastwood
E. O. Essig
Barton W. Evermann
E. C. Franklin
E. W. Gifford
Joseph Grinnell
S. J. Holmes
C. A. Kofoid
A. L. Kroeber
A. O. Leuschner
D. T. MacDougal
F. M. MacFarland
J. H. Moore
Willis H. Rich
William E. Ritter
Alvin Seale
Edwin C. Starks
F. B. Sumner
S. D. Townley
E. P. Van Duzee
Edwin C. Van Dyke
Daniel L. Webster
Ray Lyman Wilbur
W. S. Wright

## USE OF THE ACADEMY'S LIBRARY AND COLLECTIONS BY INVESTIGATORS AND STUDENTS

As in past years, students and investigators continue to avail themselves of the facilities afforded by the Academy for study and research.

The Boy Scouts, under Scout Master Harold E. Hanson, have continued their regular Friday night meetings at the Academy throughout the year.

PUBLICATIONS BY THE MUSEUM STAFF

The curators and other members of the Museum staff have, as heretofore, continued active in research work and have contributed numerous papers to the literature of their respective departments and other subjects. The list for 1921 is as follows:

Evermann, Barton Warren

1. Events which have most influenced my Life. <Touchstones of Success, pp. 106-108, September, 1920.
2. Can the Alaska Salmon Fisheries be Saved? <The Scientific Monthly, Vol. XII, No. 2, February, 1921, 163-184, 12 half tones.
3. The Año Nuevo Steller Seal Lion Rookery. <Journal of Mammalogy, Vol. 2, No. 1, February, 1921, 16-19, pls. 1-3.
4. Animal Habitat Groups. <American Forestry, Vol. 27, No. 328, April, 1921, 208-215, 12 plates.
5. The Fishes of Yosemite National Park. <Handbook of Yosemite National Park, pp. 183-201, June 29, 1921.
6. Report of the Director of the Museum for the Year 1920. <Proceedings, California Academy of Sciences, Vol. X, No. 12, July 2, 1921, pp. 128-163.
7. Trout of California One of State's Important Resources. <San Francisco Chronicle, October 13, 1921.
8. Hard to distinguish between Steelhead and Rainbow Trout. <San Francisco Chronicle, October 24, 1921.
9. Ulysses Orange Cox (In Memoriam). <Proceedings of the Indiana Academy of Science for 1920, October, 1921, pp. 45-49.
10. Notes on the Birds of Carroll, Monroe, and Vigo Counties, Indiana. <Proceedings of the Indiana Academy of Science for 1920, October, 1921, pp. 315-401.
11. Thomas H. Britton. An Appreciation. <The Delphi Journal, Vol. 73, No. 7, December 1, 1921, p. 4; <The Camden Record, Vol. XLI, No. 51, December 1, 1921, p. 1; and <The Hoosier Democrat, Vol. XXV, No. 20, December 17, 1921.
12. Fur Seals off the Farallons. <Science, Vol. LIV, No. 1405, December 2, 1921, pp. 547-548.
13. An Educational Exhibit of the Birds of Golden Gate Park. <The Sierra Educational News, Vol. XVII, No. 10, December, 1921, p. 516.
14. My Cruise on a Fishing Smack. <The American Angler, Vol. VI, No. 8, December, 1921, pp. 407-412.

Eastwood, Alice

1. Tamalpais Wild Flowers. <Trails, Vol. I, No. 2, pp. 50-54.

Hanna, G. Dallas

1. Mammals of the St. Matthew Islands, Bering Sea. <Journal of Mammalogy, Vol. I, No. 3, pp. 118-122, May, 1920.
2. Experiments in the Breeding of Cerions by Paul Bartsch. <Carnegie Institution of Washington, Vol. XIV, Publication, No. 282, 1920.
   Contained in the above work is "A comparative anatomical discussion of the five species of Cerions involved in the breeding experiments," pp. 7-13, pls. I-VI, by G. Dallas Hanna.
3. Results of Fur Seal Protection. <The Gull, Vol. III, No. 1, January, 1921.
4. *Modiolus demissus* Dillwin, in San Francisco Bay. <The Nautilus, Vol. XXXIV, No. 3, pp. 91-92, January, 1921.
5. The Pribilof Sandpiper. <The Condor, Vol. XXIII, No. 2, pp. 50-57, text figure, 13, March-April, 1921.
6. Review of "Lake Maxinkuckee: A Physical and Biological Survey," by Barton Warren Evermann and Howard Walton Clark. <The Nautilus, Vol. XXXIV, No. 4, p. 142, April, 1921.
7. New Bird Records for North America with notes on the Pribilof Island List. <The Condor, Vol. XXIII, pp. 93-95, May-June, 1921. (With Joseph Mailliard.)
8. Report of the Department of Invertebrate Paleontology for 1920. <Proceedings, California Academy of Sciences, Vol. X, p. 143, July 2, 1921.
9. Genital Organs of Hermaphroditic Fur Seals. <The American Naturalist, Vol. LV, No. 640, pp. 473-475, September-October, 1921.
10. *Epiphragmophora fidelis* (Gray) near San Francisco Bay. <The Nautilus, Vol. XXXV, No. 2, p. 34, October, 1921.
11. Frederick Morton Chamberlain. <The Nautilus, Vol. XXXV, No. 2, p. 60, October, 1921.
12. Frederick Morton Chamberlain. <Science (New Series), Vol. LIV, No. 1397, p. 323, October 7, 1921.
13. Miocene Land Shells from Oregon. <The Kansas University Science Bulletin, Vol. XIII, No. 1, October, 1921.
14. Pleistocene Mollusks from Wallace County, Kansas. <The Kansas University Science Bulletin, Vol. XIII, No. 2, October, 1921.
15. Introduction to "Insects of the Pribilof Islands." <Proceedings, California Academy of Sciences, Vol. XI, 4th Ser., No. 14, pp. 153-195, November 2, 1921.
16. Announcement of appointment of Dr. Barton W. Evermann, Director, and Mr. Alvin Seale, Superintendent, of the new Steinhart Aquarium. <Science (New Series), Vol. LIV, No. 1403, p. 489, November 18, 1921.
17. Census of Alaska Fur Seals in 1920. <Appendix VI to the Annual Report of the United States Commissioner of Fisheries for 1921, Bureau of Fisheries Document No. 909, pp. 104-121, figure 3, December, 1921.

18. Natural History Records of the Pribilof Islands. <Appendix VI to the Annual Report of the United States Commissioner of Fisheries, Bureau of Fisheries Document No. 909, pp. 122-127, December, 1921.
19. Alaska Fur Seals. <Hamlyns Menagerie Magazine, London, August, 1921.
20. Alaska Fur Seals. <Reprint of above article in Yearbook of the Amateur Menagerie Club, London, 1921.
21. A Fossil Ammonite Exhibited. <Golden Gate Pathfinder, Vol. II, No. 15, p. 15, July 17, 1921.
22. Galls and Gall Insects Exhibit in Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 16, p. 12, July 24, 1921.
23. Flower Exhibit in the Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 17, p. 15, July 31, 1921.
24. Pictures of California Lilies. <Golden Gate Pathfinder, Vol. II, No. 18, p. 15, August 7, 1921.
25. Steller Sea Lion Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 19, p. 16, August 14, 1921, 1 figure.
26. A Lecture by a Plant Expert. <Golden Gate Pathfinder, Vol. II, No. 19, p. 15, August 14, 1921. (Lecture by Dr. Albert Mann on Diatoms.)
27. California Sea Lions, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 20, p. 16, August 21, 1921, 1 figure.
28. Grizzly Bear shot by Dr. Pope with Bow and Arrow—now being installed in Academy of Sciences Museum. <Golden Gate Pathfinder, Vol. II, No. 21, p. 15, 1 figure, August 28, 1921.
29. Hair Seals in California Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 21, p. 16, 1 figure, August 28, 1921.
30. The Mule Deer Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 22, p. 16, 1 figure, September 4, 1921.
31. Desert Bird Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 23, p. 16, 1 figure, September 11, 1921.
32. The Fur-Seal Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 24, p. 16, 1 figure, September 18, 1921.
33. The White Pelican Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 25, p. 15, 1 figure, September 25, 1921.
34. Sunday Afternoon Lectures at the Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 26, p. 3, October 2, 1921.
35. The Antelope Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 26, p. 16, 1 figure, October 2, 1921.
36. Sunday Afternoon Lectures at the Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 27, p. 13, October 9, 1921.
37. The Coyote Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 27, p. 16, 1 figure, October 9, 1921.
38. Farallon Islands Bird Rookery in the Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 28, p. 16, 1 figure, October 16, 1921.

39. Progress on Steinhart Aquarium. <Golden Gate Pathfinder, Vol. II, No. 29, p. 10, October 23, 1921.
40. The California Condor Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 29, p. 16, 1 figure, October 23, 1921.
41. The Mountain Lion Group, California Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 30, p. 16, 1 figure, October 30, 1921.
42. The Wild Birds of Golden Gate Park. <Golden Gate Pathfinder, Vol. II, No. 31, p. 16, November 6, 1921.
43. The Tree Ferns of Golden Gate Park. <Golden Gate Pathfinder, Vol. II, No. 32, p. 16, November 13, 1921.
44. The Roosevelt Elk Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 33, p. 16, 1 figure, November 20, 1921.
45. The Academy of Sciences Expedition to South America. <Golden Gate Pathfinder, Vol. II, No. 34, p. 5, November 27, 1921.
46. The San Joaquin Valley Water Fowl Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 34, p. 16, 1 figure, November 27, 1921.
47. The San Joaquin Valley Water Fowl Group, Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 35, p. 16, 1 figure, December 4, 1921.
48. The Academy of Sciences Expedition to South America. <Golden Gate Pathfinder, Vol. II, No. 35, p. 5, December 4, 1921.
49. Exhibit of Painted Flowers in California Academy of Sciences. <Golden Gate Pathfinder, Vol. II, No. 36, p. 10, December 11, 1921.
50. The Robins of the Park. <Golden Gate Pathfinder, Vol. II, No. 36, p. 16, December 11, 1921.
51. The Sparrows of Golden Gate Park. <Golden Gate Pathfinder, Vol. II, No. 38, p. 16, December 25, 1921.

Mailliard, Joseph

1. Notes on some Specimens in the Ornithological Collection of the California Academy of Sciences. <The Condor, Vol. XXIII, No. 1, pp. 28-32, February 3, 1921.
2. Census of Birds' Nests in the Music Concourse, Golden Gate Park, San Francisco, Calif., for 1920. <The Gull, Vol. III, No. 2, pp. 2-3, February, 1921.
3. Anent Red-winged Blackbirds. <The Condor, Vol. XXIII, No. 2, pp. 66-68, March 31, 1921.
4. New Bird Records for North America with Notes on the Pribilof Island List. <The Condor, Vol. XXIII, No. 3, pp. 93-95, June 3, 1921 (with G. Dallas Hanna).
5. Report of the Department of Mammalogy for 1920. <Proceedings California Academy of Sciences, 4th Ser., Vol. X, No. 12, p. 147, July 2, 1921 (in Report of Director for 1920).

6. Report of the Department of Ornithology for 1920. <Proceedings California Academy of Sciences, 4th Ser., Vol. X, No. 12, pp. 148-149, July 2, 1921 (in Report of Director for 1920).
7. Notes on the Birds and Mammals of Siskiyou County, California. <Proceedings California Academy of Sciences, 4th Ser., Vol. XI, No. 5, pp. 73-94, July 11, 1921.
8. Handy Collecting Case. <Journal of Mammalogy, Vol. II, No. 3, pp. 174-176, 1 text-figure, August, 1921.
9. Extension of Breeding Range of Marsh Sparrow and Monterey Hermit Thrush. <The Condor, Vol. XXIII, No. 5, pp. 164-165, September 26, 1921.
10. Notes on Fall Migrations of Fox Sparrows in California. <The Condor, Vol. XXIII, No. 6, pp. 178-182, November 19, 1921.
11. Concerning Incubation on the Part of the Male Belted Kingfisher. <The Condor, Vol. XXIII, No. 6, pp. 194-195, November 19, 1921.

Van Denburgh, John; and Slevin, Joseph R.

1. A List of the Amphibians and Reptiles of Nevada, with Notes on the Species in the Collection of the Academy. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XI, No. 2, pp. 27-38, July 8, 1921.
2. A List of the Amphibians and Reptiles of Idaho, with Notes on the Species in the Collection of the Academy. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XI, No. 3, pp. 39-47, July 8, 1921.
3. A List of the Amphibians and Reptiles of the Peninsula of Lower California, with Notes on the Species in the Collection of the Academy. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XI, No. 4, pp. 49-72, July 8, 1921.
4. Preliminary Diagnoses of New Species of Reptiles from Islands in the Gulf of California, Mexico. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XI, No. 6, pp. 95-98, July 30, 1921.
5. Preliminary Diagnoses of more New Species of Reptiles from Islands in the Gulf of California, Mexico. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XI, No. 17, pp. 395-398, December 17, 1921.

Van Duzee, Edward P.

1. Characters of some new species of North American Hemipterous insects with one new genus. <Proc. Calif. Acad. Sci., Vol. XI, No. 10, pp. 111-134, October 15, 1921.
2. Our North American species of Strongylocoris. <Proc. Calif. Acad. Sci., Vol. XI, No. 11, pp. 135-136, October 15, 1921.
3. Characters of eight new species of North American Anthocoridæ or flower bugs. <Proc. Calif. Acad. Sci., Vol. XI, No. 12, pp. 137-144, October 15, 1921.
4. A study of North American grass-bugs of the genus Irbisia. <Proc. Calif. Acad. Sci., Vol. XI, No. 13, pp. 145-152, October 15, 1921.

5. Orthoptera, Neuroptera, Hemiptera and Lepidoptera from the Pribilof Islands, Alaska. <Proc. Calif. Acad. Sci., Vol. XI, No. 14, pp. 193-195, November 2, 1921.

## NEEDS OF THE MUSEUM

The needs of the Museum are many and urgent; so many and so urgent that it is not easy to list them in sequence of importance. The one that perhaps should be mentioned first is that of buildings. The Museum has already grown far beyond its present room-capacity. Every department is crowded; most of them have overflown into the adjacent halls. Great quantities of valuable collections are stored in the basement and under the floor of the Mammal Hall where one cannot walk erect and where there is no provision for lighting. It is therefore next to impossible even to inspect them and see that they are not deteriorating, and absolutely impossible to use them. As one illustration, there is stored away in this darkness a large and very valuable collection of woods that would make an extremely attractive and instructive exhibit if we only had space in which to display it.

We now have no place for exhibits of insects, mollusks, reptiles, amphibians, fossils, invertebrates and plants. We have already material on hand that would make splendid exhibits in these lines. We have no room for any of the several wonderful large animals of Alaska and the far north—the big brown bears of Alaska, the glacier bear, polar bear, the moose, caribou, musk ox, mountain sheep, mountain goat, buffalo, walrus, and many other great mammals of North America many of which are doomed to extinction in the near future. And we can do nothing with the great mammals of Africa and other foreign countries until we get more buildings.

These needs are so great that it is earnestly hoped the Trustees may give the matter early, serious, and sympathetic consideration. The proposed East Wing should be built in the near future, and the Whale Court should be enclosed at once. Closing in the Whale Court would help immensely. The expense would be moderate, probably not exceeding $30,000.

And then we need several endowments. Every department of the Museum should have an endowment that would yield an annual income adequate to meet all its expenses—curators' and assistants' salaries, field work, study of collections and preparation of reports of scientific investigations, purchase and care of collections, laboratory equipment, and all other expenses necessary to maintain an efficient and productive department. It is needless to say that *any* sum for endowment, however small, will be welcomed and accepted with gratitude. An endowment yielding an annual income of any amount up to $5,000 to $10,000 would be excellent.

*Library*—Among the greatest and most serious needs of the Academy are those of the Library. The amount of money which we can set aside in the budget for library purposes is far from meeting the pressing needs of that department. We need more money for the purchase of books, serial scientific publications and periodicals; particularly reports of the early exploring expeditions, volumes to complete sets of journals, bulletins, proceedings and transactions of learned societies; special monographs and treatises of a technical character, books of reference, and general natural history publications. One class of publications that we are endeavoring to complete in so far as is possible is the reports of exploring expeditions in western America and in the Pacific. These are indispensable in our work. Their cost will increase from year to year.

And then we need money for binding. The Library contains hundreds of unbound volumes of important publications and thousands of pamphlets that should be bound not only to facilitate their use, but to protect them against injury and that gradual deterioration inevitable with unbound papers.

It is also quite necessary that there should be a regular permanent staff to do the accessioning, card cataloguing, and other duties necessary to keep the Library in proper condition.

One of the best things that can be done by anyone interested in the Academy would be to provide an endowment for library purposes, the larger the better, but any amount would help.

*Publication*—The income of the Academy is too small to permit the amount for publication that is needed. Because of lack of funds, the Academy is unable to use the grade of paper for text or illustrations that the high character of our publications demands. The paper we are using will probably not last longer than 75 to 100 years.

We are also unable to accept for publication many excellent papers that would be valuable contributions to knowledge and whose publication by the Academy would reflect credit upon it.

The Academy should have a permanent publication endowment which would yield an annual income of $10,000 to $15,000; but any amount would help. We have already a small endowment of $10,000 for this purpose, known as "The John W. Hendrie Publication Endowment." Any new endowment received would be known by the name of the man or woman giving it.

*Auditorium*—The Academy maintains a Sunday afternoon lecture course. The lectures are given at 3 o'clock every Sunday in the Auditorium of the Museum in Golden Gate Park. These lectures are of popular character, usually on scientific subjects, and are given by specialists. They are free to the public. That they are appreciated is evidenced by the large audiences; the hall is almost invariably filled and standing room is in demand. It frequently happens that many have to be turned away for lack of room.

Among those who have given lectures in these courses are many of the most distinguished scientific men and publicists in America. They have been glad to appear in the Academy lecture courses entirely without compensation other than that which comes with the knowledge of having rendered public service in popularizing science. Nevertheless, the Academy regrets that it has no lecture fund from which it can at least pay the lecturer's actual expenses.

The hall in which these lectures are given is not at all suitable for the purpose. It is entirely too small and is very poorly furnished. The seats now used are mere makeshifts and the general equipment is not good.

A much larger hall of proper construction and with suitable seats and other necessary furnishings is urgently needed. It is hoped that some public-spirited citizen, who wishes to do a really splendid thing for the community, will supply the Academy with the money necessary to provide an adequate auditorium suitably equipped, and with a small endowment which will yield an income sufficient to meet the running expenses.

In addition to the Auditorium room proper, there should be at least one smaller room suitable for the use of committees, for the Boy Scouts that hold weekly meetings at the Museum, and for other societies and committees that at times desire to hold meetings at the Museum.

The proposed Auditorium would, of course, bear the name of the donor or of the man or woman for whom it is established as a memorial. A more fitting, dignified, and educationally useful memorial can scarcely be conceived.

In the weekly announcements of the lectures and other functions to be held the name of the Auditorium would always appear. These announcements go to every one of the thousand members of the Academy. They, on large placards, are displayed in most of the school buildings in San Francisco, on the bulletin boards at the University of California, at Stanford, and in other places.

In this way the Auditorium would soon become the best known memorial building in the city. The cost of such a memorial building would not be great, considering its usefulness, and the sentiment which inspired its erection. It would never appear cheap or inadequate, but would always stand as a dignified memorial in which those who provided it will ever feel a just pride.

Is there not some one in San Francisco, some one who has prospered in this world, who can come forward and do this splendid thing for the educational improvement, culture and entertainment of our people?

Several other needs of the Academy might be mentioned, but these will suffice to show that we must have more money to meet the cost of our present needs and to provide for the inevitable growth of the next few years.

## DEPARTMENT REPORTS

The various curators and their assistants, as in the past, have been active and efficient in building up and caring for the collections in their respective departments.

Early in the year, after consultation with the curators, the Director arranged to have monthly meetings of the Museum staff. These meetings are held in the Library at 9:30 A. M. of the second Friday before the last Saturday of each month.

At these meetings the interests of the various departments and the Museum as a whole are discussed. For example, at one meeting the Curator of Herpetology explained clearly and fully the methods of his department in collecting and other field work, the tagging and preservation of specimens, the recording of field observations, etc., the care of specimens when they reach the Museum, the accessioning and card cataloguing of specimens, the care of specimens in the research collections, and many other matters, including the aims and purposes of the department. At the next meeting the Curator of Birds and Mammals did the same for his department, and the others followed. These meetings have proved extremely interesting and must certainly result in great good in several ways. In the first place, they give each curator an opportunity to become informed regarding the work of the other departments, their aims, purposes, ideas, methods, and accomplishments. In this way he is brought into closer touch with the Museum as a whole, and is made more appreciative of the work of his associates. Another excellent result of these "cabinet meetings" is that each curator is lead to examine and consider more carefully the aims, methods and accomplishments of his own department.

Each curator very naturally and very properly is ambitious that *his* department shall be the best organized, the best conducted, and in every way the most up-to-date department in the Museum. When he hears from the others about their departments, he will the more critically examine the work of his own department and be inspired to greater effort. In the end the activities of the Museum will become more unified and more efficient.

### Department of Botany

The most noteworthy event in the history of the Herbarium of the California Academy of Sciences in the past year was the acquisition of the Albert Prager Herbarium from Leipsic, Germany. This was made possible through the generosity of the following members of the Academy: Mr. Wm. M. Fitzhugh, Mr. Wm. C. Van Antwerp, Mr. J. D. Grant, Mr. Wm. H. Crocker, Mr. Wm. F. Herrin, Mr. John C. Augsbury, and Mr. A. F. Morrison, who contributed the necessary funds. The price paid for the herbarium was $1,000, to which was added the cost of packing, transportation, and some incidental expenses, which made the total cost $1,266.53.

This herbarium was regarded as one of the largest and most important private herbariums in Germany and was sold chiefly because of the great age of the owner. We were most fortunate to have the chance offered to us and to be able through the generosity of the patrons and friends of the Academy to secure this collection for our herbarium, which thus becomes the greatest cosmopolitan collection on the Pacific Coast and west of the Mississippi.

Professor Prager's account tells the history and importance of the collection and follows in translation:

"The herbarium was founded in 1878 through original collections in Germany, the Alps, and Northern Italy. Its first important addition came through the purchase of Dr. Hampe's herbarium, which I bought in 1886 after his death at a rather high price. It contained besides German and Adriatic plants, a great rarity in the authentic collections of Ecklon and Zeyer in the Cape Region of Southern Africa in 1843 and 1844, containing about 1,200 species, most of which were until then unknown and on which the foundation for the Flora of South Africa was made. There were only a few sets of these collections and they are priceless, impossible now to obtain. From 1886-1892 the herbarium was enlarged by my own collections and the purchase of two important scientific herbariums, namely that of Professor Stengler and that of Professor Schlechtendahl. The last is most valuable as it contains the collections of several important botanical expeditions, namely, Willkom, Spain; Fischer & Meyer, Mediterranean countries and Algeria; Spreuner, first scientific expedition to Greece and Asia Minor, containing many plants until then unknown; Schimper, the great Arabia, Sinai, Egypt Expedition of 1825-26. This expedition traveled through a country botanically very little known, and was made possible through the unusual kindness of the Turkish rulers, never before extended to a Christian expedition. At that time no travelers came to Arabia, as the country was strictly barred against all unbelievers. This collection is complete in the Prager Herbarium and is priceless now and impossible to obtain. A new period of growth came to the Prager Herbarium through a new correspondent, Dr. Von Betche, the recently deceased Assistant Director of the Botanical Institute at Sydney, Australia. During ten years this authority on the flora of Australia sent me one of the largest collections of Australian plants and so many duplicates that I was able to secure other collections by exchange. I exchanged with the University Greifswald, Upsala (Norwegian and Lapland plants), Agram (Roumanian plants collected by Von Iriwaldsky), Prague (Carpathian), Wurtzburg, even with St. Petersburg from where I obtained the collection of the Central Asiatic expedition to Saisang-Nor, Hohenacker's Caucasian expedition, the Kamchatka and North Siberian expedition of Pallas. From Mr. Forsyth, now Director of the Botanical Gardens at Adelaide, Australia, then at Pt. Darwin, I obtained 400 species of the very little known flora of Northern Australia and a large amount of exchange material. These exchange specimens enabled me to acquire two important collections, namely, Dr. Schaffner's Mexican collection, 300 species, and Baron von Eggers' West Indian collection, 300 species. From Dr. von Betche I obtained, furthermore, his fine collection of Samoan ferns, collected chiefly on Upola during two years and the most complete collection of Samoan ferns in existence."

### Summary of the Prager Collection

Twenty thousand species phanerogams, 500 ferns, 500 mosses and hepatics, chiefly German; 500 algæ, Germany, and German seas; 3,000 fungi, all Europe, including the classic collection of Dr. Baenitz; 100 lichens, middle Europe; 10 boxes of microscope slides of diatoms and other botanical specimens.

Many species are represented by specimens from different parts of Europe and Asia, so that the number of specimens far exceeds the number of species. The species are catalogued by hand in 21 volumes, under the families and genera, according to the system of Engler and Prantl, in Pflanzenfamilien.

Some genera are represented by many specimens collected and named by authorities; for instance, Rubus, Rosa, Erica and Statice, besides the classic Hohenacker's collection of cereals numbering 200. We have estimated from the catalogue even a greater number of species than Dr. Prager. According to the estimate, there are represented in the phanerogams and ferns 1,090 genera and 21,006 species; mosses, 30 genera and 401 species; lichens, 19 genera and 279 species; fungi, 3,656 species; algæ, 500 species, and hepatics, 65 species, making a total of 22,907 species altogether.

The regular herbarium, exclusive of the Prager Herbarium, now contains 70,762 mounted specimens, and 4,698 unmounted specimens of mosses, lichens, and hepatics, bringing the total to 75,460, an increase for the year of 7,671 specimens. The collections made in Lower California, by Ivan M. Johnston, the botanist of the Expedition, are not included, as at present the exact status of the collection is not known. Specialists who have examined some of the groups assert that, in spite of the fact that the time when the collecting was done was the most unfavorable of the year, it is the best collection ever made in that little explored region. Mr. Johnston estimates about 1,500 numbers, represented by probably 6,000 specimens. There are about 300 species of which about 50 are new to science. The report will be ready for publication in the spring.

The most notable contributions to the herbarium have been as follows: 560 from Idaho by purchase; by exchange: N. Y. Botanical Garden, 225 lichens, 50 mosses from Montana, and 747 miscellaneous; Arnold Arboretum, 1,557 trees and shrubs; National Herbarium, 1,421 miscellaneous specimens, and Ira D. Clokey, 223 from Colorado. Seventy-four different persons have contributed to the herbarium, often specimens for identification, but there have been some notable gifts. Among these are 77 species of Veronica from New Zealand, by Dr. L. Cockayne, the well-known authority on New Zealand plants and a specialist on the genus. He plans to have represented in our herbarium all the New Zealand species of Veronica obtainable. Mr. C. Piper Smith has given us a valuable lot of specimens chiefly from Utah and Maryland, and

Dr. H. M. Hall, 215 miscellaneous specimens, many among them of genera on which he specializes. Eric Walther continues to add to the collection of exotics cultivated in California and has brought 692 specimens to the collection. His zeal in seeking new plants and in adding better and more complete specimens to what we already have is unbounded. It is through this earnest and capable gardener that the labelling of the trees and shrubs in Golden Gate Park is being gradually accomplished. It is expected before long that a list of the trees and shrubs can be ready for publication with a map of the park on which the position of the labelled specimens is indicated.

Miss Anna Head collected a large number of plants in Mendocino County and the Feather River region, amounting to about 550 specimens, some of them duplicates.

Mrs. E. C. Sutliffe has been indefatigable in collecting and identifying the Hepaticæ, and with the assistance of Mrs. Marian L. Campbell, has collected 61 species, chiefly in Marin and Plumas counties, which are beautifully prepared and have been sent for verification to Dr. Evans, who is an authority on this group.

The curator made several week-end trips to type localities not far from San Francisco in search of certain species, but with few exceptions the search was unsuccessful because the places were occupied by habitations and the wild land had become cultivated fields. Along the roadsides the ground was monopolized by immigrant plants which had crowded out the natives. One week-end trip was taken to Willows, Glenn County, where a small collection was made and the rare *Pilularica americana* found in an irrigating ditch. In July I was the guest of Mr. Wm. F. Herrin on a trip by automobile through Mendocino, Humboldt, Trinity, Shasta, and Siskiyou counties, and later to Medicine Lake, a small sheet of water in Siskiyou County, in a country of obsidian and lava. Altogether the curator's collections amounted to about 1,107 specimens.

Lewis Allen, one of the gardeners in the Park, has taken some fine photographs of trees and shrubs, chiefly Eucalypti, to show the habit and character of the bark, and has donated 42 to be added to the mounted specimens in the herbarium. J. August Kusche always has the herbarium in mind when collecting insects and has given 36 specimens of lichens and 29 mosses, from the Hawaiian Islands, a small unnamed collection from the Solomon Islands, and a collection made in winter at Needles on the Colorado River.

The flower exhibit at the entrance of the Museum continues to be a popular feature and is continuously kept up during the year. Several thousand species of native and exotic plants are exhibited during the year, each labelled plainly with scientific name, popular name if there is one, and the country or locality where the plant is native. Without the care of Mrs. Johanna Wilkens in keeping the shelves and receptacles clean, removing the old flowers and installing the fresh ones, it would not be possible to make this exhibition a success.

The Botanical Club holds weekly meetings or excursions and the class of gardeners meets in the herbarium every Thursday evening. The gardeners bring in rare plants for identification and are enthusiastic supporters of the herbarium. Antone Blazic, one of them, who is now in Florida, has sent about 100 specimens of native and exotic plants from Palm Beach and Miami. Besides these activities towards popularizing botany, the curator gives informal talks to clubs and schools, particularly emphasizing the need to spread the gospel of conservation of the native flora.

My assistant, Mrs. Kate E. Phelps, has been most efficient in mounting the accessions, putting them in their proper places in the herbarium, making an inventory of the collection, and generally looking after the specimens to be pressed and dried. In California this can go on throughout the entire year and takes a great deal of time and attention.

It has been impossible so far for me to do any original botanical work which adds so much to the scientific value of the herbarium, because my time is taken up with the herbarium detail work necessary to keep so rapidly growing a collection in order, and a great deal is work that only a botanist can do. I greatly need a botanical assistant as well as my present poorly paid helper.

Alice Eastwood, *Curator.*

## Department of Entomology

The outstanding feature of the work in this department during the year 1921 was the Academy's Expedition to the Islands of the Gulf of California, in which the curator took part as entomologist. This expedition was in the field from about April first to July fifteenth, which was at the end of the dry season there, and the worst possible time for collecting insects. The few insects about at that time were those that had survived a long dry season and had escaped their foes among the birds, lizards and other forms of predaceous life. A very considerable portion of the material taken was found in æstivation, either under stones and rotting wood or, in many cases, was dug out of the ground from about the roots of trees or bushes. In spite of these obstacles, over 13,000 specimens of insects were secured. After the return of the expedition much of the spare time of the curator for two or three months was occupied in mounting the specimens, printing and attaching the, over 30,000, pin labels required for this material, and in getting it assorted for study. A good beginning has now been made in the determination of these insects. Dr. F. E. Blaisdell has made good headway with the Tenebrionidæ and has found a very large percentage of new forms among them. Mr. F. R. Cole, who is working up the Diptera, has found an almost equally large proportion of new forms among the Bombyllidæ, or bee-flies. Prof. T. D. A. Cockerell is now working on the bees and has found more than half the species to be new. Miss Annette F. Braun has worked up the few microlepidoptera taken, describing several new forms. Other material from this expedition has been sent to the following specialists: the Anthomyidæ to Mr. J. R. Malloch, the Dolichopodidæ to Mr. M. C. Van Duzee, the Chrysididæ to Mr. L. H. Taylor, the Elateridæ, Buprestidæ, Cleridæ and Cerambycidæ to Dr. E. C. Van Dyke, the Aleocharinæ to Dr. A. Fenyes, the Bembecidæ to Mr. C. L. Fox, the Orthoptera to Mr. Morgan Hebard, and the Geometridæ to Mr. W. S. Wright. The curator has now completed work on nearly half of the Hemiptera and finds about one-fourth of the species to be new. The Sonoran insect fauna of Mexico has never been worked up with any approach to completeness and in only a few groups has collecting been done, except in a most desultory way. No other region accessible to the Academy could yield such numbers of new forms. It is the metropolis of several groups of insects dominant in Southern California and it would seem that its careful exploration is one of the most important fields of scientific research still open to the Academy. It is a field which will soon be covered by eastern institutions if this Academy does not undertake it.

In addition to the insects taken by the Gulf expedition, Mr. J. C. Chamberlin, who was one of the party, brought home for the Academy collection over 5,000 spiders and about 1,200 scorpions, pseudoscorpions and myriopods. Dr. Ralph V. Chamberlin of Harvard University has worked up the myriopods, describing 11 of the 15 species as new, and is now working on the spiders, while Mr. J. C. Chamberlin is at work on the scorpions and pseudoscorpions.

As no new cases were added during the year little could be done in the arrangement of our collection, although 42 boxes were available for the reception of our North American butterflies. We were fortunate in securing the services, for three weeks, of Mr. W. S. Wright of San Diego, an authority in that group of insects. With his help our material was sorted over and arranged systematically so far as the boxes would contain them. Three families of butterflies still await the purchase of new boxes. The curator has had but little time during the year for systematic work on material other than that taken by the Gulf expedition, but a few collections of Hemiptera have been determined for other workers.

Accessions to this department during 1921 number 25,915 specimens, inclusive of the spiders, myriopods, etc., taken by Mr. Chamberlin. Of this number 19,273 represent the results of the Gulf expedition. By purchase the department has secured 2,400 insects, mostly butterflies and moths, taken by Mr. J. August Kusche in North Queensland and the Solomon Islands, and 778 specimens taken by Mr. Kusche at Needles, Calif. Several valuable donations were received: From Mr. Virgil Owen, 332 specimens, mostly from Arizona; from Prof. E. O. Essig, types and cotypes of several species of Aleurodidæ; from Mr. C. L. Fox, 1,088 insects, largely from Gold Lake, Calif.; from Dr. Isabel McCracken, 62 insect-galls mounted ready for exhibition; from Dr. E. C. Van Dyke, 1,348 insects from Yosemite Valley; from Mr. J. O. Martin, 333 insects from California; from Mrs. H. E. Ricksecker, 294 insects from Cisco, Calif. Other valuable donations were received from Dr. F. E. Blaisdell, including several paratypes and many eastern beetles, Mr. Louis Slevin, California insects, Mr. E. R. Leach, Mr. Chas. Kendrick, Mr. J. W. Mailliard, Mr. W. M. Giffard, and Mr. Jos. Mailliard. During three months of the year the curator had the help of Mr. J. O. Martin in mounting and labelling the specimens received.

The most pressing need in this department for the coming year is the purchase of more cabinet boxes. At least four cases of 168 boxes should be added this year to make possible the proper systematic arrangement of the material that has been studied and is ready for incorporation in our systematic collections. Material stored away, as much of ours now is, is not only unavailable for study but is subject to attack by insect pests.

The curator would like again to call attention to the exceptional opportunity now existing for the Academy to take the lead in the entomological exploration of the Sonoran region of Mexico, an opportunity which it soon will be too late to embrace. This region was not covered in the work of securing material for the Biologia Centrali-Americana, and almost no systematic collecting has been done there except the little accomplished by the Academy in the early nineties. The importance of our occupying this field while it still is open to us is shown by the large number of new forms secured by this year's Gulf expedition. It is quite possible that the results of that expedition in the field of entomology will nearly or quite double the number of species known from those states, and at that but a start was made. The task is not limitless. New species now are not easy to find in the eastern states and that soon will be true of the Sonoran region, which includes Sonora, Lower California, Arizona and Southern California. Few institutions now have the chance to open up such a rich fauna at its very doors, and to secure the types of the many new forms, and the opportunity should not be allowed to pass unimproved.

Edward P. Van Duzee, *Curator.*

## Department of Herpetology

The Department of Herpetology during the year 1921 progressed satisfactorily and the work accomplished compares favorably with that of previous years.

At the beginning of the year 1921 the Academy's collection of reptiles and amphibians numbered 41,504 specimens. There have been added during the year 5,002 specimens, so that the collection has grown to 46,506 specimens.

The number of specimens added during each of the past six years has been about as follows: in 1916, 1,500 specimens; in 1917, 1,600; in 1918, 1,724; in 1919, 2,666; in 1920, 1,466, and in 1921, 5,002.

Gifts of specimens during the year have been received as follows: From Miss Mary McLellan, 106 specimens; Dr. Thomas Barbour, 18; Prof. V. M. Tanner, 10; Richard P. Erwin, 200; Dr. E. C. Van Dyke, 7;

E. G. Osterhoudt, 5; Mrs. A. Jannopoulos, 1; Raymond Duhen, 1; Wm. Heim, 1; C. L. Fox, 1; Dr. E. D. Chipman, 1; Robert Hawxhurst, 1; Frank Stevens, 1. Total, 353.

Specimens have been secured from 12 counties of California, as follows: Calaveras, 1; Humboldt, 5; Imperial, 1; Los Angeles, 3; Marin, 7; Mariposa, 7; San Mateo, 1; Santa Clara, 4; Santa Cruz, 1; Sonoma, 1; Tulare, 2; Ventura, 175.

Specimens from other localities are: Arizona, 2; California, 214; Florida, 8; Idaho, 206; Indiana, 2; Maine, 50; Maryland, 14; Massachusetts, 53; Michigan, 8; Nevada, 7; New Hampshire, 78; New Mexico, 4; New York, 25; North Carolina, 2; North Dakota, 8; South Dakota, 1; Texas, 8; Utah, 254; Vermont, 87; Virginia, 23; Washington, 17; West Virginia, 10; Africa, 59; Asia, 17; Austria, 7; Portugal, 1; Switzerland, 2; Corsica, 2; Sardinia, 1; Central and South America, 83; Mexico, 3,238; West Indies, 72; Fiji Islands, 1; Friendly Islands, 179; Marshall Islands, 4; Samoan Islands, 106; Solomon Islands, 81; other Pacific islands, 3; Australia, 3; East Indies, 17. The expedition to the Gulf of California resulted in the addition of 3,223 specimens to the collections of this department; among these were 20 new species of reptiles.

The classification, labelling, cataloguing and arrangement of the collection was continued during the year.

Much research has been carried on during the year. Lists of the amphibians and reptiles of Nevada, Idaho and the Peninsula of Lower California, with notes on the specimens in our collection, have been printed. A descriptive account of all of the reptiles of Western North America has been completed, and preliminary descriptions of 16 new species of lizards and snakes have been published.

The snakes of the genus Diadophis were borrowed by Dr. Blanchard of the University of Michigan, and a large collection of oriental salamanders was sent to Dr. Dunn of Smith College for study. A series of our California racers was studied by A. I. Ortenburger of the University of Michigan.

John Van Denburgh, *Curator.*

## Library

Work in the Academy library has been kept up-to-date throughout the year 1921 and considerable progress has been made toward the incorporation into the library of the miscellaneous material accumulated during past years. The number of volumes acquired by purchase during the year was much smaller than in 1920, due to the excessive prices now being charged by the European dealers and the difficulty experienced in securing books at any price from the continental dealers. Additions by gift were much more numerous than during the previous year. Most of these additions came through the gift of Dr. Barton Warren Evermann, Director of the Museum, a gift constituting by far the most important single accession received by the library in recent years. This donation numbered about 6,500 items of which nearly 1,000 were bound volumes, and 2,800 were classified and fully catalogued pamphlets and excerpts, largely on the subject of fishes, the fishery industries and other natural history subjects. Other gifts to the Academy library have been received from Mrs. Nelly Waterhouse Dorne, Miss Alice Eastwood, Mr. J. W. Mailliard, Mr. J. O. Martin, Dr. G. Dallas Hanna, Dr. F. E. Blaisdell, and other individuals and institutions.

Additions to the library during the year number 1,380 bound or complete volumes and many pamphlets, excerpts and miscellaneous papers. Of the complete volumes 205 were obtained by purchase, 914 by gift, and 261 by exchange. During the year 2,315 volumes were entered on the accession register of the library, bringing the total number of accessioned volumes up to 16,395.

Until August first the work in the library was, as in the previous year, in the hands of Miss Mary E. McLellan and Mrs. Helen Van Duzee. Miss McLellan then severed her connection with that department and Mrs. Van Duzee has since attended to all departments of the library work with the assistance, during a part of the time, of Miss Pauline Kusche. All these have given faithful and efficient service, resulting in very satisfactory progress in the work of the library. The use of the library has been even more gratifying than during previous years, especially in its connection with the work being done in the several departments of the Academy. The membership use of the library also has been most satisfactory during the past year, and it is hoped that this feature of its activities may grow proportionately with the increase of the library and of its equipment.

E. P. VAN DUZEE, *Assistant Librarian.*

## DEPARTMENT OF MAMMALOGY

The work of this department has been carried on incidentally to that of the Department of Ornithology, as before, and the trapping of rodents and other small animals was made a part of the work of each field party. For want of proper assistance, it has not been possible to undertake any work with the larger animals.

All of the specimens in the care of the department have been catalogued and arranged during the past year; a satisfactory skin room has been constructed and all the larger skins placed therein, with provision made for thorough fumigation as often as seems necessary to prevent attacks of troublesome insect pests. The removal of a large number of skins from the metal cases has made many of these cases available for departmental use and saved the department from the necessity of immediate purchase of additional ones.

The number of recorded specimens of all classes in this department is 3,978, including the following additions for the year: *By exploration,* 200 specimens. *By gift:* Dr. Sterling Bunnell, 1 specimen; Mr. A. Christoffersen, 1; C. I. Clay, 1; Mr. Joseph Dixon, 1; Dr. G. Dallas Hanna and Marcus Hanna, 2; Mr. John McLaren (Golden Gate Park), 3; Miss M. E. McLellan, 1; Miss Susie Peers, 1; Quarantine Division, California Department of Agriculture, 1; Mr. A. W. Robison, 1, and Mr. W. G. Wright, 4. *By purchase:* 7 specimens.

A great deal had been anticipated as a result of the Academy's expedition to the Gulf of California, as there must be many undescribed insular forms of small mammals upon the islands there, but the unfortunate illness of the representative from this department, who was also representing the Department of Ornithology, put a stop to all such work, and the returns were practically nothing in comparison with what they should have been. JOSEPH MAILLIARD, *Curator.*

## DEPARTMENT OF ORNITHOLOGY

During the year 1921 more work has been accomplished in this department than for several previous years. Great progress has been made in the classification and registration of the ornithological specimens; and the matter of systematizing, mounting and arranging the growing collection of birds' eggs has been undertaken, and is now well along toward completion. The services of Miss Mary E. McLellan have been secured, and with her assistance and that of Mr. Chase Littlejohn, assistant curator, all this work is reaching such a satisfactory status that time will be available in the near future to permit the resumption of research work.

In the field the department has shown marked activity. Most unfortunately, however, this department's representative on the Academy's expedition to the Gulf of California was disabled by illness very soon after the field of action was reached and hence the results, except for the collecting of a number of rare specimens of birds' eggs, were extremely disappointing. The most valuable portion of the eggs secured was an exceptionally fine series of eggs of the Elegant Tern (*Sterna elegans*), which gives the Academy possession of what is probably the best representation at present existing of these variedly and beautifully marked eggs.

On account of the amount of the funds devoted to the expenses of the Gulf of California Expedition, field work in California was somewhat circumscribed, but a fair amount was carried on along the same lines as in recent years.

With Mr. Chase Littlejohn as assistant, the curator took the field on the northwest coast of California for the observation of bird migration, the collection of resident species for comparison and identification, and the recording of such species as might be noted by the field party. Requa, Del Norte County, was the locality selected for this work because of its being actually on the coast, as well as being in a region in which but little work of this sort had been carried on. This field was reached on April 20, and there, with the exception of some side excursions of short duration, operations were carried on until June 2. The means of transportation were the ordinary train and stage. Through the courtesy of the superintendent of the Hoopa Indian Reservation, Mr. J. B. Mortsolf, within whose jurisdiction it was, the Indian Service cottage at Requa was placed at the disposal of the field party, by which it was occupied during the greater part of the time passed in the field.

A trip of a few days was made to Patrick's Creek, some 30 miles northwest of Crescent City, on the road to Medford, Oregon, and several days were passed in this locality, which is on the dividing line between the humid coast belt and the more arid interior.

On the way back to San Francisco a stop of several days was made at Eureka, and some interesting points in that vicinity were visited, where various specimens and notes were obtained.

The rewards of this field work were in the making of several new geographic and migrational records, which extend the known range of some of the species met with, the securing of a number of specimens of resident birds, and the compiling of a list for future reference of the land birds noted in that portion of Del Norte County in which Requa is situated.

The autumn field work consisted in the revisiting of part of the ground covered in the spring, in order to obtain certain residents thereof in the freshest fall plumage, and to make observations upon the fall migration of the fox sparrow group, in continuance of similar work done in the past two seasons. This trip was made in company with Mr. Chester C. Lamb as assistant, with complete camp outfit and means of transportation. The party remained in the field from September 12 to October 12, the greater part of the time either actually on, or at least within a few miles of, the coast itself, between Requa and the southern border of Humboldt County. Material for several papers was secured, as well as many specimens, and the known range of some species of birds considerably extended.

Accessions to the Department of Ornithology during the year have been as follows: Bird skins—*By exploration:* 384 specimens. *By gift:* Mrs. F. W. Beardslee, 6 specimens; Mr. Ralph Borden, 8; Dr. Sterling Bunnell, 1; Dr. Ernest D. Chipman, 1; Mr. A. Christoffersen, 1; Miss Ava Evermann, 2; Mrs. D. Ghirardelli, 1 case of South American Hummingbirds; Mr. W. M. Giffard, 1 specimen; Dr. Goodman, 1; Hackmeier and Company, 2; Dr. G. Dallas Hanna and Mr. Marcus A. Hanna, 20; Mr. F. C. Holman, 5; Miss Caro L. Kidder, 1; Mr. John McLaren (Golden Gate Park), 5; Miss M. E. McLellan, 47; Mr. James Moffitt, 1; Robison's Bird Store, 2, and Dr. J. R. Slonaker, 190. *By purchase:* 158 specimens.

The total number of specimens on hand at the end of the year is 38,903.

In addition to the above, the department has received specimens of birds' eggs, as follows: *By exploration:* 795 sets. *By gift:* Alaska Packers Association, 346 eggs; Dr. G. Dallas Hanna and Mr. Marcus A. Hanna, 68 sets and 43 nests; Captain B. McGrath, 3 eggs; Mr. Russel Ruble, 9 sets; Mr. F. L. Saylor, 1 nest, and Dr. J. R. Slonaker, 197 sets. *By purchase:* 8 Megapode eggs.

With these accessions the oölogical collection now comprises 3,778 sets.

JOSEPH MAILLIARD, *Curator.*

## Department of Invertebrate Paleontology

On January 1, 1921, the Curator of the Department left San Francisco for Washington, D. C., at the request of the United States Commissioner of Fisheries, for the purpose of attending a conference on Alaska fur seals on January 10. Among other things accomplished, the persons present at the conference expressed entire satisfaction with the methods of fur seal computation which have been developed and applied by the writer from 1915 to 1920.

On the return trip from Washington a representative series of Cretaceous fossils was obtained at Austin, Texas; also a considerable collection of land shells was made there but at the end of the year they remained unsorted and uncatalogued.

A considerable amount of field work was done on this trip in various portions of Imperial Valley, California, particularly in the vicinity of Carrizo Creek. Collections then made were sufficient to warrant the completion of a report on the fossils of the region and the paper is now ready for the press except for the checking of a few stratigraphical observations in the region. The working up of the large amount of material secured on that trip occupied the greater part of the curator's time in the laboratory during the year, but it is felt that the results obtained have more than compensated for the time expended. During this study use was made of practically all collections from the region which have been assembled. These have been identified and returned to their respective owners with the exception of a small number of specimens which belong to the University of California; they were retained for a brief period for photographic purposes.

Other field work undertaken by the curator during the year consisted of two short trips to the Sierra Nevada Mountains and one to Point Reyes. On all of these the work was done in cooperation with Dr. Emmet Rixford of San Francisco, and primarily for the purpose of adding to the knowledge of the distribution of California mollusks.

The month of May and the first half of June were spent in the field in Los Angeles and Ventura counties, where the curator was ably assisted by Marcus A. Hanna of the University of California. The collections of fossils made there fill important gaps in the Academy's series and provide an abundance of well preserved specimens for exchange. At the end of the year this material had not been catalogued. The trip furnished an opportunity to secure good series of land shells at many places, and some birds, eggs, reptiles and amphibians were collected.

The department was represented on the Gulf of California Expedition by Dr. Fred Baker of Point Loma, California, and the collections in conchology and paleontology made by him and his associates are very large and valuable. They filled 28 packing cases and two tanks. The shipment arrived in San Francisco too late to be unpacked before the end of the year; therefore it is impossible to venture an estimate of the number of species or specimens collected.

The total number of accessions recorded during the year was 76, or 45,091 specimens. This does not include the three large collections which have been mentioned as remaining uncatalogued.

The most notable accession was the gift to the Academy of 29,698 land and fresh water shells by Mr. Edward C. Johnston of the U. S. Bureau of Fisheries. This large and well kept collection consisted chiefly of species from the Mississippi Valley. All cataloguing, indexing and identification had been done, so that parctically no labor was required to place the collection ready for reference.

Other accessions which deserve special mention are the series of South Sea Island shells received from Miss M. E. McLellan, Mr. J. August Kusche and Dr. Roy E. Dickerson. A valuable collection of land shells was made in Del Norte County, California, by Mr. Joseph Mailliard and Mr. Chase Littlejohn while pursuing ornithological explorations. They covered a section of the state which was previously unknown conchologically.

Owing to the expense involved in connection with the Gulf of California Expedition, assistance in the laboratory was cut to a minimum. Therefore as much routine cataloguing and identifying of specimens was not accomplished as might have been expected.

Extensive use was made of the Academy's collection by various students, particularly by Mr. Frank M. Anderson of Berkeley, California, formerly curator and now honorary curator, of the department. In 1916 and 1917 Mr. Anderson spent several months in the United States of Colombia, where he was engaged in economic petroleum investigations. At odd moments he assembled a very considerable collection of recent and fossil mollusks which he generously presented to the Academy. In 1921 he spent much time in arranging and naming this collection and left it in practically perfect museum shape, thus relieving the staff of the department of a large amount of routine labor.

Mr. Anderson was so impressed with the problems which were partially unfolded by his first geological work in Colombia that he determined to make a second trip. He succeeded in arranging for the financing of an expedition for further study and accordingly departed on November 21 with three assistants. The party expects to return some time in the summer of 1922.

Others nearby who made use of the collections were Professor Bruce L. Clark of the University of California and his students; Marcus A. Hanna, Merle Israelsky and R. N. Nelson. Mr. Henry V. Howe of Stanford University found much material from the vicinity of Astoria, Oregon, which interested him and he described several new species from it.

Outstanding loans of material from the department at the end of the year were as follows:

Dr. S. S. Berry, Redlands, California, chitons; Dr. W. S. W. Kew, U. S. Geological Survey, fossil sea urchins; Dr. Bruce L. Clark, University of California, oligocene fossil mollusks; Mr. Marcus A. Hanna, University of California, eocene venericard mollusks; Mr. Merle Isrealsky, University of California, fossil sea urchins; Miss Mary J. Rathbun, U. S. National Museum, fossil crabs, and Dr. T. Wayland Vaughan, U. S. Geological Survey, fossil mollusks from Mexico.

G. DALLAS HANNA, *Curator.*

## ACCESSIONS TO MUSEUM AND LIBRARY

Abernathy, Mrs. F. L., Berkeley: One specimen of Singing-fish (*Porichthys notatus*). Gift.

Academy of Natural Sciences, Philadelphia, Pa.: One snake from Santa Rita Mountains, Ariz. Exchange.

Alaska Packers Association, San Francisco: Three hundred and forty-six bird eggs from Alaska. Gift.

Allen, Mr. Lewis, Golden Gate Park: Fifty-four photographs of trees, shrubs and cultivated plants, from Golden Gate Park and other localities near San Francisco. Gift.

American Museum of Natural History, New York, N. Y.: One lizard from Lower California. Exchange.

American Philosophical Society, Philadelphia, Pa.: Proceedings, Nos. 119, 177 and 179, and Transactions, Vol. XXI, Nos. 1, 2. Gift.

Anderson, Mr. F. M., Berkeley: One California plant. Gift.

Arnold Arboretum, Cambridge, Mass.: One thousand five hundred and fifty-seven specimens of shrubs and trees, cultivated and native. Exchange.

Arnold, Mrs. A. R., Tracy: One botanical specimen from Tracy. Gift.

Baker, Dr. Fred, Point Loma: One marine shell from Lower California, new to the Academy collection, and one fossil shell. Gift.

Barbour, Dr. Thomas, Cambridge, Mass.: One lizard from Chihuahua and 15 other reptiles from Mexico and New Mexico. Gift.

Bassinger, Mr. A. J., Davis; Twelve botanical specimens from Mt. Oso, Mt. Diablo Range. Gift.

Bateman, Mr. William, Bakersfield: Two marine shells from Salina Cruz, Mexico. Gift.

Baxley, Ellen Cooper, Santa Barbara: One botanical specimen. Gift.

Beall, Mr. M. E., Berkeley: Boccaccio, Della Genealogia de gli Dei. Gift.

Beals, Mr. E. A., U. S. Weather Bureau, San Francisco: Thirteen numbers of the Pedagogical Seminary, 13 numbers of the American Journal of Psychology. Gift.

Bent, Mr. A. C., Taunton, Mass.: Fourteen bird eggs. Exchange.

Beardslee, Mrs. F. W., San Francisco: One case of mounted birds. Gift.

Bethel, Mr. Ellsworth, State Museum, Denver, Colo.: Two botanical specimens from Nevada. Gift.

Bither, Mr. S. Hall, Berkeley: Two specimens of marble from Mariposa County, such as is used for the manufacture of carbonic acid gas. Gift.

Blaisdell, Dr. Frank E., San Francisco: Seventeen numbers of North American Fauna. Gift.

Blazic, Mr. Antone, Los Angeles: Sixty-three botanical specimens from Southern California and Florida, eight photographs of native trees on Mt. Wilson and in adjacent country. Gift.

Borden, Mr. Ralph, Oakland: Eight ornithological specimens from Borneo and Australia. Gift.

Bowles, Mr. J. Hooper, Tacoma, Wash.: Nest and set of six eggs of Tennessee warbler, and 12 other sets of bird eggs. Exchange.

Bunnell, Dr. Sterling, San Francisco: One kangaroo rat from Alameda County, and one red-tailed hawk in flesh from Monterey County. Gift.

Burlingame, Mrs. C., Sonoma: Eight botanical specimens from Sonoma County. Gift.

Cain, Mr. Addison, Salt Lake City, Utah: One snake from Utah. Purchase.

Cain, Mr. Brighton C., Salt Lake City, Utah: One desert tortoise from Utah. Purchase.

Ten toads, two lizards, seven snakes, six frogs, 18 salamanders from Utah; one snake from Idaho, two lizards from Texas. Exploration.

California Department of Agriculture, Quarantine Division, Sacramento: One shrew in flesh. Gift.

California State Mining Bureau, San Francisco: Catalogue of the State Museum, in five volumes. Gift.

Campbell, Mr. Harry A., San Francisco: Three hundred and thirty-one specimens of marine shells from the Arctic Coast of Alaska. Gift.

Campbell, Mrs. Marian L., Mill Valley: One hundred and twenty-four specimens of plants from Southern California, 56 specimens from Shasta County, and three specimens from Mill Valley. Gift.

Campbell, Mrs. Robert, Pasadena: One hundred and nineteen specimens of plants from Southern California. Gift.

Carnegie Museum, Pittsburgh, Pa.: Two bird skins from the Kermadec Islands. Exchange.

Chilton, Dr. Charles, Canterbury College, Christchurch, N. Z.: Eight maps of New Zealand. Gift.

Chipman, Dr. Ernest D., San Francisco: Head of Wood Duck (*Aix sponsa*) taken in Marin County. Gift.

Christofferson, Mr. A. P., San Francisco: Skull and horns of reindeer, and one study skin of Black Brant from St. Paul Island, Alaska; seven marine shells from Alaska, one pamphlet. Gift.

Clay, Mr. C. I., Eureka: Skull of *Bison alleni* Lucas, from southern end of Humboldt Bay. Purchase.

Clemens, Mrs. Mary S., Pacific Grove: Thirty-five specimens of mosses, chiefly from Big Fork, Montana; 22 grasses from Crater Lake, Oregon, and Plumas County, and 77 other botanical specimens from California localities. Gift.

Clark, Dr. Frank C., Los Angeles: Sixty-one sets of birds' eggs (213 eggs) mostly from Napa County. Gift.

Clokey, Mr. Ira W., Denver, Colo.: One hundred and thirty-nine plants, and 84 grasses, from Colorado. Exchange.

Cockayne, Mr. L., Wellington, N. Z.: Seventy-seven Veronicas from New Zealand, some being duplicates of the types. Gift.

Coleman, Mr. R. A., San Francisco: Five hundred and seventy-seven specimens of fossil shells and eight fossil whale bones from the vicinity of San Diego. Gift.

Davidson, Miss Perry, Los Angeles: One fossil shell from Orange County. Gift.

Dickerson, Dr. Roy E., Manila, P. I.: One thousand four hundred and seventy marine shells from the Philippine Islands. Gift.

Dickey, Mr. Donald R., Pasadena: Twenty-four birds from Southern California. Exchange.

Dixon, Mrs. Joseph, Berkeley: One California Shrew in flesh. Gift.

Donohue, Mrs. Joseph A., Menlo Park: Two botanical specimens from Menlo Park and three from Chico. Gift.

Eastwood, Miss Alice, California Academy of Sciences: Three hundred and seventy-seven botanical specimens from Siskiyou County, 50 from Mendocino County, 84 from Yuba County, 16 from Mount Hamilton, 31 from Humboldt County, 64 from Marin County, and 501 from other California localities. Exploration.

Maiden, Critical Revision of the Genus Eucalyptus, 2 volumes. Gift.

Ehrhorn, Mr. Edward M., Honolulu, P. I.: One hundred and seventy-one specimens of marine shells from localities near Honolulu. Gift.

Erwin, Mr. Richard P., Boise, Idaho: Two hundred specimens of reptiles and batrachians from Idaho. Gift.

Evermann, Miss Ava, Kokomo, Ind.; Specimen of Ruby-throated Hummingbird (*Trochilus colubris*) from Kokomo, Indiana. Gift.

Evermann, Dr. Barton W., California Academy of Sciences: Approximately 6,500 books and pamphlets, chiefly on scientific subjects, including many serial publications of learned societies and institutions; specimen of moss from Alaska. Gift.

One garter-snake, three specimens of ore from the Finnegan Mine, Carson Hill, Calaveras County; 12 sets of eggs of White Pelican, and one set Brewer's Blackbird eggs, from Pyramid Lake, Nevada; three living specimens of Snow Plant, six living specimens of Coral-root Orchid *(Corallorhiza biglovii)*, one living specimen of Pine Mistletoe, six cones of the Big Tree (*Sequoia gigantea*), three cones of the Sugar Pine, shingles of the White Fir, Sugar Pine and Big Tree from the Giant Forest, and six other specimens of California plants. Exploration.

Fenn, Mrs. R. W., Lindsay: Two botanical specimens from Lindsay. Gift.

Fox, Mr. C. L., San Francisco: Four hundred and sixty-three specimens of Dipterous insects taken about Gold Lake, Sierra County, in July, 1921, and 70 specimens of moths from the same locality. Gift.

Galleazzi, Mr. G., San Francisco: Brass from accordian reed plates, aluminum plates from same. These were parts of accordions in the store of G. Galleazzi & Sons, San Francisco, April 18, 1906. Gift.

Garvey, Miss Maude S., San Francisco: One botanical specimen from Red Bluff. Gift.

General Electric Co., Schenectady, N. Y.: One book, Life in a Large Manufacturing Plant, by Ripley. Gift.

Ghirardelli, Mrs. D., San Francisco: Case of South American Hummingbirds, and one botanical specimen from her garden. Gift.

Giffard, Mr. W. M., Honolulu, T. H.: Two specimens of Pelee's Hair from Kilauea Volcano, three colored photographs showing panorama of Kilauea Volcano, and one bird skin from Hawaii. Gift.

Gillon, Mrs. E. E., San Francisco: Tapa cloth from Samoa. Gift.

Goodman, Dr. E., San Francisco: California Murre, juvenile, in the flesh, and two botanical specimens from San Francisco. Gift.

Gunnison, Mrs. A. M., San Francisco: One botanical specimen from her garden. Gift.

Hall, Dr. H. M., Berkeley: Two hundred and fifteen unmounted and six mounted specimens of plants from Colorado and California. Gift.

Hallowell, Mr. Harry E., San Francisco: Two cultivated plants for identification. Gift.

Hanna, Dr. G. Dallas, California Academy of Sciences: Two hundred and sixty-one land shells from Point Reyes Peninsula, collected with Dr. Emmet Rixford; 2,448 specimens of land and freshwater shells from Southern California, collected in January, 1921; 110 land shells from Tuolumne County, 142 land shells from San Joaquin County, eight freshwater shells from Marin County, 363 land shells from Calaveras County. Exploration.

One hundred and twenty-five specimens of fossil shells from St. Paul Island, Alaska; 940 specimens of fossil marine mollusks, corals, etc., from Imperial County; 44 casts of fossils from Imperial County, the originals of which are in other museums; 315 specimens of fossils from Austin, Texas, 10 shells from Alaska, one large quartz crystal from Mokelumne Hill, three botanical specimens from Imperial County, two specimens of White-footed Mice from Marin County, one lizard from Imperial County, one from Ventura County, and two lizards and two snakes from Marin County, 15 maps of the Pribilof Islands, Alaska, and sundry pamphlets. Gift.

Hanna, Dr. G. Dallas and Mr. Marcus A.: Two hundred and forty-eight specimens of land and freshwater shells from southern California, collected in May and June, 1921; 68 sets of sundry bird eggs and nests, 20 bird skins, and two bat skins from Ventura County. Exploration.

Hanna, Mr. Marcus A., Berkeley: Fifteen freshwater shells from Kansas, 11 specimens of freshwater mussels from Arkansas, and 166 land and freshwater shells from Calaveras County. Gift.

Hart, Mr. Cecil, Los Angeles: Twenty-two specimens of plants from Los Angeles. Gift.

Hawxhurst, Mr. Robert, San Francisco: Snake skin from near the Piz Piz River, Department of Cabo Gracias, Nicaragua; and sundry Academy publications. Gift.

Hayden, Dr. Walton, Marshfield, Ore.: Three hundred and thirty-one botanical specimens from Oregon. Gift.

Head, Miss Anna, Berkeley: Three hundred and fifty specimens of California plants. Gift.

Heath, Dr. Harold, Stanford University: Three land shells from Santa Cruz County. Gift.

Hercules Powder Co., Wilmington, Del.: Four pamphlets. Gift.

Herrin, Mr. W. F., San Francisco: One botanical specimen from Shasta Springs; copy of Marquard's Flora of Guernsey and the Lesser Channel Islands. Gift.

Holladay, Mr. E. B., San Francisco: Two old documents pertaining to the incorporation of the California Academy of Sciences; six copies of California Academy of Natural Sciences Circular, 1853. Gift.

Holman, Mr. F. C., San Francisco: Five ornithological specimens, San Diego County. Gift.

Hovey, Mrs. W. T., San Francisco: Twenty-five specimens of mollusks, birds' eggs, and sea urchins. Gift.

Howe, Mr. Henry V., Berkeley: Sixty-four land and freshwater shells from Oregon, by gift; and sundry Academy publications by exchange.

Howell, Mr. A. B., Pasadena: Twenty-eight specimens of land shells from Oregon, Idaho, and Montana. Gift.

Hunt, Mrs. Clara, St. Helena: Thirty-seven specimens of California plants. Gift.

Hunter, Mr. J. S.: One botanical specimen from Marin County. Gift.

Israelsky, Mr. Merle, San Francisco: Two hundred and nine specimens of freshwater shells from Nevada. Gift.

Johnston, Mrs. C. R., San Francisco: A miscellaneous collection as follows: 18 fossils, 20 corals, three starfishes, three sea urchins, 200 minerals, 300 marine shells. Gift.

Johnston, Mr. Edward C., Washington, D. C.: Twenty-nine thousand six hundred and ninety-eight specimens of land and freshwater shells, representing 300 species, chiefly from the Mississippi Valley. Fifty-five specimens of fossil shells from St. George Island, Alaska. Gift.

Jones, Mr. Vincent, San Francisco: Five botanical specimens from Sierra County. Gift.

Kavanaugh, Officer James H., California Academy of Sciences: Two botanical specimens from California; six specimens of lava and obsidian from Clear Lake, California. Gift.

Kellers, Dr., U. S. Navy: Forty-two land shells from Tutuila, Samoa. Gift.

Kelly, Mrs. G. Earle, Alameda: Twenty specimens of slugs from Alameda; 42 botanical specimens from California. Gift.

Kidder, Miss Caro, Berkeley: Skin of Bird of Paradise from New Guinea. Gift.

Knoffe, E. S., Santa Catalina Island: One botanical specimen from Santa Catalina. Gift.

Kusche, Mr. J. August, San Francisco: One hundred and seven botanical specimens from Needles; 30 specimens of plants from Solomon Islands; 36 specimens of lichens from the Island of Kauai, Hawaiian Islands, and 29 species of mosses from same locality; 200 land shells from Hawaii; and 22 specimens of land and freshwater shells from Shasta County. Gift.

One thousand three hundred and sixty-seven marine shells, 310 land and freshwater shells, 14 corals, 25 crabs, two stone axes, 152 bird skins from Kauai, Hawaiian Islands, Australia, and Solomon Islands, 10 eggs of *Megapodius eremita* and 7 mammal skins from the Solomon Islands, and two mineral specimens from Guadalcanar Island, Solomon Islands. Purchase.

Leach, Mr. Frank A., Piedmont: Five California botanical specimens. Gift.

Levy, Mr. Henry: One book, Sketches of Creation, by Winchell. Gift.

Lewis, Mr. W. C., Sausalito: One botanical specimen from Sausalito. Gift.

Littlejohn, Mr. Chase, Redwood City: Seventeen land shells from San Mateo County; 256 marine shells from Half Moon Bay; sea urchin from Midway Island; 12 fossil shells from Lower California; 172 specimens of shells from San Francisco Bay, and one from Alaska. Gift.

Mailliard, Mr. John W., San Francisco: One specimen of the Giant Owlet Moth, taken at Belvedere. Gift.

Mailliard, Mr. Joseph, California Academy of Sciences: Seventy-four land and freshwater shells from Northern California; 122 land shells from Del Norte County; 20 specimens of freshwater shells from Sonoma County; 20 fossil shells from Del Norte County; and 549 land and freshwater shells from same locality, the last two items collected in company with Mr. Chase Littlejohn. Exploration.

Marshall, Mr. Byron C., Imboden, Ark.: Six specimens of rocks from Arkansas. Gift.

Martin, Mr. J. O., Berkeley: Sundry numbers of Contributions from the National Herbarium, and other publications. Gift.

McCracken, Dr. Isabel, Stanford University: Twelve cases of oak-gall producing insects. Gift.

McGanney, Mrs. D. C., San Francisco: Three specimens of California plants. Gift.

McGrath, Capt. B., Mill Valley: Three eggs of *Pandion leucocephalus* (?) from the Solomon Islands. Gift.

McLaren, Mr. John, Golden Gate Park: One Alaskan bear; one male kangaroo; five black swans, two adults, two juveniles, and one nestling, all from Golden Gate Park. Gift.

McLean, Mr. T., Chico: Twenty-eight specimens of weeds from the rice fields near Chico. Gift.

McLellan, Miss M. E., California Academy of Sciences: Collection from Samoa as follows: 47 bird skins; one flying fox; 866 specimens of land, freshwater and marine shells; two turtles; and 104 lizards. Gift.

Meiere, Mrs. Ernest, Los Altos: Nine botanical specimens from Tulare County and Los Altos. Gift.

Menzies, Mr. Robert, San Rafael: Three botanical specimens from San Rafael. Gift.

Michaels, Mrs. Enid, Yosemite: Nineteen botanical specimens from Yosemite National Park. Gift.

Moffitt, Mr. James, San Francisco: One specimen of Pacific Golden Plover from near Honolulu. Gift.

Moxley, Mr. George L., Los Angeles: Three botanical specimens from Los Angeles. Gift.

Murphy, Mr. Robert C., New York, N. Y.: One pair *Pelecanoides georgicus*. Purchase.

Museum of Comparative Zoology, Cambridge, Mass.: Two lizards from Utah, 17 lizards from Lower California and adjacent islands, 78 specimens of reptiles from Africa and West Indies, 52 specimens of reptiles and amphibians from Solomon Islands, East Indies, and Africa. Exchange.

Naturhistorisches Museum, Basel, Switzerland: One frog, two snakes, four lizards and one salamander from New Caledonia, New Guinea, and Syria. Exchange.

Nelson, Mr. E. W., Washington, D. C.: Sixty-eight books and pamphlets. Gift.

New York Botanical Garden, New York, N. Y.: Seven hundred and forty-seven botanical specimens; 225 specimens of lichens chiefly duplicates from the Underwood Herbarium. Gift.

Norton, Mr. A., Salinas: One botanical specimen from Salinas. Gift.

O'Conor, Miss Mary, San Rafael: Twenty-four botanical specimens from Fresno and Eureka. Gift.

Osterhoudt, Mr. E. G., San Francisco: Five frogs from Eureka. Gift.

Owen, Mr. Virgil W., San Diego: Five hundred and seventy-one land and freshwater shells from the Chiricahua Mountains of Arizona. Gift.

Pack, Mr. Herbert J., Logan, Utah: One snake and one lizard from Utah. Exchange.

Packard, Dr. Earl L., Eugene, Ore.: Ten plaster casts of type specimens of fossil mollusks. Gift.

Parish, Mr. Herbert, Toronto, Canada: One thousand four hundred and ninety-two beetles from Brazil and Peru. Purchase.

Payson, Mr. Edwin, St. Louis, Mo.: Five hundred and sixty botanical specimens from Idaho. Purchase.

Peers, Miss Susie, San Francisco: One fox squirrel in flesh from Golden Gate Park; and Science, volume for 1921. Gift.

Penny, Mr. D. D., Watsonville, through Mr. E. O. Essig: Twelve slides of Aleurodidæ. Gift.

Philippine Bureau of Science, through Dr. Roy E. Dickerson, Manila, P. I.: Nine hundred and eighty-eight land, freshwater and marine shells from the Philippine Islands. Gift.

Pomeroy, Mr. C. S., Riverside: One specimen of *Tagetes minuta* L., a weed reported in the United States for the first time. Gift.

Queensland Geological Survey, Brisbane, Queensland: Eight maps of Queensland, Australia. Gift.

Ran, Mr. Venkata: One specimen of California plant. Gift.

Ray, Mr. Milton S., San Francisco: Two Moro baskets and one grass skirt. Gift.

Reed, Mr. C. A., Santa Cruz: Four botanical specimens from the Big Basin. Gift.

Rigg, Mr. George B.: One botanical specimen from Oregon. Gift.

Rixford, Mr. G. P., San Francisco: Fourteen botanical specimens, chiefly from San Antonio, Texas. Gift.

Rixford, Dr. Emmet, San Francisco: Two botanical specimens from Tulare County. Gift.

Robinson, Mr. Ansel, San Francisco: One snake. Gift.

Robinson, A. W. & Co., San Francisco: One adult orang-utan in flesh from Borneo (?). Gift.

Rose, Mr. Alex.: Seven botanical specimens from California. Gift.

Ruble, Mr. Russel, Geddes, So. Dak.: Nine sets of birds' eggs from Geddes, So. Dak. Gift.

Ryan, Mr. Clarence, University of California: One fossil land shell from Asphalt Pit of Rancho La Brea, near Los Angeles. Gift.

San Diego Society of Natural History, San Diego: Two lizards from San Luis Obispo County. Exchange.

Scudder, Mr. R. W., San Diego: Two botanical specimens from San Diego. Gift.

Scupham, Major J., San Francisco: Two botanical specimens from Carmel. Gift.

Sellmer, Mr. Walter B., San Anselmo: One botanical specimen from Marin County. Gift.

Shepard, Mr. Vernon, San Rafael: Skull of black bear. Exchange. Specimen of the Farallon Rail (*Porzana coturniculus*). Gift.

Shortridge, Senator Samuel M., San Francisco: Congressional Directory. Gift.

Simmons, Mr. L. S., Sonoma: One botanical specimen from Sonoma County. Gift.

Slevin, Mr. L., Carmel: Six photographs of Cactaceæ from Arizona. Gift.

Slonaker, Dr. J. R., Stanford University: Two snakes from Wisconsin, 190 study skins of birds and 197 sets of birds' eggs, chiefly from Indiana and Wisconsin. Gift.

Small, Mr. E. C., Berkeley: Two specimens of Mariposite from Finnegan Mine, Carson Hill, Calaveras County. Gift.

Smith, Mr. Charles Piper, San Jose: Four hundred and fourteen botanical specimens from East and middle West. Gift.

Smithsonian Institution, Washington, D. C.: Ten pamphlets. Gift.

Soares, Mr. Antone J., Hayward: Eight botanical specimens from California. Gift.

Stanford University: One specimen of marine shell from Panama. Exchange.

Stephens, Dr. W. B., Alameda: One box of freshwater diatoms from Shasta County. Gift.

Stevens, Mr. Frank, San Diego: One lizard from Coronado Islands. Gift.

Stevens, Mr. Neville, University of California: One botanical specimen from Los Angeles. Gift.

Stewart, Mr. H. W., Emmett, Idaho: Fourteen freshwater shells from Lower Klamath Lake, Ore., and 11 marine shells from St. Paul Island, Alaska. Gift.

Sumner, Dr. F. B., La Jolla: One botanical specimen from San Diego County. Gift.

Sumner, Mr. P. W., San Diego: Six specimens of California plants. Gift.

Sutliffe, Mrs. E. C., San Francisco: Seventy-six botanical specimens from California localities, 61 specimens and species of Hepatics. Gift.

Tableman, Mr. Fred S., Newark, N. J.: Six vials of fossil diatoms. Exchange.

Tanner, Prof. V. M., St. George, Utah: Eight snakes and two lizards from Utah. Gift.

Taylor, Dr. Walter P., La Jolla: One hundred and eighteen botanical specimens from the Olympic Mountains, and eight from San Diego County. Gift.

Turner, Miss Laura A. L., Riverside: One botanical specimen from Riverside. Gift.

Udden, Dr. L. S., Austin, Texas: Fourteen land and brackish-water shells from Texas. Gift.

University of California, Berkeley: Four land shells from Oregon and Washington. Exchange.

Three fossil land shells from Shasta County. Gift.

University of Colorado, Boulder, Colo.: One hundred and fourteen specimens of fossils from the Rocky Mountain region, 377 specimens of land and freshwater shells, same locality. Exchange.

University of Michigan, Ann Arbor, Mich.: Forty-four specimens of reptiles and amphibians from Central and South America. Exchange.

University of Utah, Salt Lake City, Utah: One lizard from Nevada. Exchange.

Upton and Bymes, Corcoran: Fifteen specimens of freshwater shells from Tulare Lake; one vertebra and one tooth of mammal from Tulare Lake fossil beds. Gift.

U. S. Bureau of Fisheries and U. S. National Museum, through Dr. F. H. Moore, Washington, D. C.: Forty sponges for exhibition purposes. Gift.

U. S. Coast Guard, Washington, D. C.: Annual report, 1915. Gift.

U. S. National Herbarium, Washington, D. C.: One thousand four hundred miscellaneous duplicates, and 21 specimens of plants. Exchange.

Van Denburgh, Dr. John, California Academy of Sciences: One botanical specimen from San Benito County. Gift.

Van Duzee, Mr. E. P., California Academy of Sciences: Thirteen thousand and seventy-three specimens of insects taken on Academy Expedition to the Islands of the Gulf of California, April 2 to July 8, 1921. Exploration.

One hundred and thirty specimens of marine shells from San Francisco Bay. Gift.

Van Dyke, Dr. E. C., Berkeley: One thousand three hundred and forty-eight specimens of insects from Yosemite Valley, three salamanders, three lizards, and one snake from Yosemite Valley, one botanical specimen from Bakersfield. Gift.

Van Wyck, Mr. Sidney M., Jr., San Francisco: One pamphlet. Gift.

Walther, Mr. Eric, San Francisco: Three hundred and sixty-five botanical specimens from Golden Gate Park, 267 from southern California, and 75 from Marin County. Gift.

Walter, Miss Henrietta, San Diego: Forty-two botanical specimens from the Alps. Gift.

Wicks, Miss Ethel, San Francisco: One botanical specimen from California. Gift.

Wilkens, Mrs. Johanna E., California Academy of Sciences: One botanical specimen from Golden Gate Park. Gift.

Willett, Mr. George, Wrangell, Alaska: Eight sets of birds' eggs and one nest from Alaska. Exchange.

Williams, Mr. Robert S., New York, N. Y.: Fifty specimens of Montana mosses. Gift.

Wilson, Mrs. Arno H., Atlas: One botanical specimen from Napa County. Gift.

Wolley-Dod, Col. A. W., London, England: Twenty-eight botanical specimens from California localities. Gift.

Woodrum, Mr. J. H., San Francisco: Two specimens of native copper ore in quartz from Calumet and Hecla Mine, Michigan. Gift.

Wright, Miss Alice B., San Francisco: One botanical specimen from El Dorado County. Gift.

Wright, Mr. A. H., Ithaca, N. Y.: Six salamanders from New York. Exchange.

Wright, Mr. W. G., San Diego: Four skins of small rodents from Alaska and Washington. Gift.

Zetek, Mr. James, Ancon, Canal Zone: Three hundred shells from the vicinity of the Isthmus of Panama. Exchange.

# FINANCIAL STATEMENTS

## REPORT OF THE TREASURER

for the fiscal year ending March 31, 1922.

| | | |
|---|---|---|
| April 1, 1921, Balance due Crocker National Bank | | $2,756.62 |

### *Receipts*

| | | |
|---|---|---|
| Dues | $ 3,708.31 | |
| Charles Crocker Scientific Fund Endowment Income | 1,290.48 | |
| James Lick Endowment Income | 51,935.47 | |
| General Income | 17,880.70 | |
| John W. Hendrie Endowment Income | 900.00 | |
| U. S. Treasury Certificates | 16,000.00 | |
| Interest | 799.14 | |
| U. S. Treasury Certificates, Steinhart Trust | 28,000.00 | |
| Ignatz Steinhart Trust Interest | 18,721.83 | |
| Museum | 158.41 | |
| Publication | 154.23 | |
| Library | 33.50 | |
| W. G. Wright Fund | 77.00 | |
| Sundry Advances | 185.07 | |
| Yosemite Game Paddocks Donations | 350.00 | |
| John C. Augsbury Donation | 100.00 | |
| A. F. Morrison Donation | 200.00 | |
| William F. Herrin Donation | 200.00 | |
| William H. Crocker Donation | 200.00 | |
| Antelope Fund Donation | 335.00 | |
| Contingent Fund | 5.00 | |
| Post Card Sales | 1,398.60 | |
| | | $142,632.74 |
| | | $139,876.12 |

## REPORT OF THE TREASURER—*Continued*

### *Expenditures*

| | | |
|---|---|---|
| Expense | $ 2,328.72 | |
| Salary Expense (General) | 18,073.28 | |
| Bills Payable | 10,000.00 | |
| Insurance | 1,255.64 | |
| Interest | 16,921.58 | |
| Museum, Department Appropriations | 4,770.73 | |
| Museum, Department Salaries | 12,327.76 | |
| Library | 2,267.64 | |
| Publication | 6,814.85 | |
| Tools and Equipment | 243.20 | |
| U. S. Treasury Certificates | 18,000.00 | |
| U. S. Treasury Certificates, Steinhart Trust | 27,000.00 | |
| Ignatz Steinhart Trust Interest | 52.20 | |
| Steinhart Aquarium Construction | 13,146.79 | |
| Yosemite Game Paddocks | 200.61 | |
| Grizzly Bear Group | 3,236.74 | |
| Antelope Fund | 149.05 | |
| W. G. Wright Fund | .28 | |
| Post Card Sales | 9.50 | |
| Prager Herbarium | 1,110.50 | |
| Gulf of California Expedition | 3,010.94 | |
| Sundry Creditors | 894.32 | |
| Sundry Advances (Museum) | 268.08 | |
| Contingent Fund | 387.66 | |
| | | $142,470.07 |
| March 31, 1922, Balance due Crocker National Bank | | $ 2,593.95 |

M. Hall McAllister, *Treasurer.*

Examined and found correct,

McLaren, Goode & Co., *Certified Public Accountants.*

San Francisco, Calif., April 21, 1922.

## INCOME AND OPERATING EXPENSES

For the Period April 1, 1921, to March 31, 1922.

| | | |
|---|---|---|
| *Income:* | | |
| Charles Crocker Scientific Fund Endowment Income | | $ 1,290.48 |
| James Lick Endowment Income | | 51,935.47 |
| General Income | | 17,880.70 |
| Dues | | 3,713.31 |
| *Expenditures:* | | |
| General Expense | $ 2,776.57 | |
| Salaries | 30,401.04 | |
| Interest | 16,046.61 | |
| Insurance | 1,255.64 | |
| Balance to Surplus Account | 24,340.10 | |
| | $74,819.96 | $74,819.96 |

## SUMMARY OF SURPLUS ACCOUNT

March 31, 1922

| | | |
|---|---|---|
| Balance March 31, 1921 | | $348,378.77 |
| *Add* Excess of Income over Operating Expenses | $24,340.10 | |
| Library Account, Purchases from W. G. Wright Fund in 1921-22 | 76.72 | |
| Post Card Sales | 591.96 | |
| Donations: | | |
| Yosemite Game Paddocks | 350.00 | |
| Antelope Fund | 335.00 | |
| William M. Fitzhugh | 200.00 | |
| John C. Augsbury | 100.00 | |
| A. F. Morrison | 200.00 | |
| William F. Herrin | 200.00 | |
| S. Levi | 103.60 | |
| | | 26,497.38 |
| | | $374,876.15 |
| *Less* Yosemite Game Paddocks | $ 350.00 | |
| Antelope Fund | 335.00 | |
| Depreciation | 14,922.81 | |
| | | 15,607.81 |
| | | $359,268.34 |

## IGNATZ STEINHART TRUST

March 31, 1922

| | | |
|---|---|---|
| Bequest from the Ignatz Steinhart Estate........ | | $250,000.00 |
| Interest on temporary investments............... | | 40,556.24 |
| | | $290,556.24 |
| Investments: | | |
| Steinhart Aquarium Construction ............ | $ 16,067.71 | |
| Steinhart Aquarium Equipment ............ | 78.29 | |
| Temporary investments: | | |
| Bills Receivable ........................ | 250,000.00 | |
| U. S. Treasury Certificates ............... | 24,000.00 | |
| Balance receipts over investments........ | 410.24 | |
| | $290,556.24 | |

## BALANCE SHEET

March 31, 1922

***Assets***

| | | |
|---|---|---|
| Real Estate: | | |
| Market Street Lot | $600,000.00 | |
| Jessie Street Lot | 8,083.65 | |
| Commercial Building | 516,818.66 | |
| | | $1,124,902.31 |
| Stocks: | | |
| 60 shares Savings Union Branch of the Mercantile Trust Co. | | 13,600.00 |
| Ignatz Steinhart Trust: | | |
| Bills Receivable | 250,000.00 | |
| U. S. Treasury Certificates | 24,000.00 | |
| Steinhart Aquarium Construction | 16,146.00 | |
| Receipts in excess of investments | 410.24 | |
| | | 290,556.24 |
| U. S. Treasury Certificates | | 10,000.00 |
| Museum Construction | | 192,025.92 |
| Museum: | | |
| General Collections | 118,307.00 | |
| Tools and Equipment | 25,109.95 | |
| | | 143,416.95 |
| Library: | | |
| Publications | 32,372.27 | |
| Books and Equipment | 23,139.63 | |
| | | 55,511.90 |
| Office Furniture | | 3,343.44 |
| Foreign Exchange | | 71.90 |
| Sundry Advances: | | |
| Prager Herbarium | 146.53 | |
| Yosemite Game Paddocks | 186.11 | |
| | | 332.64 |
| Post Cards in Stock | | 2,468.82 |
| | | $ 1,836,230.12 |

**BALANCE SHEET**—***Continued***

***Liabilities***

| | | |
|---|---|---|
| Endowments: | | |
| James Lick Endowment .................... | 804,902.31 | |
| Charles Crocker Scientific Fund Endowment.. | 20,000.00 | |
| John W. Hendrie Endowment ............... | 13,600.00 | |
| | | $838,502.31 |
| Ignatz Steinhart Trust ......................... | 250,000.00 | |
| Ignatz Steinhart Trust Interest Account .......... | 40,556.24 | |
| | | 290,556.24 |
| Alvord Bequest Botanical ....................... | | 5,000.00 |
| John W. Hendrie Income Account................ | | 900.00 |
| A. K. Macomber Donation ...................... | | 3,500.00 |
| William C. Van Antwerp Donation............... | | 5,120.00 |
| William H. Crocker Donation.................... | | 3,768.73 |
| W. B. Bourn Donation........................... | | 2,659.31 |
| J. D. Grant Donation ........................... | | 2,710.42 |
| Herbert Fleishhacker Donation .................. | | 3,500.00 |
| Ogden Mills Donation .......................... | | 5,000.00 |
| John W. Mailliard Donation ..................... | | 1,250.00 |
| Bills Payable .................................. | | 280,000.00 |
| Antelope Fund ................................ | | 185.31 |
| Sundry Creditors .............................. | | 1,568.09 |
| Cash: | | |
| Amount due Ignatz Steinhart Trust.......... | 410.24 | |
| Overdraft with Crocker National Bank........ | 2,593.95 | |
| | $3,004.19 | |
| *Less* Cash in Safe.......................... | 71.51 | 2,932.68 |
| Depreciation .................................. | | 29,808.69 |
| Surplus ...................................... | | 359,268.34 |
| | | $1,836,230.12 |

W. W. Sargeant,
*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.,
April 21, 1922.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XI, NOS. 22 AND 23, pp. 655-700 AUGUST 22, 1923

XXII

# REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1922

By C. E. GRUNSKY
*President of the Academy*

The year just completed has been another year of satisfactory progress with several noteworthy events to the credit of the Academy as will appear from the following concise review of the year's work.

The net increase in membership has been 38. There were 1030 members on January 1, 1923. There were 120 new members admitted during 1922. The Academy lost by death 18, by resignation 28, and it dropped for arrearages 36.

The membership as of January 1, 1923, was made up of:

| | |
|---|---|
| Patrons | 13 |
| Honorary Members | 25 |
| Life Members | 84 |
| Fellows | 23 |
| Members | 884 |
| Total | 1029 |

The Academy carries on its list of patrons the following names:

*Living*

William B. Bourn
George C. Beckley
William H. Crocker
Peter F. Dunne
Barton Warren Evermann
Herbert Fleishhacker
Joseph D. Grant
A. Kingsley Macomber
John W. Mailliard
Joseph Mailliard
M. Hall McAllister
Ogden Mills
William C. Van Antwerp

*Deceased*

| | |
|---|---|
| William Alvord | James Lick |
| Charles Crocker | Alexander F. Morrison |
| John W. Hendrie | Amarish Pierce |
| Charlotte Hosmer | Ignatz Steinhart |

Those who were called by death in 1922 are as follows:

| | | |
|---|---|---|
| Bentley, Charles H. | Member | December 30, 1922 |
| Branner, Dr. John C. | Fellow | March 1, 1922 |
| Brown, Herbert H. | Member | July 31, 1922 |
| Conolley, Mrs. E. D. | Member | February 22, 1922 |
| Field, George R. | Member | May 1, 1922 |
| Frankl, A. | Member | November 20, 1922 |
| Hanify, John R. | Life | May 6, 1922 |
| Hill, Harry | Member | September, 1921 |
| Niebling, E. T. | Member | September 27, 1922 |
| Price, William W. | Life | November 9, 1922 |
| Raymond, Albert | Member | September 22, 1922 |
| Reynolds, Laurence R. | Member | October 9, 1922 |
| Taussig, Rudolph J. | Member | January 24, 1922 |
| Twiggs, John W. | Life | January 30, 1922 |
| Waterhouse, Mrs. Amelia A. | Member | October 28, 1922 |
| Weinstock, Colonel Harris | Member | August 22, 1922 |
| Willard, Charles W. | Member | December 7, 1922 |
| Wolfe, Edward I. | Member | January 25, 1922 |

The Academy published in 1922 the following papers and reports, among which the contribution of Dr. John Van Denburgh, entitled "The Reptiles of Western North America," in two volumes, with an aggregate of 1028 pages and 128 half-tone plates, stands out as a notable achievement:

FOURTH SERIES OF THE PROCEEDINGS

Vol. XI, No. 18, pp. 399-526—FOSSIL CHITONS OF WESTERN NORTH AMERICA, by S. Stillman Berry.

Vol. XI, No. 19, pp. 527-601—TERTIARY AND QUATERNARY HISTORY OF THE PETALUMA, POINT REYES AND SANTA ROSA QUADRANGLES, by Roy E. Dickerson.

Vol. XI, No. 20, pp. 603-610—REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1921, by C. E. Grunsky.

Vol. XI, No. 21, pp. 611-653—REPORT OF THE DIRECTOR OF THE MUSEUM FOR THE YEAR 1921, by Barton Warren Evermann.

Occasional papers:

No. 10, Vol. I, pp. 1-611, and Vol. II, pp. 613-1028, with 128 half-tone plates —THE REPTILES OF WESTERN NORTH AMERICA: Vol. I, LIZARDS. Vol. II, SNAKES AND TURTLES, by John Van Denburgh.

Free lectures have been delivered at the stated meetings of the Academy in 1922, as follows:

JANUARY 4. The Conservation of Marine Life of the Pacific (illustrated), by Dr. Barton Warren Evermann, Director, California Academy of Sciences.

MARCH 1. Faunal and Floral Migration Routes to the Philippines, by Dr. Roy E. Dickerson, Honorary Curator, Department of Invertebrate Paleontology, California Academy of Sciences.

APRIL 5. The Expedition of the California Academy of Sciences to the Galapagos Islands (illustrated), by Mr. Joseph R. Slevin, Assistant Curator, Department of Herpetology, California Academy of Sciences.

MAY 3. Some Birds of Ventura County, California (illustrated), by Dr. G. Dallas Hanna, Curator, Department of Invertebrate Paleontology.

JUNE 7. The Life History and Growth of the Pismo Clam (illustrated), by Dr. F. W. Weymouth, Assistant Professor of Physiology, Stanford University.

JULY 5. The Recent Salt Lake City Meeting of the Pacific Division, American Association for the Advancement of Science, by Dr. Barton Warren Evermann, Retiring President, Pacific Division American Association for the Advancement of Science.

AUGUST 2. General Features of the Distribution of Plants in California, by Miss Alice Eastwood, Curator, Department of Botany, California Academy of Sciences.

SEPTEMBER 6. The Recent Expedition to the Islands off the West Coast of Lower California, by Dr. G. Dallas Hanna, Curator, Department of Invertebrate Paleontology, and Mr. Frank Tose, Chief Taxidermist, California Academy of Sciences.

OCTOBER 4. The Netherlands East Indies, from geographical, topographical, historical, ethnological, psychological, economical and political standpoints, in the past, present and future (illustrated), by Hon. H. A. van Coenen Torchiana, Consul General of the Netherlands.

NOVEMBER 1. Abyssinia, the Land of the Negus (illustrated), by Hon. Gerald Campbell, F. R. G. S., British Consul General.

DECEMBER 6. The Problem of Ocean Trade Routes, by Captain I. N. Hibberd, San Francisco.

The Sunday afternoon lectures delivered in the Museum building in 1922 have included the following:

JANUARY 8. Animal Life of the Apache Trail, Arizona (illustrated with motion pictures and stereopticon), by Mr. Harry S. Swarth, Curator of Birds, Museum of Vertebrate Zoology, University of California.

JANUARY 15. The Nation's Public Hunting Grounds (illustrated), by Mr. J. W. Nelson, Assistant District Forester, Fifth District, United States Forest Service, San Francisco.

JANUARY 22. Why the California Redwoods Should be Saved (illustrated), by Mr. R. F. Hammatt, Secretary-Manager of the California Redwoods Association, San Francisco.

JANUARY 29. Hetch-Hetchy in Pictures (illustrated with motion pictures), by Mr. M. M. O'Shaughnessy, City Engineer, San Francisco.

FEBRUARY 5. The Work of the United States Forest Service (illustrated), by Mr. Paul G. Redington, District Forester, Fifth District, United States Forest Service, San Francisco.

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|---|---|
| February 12. | Modern Bolivia (illustrated with stereopticon slides and native music, played on the Euphona Solo Player Piano, courtesy of the Wiley B. Allen Company), by Hon. Alberto Palacios, Consul General of Bolivia. |
| February 19. | The Political and Financial Life of Chile (illustrated), by Hon. Marcos G. Huidobro, Consul of Chile to San Francisco. |
| February 26. | The Scenic Features of the Southern High Sierra (illustrated), by Mr. Ansel F. Hall, Park Naturalist, Yosemite National Park. |
| March 5. | The Truth About Vivisection (illustrated), by Mr. Ernest Harold Baynes, General Manager, The Meriden Bird Club, Meriden, New Hampshire. |
| March 12. | The Republic of Mexico (illustrated), Hon. Alejandro Lubbert, Consul of Mexico. |
| March 19. | The Republic of Ecuador (illustrated), by Dr. Manuel C. de Vaca, Consul General of Ecuador, and Professor of Political Science at the University of Quito. |
| March 26. | Why the Navajos are a Specially Interesting Tribe of Indians (illustrated), by Dr. William E. Ritter, Director, Scripps Institution for Biological Research, University of California, La Jolla. |
| April 2. | The Natural History of the Galapagos Islands (illustrated), by Mr. Joseph R. Slevin, Assistant Curator, Department of Herpetology, California Academy of Sciences. |
| April 9. | Deserts East and West (illustrated), by Dr. D. T. MacDougal, Director, Department of Botanical Research, Carnegie Institution of Washington. |
| April 16. | Vision—Some Facts About Our Eyes (illustrated), by Prof. Rufus L. Green, Professor of Mathematics, Stanford University. |
| April 30. | How Beavers Work (illustrated), by Mr. Joseph Dixon, Economic Mammalogist, Museum of Vertebrate Zoology, University of California. |
| May 14. | India (illustrated), by Mr. I. H. Morse, San Francisco. |
| May 21. | The Steinhart Aquarium (illustrated), by Mr. Alvin Seale, Superintendent, Steinhart Aquarium. |
| May 28. | A Perspective Glance at California Irrigation (illustrated), by Mr. Frank Adams, Professor of Irrigation Investigations, University of California. |
| October 1. | The Experimental Method in Animal Psychology, by Dr. Samuel J. Holmes, Professor of Zoology, University of California. |
| October 8. | Equilibration of Animals and Aviators, by Dr. Samuel S. Maxwell, Professor of Physiology, University of California. |
| October 15. | The Use of Animals in the Diagnosis and Prevention of Disease, by Dr. Carl A. L. Schmidt, Associate Professor of Biochemistry, University of California. |
| October 22. | Animal Experimentation, by Dr. T. D. Beckwith, Professor of Bacteriology, University of California. |
| October 29. | Animal Foes of the Human Body and How to Control Them, by Dr. Charles A. Kofoid, Professor of Zoology, University of California. |
| November 5. | What Animal Experimentation Has Done for Childhood, by Dr. E. C. Fleischner, Clinical Professor of Pediatrics, University of California. |

| | |
|---|---|
| November 12. | The Panama-Pacific Exposition (illustrated), by Mr. Charles B. Turrill, San Francisco. |
| November 19. | The Conservation of the Marine Life of the Pacific (illustrated with moving pictures and stereopticon slides), by Dr. Barton Warren Evermann, Director, Museum California Academy of Sciences. |
| November 26. | Discovery of the Cause of Magnetism and of Universal Gravitation (illustrated), by Captain T. J. J. See, Professor of Mathematics, United States Navy. |
| December 2. | A Recent Trip to the Republic of Colombia (illustrated), by Mr. C. B. Lastreto, San Francisco. |
| December 10. | Indo-China, by Mdlle. Jehanne Bietry, Publisher, "Bulletin Financier et Economique de l'Indochine," Saigon, Indo-China. |
| December 17. | The California Academy of Sciences Expedition to the Gulf of California (illustrated), by Mr. Joseph R. Slevin, Assistant Curator, Department of Herpetology, California Academy of Sciences. |

The Academy, through the co-operation of the National Geographic Society, the San Diego Society of National History and the Scripps Institution for Biological Research, was able to take advantage of the courteous offer of the Government of Mexico and visited the islands off the coast of Lower California to ascertain the status of the fur seal, the sea otter and the elephant seal, which, it was known, formerly occurred in those waters.

The fish patrol boat "Tecate" of the Mexican Government was placed at the disposal of the expedition without cost. The results of the expedition will be noted in the reports of the Director and of the Curators of the Museum. I desire merely to state that the total cost of this expedition, including all expenses and services of those who participated, was $1,917.42 which was shared as follows:

| | |
|---|---|
| National Geographic Society | $500.00 |
| San Diego Society of National History | 355.44 |
| Scripps Institution for Biological Research | 264.64 |
| California Academy of Sciences | 797.34 |

The Grizzly Bear Habitat Group, which, as noted in last year's report, was made possible by a generous donation from Mr. Ogden Mills, has been completed and was opened to the public on March 12, 1922. With this installation the available space for the large-size habitat groups has been exhausted and any further installations must await the acquisition of more building space.

To the Antelope Fund and for Conservation of Wild Animal Life there have been contributed during the year $461.48. This amount has enabled the Academy's Committee to continue its effective work in conservation.

The Academy has been fortunate in acquiring a collection of reptiles and batrachians of the Philippine Islands made by Edward H. Taylor. The acquisition of this collection was made possible by the generosity of two Academy members, Mr. W. H. Crocker, who contributed $4500 and Mr. Herbert Fleishhacker who contributed $500 toward the cost price of $5000.

A balance due on the purchase of the Prager Herbarium, the acquisition of which was noted a year ago, in the amount of $146.53 was contributed by Mr. Wm. F. Herrin and Mr. Wm. H. Crocker.

The Academy received, too, from Mr. Wm. F. Herrin $100 to be applied on the purchase of containers for the Taylor collection of reptiles, and since the close of the year further donations for this purpose have been received as follows:

| | |
|---|---|
| From C. O. G. Miller | $100.00 |
| From Selah Chamberlain | 100.00 |
| From Louis F. Monteagle | 50.00 |
| From George Uhl | 20.00 |

The current receipts of the Academy were made up of rent in the sum of $72,669; dues, $3455; post card sales, $1274; interest, $1461; and a small amount from sales of publications and the like. The total receipts for the year aggregated about $79,500 apart, of course, from the funds handled in trust for the Steinhart Aquarium. The Academy has had need for all its income. If it had had more it would have increased the publication of scientific papers. It has, however, been found possible to apply another $10,000 on the mortgage on the Commercial Building, thus reducing the same to $270,000. The outgo for interest has been $16,453.

Work on the Steinhart Aquarium has progressed steadily and the building is now nearing completion. The wisdom of deferring construction for a time has now been fully demonstrated. The prices of materials and the wage scale fell considerably from the high peak of 1920 so that more could be accomplished than would otherwise have been possible, and, in the meantime, the available fund has grown from the original $250,000 to an aggregate of a little over $300,000.

The City will now be asked to make the necessary provision for operating expenses so that the public may enter upon full enjoyment of the aquarium early in the next fiscal year.

The Academy has been the recipient of many donations and contributions to its store of scientific material during the year and I take this occasion to express, on behalf of the Academy, the assurance of sincere appreciation to the generous donors of funds as already noted, as well as to those who have contributed scientific material, or of their time and knowledge.

Among the donations of special note are 13 beautifully mounted heads of wild game animals, including moose, elk, deer, mountain sheep, etc., presented on June 14, 1922, by Mr. George C. Beckley. This is a remarkable collection of hunting trophies easily representing an outlay of $10,000 to $12,000. They have been installed in the Mammal Hall of the Museum where they form a most attractive exhibit.

From George Sturtevant and Roger Sturtevant of Oakland, California, the Academy received on December 15, 1922, as a donation, a valuable collection of books, shells, curios and carvings formerly belonging to the grandfather of the donors, the late J. N. Webster. The books included in this collection, comprising 369 volumes, constitute an important addition to the Academy's library.

The Academy has also received during the past year a valuable contribution from Miss Alice Eastwood, the Curator of the Department of Botany. This was in the nature of the employment of Ivan M. Johnston to identify the specimens and prepare the report of the Botanical Section of the Academy's Gulf of California expedition. The expense involved in the preparation of this report amounting to $640 was defrayed entirely by Miss Eastwood.

The officers of the Academy have to thank the membership for loyal support in their efforts to make the Academy useful to the public, and they desire particularly to acknowledge the faithful and efficient service which has been rendered by the Curators of the Academy's various departments and they recognize and appreciate the willingness of all that are connected with the Academy's activities to do whatever is in their power to make these activities successful.

# XXIII

# REPORT OF THE DIRECTOR OF THE MUSEUM FOR THE YEAR 1922

*By* BARTON WARREN EVERMANN
*Director of the Museum*

The annual report of the Director for the year 1921 was presented to the Academy at the annual meeting February 15, 1922. The completion of the Grizzly Bear Group soon thereafter utilized the last of the spaces in the Museum suited to large habitat groups. No more groups of that size and character will, therefore, be possible until another hall is provided. There remain, however, a considerable number of spaces for small panel groups upon which the department of exhibits has been largely engaged during much of the year. This department has also prepared a number of portable exhibits suitable for sending out to the public schools. Considerable time has been devoted to the Museum's study series of mammal skins and skulls. Practically all the skins have been tanned and put in proper condition for permanent preservation and rapid progress has been made with the skulls.

## PERSONNEL

The personnel of the Museum has had only a few changes since the last report. The employes of the Academy at this date are the following: Dr. Barton Warren Evermann, Director and Executive Curator of the Museum, Editor, and Director of the Steinhart Aquarium; W. W. Sargeant, Secretary of the Board of Trustees; Miss Susie M. Peers, Secretary to the Director; Joseph W. Hobson, Recording Secretary; Miss Alice Eastwood, Curator, and Mrs. Kate E. Phelps, assistant, Department of Botany; Edward P. Van Duzee, Curator, and Dr. F. R. Cole, Curator in Dipterology, Department of Entomology; Dr. John Van Denburgh, Curator, and Joseph R. Slevin, assistant curator, Department of Herpetology; Dr. G. Dallas Hanna, Curator, and Dr. Roy E. Dickerson and F. M. Anderson, honorary curators, and William Barbat, temporary assistant, Department of Invertebrate Paleontology; Joseph Mailliard, Curator, and Miss Mary E. McLellan, assistant curator, Department of Ornithology and Mammalogy; Dr. Walter K. Fisher, Curator, Department of Invertebrate Zoology; Frank Tose, Chief Taxidermist; Edward P. Van Duzee, assistant librarian; Mrs. Helen Van Duzee, library assistant; Wm. C. Lewis, janitor; Fred Maag, carpenter and assistant janitor; George C. Edwards, assistant janitor; Frank W. Yale, assistant janitor; J. N. Kavanaugh, day watch; Mrs. Johanna E. Wilkens, janitress.

## ACCESSIONS TO THE MUSEUM AND LIBRARY

Accessions to the Museum and to the Library have been many and valuable. A few of the more notable are mentioned in the President's report and a detailed list will be found in the appendix to this report (pp. 660-662).

## CO-OPERATION WITH PUBLIC AND PRIVATE SCHOOLS

The Museum continues co-operation with the schools whenever opportunity offers. The Director and curators have given a number of lectures in various schools and elsewhere in the interest of public education.

Within the year many specimens and small collections of birds or other specimens were loaned to teachers in the schools for use in connection with nature lessons they were giving to their classes, and a number of teachers brought their classes to the Museum to study particular specimens in the research collections.

Visits by schools and classes to the Museum during the year have been as follows:

| | |
|---|---|
| *Schools of San Francisco:* | |
| Number of classes | 167 |
| Number of teachers | 157 |
| Number of pupils | 4923 |
| *Schools outside of San Francisco:* | |
| Number of classes | 30 |
| Number of teachers | 28 |
| Number of pupils | 5572 |

## VISITORS TO THE MUSEUM

As heretofore in accordance with established policy, the Museum was open to the public every day in the year. The number of visitors by months for each year since the

Museum was first opened to the public is shown in the following table:

| Month— | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 |
|---|---|---|---|---|---|---|---|
| January ... | ..... | 23170 | 25260 | 17241 | 27013 | 25755 | 19038 |
| February... | ..... | 22058 | 23698 | 17586 | 23450 | 25679 | 18534 |
| March .... | ..... | 31606 | 26810 | 27397 | 25419 | 28279 | 27922 |
| April ...... | ..... | 32175 | 23274 | 25994 | 32208 | 24939 | 36057 |
| May ...... | ..... | 26154 | 26391 | 28369 | 37107 | 25517 | 27237 |
| June ...... | ..... | 32123 | 29843 | 32248 | 36207 | 29406 | 27131 |
| July ....... | ..... | 37193 | 31420 | 48028 | 52492 | 43186 | 36263 |
| August .... | ..... | 24619 | 31137 | 43730 | 53470 | 39422 | 34787 |
| September .. | 16448 | 27866 | 29847 | 34007 | 42013 | 31458 | 28408 |
| October .... | 36933 | 20629 | 14743 | 30463 | 33500 | 24861 | 19459 |
| November . | 27718 | 21810 | 8531 | 25246 | 19347 | 18593 | 19080 |
| December .. | 15002 | 21693 | 19588 | 21188 | 21340 | 15062 | 13339 |
| Total... | 96101 | 321096 | 290542 | 351497 | 403566 | 332157 | 307255 |

## FIELD WORK OF THE MUSEUM STAFF

Field work was carried on by the Museum within the past year as follows:

### EXPEDITION TO THE ISLANDS OFF LOWER CALIFORNIA

The most important expedition sent out by the Academy in 1922 was that to the islands off the west coast of Lower California. This expedition was one of the direct results of the activities of the Committee on Conservation of Marine Life of the Pacific, appointed in 1921 by President Hale of the Pacific Division of the American Association for the Advancement of Science. The expedition was made possible through the co-operation of the Mexican Government and the Committee on Conservation of Marine Life of the Pacific, the California Academy of Sciences, the San Diego Society of Natural History, the Scripps Institution for Biological Research, the National Research Council, and the National Geographic Society. The Government of Mexico generously supplied the vessel and crew, and met all the running expenses, and the National Geographic Society contributed liberally to the fund for meeting other expenses.

The personnel of the expedition was as follows: Representing the Mexican government: Professor Carlos Cuesta

Terron, in charge; Professor José Ma. Gallegos, botanist; Srs. Joaquin Palacios, inspector and Rudolfo Lascano, assistant inspector of lighthouses; Sr. Enrique Gonzales, fisheries inspector, and Sr. Luis Rubio, taxidermist. From the California Academy of Sciences: Dr. G. Dallas Hanna, in charge of investigations; Joseph R. Slevin, herpetologist; and Frank Tose, taxidermist. From the San Diego Museum of Natural History: A. W. Anthony, mammalogist and ornithologist, and Ernest Hinkley, general assistant. From the Scripps Institution: P. S. Barnhart, oceanographer and planktologist.

The expedition sailed from San Diego July 9, on the Mexican fisheries motorboat *Tecate,* Captain Victor Angulo in command. It returned to San Diego August 16. Visits were made to Guadalupe, San Martin, Cedros, San Benitos, Natividad, San Roque, Asuncion, Magdalena, and Santa Margarita islands; and landings on the peninsula of Lower California were made at Ensenada, San Quintin, San Bartholome Bay, and Abreojos Point.

The primary purpose of the expedition was to determine the present abundance and distribution of certain species of marine mammals in those waters and to make collections and study of the fauna and flora of the islands visited. It was particularly desired to learn whether there are any elephant seals, fur seals and sea otters left in the waters about those islands. Each of these three valuable species of marine mammals was at one time very abundant in those waters, but through greed and indiscriminate killing they had been reduced, it was known, to commercial, if not to actual extinction.

It is gratifying to know that the expedition found a very satisfactory remnant of an elephant seal herd large enough, if given proper protection, to enable that species to rehabilitate itself to its former abundance and commercial importance. An excellent moving picture reel was obtained of the elephant seals. No fur seals or sea otters were seen.

The expedition proved very successful and satisfactory. Valuable collections of reptiles, birds, mammals, shells, insects, and plants were made, and much valuable knowledge regarding the fauna and flora of the islands visited was gained.

Specialists are now preparing the reports on the scientific results of the expedition and it is hoped they will soon be ready for publication.

Reports on other field work carried on by the Museum staff will be found in the reports of the respective curators. Mr. E. P. Van Duzee, curator of entomology, spent several weeks in Utah where he made large and valuable collections of insects. Joseph Mailliard, curator of birds and mammals, continued his study of problems of geographic distribution in northern California. Dr. John Van Denburgh and Joseph R. Slevin spent several weeks (August 23 to September 14) in the high Sierras of California making collections of reptiles and amphibians, but chiefly to secure specimens of the very rare and interesting salamander, *Eurycia platycephala,* of which they were fortunate in obtaining five specimens.

Dr. G. Dallas Hanna, curator of paleontology, spent several days in southern California in investigations regarding the age of the Tertiary formations, which outcrop at Coyote Mountain. The Director of the Museum made a brief trip to the recently discovered cave near Vallecita, Calaveras County, for the purpose of examining the animal remains found therein. He also visited the Farallon Islands to make a search for fur-seal bones that may be found there.

## MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ITS AFFILIATED SOCIETIES

The 1922 meeting was held at Salt Lake City, Utah, June 22 to 24, in the buildings of the University of Utah. The meeting was held in conjunction with the Summer Session of the American Association for the Advancement of Science and proved to be one of the most successful meetings the Division has ever had.

The Academy was well represented in the attendance and on the program. Director Evermann delivered the Presidential address on the evening of June 22, his subject being

"The Conservation and Proper Utilization of our Natural Resources," and President Grunsky presented a paper on "The Interstate and International Aspects of the Colorado River Problem."

Among those appearing on the programs or in attendance were the following:

Edward A. Beals, C. E. Grunsky, Jr., Barton Warren Evermann, L. O. Howard, David Starr Jordan, Edgar Lucien Larkin, E. P. Lewis, A. L. Lovett, D. T. MacDougal, James McMurphy, Howard S. Reed, W. W. Sargeant, F. B. Sumner, E. P. Van Duzee, Mrs. E. P. Van Duzee, Bailey Willis.

## THE PAN-PACIFIC UNION COMMERCIAL CONFERENCE AT HONOLULU, OCTOBER 25 TO NOVEMBER 8, 1922

The Director of the Museum was in attendance upon this Conference as the representative of the National Research Council, the National Academy of Sciences, the California Academy of Sciences, and the Pacific Division of the American Association for the Advancement of Science; he was also one of the delegates from the San Francisco Chamber of Commerce.

The Conference proved very important and successful. There were present delegates from nearly all the countries bordering on the Pacific, and many problems of common interest to those countries were discussed. Among those which received much attention was that of the fisheries of the Pacific on which the Director presented a paper, the specific title of which was "The Conservation of the Marine Life of the Pacific." This paper called attention to the former abundance of a number of natural resources of the sea and their almost or complete commercial extinction through greed and improper fishery methods. He showed that these resources can be restored only through an international treaty participated in by all countries bordering on the Pacific.

Following the reading of the paper, the Conference unanimously adopted the following resolutions:

Whereas, It is known that many valuable species of marine mammals such as fur seals, sea otters, elephant seals and whales, and many species of important food fishes such as salmon and halibut, formerly occurred in the Pacific in such vast numbers as to constitute the objects of fisheries whose annual products were worth more than one hundred million dollars, and

Whereas, Nearly all of those great natural resources have been seriously depleted, many of them even to commercial extinction, through greed and shortsightedness and ill-considered fishery methods, and

WHEREAS, It is known that small remnants of fur-seal and sea-otter herds and small numbers of whales and of other commercially valuable species still remain in certain places, and

WHEREAS, The rapid recovery of the Alaska fur-seal herd in the short period of ten years from complete commercial ruin to an annual production of more than one million five hundred thousand dollars, as a result of the international fur-seal treaty of 1911, demonstrates conclusively the wonderful recuperative power of such depleted natural resources of the sea under international co-operation, and justifies the belief that other depleted fisheries can be rehabilitated through similar co-operation among the nations concerned, and

WHEREAS, It is conservatively estimated that these resources when rehabilitated will yield to the world a regular annual product of more than one-half billion dollars in value, therefore be it

*Resolved,* That the Pan-Pacific Commercial Conference strongly recommends that the various countries bordering on, or interested in, the Pacific, take such steps as may be necessary to bring about an international treaty for the restoration of the vanishing resources of the Pacific to their former abundance, that they may be maintained for all time as the objects of great commercial fisheries of which they are easily capable, and be it further

*Resolved,* That this Commercial Conference recommends that the governments of the countries bordering on the Pacific enter into correspondence for the purpose of establishing an International Commission for the scientific study of the biology, physics and chemistry of the Pacific in the interest of the restoration, proper utilization, and conservation of its vanishing natural resources.

These resolutions have since been endorsed by the California Academy of Sciences, the Chambers of Commerce of San Francisco, Los Angeles and San Diego, the Scripps Institution for Biological Research, the San Diego Society of Natural History, the Commonwealth Club of California, and by other organizations. Copies of the resolutions adopted by these various bodies have been communicated to the Department of State and Commerce through the National Research Council at Washington.

## USE OF THE ACADEMY'S LIBRARY AND COLLECTIONS BY INVESTIGATORS AND STUDENTS

Students and investigators continue to make use of the facilities for research and study afforded by the Academy's library and study collections.

The Boy Scouts, under Scout Master Harold E. Hansen, continue to hold their regular weekly meetings in the Academy's auditorium.

## PUBLICATIONS BY THE MUSEUM STAFF

The curators and others connected with the Museum staff have continued, as in the past, to contribute to the literature of their respective subjects.

The list of their contributions for 1922 is as follows:

Evermann, Barton Warren

1. Rainbow or Steelhead. <Forest and Stream, Vol. XCII, No. 3, p. 116, March, 1922.
2. Naturalists Will Explore West Coast of Lower California. <Catalina Islander, Vol. IX, No. 28, pp. 1 and 10, July 26, 1922.
3. The Steinhart Aquarium. <Golden Gate Pathfinder, Vol. III, No. 30, pp. 6-7, July 30, 1922.
4. Why Not Save the Marine Mammals of the Pacific? <Bull. Pan-Pacific Union, No. 34, New Series, pp. 12-16, August, 1922.
5. A Scientific Expedition to the Islands Off the West Coast of Lower California. <Sports Afield, Vol. 69, No. 2, pp. 102-103, August, 1922.
6. A Scientific Expedition to the Islands Off the West Coast of Lower California. <Science, New Series, Vol. LVI, No. 1440, pp. 135-137, August 4, 1922.
7. Will Study Marine Mammals. <Pacific Fisherman, Vol. XX, No. 8, p. 16, August, 1922.
8. San Francisco to Have $300,000 Aquarium. <Catalina Islander, Vol. IX, No. 35, pp. 1-3, Sepember 13, 1922.
9. Texas Fishes. <Southwestern Sportsman, Vol. 1, No. 10, p. 6, October, 1922.
10. The Conservation and Proper Utilization of Our Natural Resources. <The Scientific Monthly, Vol. XV, No. 4, pp. 289-312, October, 1922.
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8. [Note on the gift of the Johnston Collection of Shells to the California Academy of Sciences.] <The Nautilus, Vol. XXXV, No. 4, p. 133, April, 1922.
9. Pictures of some of California's Wild Flowers Exhibited. <Golden Gate Pathfinder, Vol. III, No. 14, p. 16, April 2, 1922.
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15. What becomes of the Fur-seals. <Science, New Series, Vol. LV, No. 1428, pp. 505-507, May 12, 1922.
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19. Manzanita, the little Apple of California. <Golden Gate Pathfinder, Vol. III, No. 24, p. 16, June 18, 1922.
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30. The Protection of Wild Life. <Golden Gate Pathfinder, Vol. III, No. 36, pp. 2, 15, September 15, 1

31. The Mountain Lion Group, California Academy of Sciences. <Golden Gate Pathfinder, Vol. III, No. 37, pp. 2, 4, September 17, 1922.
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34. Sunday Afternoon Lectures at the California Academy of Sciences. <Golden Gate Pathfinder, Vol. III, No. 39, pp. 2, 6, October 1, 1922.
35. Elephant Seals. <Golden Gate Pathfinder, Vol. III, No. 40, p. 2, October 8, 1922.
36. Attu Island Basketry. <Golden Gate Pathfinder, Vol. III, No. 42, p. 2, October 22, 1922.
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2. A Pygmy Owl Bathing. <Condor, Vol. XXIV, No. 1, pp. 31-32, January 25, 1922.
3. The Fox Sparrows of Golden Gate Park *(concluded)*. <Golden Gate Pathfinder, Vol. III, No. 6, p. 16, January 29, 1922.
4. The Gulls in Golden Gate Park. <Golden Gate Pathfinder, Vol. III, No. 8, pp. 2, 15, February 19, 1922.
5. Acute Sense of Sound Location in Birds. <Science, n. s., Vol. LV, No. 1417, February 24, 1922.
6. The Nuttall Sparrow in Golden Gate Park, and its nearest relatives. <Golden Gate Pathfinder, Vol III, No. 15, p. 16, April 9, 1922.
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9. New Nesting Records of the American Osprey in Northern California. <Condor, Vol. XXIV, No. 2, p. 67, April 6, 1922.
10. Further Record of the Savannah Sparrow in California. <Condor, Vol. XXIV, No. 3, pp. 95-96, June 10, 1922.
11. Eggs of the Aleutian Rosy Finch. <Condor, Vol. XXIV, No. 3, pp. 92-93, June 10, 1922.
12. Ring-necked Ducks in Golden Gate Park, San Francisco, California. <Condor, Vol. XXIV, No. 3, p. 101, June 10, 1922.

13. On the Status of the Crested Jays (*Cyanocitta stelleri*, subspecies) on the Northwest Coast of California. <Condor, Vol. XXIV, No. 4, pp. 127-133, July 29, 1922.
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## THE NEEDS OF THE MUSEUM

On this subject, I can only repeat and emphasize what I said one year ago. The needs then mentioned still exist and are even more urgent.

The proposed East Wing is perhaps the most important, most pressing need. We simply must have more room if the Museum is to continue to develop and grow in its scientific and educational work as I am sure every member of the Board of Trustees would like to see it grow. And it is earnestly hoped that some way may be found to increase our income so that we may pay more nearly adequate salaries to the scientific staff, and that more funds may be available for library, publications, and for scientific research. The salaries we are able to pay our curators and other employes are pitifully small and must be increased at the first opportunity.

I wish again to express publicly my appreciation of the fine spirit of scientific interest, enthusiasm, co-operation and loyalty with which members of the staff have carried on their work during the year just ending, as in the past. The absence of that spirit would indeed be unfortunate.

## DEPARTMENT REPORTS

The various curators and their assistants have continued active in their respective departments. The increases in the collections have been unusually large and important, as will appear from the department reports which follow:

### Department of Botany

*Inventory of the Herbarium*

| | SPECIES | SPECIMENS |
|---|---|---|
| General collection in cases | 22,788 | 107,026 |
| Mosses | 1,511 | 3,826 |
| Hepatics | 244 | 537 |
| Lichens | 849 | 1,541 |
| Algæ (Prager Herbarium) | | 614 |
| Fungi " | | 3,656 |
| Ferns " | | 985 |
| Cereals " Hohenacker Collection | | 172 |
| Mounted specimens (Kleeberger Herbarium) | | 3,293 |
| Unmounted specimens " | | 1,319 |
| Unmounted Texas specimens (Ferris Collection) | | 1,153 |
| " miscellaneous | | 959 |
| " from Eric Walther | | 176 |
| " from Antone Blazic | | 327 |
| Number of species and specimens | 24,392 | 125,584 |

*Duplicates Distributed*

Twenty-six specimens of ferns and 278 general to the National Herbarium; 230 general to the Gray Herbarium; 180 woody plants to the Arnold Arboretum; 726 general to Ira D. Clokey, Denver, Colorado Museum; 244 general to Philip A. Munz, Pomona College, Claremont, California.

Besides these duplicates there are thousands of other duplicates on hand to be distributed in the future and which are not even counted.

It is ten years since the reestablishment of the Botanical Department and this represents the growth from the nucleus that was saved from the fire to the present. The most important addition was that of the Prager Herbarium which was secured in 1921 through the generous contributions of William H. Crocker, William F. Herrin, William M. Fitzhugh, William C. Van Antwerp, J. D. Grant, A. F. Morrison and John C. Augsbury. In 1922 another valuable collection was added when Mr. George R. Kleeberger donated his herbarium. This is especially valuable to us since it contains a set of specimens collected by Dr. A. Kellogg and W. G. W. Harford in 1868-69, with type duplicates and authenticated specimens of a numbered set. Besides the donor's own rich collections, chiefly in Connecticut and Wisconsin, there is a very valuable collection of mosses and hepatics, a numbered set of which he purchased from Coe F. Austin who was an authority on those families and who made one of the most complete collections ever made in the Appalachian mountains.

Our collection of mosses and hepatics is now arranged for convenient reference and with the collections in the Kleeberger Herbarium, the cosmopolitan collection of the Prager Herbarium, the valuable donations from the New York Botanical Garden Herbarium, and the collection of Dr. C. Hart Merriam, we have an excellent collection and it will be one of my aims to increase it by interesting everyone in collecting mosses and hepatics. The collection of Californian hepatics is being constantly increased through the enthusiastic efforts of Mrs. E. C. Sutliffe and Mrs. Marion L. Campbell. They have added 10 species and one genus to the known species of the state, according to the determination of Dr. Alexander W. Evans of Yale University, the authority on this family.

Our collection of lichens has also been put in order and contains a set of the Hasse collection of California lichens, a small Californian collection donated by the collector, Albert W. C. T. Herre, a collection of 21 species and 51 specimens donated by the collector, J. August Kusche, and named by well-known authorities; and the specimens in the Prager Herbarium.

Our collection of Fungi is not yet arranged but contains the Harkness types which were saved from the fire of 1906, some from the National Herbarium, my own collections, and the large collection in the Prager Herbarium.

Eric Walther has been of the greatest assistance in adding to the collection of exotics cultivated in California and in keeping the exhibition of native and exotic flowers on exhibition at the entrance of the museum supplied with specimens. He has now labelled every species in the Golden Gate Park and has made a list on which the location of the labelled specimens is indicated on a map of the park. It is very desirable that this should be published in the near future. The work has been a labor of love by this capable and enthusiastic young gardener. Our collection of the exotics cultivated in California is now unsurpassed. Antone Blazic, another young and enthusiastic gardener, has been spending the past year, during the winter in Southern Florida and during the spring, summer and fall at the Arnold Arboretum near Boston, Mass. He collected assiduously for our herbarium and added 210 specimens from Florida and more than 900 from the Arnold Arboretum, adding many species and even genera to our collection. This, too, was a labor of love. Miss Anna Head collected over 800 specimens in the Feather River region and gave them to our herbarium. We have received in exchange 827 specimens from the New York Botanical Garden Herbarium, 696 specimens from the National Herbarium and 276 Colorado specimens from Ira D. Clokey of Denver. There have been many smaller donations, generally sent for identification and the names of the donors will appear in the general list. There are more than 40 donors.

A fine collection of Texas plants made by Mrs. R. S. Ferris of Stanford University, consisting of over a thousand specimens, was purchased from the collector by the Academy. The Botanical Club donated 120 colored photographs of California native flowers purchased from the artist, Antone J.

Soares, at a cost of $90. These will be put on exhibition in the museum from time to time.

The small collection made on Guadalupe and Cedros islands, the large collection made by Ivan M. Johnston on the expedition to the Gulf of California, and my own collections have not been included. The curator has had too much herbarium work to attend to for any extended collecting.

There is a great deal of correspondence to be attended to chiefly determining specimens for everyone who sends; the flower show is kept up throughout the year and is one of the most popular features of the museum; the evening class of the gardeners is held weekly and the Botanical Club has weekly meetings or excursions. Many botanical talks have been given to different clubs and thereby the influence of the Academy has been extended along popular lines.

Mrs. Wilkens has looked after keeping the flower show in order and clean and Mrs. G. H. Phelps has been most efficient in mounting the specimens, in putting them into their proper places and in making the inventory. In order to be able to do any real scientific work I need an assistant who knows something about botany so that some of the work can be taken from me.

Alice Eastwood, *Curator.*

## Department of Entomology

The year 1922 was one of steady progress in the Department of Entomology, although this progress was somewhat limited by the fact that for most of the year the curator had to work single handed. So large a proportion of the funds available in 1922 was required for the purchase of new cases, which were absolutely essential to the development of the collection, that little was left with which to employ an assistant. Thus the work of mounting and labeling the large number of specimens added during the summer had to be done entirely by the curator, which left very little time for working up the material secured. However, in spite of this handicap, good progress was made in the determination and arrangement of the material secured by the Gulf of California Expedition of 1921, and in the general collection of insects. Such systematic work as could be done was largely devoted to the study and arrangement of the leaf hoppers and other groups of the Hemiptera. Work on this order is being pushed and it is hoped that another year will see the completion of the determination and arrangement of all Academy material in this order. In the Coleoptera, or beetles, Dr. F. E. Blaisdell has worked tirelessly and efficiently in the study of the Academy material. First, he completed work on the Tenebrionidæ of the Gulf Expedition, which are now in perfect order, and his report on which now awaits publication, and later he has determined many uncertain forms in all families of the beetles which have recently been added to the collection. Dr. F. E. Cole completed his work on the Bombyllidæ of the Gulf Expedition and his report on these bee-flies is ready for publication. He has also done much toward the determination of other dipterous insects in the Academy collection. Material in other orders of insects has been placed in the hands of specialists and work on them is well under way.

The field work of the curator in 1922 was largely done in Utah from June 25 to July 25. The selection of that locality for work enabled him to make arrangements for the meeting of the entomologists, held in connection with the annual meeting of the Pacific Division of the American Association for the Advancement of Science at Salt Lake City, and to secure a very fair representation of the insects of eastern and northern Utah, a region scarcely represented in the Academy's collection of insects. Through this work in Utah 6,000 specimens were added to the Academy collection, a very large proportion being of species unrepresented in the Academy.

Three shorter trips were made during the summer. One to Sacramento and Chico in April, adding 976 specimens; one of five days to Lake County in May, through the kindness of Dr. Hanna, adding 1265 specimens; and one of two days in November, to Giant Forest, adding 171 specimens. The latter trip was undertaken for the purpose of securing a sample of infested wood from a portion of a fallen Big Tree *(Sequoia gigantea)* immediately adjoining the section presented to the Academy by Hon. J. D. Grant and Col. J. R. White. This tree had been struck by lightning 1200 years ago and had then become infested by the larvæ of a flat-headed borer. The covering of this infested wood by the growth of the tree hermetically sealed the work of the beetles and any dead insects remaining in the galleries, it was surmised, would still be in as good condition as when so sealed. The examination of the material brought home justified that prediction and resulted in the finding of two fairly perfect specimens of the beetle which proved to be a green buprestid, *Trachykele opulenta* Fall, and to differ in no way from specimens now living on the same trees in the same forest. This was an exceptional opportunity to compare a beetle now living with a specimen of the same species that had been preserved for 1200 years.

Accessions to the Department of Entomology during 1922 number 21,419 specimens. Of these 8,823 were taken by the curator in his field work and week-end trips about San Francisco. Of the balance, 3780 specimens, collected in Arizona, New Mexico and Texas by Mr. C. D. Duncan and 700 taken at Needles, Calif., by Mr. J. A. Kusche, were purchased. 1138 were taken by Dr. G. D. Hanna and Mr. J. R. Slevin on an expedition, made through the courtesy of the Mexican Government, to Gaudalupe Island and the islands off the western coast of Lower California. Many valuable donations were received during the year, among which may be mentioned the following: From Dr. E. C. Van Dyke, 3036 specimens, mostly from Eastern Oregon, a region scarcely represented in our collection; from C. L. Fox, 1510 specimens, largely from Modoc County, California; from Dr. F. E. Blaisdell, 738, including a good series of spiders from Mt. Herman, Santa Cruz County, California; from Mr. C. T. Dodds, 1700 insects, mostly from Sinaloa, Mexico, and constituting a most valuable addition to our collection of insects from that country; from J. Preston Clark of Boston, 274 insects from Mazatlan, Mexico; from W. C. Van Heurn of Buitenzorg, Java, 384 insects from that vicinity; from L. S. Slevin, 550 specimens from Monterey County, California; from Frank R. Mason of Philadelphia, 145 insects from Africa; from J. O. Martin, 754 specimens, mostly from Lassen County, California; from B. C. Marshall, 150 beetles from Lawrence County, Arkansas; from A. C. Kinsey, 322 oak galls and the Cynipids bred from them; and from E. R. Leach, 122 moths from Michigan Bluff, California. Other donations to the department collection were received from Virgil Owen and Dr. F. C. Clark of Los Angeles; Dr. F. W. Goding of Guayaquil, Ecuador; M. C. Van Duzee of Buffalo; B. G. Thompson of Sacramento, including topotypes of the very rare *Desmocerus dimorphus;* from Jos. Mailliard and E. O. Essig, including paratypes of some interesting species, and others from Dr. F. C. Clark, Dr. F. E. Blaisdell and Mrs. H. E. Ricksecker, which are still unmounted and will have to be recorded another year. Not only are these gifts unusual in number but they are of exceptional value.

The Academy collection of insects has now reached such a size that the help of a preparator is almost a necessity if any progress is to be made in the classification of the material. During 1923 less will be required for the purchase of new cases and it is hoped that this will supply in part the funds needed for the hire of an assistant. Our collection of insects is much too valuable to be stored in packing boxes. They should be determined and arranged in systematic order and so made available to students who may need to consult western forms, but this taxonomic work cannot be done while the curator is doing the work of a preparator. EDWARD P. VAN DUZEE, *Curator.*

## DEPARTMENT OF EXHIBITS

The beginning of the year 1922 saw the completion of the habitat group of the Imperial Grizzly Bear *(Ursus horribilis imperator)*, which was donated to the Academy by Mr. Ogden Mills, of New York. The specimens for this group were secured in the Yellowstone National Park, Wyoming, by Dr. Saxton Pope and Mr. Arthur Young, principally by means of bows and arrows, and presented to the Academy by Dr. Pope. The group was designed and prepared by Mr. C. J. Albrecht, of the University of Washington, and the background was painted by Prof. C. C. Judson, of the University of California.

In June last a handsome present was made to the Academy by Mr. George C. Beckley, of San Francisco, California, consisting of thirteen finely mounted heads of the following animals: One moose, two caribou, three mountain sheep, one mule deer, one mountain goat, two antelope, and three elk.

Material for another sheep group, consisting of five specimens, was secured in Southern California by Mr. Edwin H. Ober, and presented by him to the Academy at the end of the year.

In the spring of 1922 Mr. Frank Tose was employed for small group work, which has been resumed. There is no more room at present for large habitat groups of birds or animals, but between those large groups now installed there yet remain spaces for several small panel groups, three of which have already been put in place by Mr. Tose. One of these is a group of the Bushy-tailed Wood Rat *(Neotoma cinerea occidentalis)*, one of the Western Robin *(Planesticus migratorius propinquus)*, and one of the Western Meadowlark *(Sturnella neglecta)*.

No large habitat groups can be installed until either a complete new wing is constructed, with halls set apart for this purpose, or until a sadly needed auditorium is built, which would release for exhibition purposes the room now used as an auditorium.

Several portable loan groups of nesting birds have been prepared for school work, and others are in process of construction.

Joseph Mailliard, *Curator.*

## Department of Herpetology

At the beginning of the year 1922 the Academy's collection of reptiles and amphibians numbered 46,506 specimens. There have been added during the year more than 4,500 specimens, so that the collection has grown to 50,914 specimens.

The largest single accession of the year was the William H. Crocker Collection of Oriental Reptiles and Amphibians consisting of more than 3,100 specimens from the Philippine Islands, China and Siam, purchased from Mr. Edward H. Taylor. This collection contains about 335 species and subspecies and about 80 types and paratypes, and will be extremely valuable for study in connection with the Academy's great collections from China, Korea, Formosa, the Loo Choo Islands, and Japan. The acquisition of this collection was made possible by the generosity of Mr. William H. Crocker. Other gentlemen who contributed funds for the purchase of this collection or of glass jars to care for it, are: Mr. Herbert Fleishhacker, Mr. William F. Herrin, Mr. Louis F. Monteagle, Mr. C. O. G. Miller, Mr. Selah Chamberlain, and Mr. George Uhl.

During the year the assistant curator, Mr. J. R. Slevin, carried on explorations along the western coast of Lower California, where he secured 923 specimens from Cedros, Natividad, San Martin, San Roque, Ascuncion, Santa Margarita, and Magdalena islands and various localities on the peninsula.

Late in August the curator and assistant curator visited the Yosemite National Park for the purpose of securing certain species found in the high Sierras. This expedition resulted in 418 specimens including five of the Mt. Lyell Salamander which had been found only once before, and other species not previously represented in the Academy's collections.

The number of specimens added to the collection during the past six years has been about as follows: in 1917, 1,600 specimens; in 1918, 1,724; in 1919, 2,666; in 1920, 1,466; 1921, 5,002; and in 1922, 4,934.

Gifts of specimens during the year have been received as follows: From Mr. William H. Crocker and Mr. Herbert Fleishhacker, 3,135 specimens; Dr. J. Van Denburgh, 12; C. L. Fox, 2; Richard P. Erwin, 55; Prof. V. M. Tanner, 9; F. Maag, 1; Mrs. J. E. Wilkens, 1; Mr. Frank Tose, 1; L. A. Peterson, 1; Marcus Hanna, 1; Don P. Johnston, 1; E. P. Van Duzee, 1; W. Sargeant, Jr., 1; Mrs. E. C. Sutliffe, 1; L. M. Klauber, 1.

Two specimens of the rare Chinese Alligator have been received, by exchange, from Harvard University.

Specimens have been secured from 18 counties of California as follows: Alameda, 1; Del Norte, 7; Fresno, 1; Humboldt, 2; Kern, 1; Lake, 1; Madera, 21; Marin, 3; Mariposa, 130; Merced, 1; Modoc, 1; Placer, 1; San

Benito, 6; San Luis Obispo, 1; Santa Clara, 41; San Diego, 2; San Francisco, 2; San Mateo, 15; Tuolumne, 269.

Specimens from other localities are: Arizona, 5; Florida, 7; Idaho, 55; Illinois, 1; Louisiana, 1; New Mexico, 1; New York, 3; North Carolina, 1; Oregon, 5; Texas, 2; Utah, 9; Washington, 62; Europe, 25; Asia, 25; Africa, 102; South America, 1; Mexico, 944; Porto Rico, 1; New Zealand, 1; Austral Islands, 9; Tuamotu Islands, 16; Society Islands, 3; Christmas Island, 8; Marshall Islands, 4; East Indies, 6; Sumatra, 1; Indian Ocean, 2; Australia, 2; Philippine Islands, China and Siam, 3135.

The classification, labeling, cataloging, and arrangement of the collection was continued during the year.

A descriptive account of all the reptiles of Western North America has been published.

Specimens have been studied by A. I. Ortenburger of the American Museum of Natural History, Dr. E. R. Dunn of Smith College, Dr. F. N. Blanchard of the University of Michigan, and Dr. Tracy I. Storer of the University of California.

JOHN VAN DENBURGH, *Curator.*

## DEPARTMENT OF INVERTEBRATE PALEONTOLOGY

The activities connected with the Department of Invertebrate Paleontology during the calendar year 1922, centered chiefly in five major exploration projects which are mentioned below in chronological order.

On January 1, Mr. Frank M. Anderson, for many years curator of the department and lately honorary curator, was in Colombia, South America, continuing his studies of geology and paleontology which were begun there in 1914. He returned to the United States in June and the large collection he made arrived soon afterwards. This was deposited in the Academy where the collector has been engaged for some time in properly arranging and classifying it. The acquisition of this material makes the Academy by far the foremost museum depository of Colombian paleontology.

In April, the curator again visited the region of Coyote Mountain, Imperial County, California, for the purpose of checking certain geological observations before the final completion of the report upon that locality. The collections from there which have been borrowed from the University of California and the United States National Museum were all returned early in the year.

In May, the curator, accompanied by Mr. Edward P. Van Duzee of the Department of Entomology, paid a short visit to the region about Clear Lake, Lake County, California. The primary purpose of the trip was the collecting of fossils found in that vicinity as well as the ascertaining of the status of the unique freshwater molluscan fauna of Clear Lake. Both undertakings were successful. It was learned that the remarkable species of shells of the lake have become almost, if not entirely, extinct, due to the activities, residents said, of the German carp which have been introduced there.

On July 16, the curator left San Diego as a member of the expedition which was sent to Guadalupe and other islands off the west coast of Lower

California. Very large collections of living and fossil invertebrates were collected during the four weeks the party was in the field.

In the latter part of November, the curator and Mr. Frank M. Anderson visited the Type Section of the Tejon Group at the southern end of the San Joaquin Valley for the purpose of obtaining additional collections from this famous fossil deposit and also to work out the stratigraphy of the region. A report is in preparation on the geology and paleontology on this Eocene formation because it forms the basis to which all of the studies of the older Tertiaries of California must be referred.

Satisfactory progress was made during the year in several lines of research. One of the most important of these was in connection with the unpacking, sorting, identifying and labeling of the enormous collection obtained in the Gulf of California in 1921 by the expedition from the Academy. A conservative estimate of this collection is 200,000 specimens; thus far sufficient time has not been available to make an accurate count. Over 300 species of living marine mullusks have been identified through the aid of Dr. Fred Baker, who collected the material. The collection was so large that special methods of handling the great numbers of duplicates from many localities had to be devised. At the end of the year all of the larger species had been sorted, labeled and arranged systematically.

The land shells of the 1921 Gulf Expedition were likewise assorted and the collection was partially identified by the curator.

The shortage of funds made it impossible to obtain any but a negligible amount of assistance for the laboratory routine. As a consequence the cataloging of the collections in hand fell far behind the new accessions.

Students and investigators continued to find the rich collections of the department of great value in their work. Members of the faculties of both neighboring universities have borrowed material in certain groups from time to time and there is every assurance that the co-operation thus maintained has been of material benefit to all three institutions.

The special training of the curator in microscopical paleontology enabled him to assist in the making of plans and the selecting of equipment for use in such work which has recently been undertaken in Stanford University. And, upon the request of Professor Bruce L. Clark of the University of California, two students from that institution were permitted to pursue their studies in this subject at the Academy under the direct instruction of the curator. A widespread interest in microscopical paleontology has recently developed through its economic application in the petroleum and related industries.

At the end of the year the following were the outstanding loans from the department:

Dr. Fred Baker, Point Loma, California, living mollusks from the Gulf of California; Dr. Bruce L. Clark, University of California, Eocene and Oligocene fossils; and for his students: Merle Israelsky, living and fossil echinoderms; R. N. Nelson, Martinez fossils; Mr. Marcus A. Hanna, University of Washington, Eocene fossils; Dr. David Starr Jordan, Stanford University, Miocene teeth of sharks; Miss Mary J. Rathbun, U. S. National Museum, fossil crustaceans; Mr. Waldo Schmitt, U. S. National Museum, living crustaceans; Dr. T. Wayland Vaughan, U. S. Geological Survey, fossil mollusks from Mexico. G. Dallas Hanna, *Curator.*

## Library

Accessions to the library during 1922 number 903 complete volumes besides pamphlets and single numbers of serials. Of these complete volumes 189 were secured by purchase, 301 through exchange for the Academy publications, and 423 by gift. These figures are a little smaller than for the preceding year. A little less money was available for the purchase of books and there was no such large single gift as in 1921. The largest single donation received during the year was the J. N. Webster collection of 369 volumes received through the generosity of Mr. George Sturtevant.

Mrs. Helen Van Duzee has done the entire library work throughout the year besides helping with the care of the Academy publications and in other lines of effort. The portion of her time left for library work, after the care of current accessions, was insufficient to make any large advance toward completing the accessioning and cataloging of the miscellaneous material stored in the lower stack room. Publications on agriculture were, however, arranged and catalogued and a good start made on the subjects of education and engineering. A total of 491 volumes were accessioned during the year, which represents the growth of the library, excepting the Webster collection, which was received too late in December to admit of accessioning before the end of the month. All other additions to the library were fully catalogued and much was done to add to the efficiency of the library equipment, especially in the way of rendering more accessible the resources of the library.

Broadly speaking, the library work has been kept thoroughly up to date although, with the limited time available, but little could be done toward working up the miscellaneous material stored in the lower stack room. The use of the books has been satisfactory, showing an appreciation of the improved accessibility of the resources of this department of the Academy's activities. Edward P. Van Duzee, *Assistant Librarian.*

## Department of Mammalogy

As heretofore this department has been conducted conjointly with the Department of Ornithology, and field work was carried on as opportunity offered in that connection. The matter of greatest interest resulting from the field work in this department in the past year was the taking of a Mazama Red-backed Mouse *(Evotomys mazama)* at Quincy, Plumas County, California, which appears to be the first specimen of this genus actually recorded from the interior of this state, south of Mt. Shasta. Others may have been taken, but, apparently, not recorded in any publication.

The number of specimens of various classes in this department, as entered upon the accession register, is 4,387, including the following additions for the year: On hand, but not before recorded: 26. *By exploration:* 283. *By Gift:* Mr. Otto Anderson, 4; Mrs. Vilinda Blakely, 1; California Fish and Game

Commission, 5; Mr. G. W. Edwards, 1; Mr. E. R. Leach, 2; Mr. J. W. Mailliard, Jr., 1; Rev. W. S. Matthew, 1; Mr. John McLaren (Golden Gate Park), 6; Mr. W. L. Morris, 2; Mr. Paul O'Brien, 1; Mr. E. H. Ober, 5; Miss Susie Peers, 1; Dr. Emmet Rixford, 1; Mr. Rosenblatt, 9; Mr. Frank Tose, 2; Mrs. J. Wilkens, 1. *By Purchase:* 108.

Joseph Mailliard, *Curator.*

## Department of Ornithology

Throughout the year 1922 work in this department has been carried on without interruption. For the first three months of the year the department had the benefit of the services of both Miss M. E. McLellan and Mr. Chase Littlejohn, after which time Miss McLellan was the only assistant regularly employed. Other than routine work, the mounting, cataloging, and card-indexing of the egg collection has been the main occupation of the office force during the year. Considerable work has also been accomplished in the field.

The curator, with Mr. Herbert Barth as an enthusiastic but inexperienced assistant, made a field trip to Siskiyou County, California, to continue the work commenced there by an Academy party in 1920 (*vide* Mailliard, Proc. Calif. Acad. Sci., 4th Ser., Vol. XI, No. 5, pp. 73-94). The expedition of 1922 was equipped with an automobile and a full camping outfit, which enabled it to reach and examine places in this region that had been inaccessible upon the previous visit. The party was in the field from May 12 to June 26, making observations and collecting specimens in several sections of Siskiyou County. The search for possibly existing breeding grounds of the genus *Passerella*—fox sparrows—in the mountain ranges west of Shasta and Scott valleys was one of the principal objects of the spring field work, and the discovery of this genus nesting in several places from which it has never before been recorded was ample recompense for the time and trouble spent in accomplishing this result.

During the ten days passed in Yreka and vicinity, a good list of the breeding birds of the locality was obtained, and a reasonable number of specimens were secured. The Salmon and Forest Mountain ranges, as well as Gazelle Mountain, were visited, and valuable data procured.

A field party, consisting of the curator and an untrained assistant, Mr. W. B. Smith, with car and camp equipment as before, carried on some work in Plumas and Yuba counties for a month in the autumn. The principal object of this trip was to study the movements of fox sparrows among the foothills along the western side of the Sacramento Valley, where little or no work of this sort had ever been done. Enough notes and specimens were secured to add considerably to our stock of knowledge of these birds.

Use has been made of the Academy material and facilities by various persons, but not nearly to so great an extent as is desired.

A loan collection of bird skins has been arranged for the use of the public school teachers, and there is a constant demand for various of its units for educational purposes. Loans of material for study and comparison have also been requested from time to time by different persons living at a distance from San Francisco.

Accessions to the Department of Ornithology during the year 1922 have been as follows: Bird skins—*By exploration:* 504 specimens. *By gift:* Mr. W. Adams, 19; Mr. Ralph Borden, 19; Miss I. N. Clifford, 1; Mr. Ben. Foster, 1; Mr. John Hanson, 1; Mr. F. C. Holman, 1; Mr. C. H. Leong, 43; Mrs. J. A. Leonard, 1; Mr. John McLaren (Golden Gate Park), 7; Mr. V. J. A. Rey, 1; Mr. Rosenblatt, 2; Mr. Alvin Seale, 1; Mr. Frank Tose, 2; Dr. John Van Denburgh, 2; Dr. Otto Westerfeld, 1. *By purchase:* 63 specimens. The total number of specimens on hand at the end of the year 1922, as recorded, is 39,338.

A number of nests and sets of birds' eggs have been received, by exploration and by gift, from the following: Alaska Packers' Association, Messrs. A. Christoffersen, F. C. Clark, Joseph Cotton, Jacob Gorius, M. A. Hanna, E. C. Johnston, W. C. Lewis, Paul O'Brien, M. Schweitzer, Dr. John Van Denburgh, and Mrs. J. Wilkens.

JOSEPH MAILLIARD, *Curator.*

## ACCESSIONS TO MUSEUM AND LIBRARY

Adams, Mr. Wallace, San Francisco: Nineteen bird skins from Mexico. Gift.

Alaska Packers' Association, San Francisco: Five sets of eggs from Alaska. Gift.

Allen, Mr. Lewis, San Francisco: Twenty-seven photographs of plants, chiefly California trees and shrubs. Gift.

American Museum of Natural History, New York: Two salamanders from China; one lizard from Porto Rico; two lizards from Arizona; one frog from Louisiana; one lizard from Utah; four lizards from Mexico; nine lizards from Austral Islands; eight lizards from Christmas Island; 16 lizards from Taumotu Islands; three lizards from Society Islands; one lizard from New Mexico; 70 bird skins. Exchange.

Anderson, Mr. F. M., Berkeley: One hundred and ten specimens, representing 26 species of marine fossils from Lower Miocene deposits in Kern County. Gift.

Anderson, Mr. Otto, San Francisco: Four sets of antlers of *Capreolus capreolus capreolus.* Gift.

Anthony, Mr. A. W., San Diego: Sixteen specimens of land shells from South Coronado Island, Lower California. Gift.

Arnold, Mrs. A. R., Tracy: Seven California plants for identification. Gift.

Augsbury, Mrs. J. C., San Francisco: Fifteen botanical specimens from the Yosemite for identification. Gift.

Baker, Dr. Frank C., Urbana, Illinois: Four pamphlets. Gift.

Baker, Dr. Fred, Point Loma: Two rare land shells (*Eulota elongata* Pilsbry) from Formosa; one rare specimen of Plemotomaria from Japan; 235 land, freshwater and marine shells from various localities, including paratypes of 10 species from Brazil, and two rare land shells from Java. Gift.

Baldwin, Mrs. William S., San Francisco: One botanical specimen from Paso Robles for identification. Gift.

Barbat, Mr. William, San Francisco: Eight specimens of freshwater shells from Shasta County, and one botanical specimen from Siskiyou County for identification. Gift.

Barbour, Dr. Thomas, Cambridge, Massachusetts: One salamander from North Carolina; five snakes from Florida; two alligators from China; one lizard from Texas. Exchange.

Beattie, Mr. R. Kent, Bureau of Plant Industry, Washington, D. C.: One botanical specimen from Oregon. Gift.

Beckley, Mr. George C., San Francisco: One moose, two caribou, one Stone sheep, one Fannin sheep, one Rocky Mountain sheep, one mule deer, one mountain goat, two antelope and three Montana elk. Gift.

Berry, Dr. S. S., Redlands: Four specimens of land shells from Shasta County and 17 specimens of fossil chitons from Southern California. Gift.

Bethel, Mr. Ellsworth, Denver, Colorado: One botanical specimen. Gift.

Bibble, Mr. A.: Thirty specimens of freshwater shells from Placer County. Gift.

Blaisdell, Dr. F. E., San Francisco: Seven hundred and thirty-eight insects, mostly spiders from Mount Hermon, Santa Cruz County (includes four types of Cicadidæ); 173 government bulletins, 34 pamphlets and four books. Gift.

Blakely, Mrs. Velinda, San Francisco: Piece of tanned elephant hide. Gift.

Blanchard, Mr. Frank N., Ann Arbor, Michigan: Fifty herpetological specimens from Massachusetts, 50 from Maine, 14 from Maryland, 78 from New Hampshire, 19 from New York, 23 from Virginia, 87 from Vermont, 15 from Washington, six from West Virginia. Purchase.

Blazic, Mr. Antone J., Los Angeles: Two hundred and thirteen specimens of wild and cultivated plants from Florida; 641 specimens of trees, shrubs and wild flowers from the Arnold Arboretum and elsewhere in Massachusetts. Gift.

Borden, Mr. Ralph, Oakland: Nineteen African birds, in flesh. Gift.

Bowles, Mr. Charles W., Menlo Park: Sun spot sketches and earthquake notes, made by J. Arthur Bowen, 1638 Oxford Street, Berkeley, with 3″ and 6″ telescope. Gift.

Bradshaw, Mr. R. V., Palo Alto: Eighteen botanical specimens of willows from Oregon. Gift.

Brown, Mr. E. Call, Los Angeles: One specimen of fossil shell from oil well at Signal Hill field. Gift.

Bruce, Mr. Jay, San Lorenzo: One adult and two mountain lion cubs. Purchase.

Bulmer, Mrs. Joseph, San Francisco: Twenty-one obsidian Indian arrow and spear heads from vicinity of Calistoga. Gift.

Burlingame, Mrs. C. A., Sonoma: One botanical specimen from Sonoma County for identification. Gift.

Cain, Mr. Brighton C., Stanford University: Thirteen snakes, 23 lizards, three frogs, one turtle, four salamanders from California; one snake skin from Texas. Purchase. Twenty-two insects from Utah. Gift.

California Academy of Sciences Expedition to the Gulf of California, 1921: Two thousand two hundred and eleven land shells from Lower California and islands in the Gulf of California. Exploration.

California Botanical Club, San Francisco: One hundred and twenty-two photographs of California wild flowers, photographed and colored by Antone J. Soares. Gift.

California Fish and Game Commission: Six skulls of Pacific Coast cougar, four of which were donated, and the other two, kitten skulls, were purchased. One skin of *Felis oregonensis oregonensis.* Gift.

California State Mining Bureau, San Francisco: Fifteen specimens of Jurassic fossils from 10 miles east of Folsom. Gift.

Camp, Dr. Charles, Berkeley: One stump from ranch of René Guillon. Gift.

Campbell, Mrs. H. C., Sausalito: Four botanical specimens from Porterville. Gift.

Campbell, Mrs. Marian L., Mill Valley: One botanical specimen from Mount Tamalpais for identification. Gift.

Campbell, Mrs. R. W., Pasadena: Forty-four botanical specimens from Southern California. Gift.

Cantwell, Mrs. F. S., Sausalito: Six botanical specimens from Carmel for identification. Gift.

Christoffersen, Mr. A., San Francisco: Twenty land shells from Alaska; one set of four eggs of *Calcarius lapponicus alascensis.* Gift.

Chular School, Monterey: Eight botanical specimens from Monterey for identification. Gift.

Clark, Mr. B. Preston, Boston, Massachusetts: Two hundred and seventy-four insects from Mexico. Gift.

Clark, Dr. Frank C., Los Angeles: Forty insects from California; six sets of bird eggs from Napa and Santa Clara counties. Gift.

Clemons, Mrs. Joseph, Pacific Grove: Forty botanical specimens from Southern California for identification. Gift.

Clifford, Miss Ivy N., Tahoe City: One *Archibuteo ferrugineus,* in flesh, from Tahoe City. Gift.

Clokey, Mr. Ira W., Denver, Colorado: Two hundred and seventy-six specimens of Colorado wild flowers. Exchange.

Colton, Mr. Joseph, San Francisco: One hundred and twenty-eight bird eggs. Gift.

Crocker, Mr. William H. and Fleishhacker, Mr. Herbert, San Francisco: Three thousand one hundred and twenty-five herpetological specimens from Philippine Islands and neighboring territory. (Purchase from Edward H. Taylor). Gift.

Crocker, Mr. William H. and Mailliard, Mr. John W., San Francisco: One package containing Dr. J. G. Cooper's manuscripts, notes, memoranda, letters, etc., purchased from W. Otto Emerson in connection with his bird collection. Gift.

David, Mr. J., San Francisco: Three botanical specimens from San Francisco for identification. Gift.

Dodds, Mr. C. T., Berkeley: Seventeen hundred and five insects from Los Moches, Sinaloa, Mexico. Gift.

Dominion Museum, Wellington, New Zealand: One frog from New Zealand. Exchange.

Donohoe, Mrs. Joseph, Menlo Park: Five botanical specimens from Menlo Park. Gift.

Duncan, Mr. Carl D., Stanford University: Three thousand seven hundred and eighty insects from Texas. Purchase.

Dutton, Mrs. C. S., San Francisco: One California plant. Gift.

Eastwood, Miss Alice, California Academy of Sciences: Three hundred and seventy-seven specimens of California plants. Exploration.

Two books and 176 pamphlets. Gift.

Edwards, Mr. George W., San Francisco: Two tusks from South America. Gift.

Engel, Mrs. F. G., San Francisco: One botanical specimen from Rubicon Springs. Gift.

Erwin, Mr. Richard P., Boise, Idaho: Five snakes from Idaho. Gift.

Essig, Prof. E. O., Berkeley: Eighteen insects from Santa Clara County. Gift.

Evermann, Dr. Barton Warren, California Academy of Sciences: Seventeen books and 235 pamphlets; one botanical specimen from Texas and four specimens of plants from Unalaska; three sets of bird eggs; 39 marine shells and a collection of bones from Farallon Islands; two specimens of *Peromyscus maniculatus dubius* from Coronado Islands; three barnacles from a Hump-back whale. Gift.

Thirty specimens of land shells, 10 lizards and six salamanders from Coronado Islands, Lower California. Exploration.

Farallon Islands Lighthouse Keeper: Collection of seal bones from the Farallon Islands. Gift.

Ferris, Mrs. R. S., Stanford University: One thousand one hundred and fifty-three numbers of Texas plants and 15 photographs of trees and shrubs. Purchase.

Fitzhugh, Mr. William M., San Francisco: Three volumes (The Outline of Science). Gift.

Fleishhacker, Mr. Herbert and Crocker, Mr. William H., San Francisco: Three thousand one hundred and twenty-five herpetological specimens from Philippine Islands and neighboring territory. (Purchase from Edward H. Taylor). Gift.

Fleming, Mr. G. L., La Jolla: Twenty botanical specimens from Southern California. Gift.

Foster, Mr. Ben, San Rafael: One *Lophodytes cucullatus*, in flesh, from Marin County. Gift.

Foster, Mrs. George, San Francisco: Mounted ferns and algæ. Gift.

Fox, Mr. C. L., San Francisco: One snake from Marin County, one snake from Modoc County; 1355 insects, mostly from Modoc County. Gift.

Gallegos, Prof. José M., San Diego: Twelve photographs of plants from Cedros and Guadalupe islands. Gift.

Garrecht, Miss Ruth, Redding: Three botanical specimens from Redding for identification. Gift.

Ghirardelli, Mrs. Domingo, San Francisco: Fifty-five botanical specimens from Glacier National Park and one cultivated plant from San Francisco. Gift.

Gilman, Dr. P. K., San Francisco: Four books. Gift.

Goding, Dr. F. W., American Consulate, Guayaquil, Ecuador: Twelve insects from Ecuador. Gift.

Goodman, Dr. E., San Francisco: Ten botanical specimens from Marin County for identification. Gift.

Goodwin, Mr. Clay: One botanical specimen from Arizona. Gift.

Gorius, Mr. Jacob, San Francisco: One ostrich egg from Panama-Pacific International Exposition. Gift.

Graff, Mr. A. J., Cazadero: One botanical specimen from Cazadero for identification. Gift.

Griffin, Miss Alice, El Verano: Twelve botanical specimens from El Verano for identification. Gift.

Gulf of California, 1921, California Academy of Sciences Expedition to: Two thousand two hundred and eleven land shells from Lower California and islands in the Gulf of California. Exploration.

Hanna, Dr. G. Dallas, California Academy of Sciences: Seventy insects from Santa Cruz County; 40 land shells from Pescadero. Gift.
Forty-three specimens of land and freshwater shells from Southern California; 40 fossil shells and 534 land and freshwater shells from Lake County; one turtle from Lake County and one lizard from Kern County. Exploration.

Hanna, Mr. Marcus A., Seattle, Washington: One set of Nighthawk eggs, 12 land shells and one snake from San Diego County. Gift.

Hansen, Mr. John, St. Paul Island, Alaska: One specimen of *Iridoprocne bicolor* from St. Paul Island, Alaska. Gift.

Hart, Mr. Cecil, Los Angeles: One hundred and eighteen botanical specimens from Southern California for identification. Gift.

Head, Miss Anna, Berkeley: Three hundred and eighty-two specimens of plants from the Feather River region and one botanical specimen for identification. Gift.

Heath, Dr. Harold, Stanford University: One hundred and twenty land shells from Monterey County. Gift.

Herrin, Mr. W. F., San Francisco: Six botanical specimens from Shasta Springs for identification. Gift.

Holman, Mr. F. C., San Francisco: One Fox Sparrow. Gift.

Howe, Mr. Henry V., Stanford University: One cotype of a new species of fossil shell and seven casts of new species of fossil shells from Oregon. Gift.

Huffins, Mrs. L. H., Petaluma: One botanical specimen from Petaluma. Gift.

Hunt, Mrs. D. O., St. Helena: One botanical specimen from St. Helena for identification. Gift.

Jeffers, Mr. Le Roy, New York City: Three books. Gift.

Johnston, Mr. Don P., Okeechobee, Florida: One turtle from Florida. Gift.

Johnston, Mr. E. C., Bureau of Fisheries, Washington, D. C.: Sixty-eight bird eggs. Purchase.

Johnston-Lavis, Madame Fournier, Paris, France: One book. Gift.

Jones, Miss Katherine, Berkeley: One botanical specimen from Modesto. Gift.

Kellogg, Mrs. Harriet S., Berkeley: Thirty-six sheets of marine algæ chiefly from the coast of California. Gift.

Kelly, Mrs. G. Earle, Alameda: Seventy-five specimens of plants from Porterville and 49 botanical specimens from Sequoia National Park for identification. Gift.

Kelsey, Mr. F. W., San Diego (through Dr. Fred Baker): Two paratypes of *Amphithalamus tenuis* Bartsch from La Jolla and 42 land and freshwater shells from western North America. Gift.

Kinsey, Mr. A. C., Bloomington, Indiana: Three hundred and thirty-two Cynipidæ and their galls. Gift.

Klauber, Mr. L. M., San Diego: One snake from San Diego County. Gift.

Kleeberger, Mr. George R., Berkeley: Two thousand two hundred and fifty-six mounted plants. Gift.

Kusche, Mr. J. August, Los Angeles: Nineteen specimens of Hawaiian lichens, named by C. C. Plitt and Dr. Zahlbruckner and 20 specimens of desert plants. Gift.

One hundred and fifty-two bird skins and seven mammal skins from Australia and Solomon Islands; 63 bird skins and 50 mammal skins from Needles and 700 insects from Needles. Purchase.

Leach, Mr. E. R., Piedmont: One hundred and twenty-two moths from Michigan Bluff; one *Dipodomys heermanni californicus,* in flesh, from Mendocino County, and one *Sciuropterus alpinus lascivus* from Placer County. Gift.

Leonard, Mrs. J. A., San Francisco: One Japanese crane, mounted. Gift.

Leong, Mr. C. H., Watsonville: Forty-three skins of Chinese birds. Gift.

Lewis, Mr. William C., Sausalito: One Coast Bush Tit nest. Gift.

Maag, Mr. Fred, San Francisco: One snake from San Francisco. Gift.

Mailliard, Mr. J. W., San Francisco: Two books, one pamphlet and one map. Gift.

Mailliard, Mr. John W. and Crocker, Mr. William H., San Francisco: One package containing Dr. J. G. Cooper's manuscripts, notes, memoranda, letters, etc., purchased from W. Otto Emerson in connection with his bird collection. Gift.

Mailliard, Mr. J. W., Jr., San Francisco: One *Bassariscus astutus raptor,* male, from Mendocino County. Gift.

Mailliard, Mr. Joseph, California Academy of Sciences: One Remington typewriter No. 10, one typewriter desk and one desk chair; one botanical specimen from San Francisco for identification. Gift.

Twenty-three mammal skins and skulls and 15 bird skins from Plumas County; 11 mammal skins and 91 bird skins from Yuba County; 12 bird skins and 53 mammal skins from Los Angeles County; five sets of bird eggs, 224 bird skins and one nest and eggs, 64 mammal skins and 58 skulls of mammals from Siskiyou County; 23 marine shells from Eureka, Humboldt County. Exploration.

Marshall, Mr. B. C., Imboden, Arkansas: One hundred and fifty insects from Arkansas. Gift.

Martin, Mr. H. T., Lawrence, Kansas: Six casts of types of fossil land shells from Oregon; one fossil land shell from Oregon; and one fossil crinoid from Kansas. Gift.

Martin, Mr. J. O., Berkeley: Three books and 10 pamphlets; 754 insects, largely from Lassen County. Gift.

Mason, Mr. Frank E., Germantown, Philadelphia, Pennsylvania: One hundred and forty-five insects from Africa. Gift.

McAllister, Mr. M. Hall, San Francisco: One picture of old Academy on Market Street. Gift.

Matthew, Rev. W. S., San Mateo: One skin of *Ursus horribilis californicus* from Placer County. Gift.

McLaren, Mr. John, Golden Gate Park, San Francisco: Two *Accipiter cooperi* in flesh, one *Buteo borealis calurus* in flesh, one *Ceryle alcyon caurina* and one *Colymbus auritus* in flesh, one kingfisher in flesh, one *Cervus axis,* two weasels in flesh, one elk and two kangaroos, from Golden Gate Park; 78 specimens of Hawaiian ferns. Gift.

McLellan, Miss M. E., San Francisco: Fifteen bird skins from British Columbia. Exploration.

McMurray, Mr. William, Portland, Oregon: Three fossil shells from northern Oregon. Gift.

McQuarrie, Mrs. J. G., San Francisco: One botanical specimen from Yuma, Arizona. Gift.

Meiere, Mrs. Ernest, Los Altos: Three botanical specimens from Los Altos for identification. Gift.

Meinecke, Dr. E. P., San Francisco: One botanical specimen from Lake County. Gift.

Merriam, Dr. C. Hart, Lagunitas: One botanical specimen from Humboldt County. Gift.

Mexican Islands Expedition: One thousand one hundred and thirty-eight insects; 61 mammal skins and skulls and nine specimens in alcohol; 126 bird skins, one set of primaries, five specimens in alcohol and three eggs of *Halocyptena microsoma.* Exploration.

Michaels, Mrs. Enid, Yosemite: Sixty-three botanical specimens from Yosemite National Park. Gift.

Miller, Mr. S., San Francisco: One sea urchin from four miles south of Cliff House. Gift.

Mitchell, Mrs. H. M., San Francisco: Fourteen botanical specimens from the Lake Tahoe region. Gift.

Monroe, Dr. Will S., New York: (through Mrs. Enid Michaels). Fifteen botanical specimens from the Yosemite National Park. Gift.

Morris, Mr. W. L., Woodland: Two gophers in flesh (one albino, one melanistic). Gift.

Museo Nacional, Mexico City: One lizard from Mexico. Exchange.

Newell, Mrs. Gwendolyn, San Francisco: Two specimens of plants from Monterey County. Gift.

New York Botanical Garden, New York: Three hundred and forty-six specimens of North American plants. Exchange.

Ober, Mr. E. H., Big Pine: Five Desert Mountain Sheep, skins, leg bones, and skulls. Gift.

O'Brien, Mr. Paul, San Francisco: One mole in flesh from San Francisco and one set of eggs and nest of *Zonotrichia leucophrys nuttalli.* Gift.

Orpet, Mr. E. O., Santa Barbara: Four botanical specimens from Santa Barbara for identification. Gift.

Otis, Mr. Ira C., Seattle, Washington: Fifty-five specimens of plants from Washington. Gift.

Owen, Mr. Virgil, Los Angeles: Eighty-five insects from Arizona, including many rare moths. Gift.

Packard, Dr. Earl L., Eugene, Oregon: Six casts of fossil land shells from Oregon. Gift.

Peers, Miss Susie, San Francisco: Science for 1922 and 44 preceding numbers of Science and one fox squirrel. Gift.

Peterson, Mr. L. A., Colfax: One lizard from Colfax. Gift.

Phillips, Mr. W. M., Park Game Warden, Golden Gate Park: Two Cooper's Hawks, one *Buteo borealis calurus* in flesh, one *Ceryle alcyon caurina* and one *Colymbus auritus* in flesh, one kingfisher and two weasels in flesh. Gift.

Phipps, Mrs. E. C., San Francisco: Eleven botanical specimens from Marin County for identification. Gift.

Pope, Lt.-Col. Benj. H., San Francisco: One mounted head of *Ovis ammon*. Loan.

Pope, Dr. Saxton, San Francisco: One bow and two arrows used by Dr. Pope and Mr. Arthur Young in hunting bears. Gift.

Putnam, Mr. P. G., Lake Cushman, Washington: Six frogs, 45 toads, eight snakes and one salamander from Washington. Purchase.

Ray, Mr. Milton S., San Francisco: One set of eggs of Farallon Rail. Exchange.

Reed, Mr. C. A., Santa Cruz: Five botanical specimens from Santa Cruz for identification. Gift.

Reed, Mrs. P. B., San Francisco: Five botanical specimens from San Francisco for identification. Gift.

Rey, Mr. V. J., Belvedere: One Cedar Waxwing. Gift.

Richards, Miss Esther, Houston, Texas: One hundred and forty-six lots (about 1000 specimens), of marine fossils from states bordering on Gulf of Mexico. Exchange.

Richardson, Miss Belle, San Rafael: Four plants from Point Reyes for identification. Gift.

Rixford, Dr. Emmet, San Francisco: One *Neosorex navigator navigator* from Kern County. Gift.

Rixford, Mr. G. P., San Francisco: One botanical specimen from San Francisco. Gift.

Rohrback, Mr. D. L., San Benito: One fossil ammonite from San Benito County. Gift.

Romaine, Mr. F. M., San Francisco: One botanical specimen. Gift.

Rose, Mr. Alex, San Francisco: Three botanical specimens from Marin County. Gift.

Rosenblatt, Mr., San Francisco: Two mounted pheasants, two buffalo horns, five claws, one elk tooth, one seal tooth, 21 teeth of fossil shark, one copper matte vase, one copper spoon, two military buttons, piece of Pacific cable, four rattlesnake rattles, one sheath knife, one turquoise set brooch, one invitation to Executive ball, Honolulu, and one polished wood cup. Gift.

Roule, Prof. Louis, Paris, France: One hundred and seven specimens of reptiles and amphibians from Europe, Africa, and East Indies. Exchange.

Ruddock, Mr. George T., San Francisco: Two specimens of desert plants. Gift.

Sargeant, Mr. W. W., Jr., Sausalito: One snake from Marin County. Gift.

Sargent, Miss Alice D., San Francisco: Seven botanical specimens from Russian River for identification. Gift.

Scripps Institution for Biological Research, La Jolla: Thirteen specimens of echinoderms from southern California. Gift.

Seale, Mr. Alvin, San Francisco: One *Otus asio bendirei* and one botanical specimen from Santa Cruz County. Gift.

Slevin, Mr. Joseph R., California Academy of Sciences: Two snakes, three lizards and one turtle from San Benito County. Exploration.

Slevin, Mr. Louis S., Carmel: Five hundred and fifty insects from Monterey County and one botanical specimen. Gift.

Small, Mr. E. C., Berkeley: Three specimens of native graphite from metamorphic coal, Metape Valley, Sonora, Mexico. Gift.

Smith, Mr. A. M., San Francisco: One walrus head. Gift.

Soares, Mr. Antone J., Haywards: Twenty-two botanical specimens from Shasta County. Gift.

Stacey, Mr. J. W., San Francisco: Eight specimens of California plants for identification, 13 botanical specimens from Nevada County, and three books. Gift.

Stanford University: One specimen of rock containing fossil ear bones of fishes, and fourteen casts of type specimens of fossils. Gift.

Stephens, Mr. A. D., San Francisco: One glass case containing exhibition of mollusks from Mexico made into flower designs. Gift.

Stephens, Mr. Frank, San Diego: Thirty-four mammal skins, 33 skulls and 22 skins and skulls of mammals from Southern California. Purchase.

Stephens, Mrs. Kate, San Diego: Three marine shells from Alaska, and two casts of rare marine shells. Exchange.

Sternenberg, Miss Frances, Austin, Texas: Three fossils shells from the Cretaceous of Texas. Gift.

Stewart, Miss Elizabeth Craig, Unalaska: Five botanical specimens from Unalaska. Gift.

Sturtevant, Mr. George and Sturtevant, Mr. Roger, Alameda: Seven specimens of marine shells, 310 shells and five corals, 369 books; one pair ox horns, mounted; one carved paddle; one set of chess, carved; one bronze eagle; one box of carvings made by J. N. Webster coming around the Horn; three steer horns; four cones; one bunch wood carvings; one bunch carvings chain; one piece from the ship CADMUS; one bugle presented to the children at dedication of the Playground, Golden Gate Park in 1888; one ivory carving; two sperm whale teeth; two fish hooks, shell; two small horns; one bone carving; one carved canoe; five maps; one wall case; seven packages old newspapers 1849; papers relating to Francis Scott Key dedication, July 4, 1888; two copies Union Ticket, electors 1864, Lincoln and Johnson; one chain (cotton) made by Miss Cena Amada Washburn, later wife of J. N. Webster, 1834; one string of wampum; five canes gathered in different parts of California by J. N. Webster in the 50's; two Chinese pipes and one tobacco bag; one flute, 1849; two arrows from the Dakotas, early 70's; one Indian pipe captured from the Sioux Indians by Edgar Webster in early 70's; one shark's teeth club; one bayonet and cartridge box worn by Morris Case Webster, son of J. N. W. during the Rebellion. Gift.

Sutherland, Mr. R. S., Puysegur Point Lighthouse, Invercargill, New Zealand: Eleven bird skins, three *Pterodroma inexpectata,* two *Pterodroma cooki,* four *Pachyptila vittata,* two *Garrodia nereis.* Gift.

Sutliffe, Mrs. E. C., San Francisco: Twenty-three botanical specimens from Marin County, and one lizard from Alameda County. Gift.

Tanner, Prof. V. M., St. George, Utah: One lizard, two salamanders, one snake, one frog, and one toad from Utah; two salamanders and one toad from Arizona. Gift.

Tebby, Mr. Will S., Weed: One block of diatomaceous earth from Pit River and two mineral specimens from Pit River diatomaceous deposits. Gift.

Thompson, Mr. B. G., Sacramento: Twenty-seven insects from Sacramento and vicinity. Gift.

Tose, Mr. Frank, California Academy of Sciences: One yellow-bellied Sapsucker, one Carolina Rail and one red squirrel; and one snake from San Mateo County. Gift.

Fifteen birds from San Mateo County; one *Thomomys bottæ bottæ* in flesh, one pocket gopher skin, one squirrel skin from Golden Gate Park. Exploration.

Trosper, Mrs. T. B., Cazadero: One botanical specimen. Gift.

University of Colorado, Boulder, Colorado: Six specimens of freshwater shells from Idaho. Gift.

University of Michigan, Ann Arbor, Michigan: One snake from Illinois, one snake from Florida, two frogs from Republic of Colombia, and two snakes from Texas. Exchange.

Van Denburgh, Dr. John, California Academy of Sciences: Five salamanders from Santa Clara County; four salamanders, two lizards, one snake from San Mateo County; one nest of California Woodpecker, one rough-winged swallow and one bank swallow, in flesh. Gift.

Van Duzee, Mr. E. P., California Academy of Sciences: One snake from Marin County. Gift.

Six thousand insects taken on Utah trip, 976 insects taken on Sacramento trip, 1265 taken on Lake County trip, 171 taken on Giant Forest trip and 461 taken on miscellaneous trips. Exploration.

Van Duzee, Mr. Millard C., Buffalo, New York: Fifty insects from Western New York. Gift.

Van Dyke, Dr. E. C., Berkeley: Three thousand and thirty-six insects, mostly from Eastern Oregon. Gift.

von Heurn, Mr. W. C., Department of Agriculture, Buitenzorg, Java: Two hundred and seventy-four insects from Java. Gift.

Walter, Mr. Frank, San Diego: Two botanical specimens from San Diego for identification. Gift.

Walther, Mr. Eric, San Francisco: Three hundred and seventy-eight specimens of cultivated plants from San Francisco. Gift.

Wayson, Dr. U. E., San Francisco: Thirteen freshwater shells from Oregon. Gift.

Weinberger, Mrs. H. M., St. Helena: Two botanical specimens from St. Helena for identification. Gift.

Werner, Mr. F., Vienna, Austria: Four herpetological specimens from Marshall Islands, five from Egypt, two from Australia, 18 from Africa, two from Corsica, one from India, six from Asia Minor, seven from Austria, one from Sumatra, one from Sardinia, one from Portugal, two from Ceylon, one from Madagascar, one from Switzerland. Purchase.

West, Mr. T. C., Yreka: Seventeen specimens of freshwater shells from Eagle Lake, California, one species new. Gift.

Westerfeld, Dr. Otto, San Francisco: One albino *Mareca americana* in flesh, from Solano County. Gift.

Wilkens, Mrs. Johanna E., San Francisco: One toad, one mole and one set of eggs of *Zonotrichia leucophrys nuttalli* from San Francisco. Gift.

Wisconsin Academy of Sciences, Arts, and Letters, Madison: One medallion. Gift.

Worden, Mr. Clinton E., San Francisco: One book (Elisha Brooks, The Life-Story of a California Pioneer). Gift.

Wright, Mr. A. H., Ithaca, New York: Three salamanders from New York. Exchange.

Wright, Miss Elizabeth, Calistoga: Fourteen botanical specimens from St. Helena and Calistoga for identification. Gift.

# FINANCIAL STATEMENTS

## REPORT OF THE TREASURER

for the fiscal year ending March 31, 1923

| | | |
|---|---|---|
| April 1, 1923, Balance due Crocker National Bank | | $2,593.95 |

### *Receipts*

| | | |
|---|---|---|
| Dues | $ 3,563.50 | |
| Charles Crocker Scientific Fund Endowment Income | 1,326.41 | |
| James Lick Endowment Income | 53,381.54 | |
| General Income | 17,961.62 | |
| John W. Hendrie Endowment Income | 900.00 | |
| U. S. Treasury Certificates | 11,995.96 | |
| Interest | 656.55 | |
| Bills Receivable Ignatz Steinhart Trust | 115,000.00 | |
| U. S. Treasury Certificates, Steinhart Trust | 19,000.00 | |
| Ignatz Steinhart Trust Interest | 11,530.05 | |
| Museum | 175.70 | |
| Publication | 304.68 | |
| Library | 19.46 | |
| W. G. Wright Fund | 70.20 | |
| C. O. G. Miller Donation | 100.00 | |
| Selah Chamberlin Donation | 100.00 | |
| Louis F. Monteagle Donation | 50.00 | |
| Herbert Fleishhacker Donation | 500.00 | |
| George Uhl Donation | 20.00 | |
| William H. Crocker Donation | 4,573.53 | |
| William F. Herrin Donation | 173.00 | |
| Guadalupe Island Expedition Donation | 500.00 | |
| Ducks of the World Donation | 40.00 | |
| Sundry Donations | 6.00 | |
| Mary E. Hart Bequest | 100.00 | |
| Antelope Fund Donation | 325.00 | |
| Yosemite Game Paddocks Donation | 1.48 | |
| Post Card Sales | 1,278.93 | |
| | | $243,653.61 |
| | | $241,059.66 |

## REPORT OF THE TREASURER—Continued

### *Expenditures*

| | | |
|---|---|---|
| Expense | $ 2,219.95 | |
| Salary Expense (General) | 17,733.20 | |
| Bills Payable | 10,000.00 | |
| Insurance | 1,116.94 | |
| Interest | 16,303.33 | |
| Museum, Department Appropriations | 8,238.90 | |
| " (Edward H. Taylor collection) | 5,000.00 | |
| " Department Salaries | 13,200.00 | |
| Library | 1,225.56 | |
| Publication | 7,328.40 | |
| Office Furniture | 242.06 | |
| U. S. Treasury Certificates | 7,000.00 | |
| Steinhart Aquarium Construction | 147,424.82 | |
| " " Equipment | 3,484.14 | |
| Guadalupe Island Expedition | 383.61 | |
| Antelope Fund | 300.67 | |
| Gulf of California Expedition | .50 | |
| Yosemite Game Paddocks | 16.25 | |
| Grizzly Bear Group | 2.25 | |
| Sundry Creditors | 1,675.95 | |
| Contingent Fund | 413.03 | |
| | | $243,309.56 |
| March 31, 1923, Balance due Crocker National Bank | | $ 2,249.90 |

M. Hall McAllister, *Treasurer.*

Examined and found correct,

McLaren, Goode & Co., *Certified Public Accountants.*

San Francisco, Calif., April 16, 1923.

## INCOME AND OPERATING EXPENSES

For the Period April 1, 1922, to March 31, 1923

| | | |
|---|---|---|
| *Income:* | | |
| Charles Crocker Scientific Fund Endowment Income | | $ 1,326.41 |
| James Lick Endowment Income | | 53,381.54 |
| General Income | | 17,961.62 |
| Dues | | 3,563.50 |
| Interest from temporary investments | | 589.39 |
| | | $76,822.46 |
| *Expenditures:* | | |
| General Expense | $ 2,396.97 | |
| Salaries | 31,124.05 | |
| Interest | 16,303.33 | |
| Insurance | 1,116.94 | $ 50,941.29 |
| Net Income transferred to Surplus Account | | $ 25,881.17 |

## SUMMARY OF SURPLUS ACCOUNT

March 31, 1923

| | | |
|---|---|---|
| Balance March 31, 1922 | | $359,268.34 |
| *Additions:* | | |
| Net Income for fiscal year | $ 25,881.17 | |
| Donations: | | |
| Yosemite Game Paddocks | 1.48 | |
| Sundry Donations | 6.00 | |
| William F. Herrin | 173.00 | |
| Guadalupe Island Expedition | 500.00 | |
| Antelope Fund | 325.00 | |
| George Uhl | 20.00 | |
| C. O. G. Miller | 100.00 | |
| Selah Chamberlin | 100.00 | |
| Louis F. Monteagle | 50.00 | |
| Mary E. Hart Bequest | 100.00 | |
| Post Card Sales | 496.38 | |
| | | $ 27,753.03 |
| | | $387,021.37 |
| *Deductions:* | | |
| Office Furniture (Depreciation) | $ 52.08 | |
| Depreciation | 14,959.81 | |
| Antelope Fund | 124.12 | |
| Yosemite Game Paddocks | 202.36 | |
| | | $ 15,338.37 |
| Surplus March 31, 1923 | | $371,683.00 |

## IGNATZ STEINHART TRUST

March 31, 1923

| | | |
|---|---|---|
| Bequest from the Ignatz Steinhart Estate | | $250,000.00 |
| Interest on temporary investments | | 52,149.41 |
| | | $302,149.41 |
| Investments: | | |
| Steinhart Aquarium Construction | $163,517.68 | |
| Steinhart Aquarium Equipment | 3,583.03 | |
| Temporary Investments: | | |
| Bills Receivable | 135,000.00 | |
| Balance receipts over investments | 48.70 | |
| | $302,149.41 | |

## BALANCE SHEET

March 31, 1923

### *Assets*

| | | |
|---|---|---|
| Real Estate: | | |
| Market Street Lot | $600,000.00 | |
| Jessie Street Lot | 8,083.65 | |
| Commercial Building | 516,818.66 | |
| | | $1,124,902.31 |
| Stocks: | | |
| 60 shares Savings Union Branch of the Mercantile Trust Co. | | 13,600.00 |
| Ignatz Steinhart Trust: | | |
| Bills Receivable | $135,000.00 | |
| Steinhart Aquarium Construction | 163,517.68 | |
| Steinhart Aquarium Equipment | 3,583.03 | |
| Receipts in excess of investments | 48.70 | |
| | | 302,149.41 |
| U. S. Treasury Certificates | | 10,000.00 |
| Museum Construction | | 192,025.92 |
| Museum: | | |
| General Collections | 131,413.41 | |
| Tools and Equipment | 26,816.57 | |
| | | 158,229.98 |
| Library: | | |
| Books and Equipment | 24,016.64 | |
| Publication | 42,718.14 | |
| | | 66,734.78 |
| Office Furniture | | 3,673.24 |
| Foreign Exchange | | 36.84 |
| Post Cards in Stock | | 1,687.57 |
| | | $1,873,040.05 |

## BALANCE SHEET—Continued

### *Liabilities*

| | | |
|---|---|---|
| Endowments: | | |
| James Lick Endowment | $804,902.31 | |
| Charles Crocker Scientific Fund Endowment | 20,000.00 | |
| John W. Hendrie Endowment | 13,600.00 | |
| | | $838,502.31 |
| Ignatz Steinhart Trust | 250,000.00 | |
| Ignatz Steinhart Trust Interest Account | 52,149.41 | |
| | | 302,149.41 |
| Alvord Bequest Botanical | | 5,000,00 |
| John W. Hendrie Income Account | | 1,800.00 |
| W. G. Wright Fund | | 70.20 |
| A. K. Macomber Donation | | 3,500.00 |
| William C. Van Antwerp Donation | | 5,120.00 |
| William H. Crocker Donation | | 8,342.26 |
| W. B. Bourn Donation | | 2,659.31 |
| J. D. Grant Donation | | 2,710.42 |
| Herbert Fleishhacker Donation | | 4,000.00 |
| Ogden Mills Donation | | 5,000.00 |
| John W. Mailliard Donation | | 1,250.00 |
| Bills Payable | | 270,000.00 |
| Antelope Fund | | 8.76 |
| Herpetological Fund | | 370.00 |
| Ducks of the World Fund | | 40.00 |
| Sundry Creditors | | 3,838.34 |
| Cash: | | |
| Amount due Ignatz Steinhart Trust | 48.70 | |
| Overdraft with Crocker National Bank | 2,249.90 | |
| | 2,298.60 | |
| *Less* Cash in Safe | 71.06 | 2,227.54 |
| Reserve for Depreciation | | 44,768.50 |
| Surplus | | 371,683.00 |
| | | $1,873,040.05 |

W. W. SARGEANT,
*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.
April 16, 1923.

# INDEX TO VOLUME XI, FOURTH SERIES

New names in heavy-faced type.



August 14, 1925.

August 14, 1925.

August 14, 1925.